UNITED STATES DEPARTMENT OF AGRICULTURE
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Washington, D. C. Issued February 1949

THE TECHNICAL LITERATURE OF AGRICULTURAL MOTOR FUELS

Including

Physical and Chemical Properties,
Engine Performance, Economics, Patents, and Books

By

Richard Wiebe and Janina Nowakowska, Chemists
Northern Regional Research Laboratory
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PREFACE

The accelerated increase in the production of gasoline, together with the relatively small domestic reserves of petroleum, have aroused interest in the future supply of motor fuels. Many inquiries for information on the utilization of agricultural motor fuels have resulted. Questions arise on engine operation, fuel testing, engine design and design changes, blending, storage, fuel stability, and world-wide past experience with the use of such motor fuels. In answer to these inquiries this work was undertaken.

In this review of the technical literature on motor fuels from agricultural sources an attempt has been made to cover quite thoroughly all that has appeared on the subject since 1920. A few references to work done prior to that date are included, for example, that done by Lucke and Woodward for the United States Department of Agriculture and by Strong and Stone of the Bureau of Mines. A section on vegetable oils is included and although not as complete as could be desired, it is sufficient to indicate the scope of the work. References to the use of agricultural residues in gas generators for the production of gaseous fuels have been omitted since these have appeared recently in another publication.[1] Vegetable oil lubricants likewise have been omitted except when mentioned incidentally in connection with the fuel problem; this subject in itself would be too extensive for treatment here if, for example, the field of lubricant additives were included.

Another field, that of combustion theories, kinetics of combustion, precombustion phenomena, and the like, does not come within the intended scope of this publication. Much miscellaneous information which should prove helpful, however, either in understanding the problems or for indicating borderline cases, has been included. Among the items covered are jet fuels containing alcohol, carburetor de-icing, and alcohol injection.

In all the more important items as well as in a majority of others the original article was read and the information condensed. The length of the annotation is not in all cases a measure of the importance of the work, since it would, for instance, be impossible to do full justice to such papers as those by Ricardo. Many articles of somewhat general nature were found which contained interesting comment. It has been deemed desirable to call attention to them inasmuch as the information is not readily available to most readers.

The classification of articles under the first five headings may appear somewhat arbitrary at times; yet it was thought that such a division would be of sufficient assistance to overshadow its shortcomings. References appear only once in the text. Both an author and a subject index are included; the latter should be of considerable help in finding the required information. Patents have been classified according to the date of publication.

References are arranged chronologically under each general heading and listed alphabetically for each year. A consecutive

[1] Nowakowska, Janina, and Wiebe, Richard. Construction, design, economics, performance, and theory of portable and small stationary gas producers. Bur. Agr. and Indus. Chem. Cir. AIC-103, 96 pp. 1945. Northern Regional Research Laboratory, Peoria, Ill. [Mimeographed]

numbering system was adopted to facilitate indexing. Titles are given in English only, to save space; translations have been carefully checked. A list of all publications is given in unabbreviated form; the abbreviations used in the text are those found in United States Department of Agriculture Miscellaneous Publication 337, April 1939.

The assistance of Opal M. Fry and particularly of Wanda C. Pringle in compiling the information is acknowledged with thanks. Grateful acknowledgment is also made to the library of the Department of Agriculture in Washington, as well as to the editor of this Laboratory, George F. Jordan, and for the efficient stenographic help of Mary R. Mlakus.

KEY TO ABBREVIATIONS

The following abbreviations are used. Some of them have been coined for this particular work. Several others appear which are not common to the technical literature of the several professions likely to be represented among readers.

A. angstrom.
A/F. air-fuel ratio.
A. S. T. M. American Society for Testing Materials.
b. hp. brake horsepower.
b. m. e. p. brake mean effective pressure.
b. p. boiling point.
b. s. f. c. brake specific fuel consumption.
B. T. C. before top center.
B. t. u. British thermal unit.
cal./gm. calories per gram.
cal./mol. calories per molecule.
C. F. R. Cooperative Fuel Research (type of engine).
C. R. compression ratio or ratios.
G. L. Gay-Lussac.
H. U. C. R. highest useful compression ratio.
i. hp. indicated horsepower.
i. m. e. p. indicated mean effective pressure.
i. s. f. c. indicated specific fuel consumption.
kg. cal./hp.-hr. kilogram calorie per horsepower hour.
m. e. p. mean effective pressure.
mm. Hg millimeters of mercury.
s. f. c. specific fuel consumption.
S. I. T. spontaneous ignition temperature.
T. C. top center.
T. E. L. tetraethyl lead.

CONTENTS

THE TECHNICAL LITERATURE ON AGRICULTURAL MOTOR FUELS

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By Richard Wiebe and Janina Nowakowska, *chemists, Northern Regional Research Laboratory, Peoria, Ill., Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration*

I. METHODS OF ANALYSIS; PHYSICAL, CHEMICAL AND THERMODYNAMIC PROPERTIES; CORROSION STUDIES; STORAGE PROBLEMS

1917

Dieterich, K. R. (1)

EVAPORATION VELOCITIES AND EVAPORATION CURVES OF MOTOR FUELS. Petrol. Ztschr. 12: 676–677. 1917.

Rate of evaporation of gasoline, motor benzene (90 percent), and motor alcohol (95 percent) was determined and plotted against the time. The method is useful in evaluating a motor fuel; the best quality of fuel being indicated by a short, steep, straight curve.

Abstract *in* Soc. Chem. Indus. Jour. 38: 244A. 1919.

1920

Baume, G., Nicolardot, P., Erickman, P. E., and Vigneron, H. (2)

PHYSICOCHEMICAL RESEARCHES ON LIQUID FUELS. Chim. & Indus. [Paris] 3: 761–768. 1920.

The critical solution temperatures of mixtures of hydrocarbons, ethanol, benzene, and of ether were measured. The critical temperature is lowered if the ethanol content is increased, if the water content is lowered, and the more volatile the hydrocarbon.

Dixon, H. B. (3)

ALCOHOL AS A MOTOR FUEL. Soc. Chem. Indus. Jour. 39: 355R. 1920; Motor Traction 31: 478–480. 1920; Chem. Age [London]. 3: 450. 1921; Automotive Indus. 44: 211–215. 1921.

A lecture. At low temperatures engines will start only with difficulty when using ethanol. This is overcome through the use of blends with more volatile fuels. Natalite (45:55 diethyl ether-ethanol) and an 80:20 ethanol-benzene blend are mentioned, the latter forming an azeotrope of higher vapor pressure than that of either component. Addition of water to an ethanol-benzene solution results in separation into two layers, the lower aqueous layer containing less benzene and the upper containing more benzene than the original blend. Results on critical solution temperatures favored blends containing 20 to 30 percent by volume of benzene. Ignition temperatures of ethanol vapor in oxygen measured in a furnace were found to be 510°–515° C. and in air 595°–600°. For pentane, the respective values were 550° and 560°–570°. Similar determinations made, with adiabatic compression, agree with furnace temperatures. No marked difference was found in rates of propagation of explosion waves for mixtures of oxygen with ethanol, pentane, benzene, and diethyl ether; however, ether was slightly faster and ethanol the slowest under similar conditions.

DUMANOIS, PAUL (4)
THE ADVISABILITY OF USING LIQUID FUELS. Soc. d'Éncouragement pour Indus. Natl. Bul. 132: 436–457. 1920.

MIDGLEY, THOMAS, JR. (5)
THE COMBUSTION OF FUELS IN THE INTERNAL COMBUSTION ENGINE. Soc. Automotive Engin. Jour. 7: 489–497. 1920.

The knocking tendencies of fuels can be grouped in accordance with their chemical classification. Ethers show the greatest tendency to knock and are followed in order by olefins, naphthenes, aromatics, and alcohols.

MOORE, HAROLD (6)
A NEW INSTRUMENT TO MEASURE VAPOR TENSION. Soc. Chem. Indus. Jour., Trans. 39: 78T–80T. 1920.

Results are given of the vapor pressure of ethanol-benzene and ethanol-gasoline blends at temperatures between 20° and 50° C.

TIZARD, H. T., and PYE, D. R. (7)
SPECIFIC HEAT AND DISSOCIATION IN INTERNAL-COMBUSTION ENGINES. Engineering 110: 325. 1920. (See No. 16).

1921

MARILLER, CHARLES (8)
A METHOD OF FRACTIONATING LIQUID MIXTURES AND ITS APPLICATION IN THE PREPARATION OF A DOMESTIC (FRENCH) FUEL. [Paris] Acad. des Sci. Compt. Rend. 173: 1087–1089. 1921.

In order to effect dehydration of ethanol, 95-percent ethanol is mixed with gasoline forming a 2-layer system. For example, if at 15° C., 80 volume percent of gasoline is mixed with 20 volume percent of 95-percent ethanol, the upper layer containing 85.5 percent of the total approximates a 10 percent blend. Benzene and methanol may be added so that a blend will have the following composition: Gasoline 84.5, ethanol 10, benzene 5, and methanol 0.5 percent.

MASFARAUD, S. (9)
THE NATIONAL (FRENCH) MOTOR FUEL. Assoc. des Chim. de Sucr. et Distill. Bul. 39: 65–93. 1921.

Physical properties of methanol, ethanol, acetone, and hydrocarbons of importance in connection with their use as fuels are discussed, such as minimum temperature for complete vaporization of fuel-air mixture, lowering of temperature due to vaporization of fuel, and minimum temperature of incoming air at various air-fuel ratios required to effect complete vaporization. A blend containing 50 percent by weight of ethanol-benzene (90°) becomes turbid at —14° C., forms two layers at —20°, and crystallizes at —20.5°. Other possible blends are briefly mentioned. Except for possible cold starting troubles, this blend is satisfactory, since —14° is considerably below the normal winter temperature in France. Alcohol stocks accumulated will be disposed of at prices given in a recent decree of the Ministry of Finance. The amounts of ethanol available and various possible ways of utilization as motor fuel are discussed.

NICOLARDOT, PAUL (10)
USE OF ALCOHOL-GASOLINE BLENDS IN ENGINES. Tech. Auto. et Aerienne 12 (115): 116–124. 1921; *Ibid.* 13 (116): 18–21. 1922.

Limits of solubility of alcohol in gasoline and benzene are given.

ORMANDY, W. R., and CRAVEN, E. C. (11)
THE PHYSICAL PROPERTIES OF MOTOR FUELS. Inst. Auto. Engin. Proc. 16: 143–175. 1921; Engineering 113: 234–235. 1922.

The following data are given: Table of heats of combustion of various fuels; freezing point curves of benzene with 95-percent ethanol, toluene, xylene, hexane, and kerosene; solubility of aromatic hydrocarbons in 92 percent by weight of ethanol; solubility of pentanes, hexanes, and heptanes in 92 percent of ethanol by weight; solubility of aqueous ethanol

+5 percent of amyl alcohol in a commercial gasoline at 15° C.; table of explosive limits of a number of alcohols, aromatics, paraffins, naphthalene, and diethyl ether.

——— and CRAVEN, E. C. (12)
THE RELATION BETWEEN ALCOHOL-WATER SOLUBILITY AND SPONTANEOUS IGNITION TEMPERATURES. Inst. Petrol. Technol. Jour. 7: 325–334. 1921.

An attempt is made to correlate solubilities with spontaneous ignition temperatures. According to previous results, the ignition points of aromatic hydrocarbons are much higher than those of the aliphatic and increase with increasing complexity of the molecule. The solubility of ethanol (92 percent by weight; 94.7 percent by volume) follows the same law. This is not true, however, for other substances like ether, turpentine, etc., and for binary mixtures, where no apparent relationship exists. In further experiments it was found that a very considerable correlation exists between alcohol solubility in various gasolines and the toluene value of Ricardo.

——— and CRAVEN, E. C. (13)
THE SYSTEM ETHYL ALCOHOL-WATER-AROMATIC HYDROCARBONS FROM 30° C. TO —30° C. Inst. Petrol. Technol. Jour. 7: 422–439. 1921.

The mutual solubility of ethanol (99 percent) in benzene, toluene, commercial xylene, and in a 3:1 benzene-toluene mixture was determined at temperatures from 30° to —30° C.

OSTWALD, WALTER (14)
CALCULATION TABLE FOR MOTOR FUEL MIXTURES. Chem. Ztg. 45: 897. 1921.

The heat of combustion of mixtures of benzene, tetrahydronaphthalene, and alcohol are shown in a triangular coordinate system as a function of the composition. Method can also be used for other mixtures.

——— (15)
THE CHEMISTRY OF COMBUSTION PROCESSES IN THE INTERNAL-COMBUSTION ENGINE FROM THE STANDPOINT OF PRACTICE. Brennstoff-Chem. 2: 17–21. 1921.

Author discusses physico-chemical changes such as corrosion, carbon formation, carburetion, energy content, solubility of water, explosion velocity, and sensitivity to compression of ethanol and other fuels.

TIZARD, H. T., and PYE, D. R. (16)
CHARACTER OF VARIOUS FUELS FOR INTERNAL-COMBUSTION ENGINES. Auto. Engin. 11, Part I: 55–59; Part II: 98-101; Part III: 134–137. 1921; [Gr. Brit.] Empire Motor Fuels Committee Rpt. pp., 1–47. London, Sessions, 1923–1924.

A very thorough thermodynamic analysis is presented and results are applied to paraffins, aromatics, naphthenes, and alcohols. The following topics are discussed: Effect of mixture strength; effect of fuel; explosion temperatures and thermal efficiencies; effect of increasing expansion ratio. Calculations were made when no dissociation was assumed and also when allowing for dissociation. The high heat of vaporization of methanol and ethanol is the principal distinguishing feature between the alcohols and hydrocarbon fuels. The analysis agrees in general with results obtained in engine tests.

WEHRMANN, FRITZ (17)
THE COMBUSTION OF LIQUID FUELS IN MOTORS WITH SPECIAL CONSIDERATION OF THE STUDY OF THE EXHAUST GAS. Ztschr. f. Electrochem. 27: 379–393. 1921.[1]

Methods and apparatus are described for the determination of the heats of combustion of liquid fuels (ethanol-benzene blends) and of exhaust gases. The engine set-up is also described. Results are given by E. Terres and F. Wehrmann. (See No. 18).

[1] Sequence of annotations 17 and 18 is according to journal reference.

TERRES, E., and WEHRMANN, F. (18)
THE COMBUSTION OF LIQUID FUELS IN MOTORS WITH SPECIAL CONSIDERATION OF THE STUDY OF THE EXHAUST GAS. Ztschr. f. Electrochem. 27: 423–441. 1921.

The exhaust gas was analyzed for six conditions in which load and air-fuel ratio were varied. Two fuels were investigated, an ethanol-benzene blend and straight benzene. The former appeared to give more complete combustion.

1922

BOUSSU, R. G. (19)
LIMIT OF INFLAMMABILITY OF VAPORS OF THE GASOLINE-ALCOHOL SYSTEM AND A TERTIARY SYSTEM WITH AN ALCOHOL AND GASOLINE BASE. [Paris] Acad. des Sci. Compt. Rend. 175: 30–32. 1922.

The variations of the lower limit of inflammability of ether, alcohol, and gasoline were determined. For pure alcohol the limit of inflammability was found to be: 14 percent at 20° C.; 11.4 percent at 50°; 8.8 percent at 90°; 6.7 percent at 120°; and 5.0 percent at 150°. Experiments with various amounts of ether added to a mixture of gasoline and alcohol whose volume ratio was kept constant showed deviations of less than 6 percent from Le Chatelier's formula.

ECKART, HANNS (20)
CONTRIBUTION TO THE STUDY OF THE SOLUTION OF THE VAPORIZATION OF LIQUID FUELS. Auto Tech. 11 (14/15) : 6–9. 1922.

For the less volatile fuels either a carburetor with heating device or an injection carburetor must be used. For economic reasons the latter is preferred. In this case the problem of fuel particle suspension must be considered. Author discusses the problem from the standpoint of colloid chemistry and emphasizes the importance of surface tension and viscosity. Tables are given for methanol, ethanol, acetone, and various other fuels.

MARILLER, C., and VAN RUYMBEKE (21)
A PROCESS FOR THE PRODUCTION OF INDUSTRIAL ABSOLUTE ALCOHOL AND ITS APPLICATION TO THE PREPARATION OF A DOMESTIC MOTOR FUEL. [Paris] Acad. des Sci. Compt. Rend. 175: 588–590. 1922.

For blending with gasoline, anhydrous alcohol is preferable. A dehydration process using glycerol is described.

MIDGLEY, T. JR., and BOYD, T. A. (22)
DETONATION CHARACTERISTICS OF SOME BLENDED MOTOR FUELS. Soc. Automotive Engin. Jour. 10: 451–456. 1922; Natl. Petrol. News 14: 59, 63, 67. July 5, 1922.

The effects of admixtures of various percentages of ethanol and ethanol-benzene blends for reducing the detonating tendency of paraffin hydrocarbons (kerosene was used) were measured using xylidine in kerosene as a standard. Ethanol is more effective in supressing detonation than benzene and a blend of the two is not so effective as the mean average of the effect of the ingredients would indicate.

NORMAN, C. A. (23)
INTERNAL COMBUSTION ENGINE FUELS. Soc. Automotive Engin. Jour. 10: 187–192. 1922.

Heats of combustion and air requirements of various automotive fuels are given. The conclusion is reached that utilization of alcohol and similar fuels is not practicable at present prices. The advantages and disadvantages of the various fuels are discussed and information regarding the available supply is given.

ORMANDY, W. R., and CRAVEN, E. C. (24)
NOTE ON SOLUBILITY OF BENZENE IN WEAK ALCOHOL. Inst. Petrol Technol. Jour. 8: 213–217. 1922.

The solubility of benzene in weak alcohol has been studied at 0°, 15°, and 30° C. If an alcohol containing benzene is diluted to 35 percent, the resultant dilute alcohol will contain about 1 percent of benzene.

——— and CRAVEN, E. C. (25)
PHYSICO-CHEMICAL SIGNIFICANCE OF FLASH POINT TEMPERATURES. Chem. Trade Jour. and Chem. Engin. 70: 41–42. 1922.

Flash points of methanol, ethanol, pentanol, ether, and several hydrocarbons have been measured and results are applied to the problem of engine starting.

——— and CRAVEN, E. C. (26)
THE SYSTEMS ETHYL ALCOHOL-WATER-PARAFFIN FROM +30° TO —30° C. Inst. Petrol. Technol. Jour. 8: 181–193. 1922.

The following data were determined: Freezing points of mixtures of benzene with paraffin; solubility of pentane, isopentane, hexanes, and heptanes in ethanol (92 percent by weight) at temperatures from 30° to —30° C., solubility of hexanes and heptanes in ethanol of varying strength over the same temperature range.

OSTWALD, WALTER (27)
CORROSION PRODUCED BY BENZENE-ALCOHOL BLENDS. Auto Tech. 11 (6): 9. 1922.

It was found that the addition of 30 to 50 percent of tetralin by volume prevents the corrosion of aluminum by impure 95-percent ethanol contained in benzene-ethanol fuel blends. Tetralin is a component of the German national fuel.

WILSON, R. E. (28)
MEASURING THE TRUE VOLATILITY OF MOTOR FUEL. Soc. Automotive Engin. Jour. 10: 6, 17–20. 1922.

The determination and significance of volatility are discussed and the importance of the heat of vaporization is emphasized when ease of starting is considered. The latter applies particularly to ethanol.

1923

BARON, C., and VERLEY, A. (29)
CONTRIBUTION TO THE STUDY OF A (FRENCH) NATIONAL FUEL. [Paris] Acad. des Sci. Compt. Rend. 176: 452–454. 1923.

Authors propose a method of dehydration involving the use of potassium acetate and phenol to prepare 98-percent ethanol. A fuel consisting of 35 percent of 98-percent ethanol and 65 percent gasoline is stable to 10° C. and would be practicable in French colonies such as Indo-China.

COUTANT, and MARILLER, C. (30)
HYGROSCOPICITY OF ALCOHOL AND ALCOHOL MOTOR FUELS. Assoc. des Chim. de Sucr. et Distill. Bul. 40: 292–310. 1923.

ECKART, HANNS (31)
SEVERAL PRODUCTS WHICH MAY BE ADDED TO LIQUID MOTOR FUELS. Brennstoff-Chem. 4: 134–136. 1923.

Aside from briefly mentioning methanol and ether, the article discusses the possible use of various solid compounds in motor fuels (I, Se, and Te compounds, naphthalene, explosives such as picric acid, etc.).

GUINOT, H. (32)
A STUDY OF MIXTURES OF GASOLINE AND ALCOHOL. Chim. & Indus. [Paris] Special No., pp. 722–728. May 1923.

In order to render alcohol blends with 95-percent ethanol more stable, dehydration by means of K_2CO_3 is proposed. The use of isopropanol and butanol as stabilizers is discussed.

LEGRAND, C. (33)
STUDY OF POSSIBLE COMPOSITION OF THE (FRENCH) NATIONAL LIQUID FUEL. Chim. & Indus. [Paris] 10: 411–428. 1923.

Binary, ternary, and quaternary mixtures of benzene, 95-percent ethanol, gasoline, and anhydrous ether were studied to determine the lowest temperature at which the blends will not separate in car tanks and in storage. The results are given in tables and graphs.

LORIETTE, PIERRE (34)
HYGROSCOPICITY OF ABSOLUTE ALCOHOL; MANUFACTURE AND USE FOR THE PREPARATION OF LIQUID FUELS. Chim. & Indus. [Paris]. Special No., pp. 718–721. May 1923.

Absolute alcohol can be manufactured by using various solid reagents at only a slightly higher cost and without important modifications of existing equipment. Absolute alcohol is miscible with gasoline in all proportions, and blends will remain stable at low temperatures. Blends with 95-percent ethanol containing a stabilizer possess no advantage and are more expensive. A blend of 15 percent of 99.9-percent ethanol and 85 percent of heavy gasoline was exposed at 15° C., 80 percent humidity, and a surface/volume ratio of 1:5. After 22 days the blend became cloudy at —22° and after 43 days at —8°. Similarly, 99.8-percent ethanol changed to 99.2- and 95.65-percent in 3 and 21 days, respectively, while 96.4-percent ethanol changed to 92.55-percent during that time.

ORMANDY, W. R., and CRAVEN, E. C. (35)
FURTHER INVESTIGATIONS INTO THE PHYSICAL-CHEMICAL SIGNIFICANCE OF FLASH-POINT TEMPERATURES. Inst. Petrol Technol. Jour. 9: 33–68. 1923.

The work is divided into four parts: (a) Measurement of vapor pressures, (b) flash points at reduced or increased pressures, (c) flash points in mixed gases, (d) flash points where vapor-air mixture is further heated. Under (a) data for heptane, toluene, 99.8 percent and 95 percent by volume of ethanol are given for temperatures from —40° to 15° C. The flash points of a number of hydrocarbons and alcohols were determined and the constant $R =$ flash point °K/boiling point °K was calculated. All substances tested in the pressure apparatus fitted the formula $f = n \log P - K$, where $f =$ flash point in °C. and $P =$ total pressure in mm. Hg. Under (c) flash points of ethanol, toluene, heptane, and other compounds were measured in carbon dioxide-oxygen and in nitrogen-oxygen mixtures. Finally, the influence of experimental conditions (walls) on results is discussed and in the "discussion" Mr. Craven states that "flash points were such unreliable things."

——— and CRAVEN, E. C. (36)
FUELS HAVING AN ALCOHOL BASE. Chim. & Indus. [Paris]. Special No., pp. 635–637. May 1923.

A review of the authors' previous work on critical solution temperatures of alcohol-gasoline blends (see Nos. 25, 26, and 35).

——— and CRAVEN, E. C. (37)
SOLUBILITY RELATIONS AND OTHER PROPERTIES OF MIXED FUELS. Inst. Auto. Engin., Proc. 18: 313–326. 1923.

The paper is a summary of past work. Following data are presented: Solubility of benzene, commercial xylene, and heptane in ethanol of varying strength at temperatures from +30° to —30° C.; solubility of paraffin and standard reference fuels in 92 percent by weight of ethanol from —30° to +30° C.; table of solubility of ethanol in various gasolines, hexane, and heptane; effect of addition of 5 percent of amyl alcohol to gasoline; toluene numbers; and spontaneous ignition temperatures.

REINLER, R. F. (38)
THE USE OF ACETONE IN COMPOSITE ENGINE FUELS. Soc. Automotive Engin. Jour. 13: 23–24. 1923.

Heating values of acetone are 13,476 B. t. u. per pound (89,477 B. t. u. per gallon) and of ethanol 13,028 per pound (85,985 per gallon). Low boiling point, high vapor pressure, low freezing point, and absence of detonation make acetone an excellent motor fuel. The disadvantage is its high cost.

ROTHEN, A., and BOUTIER, D. (39)
MUTUAL SOLUBILITY OF ALCOHOL AND GASOLINE IN PRESENCE OF A THIRD SOLVENT. Chim. & Indus. [Paris]. Special No., pp. 733–736. May 1923.

The amounts of stabilizer were measured that are necessary to prevent the separation at 0° and —15° C. of 10, 20, 30, 40, and 50 percent of ethanol (96 percent) blended with "tourism" gasoline. The following stabilizers were used: Benzene, ether, acetone, isopropanol, isobutanol, n-butanol, pentanol, cyclohexanol, butylcresol, castor oil, and terpineol. The results, except for benzene and ether, show no simple relationships. At 0° the proportion of pentanol to stabilize a 50 percent ethanol blend is smaller than one containing 10 percent; however, the reverse is true at —15°. The results are applicable only to the particular gasoline.

SCHWERS, F. (40)
THE RATIONAL USE OF VARIOUS LIQUID FUELS IN INTERNAL COMBUSTION ENGINES. Chim. & Indus. [Paris]. Special No., pp. 682–701. May 1923.

SPARROW, S. W. (41)
FUEL REQUIREMENTS OF INTERNAL-COMBUSTION ENGINES. Indus. and Engin. Chem. 15: 477–479. 1923.

The following fuel requirements are discussed briefly: Availability; usability; explosion, and distillation range; heat of vaporization; flash (16° C. for 95-percent ethanol), freezing, and separation points; viscosity; detonation characteristics; spontaneous ignition temperature; corrosiveness, and power-producing ability. A table gives the xylidine equivalents for four ethanol-kerosene blends. Power-producing ability, defined as total energy obtainable per unit volume, is practically the same for all common liquid fuels, including the alcohols.

1924

BRUTZKUS, MARKUS (42)
A CONTRIBUTION TO THE THEORY OF FUELS FOR MOTORS. Soc. d'Encouragement pour Indus. Natl. Bul. 136: 397–425. 1924.

It is concluded from LeChatelier's law of equilibrium that the amount of change in the number of molecules after combustion is the best criterion for the efficient use of motor fuels. The percentage of hydrogen is more important than such properties as calorific value, specific gravity, ignition, boiling point, and viscosity. Motor fuels are classified, accordingly, as they (1) increase, (2) decrease, or (3) undergo no change in the number of molecules after ignition. All liquid fuels belong to (1), including ethane, propane, and butane, and are best utilized in the Diesel or constant-pressure cycle. Class (2) includes all industrial gases, that are best used in Otto cycle. Natural gas, methane. and ethylene belong to group (3) and should burn well in either cycle. The greater the percentage of hydrogen, the greater the change in volume and the more efficient the combustion. All liquid fuels should burn in Diesel cycle. In practice they are most used in the Otto cycle because of the engine's greater simplicity and lightness. Alcohol and benzene are two exceptions, because of the cooling effect of the air of injection of the Diesel engine. Fuels that burn slowly and show only slight variations in volume are best when used in Otto cycle. Thermodynamic formulas are developed and illustrated. Tables showing volume changes of several fuels are included.

CODEBÒ, ALBERTO (43)
ABSOLUTE ALCOHOL AND THE NATIONAL MOTOR FUEL. Cong. Naz. di Chim. Indus. Atti 1924: 232–236.

Blends of absolute ethanol and gasoline are more suitable as motor fuel than 95-percent ethanol. Physical and chemical properties are discussed.

LORIETTE, PIERRE (44)
MANUFACTURE AND PROPERTIES OF ABSOLUTE ALCOHOL. Mém. des Poudres 21: 386–395. 1924.

Alcohol-gasoline mixtures for use as motor fuel are discussed. Satisfactory absolute alcohol (99.9 percent) was obtained by dehydrating ordinary alcohol in the vapor phase by distilling through a column of calcium oxide. A blend of 85 parts of gasoline and 15 parts of ethanol did not separate under severe conditions of humidity.

MICHELET, C. F. (45)
STABILITY OF THE MIXTURES OF ALCOHOL-BENZENE-GASOLINE USED AS MOTOR FUELS. Tidsskr. for Kemi Bergvesen 4: 123–127. 1924.

The addition of benzene in amounts up to 20 percent increases the stability of mixtures composed of 96-percent alcohol and gasoline.

PANEBIANCO, GINO (46)
THE ITALIAN MOTOR FUEL OF SESTI. Cong. Naz. di Chim. Indus. Atti 1924: 236–237.

Motor fuel patented by Sesti (see No. 1184) contains approximately 80 percent commercial ethanol and 20 percent CS_2. The Sesti fuel has no corrosive action on metal parts, and addition of water does not cause separation.

PREVER, V. S. (47)
THE NATURAL MOTOR FUEL PROBLEM AND ITS RELATION TO THE MANUFACTURE OF GAS ENGINES. Cong. Naz. di Chim. Indus. Atti 1924: 195–201.

A discussion of the characteristics and relative value of gasoline, ethanol, benzene, etc. in automobile engines.

ZIMMERMAN, A. C. (48)
ALCOHOL-GASOLINE MIXTURES. U. S. Air Service Inform. Cir. 5(450): 3 pp., 5 figs. 1924.

Properties of blends consisting of aviation gasoline and 198-proof alcohol are discussed.

1925

KENNEDY, R. J. (49)
METHOD OF DETERMING THE DEW POINTS OF FUEL-AIR MIXTURES. [U. S.] Natl. Bur. Standards Sci. Paper. 500: 47–63. 1925.

The theory of the method is based upon the assumption that the initial condensate in equilibrium with the remaining vapor is of essentially constant composition for the range of pressures and temperatures encountered in the engine manifold. The dew point is obtained from an equation expressed in terms of the pressure and mixture ratio of the fuel-air mixture and developed from the Clausius-Clapeyron equation and the ideal gas laws. The equation involves several constants, characteristic of the fuels, which are determined from measurements of the condensation temperature and the average molecular weight as computed from the constant ratio between the pressure and mass of the fuel. The apparatus used for the measurement of these properties is described, and is estimated to give results accurate to within about 2° C. Measurements of the condensation temperature of alcohol agree to within less than 1° with the figures computed from tables of vapor pressures.

KONEK, FRIGYES (50)
MOTOR GASOLINE SUBSTITUTE FROM DOMESTIC RAW MATERIALS. Matematik. Természettudományi Értesitö 41: 9–12. 1925.

Isomeric amylenes are produced from fusel oil by a contact dehydration process. A blend composed of amylenes 20, benzene 40, and ethanol 40 parts gives a satisfactory motor fuel with low flash point.

LEWIS, J. S. (51)
VAPOR PRESSURES OF BINARY AND TERNARY FUEL MIXTURES. Petrol. Times 13: 667–669, 721–722. 1925.

Vapor pressure determinations from 0° to 50° C. are given for binary and ternary mixtures of various hydrocarbons, alcohol, and water. In mixtures of paraffins and naphthenes, there is very little association between the two kinds of molecules. When benzene is added to a mixture of gasoline and 95-percent alcohol until complete solubility is established, the vapor pressure of the resultant mixtures will not vary to any great extent. (See also No. 58.)

MARZAHN (52)
CORROSION THROUGH FUELS. Auto-Tech. 14(23): 8–9. 1925.

Previous results, concerning the corrosion of copper tubes by gasoline, benzene, 95-percent ethanol, and blends of 95-percent ethanol, including that of R. Fritzweiler, are discussed. A number of problems remain to be solved, particularly with respect to blends containing large proportions of 95-percent ethanol.

FRITZWEILER, R. (53)
THE PROBLEM OF CORROSION THROUGH FUELS. Auto-Tech. 14(25): 13. 1925.[2]

Marzahn's criticism (see No. 52) is rejected. Blends containing 95-percent ethanol do not attack fuel tanks of tin plate, which have stood up well in use.

1926

CLARK, G. L., and TULL, W. C. (54)
ULTRA-VIOLET SPECTROSCOPY OF FLAMES OF MOTOR FUELS. Indus. and Engin. Chem. 18: 528–531. 1926.

Photographs were taken of the ultraviolet spectra of the detonation, explosion, and combustion flames in an engine of several commercial gasolines, of pure alcohol and benzene, and of gasoline to which was added butyl nitrite (knock inducer), or tetraethyl lead (knock suppressor). The wave-length measurements were compared with a standard mercury arc spectrum. The bands were due to hydroxyl groups, to CH, CO, and possibly to CN groups. The results represent a preliminary work upon the mechanism of the reactions in internal combustion engines by means of spectroscopy.

DUMANOIS, PAUL (55)
THE PROBLEM OF ANTI-KNOCK COMPOUNDS. Chim. & Indus. [Paris] Special No., pp. 376–379. Sept. 1926.

FISCHER, EMIL (56)
ALCOHOL AS AUTOMOTIVE FUEL. Motorwagen 29: 487–493. 1926.

Physical properties pertaining to engine operation of ethanol are compared with those of ether, water, benzene, and gasoline. Mentioned are volatility, heats of combustion, and vaporization. Carburetion and manifold distribution and construction are discussed. It is brought out that ethanol prevents carbon formation; however, cylinder lubrication requires supervision.

GUINOT, H. (57)
DEHYDRATION OF IMPURE ALCOHOLS BY THE AZEOTROPIC METHOD. Chim. & Indus. [Paris] Special No., pp. 357–361. Sept. 1926.

Adaptation of laboratory method to an industrial scale for removal of impurities which are either more or less volatile than ethanol, is described.

LEWIS, J. S. (58)
VAPOUR PRESSURES OF FUEL MIXTURES. II. Inst. Petrol Technol. Jour. 12: 32–44. 1926. (See No. 51).

PIGNOT, A. (59)
AUTO-IGNITION OF FUEL MIXTURES. Jour. des Usines à Gaz. 50: 293–298. 1926.

Fuel-air mixtures necessary to produce auto-ignition when the mixture is compressed adiabatically were studied. Curves are given for methanol, ethanol, and aliphatic and aromatic hydrocarbons. For 10:1 air-fuel ratios by weight and a compression ratio of 9:1 the initial temperatures required for some materials were: Ethanol 76°, methanol 95°, benzene 69°, methyl benzene 47°, cyclohexane 60°. C.

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[2] Sequence of annotations 52 and 53 is according to journal reference.

PROKES, C. (60)

THE CORROSION OF ALUMINUM. Chem. Obzor 1: 349–358. 1926.

The corrosion of aluminum by water, acetone, alcohols, and various other substances is described.

RINDL, M. (61)

ALCOHOL MOTOR FUELS CONSISTING OF ACETYLENE DISSOLVED IN ALCOHOL OR IN ACETONE-ALCOHOL. So. African Jour. Sci. 23: 268–272. 1926.

Quantities of acetylene absorbed in ethanol and ethanol-acetone mixtures were measured. Results are given only as approximate because the rate of loss of acetylene from the solutions was very rapid. The conclusion of the article is that gasoline, benzene, or a mixture of both are better fuels.

1927

PETRLIK, KAREL (62)

DEHYDRATION OF ALCOHOL. Assoc. des Chim. de Sucr. et Distill. Bul. 44: 223–224. 1927.

Dehydration of ethanol for use as motor fuel either alone or in blends is not justified and increases cost unnecessarily.

——— (63)

MOTOR ALCOHOL AND THE HYGROSCOPICITY OF THE AIR. Ztschr. f. Spiritusindus. 50: 136–137. 1927.

It is argued that the water in 96.5° ethanol cannot affect the combustion either thermally or chemically, since the amount of water contained in a fuel blend of 50:30:20 (percent by weight) of ethanol-benzene-gasoline is considerably less than the moisture contained in air necessary for combustion of this blend at ordinary driving temperatures; that a 50:50 blend of ethanol (96.5°)-benzene is stable at —6° C.; that 45:45:10 blend of ethanol (96.5°)-gasoline (aviation), and benzene is stable at —32°; and that a 50:30:20 mixture of ethanol (96.5°)-gasoline-benzene is stable at —40°. For all these reasons it would be uneconomical to dehydrate ethanol for use as fuel. (For author's refutation of argument see C. Mariller, No. 64.)

MARILLER, CHARLES (64)

WATER-FREE OR WATER CONTAINING MOTOR FUEL? Ztschr. f. Spiritusindus. 50: 308–309. 1927. (Abstract *from:* "Le Carburant national et les carburants nationaux?" Chimistes, April 1927).[3]

The argument presented by Petrlik (No. 63) is not only not generally applicable but also not practical, particularly in France. The influence of the addition of water in combustion is too well known to be discussed; however, water in ethanol is more disadvantageous than desirable. France has very little benzene and in addition it is a very poor stabilizer for blends with American gasolines. Aviation type gasolines (volatile) are too expensive for general use and others that are poorly miscible must be used. With present methods, absolute ethanol is no more expensive than 96-percent ethanol.

SCHMIDT, E. K. O. (65)

THE CORROSION OF METALS AND LIGHT METALS BY LIQUID FUELS. Auto Tech. 16(15): 7–9. 1927; Matallbörse 17: 623–624, 681–682. 1927; Inst. Metals Jour. 39: 522. 1927.

The corrosive action of gasoline, benzene, 90-percent ethanol, and 50:50 and 30:70 ethanol blends on steel, copper, brass, aluminum, duraluminum, magnesium, and riveted combinations of these metals was investigated in order to find a satisfactory material for fuel tanks. If no action took place after 24 hours, there was none after 6 months. The influences of water, of metallic couples, corrosion of lead linings by benzene and of tin linings by ethanol are discussed. The importance of the purity of ethanol and the absence of corrosive compounds in it are emphasized.

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[3] Sequence of annotations 63 and 64 is according to journal reference.

TANAKA, Y., NAGAI, Y., and AKIYAMA, K. (66)
LOWER LIMIT OF INFLAMMABILITY OF ETHYL ALCOHOL, ETHYL ETHER, METHYL CYCLOHEXANE AND THEIR MIXTURES. Aeronaut. Res. Inst. Tokyo, Imp. Univ., Rpt. 2: 235–246. 1927.

1928

BERL, E., HEISE, K., and WINNACKER, K. (67)
CONTRIBUTION TO THE KNOWLEDGE OF THE OXIDATION PROCESS IN MOTOR FUELS. Ztschr. f. Phys. Chem. 139 Abt. A: 453–481. 1928.

The investigation of the combustion of alcohols and other fuels made to gain a better understanding of their antiknock properties, is discussed. A theory, combining the "peroxide" and the "dehydrogenation" theories, is proposed. Data are presented which show a certain relationship between ignition temperature and antiknock values; however, this is not too definite. In general, a high ignition temperature corresponds to a high antiknock value. In order to investigate the oxidation characteristics of various fuels, lean fuel-air mixtures were passed over catalysts, usually Fe_2O_3. Antiknock agents act as negative catalysts (iron pentacarbonyl, tetraethyl lead). It is assumed that finely divided metal is formed, preventing formation of or quickly reducing peroxides. Lead and iron, atomized in an arc, gave qualitatively the same result as the antiknock compounds.

FORMÁNEK, JAROSLAV (68)
DETECTION AND DETERMINATION OF GASOLINE, BENZENE, ALCOHOL, ETHER AND TETRALIN IN MOTOR FUELS. I & II. Chem. Ztg. 52: 325–326, 346–348. 1928; Chem. Obzor 3: 33–34. 1928.

Shows that tetralin gives positive reaction with algol red B or lacquer red Ciba B dyes; kerosene gives only slight reaction; and gasoline, benzene, and alcohol show no reaction.

LAYNG, T. E., and YOUKER, M. A. (69)
ACTION OF ACCELERATORS AND INHIBITORS UPON THE OXIDATION OF LIQUID HYDROCARBONS. Indus. and Engin. Chem. 20: 1048–1052. 1928.

An attempt is made to correlate the behavior of antiknock and pro-knock compounds such as T.E.L., potassium ethylate, aniline, ethanol, butyl nitrite, etc. in engines with their behavior as inhibitors or accelerators in the vapor and liquid phase oxidation of hydrocarbons (n-heptane, gasoline, kerosene). T.E.L. and both potassium and sodium ethylate, it is concluded, are accelerators of liquid-phase oxidation but ethanol, aniline, and diphenylamine are not. Aniline, diphenylamine, T.E.L., and potassium ethylate are all inhibitors of gas phase oxidation. The latter is also true for ethanol if approximately 20 percent or more is used.

MARDLES, E. W. J. (70)
AUTOXIDATION DURING SLOW COMBUSTION. [London] Chem. Soc. Jour. 1928: 872–885.

Addition of 5 percent (volume) of water to a 60:40 ether-ethanol mixture increased the H.U.C.R. from 4.9 to 5.4, while the addition of 5 percent (volume) of hydrogen peroxide (40 volumes) raised the H.U.C.R. to 5.2, indicating that H_2O_2 behaved similarly to water. The H_2O_2 formed during combustion may be the result of decomposition of more active peroxides. Five percent by volume of nitrogen peroxide added to butanol decreased the spontaneous ignition temperature (S.I.T.) from 590° to 235° C. Two percent by weight of benzoyl peroxide affected the S.I.T. of either ethanol or butanol only slightly. Twenty percent by volume of isoamyl nitrite reduced the S.I.T. of butanol from 500° to 455°.

RÖHRIG, H. (71)
THE ACTION OF ETHYL ALCOHOL FROM VARIOUS SOURCES ON SHEET ALUMINUM AND LANTAL. Korrosion u. Metallschutz. 4: 133–135. 1928.

Tests were made at 20° C. for 120 days and at 78° for 21 days. The three factors: Loss in weight, strength, and ductility changed similarly. Anhydrous ethanol and high-grade ethanol were non-corrosive, while raw molasses spirits, spirits from sulfite liquor, and raw spirits were increasingly corrosive in the order named.

1929

DIETRICH, K. R. (72)
INVESTIGATIONS ON THE CORROSION OF METALS IN AUTOMOTIVE VEHICLES BY FUELS AND FUEL BLENDS. Korrosion u. Metallschutz 5: 110–114. 1929.

Hard and soft aluminum (99.5 percent), iron, copper, zinc, iron plated with nickel, tin, and lead, galvanized iron, brass, and bronze were exposed in glass containers in the laboratory to seven fuels including 96-percent and anhydrous ethanol and various sulfur-containing gasolines and benzene. In addition, experiments were conducted on combinations of the above metals. One half of the sample was immersed in the liquid and liquids were renewed each month. After 1½ years the following results were noted: Iron was corroded by all; zinc and copper were attacked by sulfur-containing fuels; soft and hard aluminum were not affected by 96-percent ethanol nor by hydrocarbon fuels when alone, but synthetic gasoline-ethanol blends were corrosive; iron, either nickel or tin plated, was resistant to all fuels; lead-coated iron was resistant only to 96-percent ethanol and anhydrous ethanol, and was attacked by all others; brass and bronze showed no corrosion. Whenever metal coatings were injured, corrosion was observed soon in all fuels. Corrosion experiments conducted under pressure of 5 atmospheres gave the same results except in a very much shorter time.

——— and JEGLINSKI, H. (73)
INVESTIGATIONS OF ALCOHOL MOTOR FUELS. Chem. Ztg. 53: 177–178, 198–199. 1929.

Qualitative and quantitative tests are described for the determination of components of alcohol motor-fuel blends containing gasoline, benzene, methanol, ethanol, and acetone. Alcohols are determined by shaking with an aqueous calcium chloride solution, followed by separation and distillation of the lower layer. If only ethanol is present, a density determination suffices. In case methanol and ethanol are both present, density and refractive index are measured and results evaluated by means of a Gibbs triangular diagram. The upper layer is weighed.

GENSKE, E. (74)
LIQUID FUELS. Chem. Tech. Rundschau 44: 734, 763. 1929.

The storage, handling, and evaluation of petroleum fractions, benzene, and alcohol are discussed. Benzene produces more soot on combustion than does gasoline; the difference can be lessened by admixture with gasoline or alcohol.

GREBEL, A. (75)
CHANGES IN THE SPONTANEOUS IGNITION TEMPERATURES OF FUELS WITH VARIOUS ADDITIVES. [Paris] Acad. des Sci. Compt. Rend. 189: 90–92. 1929.

The classification of fuels on the basis of decreasing spontaneous ignition temperatures follows approximately the order of decreasing C.R. at which knock-free operation is possible. Experimental results are shown for gasoline, benzene, acetone, ethanol, ether, methanol, iron pentacarbonyl, T.E.L., aniline, and others and of blends containing gasoline or benzene mixed with a certain percentage of some of the above constituents. A Moore apparatus modified by Krupp was used. It was found that the treatment of the cavity in the steel block (by scraping or washing with ether) influenced the temperatures obtained.

——— (76)
CHANGES IN THE SPONTANEOUS IGNITION TEMPERATURES OF FUELS AS A FUNCTION OF THE CONCENTRATION OF THE VARIOUS COMPONENTS OF THE MIXTURE. [Paris] Acad. des Sci. Compt. Rend. 189: 856–858. 1929.

Since the previous investigation (see No. 75), it was found that the nature of the gasoline to which the various fuels were added exerts a great influence on detonating behavior. Results show the increase of spontaneous ignition temperatures, of binary, ternary, and quaternary mixtures containing gasoline, benzene, ethanol, acetone, and aniline when the composition is altered.

——— (77)
"SAFETY" FUELS FOR AIRCRAFT ENGINES. [U.S.] Natl. Advisory Com. Aeronaut. Tech. Memo. No. 494, 25 pp. 1929.

Flash point temperatures of methanol and ethanol are given.

JOACHIM, W. F., and ROTHROCK, A. M. (78)
FUEL VAPOR PRESSURES AND THE RELATION OF VAPOR PRESSURE TO THE PREPARATION OF FUEL FOR COMBUSTION IN FUEL INJECTION ENGINES. [U.S.] Natl. Advisory Com. Aeronaut. Tech. Rpts. No. 321, 13 pp. 1929.

Methanol, ethanol, mixtures of methanol and gasoline, as well as other fuels, were heated in a steel bomb in an atmosphere of nitrogen. The vapor pressure data for the alcohols checked closely the previous data by Young. Some decomposition was observed and alcohols, kerosene, and gasoline were changed from clear, white thin liquids to liquids resembling fuel oil or a very light lubricating oil.

JONES, G. W., and KLICK, J. R. (79)
INFLAMMABILITY OF MIXTURES OF ETHYL ALCOHOL, BENZENE, FURFURAL, AND ACETONE. Indus. and Engin. Chem., Indus. Ed. 21: 791–793. 1929.

Lower inflammable limits for ethanol, furfural, benzene, C. P. acetone, and commercial acetone when mixed with air and at 125° C. are 3.85, 2.10, 1.53, 2.92, and 3.18 percent, respectively. Lower inflammability limits of mixtures followed closely LeChatelier's law.

LOUIS, MARCEL (80)
THE USE OF METHANOL AND ETHANOL AS FUELS FOR INTERNAL COMBUSTION ENGINES. [France] Ann. de l'Off. Natl. des Combustibles Liquides 4: 183–274. 1929; Chim. & Indus. [Paris] Special No., pp. 312–329. Feb. 1929.

Inflammability limits of alcohol mixtures, thermal decomposition of air-fuel mixtures and corrosion produced by alcohols upon metals, particularly magnesium and lead, are discussed in great detail. Studies of decomposition of fuel-air mixtures showed that ethanol in general was more readily oxidized than methanol. Above 380° C. the formation of aldehydes and acids became very rapid to about 440° after which it decreased slowly. At 400° methanol was oxidized much less than was ethanol. Mixtures of methanol-ethanol gave values that were average for each component present. The presence of water seemed to decrease the oxidation of alcohols. It was noticed that the corrosive effects of anhydrous alcohols were about the same as of gasoline. Lead and magnesium were attacked in the cold more than other metals, and methanol was more corrosive than ethanol. For this reason methanol cannot be used in aviation engines or in automobiles equipped with magnesium or magnesium alloy pistons. Small quantities of water such as exist in commercial alcohols appeared to reduce the corrosion of metals with the exception of that of lead.

MARDLES, E. W. J., and MOSS, H. (81)
DETERIORATION OF CRACKED SPIRITS BY GUMMING. Inst. Petrol. Technol. Jour. 15: 657–673. 1929. (Abstract *by* Max Naphthali, "Gum in cracked gasoline." Chem. Ztg. 54: 371. 1930).

Addition of 10 percent of ethanol or methanol to a vapor-phase gasoline exposed to sunlight reduced the gum formation from 1950 mg. per 100 cc. to 200 and 950 mg. respectively, showing a greater effectiveness of ethanol. However, in a smilar experiment with a refined gasoline, to which 2.5 percent of ethanol and 2.5 percent of methanol had been added, the gum content was reduced from 250 to 75 and 50 mg. per 100 cc., respectively, showing approximately the same inhibition. Only a slight effect was noted when 5 percent of acetone and 5 percent of ethanol were added to a cracked gasoline exposed to ultraviolet light. A 2-percent addition of pentanol to a cracked gasoline exposed to 47° C. acted as a partial inhibitor.

NOLL, AUGUST (82)
ANALYSIS OF MOTOR FUELS CONTAINING ALCOHOL. Ztschr. f. Spiritusindus. 52: 242–243, 247–248. 1929.

Fuel containing alcohol is shaken in a flask with $CaCl_2$ solution. The volume of hydrocarbons is measured on the graduated neck and the water and alcohol are determined by difference. A further sample is twice extracted with $CaCl_2$ solution and the extracted alcohol is determined by distillation; the residual hydrocarbons are dried over ignited Na_2SO_4 and filtered. A small portion (10 cc.) is shaken with a mixture of H_2SO_4 and oleum or HNO_3 (4:1 by volume). The contents are made up to 110 cc. with H_2SO_4 and the proportion of paraffins is read; benzene is obtained then by difference.

RACKWITZ, E., and PHILIPPOVICH, A. VON (83)
BEHAVIORS OF FUELS FOR AIRPLANES UNDER LOW-TEMPERATURE CONDITIONS. Luftfahrt-Forsch. 5(4): 148–156. 1929.

It is shown that the crystallization temperatures of motor benzene and benzene-gasoline blends is a function of the distillation characteristics of the particular commercial benzene. However, benzene crystallization is not the only danger; separation of ice may also occur at low temperatures. The latter may be prevented through additions of small quantities of e.g. methanol or pyridine. Ethanol-benzene-gasoline blends were also studied and it is emphasized that ethanol should be nearly anhydrous.

SMYTH, C. P., and ENGEL, E. W. (84)
MOLECULAR ORIENTATION AND THE PARTIAL VAPOR PRESSURES OF BINARY LIQUID MIXTURES. II. SYSTEMS CONTAINING ALCOHOL. Amer. Chem. Soc. Jour. 51: 2660–2670. 1929.

The partial vapor pressures of six binary liquid systems containing alcohol (ethanol or butanol) as one of the components was measured by dynamic method. Results deviate considerably from Langmuir's theory of molecular surface energies. A theoretical discussion is presented.

ŠTAŠTNÝ, J., KEME, I., and BRODINA, R. (85)
CHEMICAL ANALYSIS OF ALCOHOL-BENZENE-GASOLINE MIXTURES. Chem. Obzor 4: 1–3. 1929.

Sulfonation method is used for analysis of Dynolkol. Ethanol is separated from the mixture 12 hours after addition of sodium chloride and the amount of unsaturated hydrocarbons and unsaturated hydrocarbons plus benzene is determined by adding 96-percent sulfuric acid to the former and 100-percent sulfuric acid to the latter. To 25 cc. of a gasoline-benzene mixture 60 to 70 cc. of 100-percent sulfuric acid is added. The increase of the amount of the lower layer before and after sulfonation corresponds to the amount of benzene; the difference is gasoline.

WAWRZINIOK, OTTO (86)
RESULTS OF INVESTIGATION TO ESTABLISH THE CAUSE OF THE CORROSION OF SHEET METAL BY MOTOR FUELS. Institut für Kraftfahrwesen an der Sächsischen Technischen Hochschule, Dresden, Mitteilungen, Sammelband 6: 45–56. 1929; Auto-Tech. 16(21): 23–25; *Ibid* 16(22): 19–28. 1927.

Twelve samples of aluminum, 3 of brass, and 1 each of zinc, iron, lead, galvanized iron, tin plate, and 18–8 stainless steel were exposed to 18 different fuels for 580 days. A few results of interest are: tin plate and three aluminum samples were slightly attacked by 99.8-percent ethanol; methanol was very corrosive towards lead and affected slightly two aluminum samples, tin plate, and galvanized iron.

Abstract *in* Jour. Inst. Metals 39: 522. 1927.

——— (87)
THE EXAMINATION OF FUELS BY MEANS OF DISTILLATION ANALYSIS. Institut für Kraftfahrwesen an der Sächsischen Technischen Hochschule, Dresden, Mitteilungen, Sammelband 6: 57–62. 1929.

Since existing methods were found to be unsuitable, a new apparatus was designed. Data for several fuels including ethanol blends are given.

1930

DIETRICH, K. R. (88)
ALCOHOL AUTOMOBILE FUELS. Automobiltech Ztschr. 33: 792–793. 1930.

Precautions to be observed in the preparation of ethanol blends are discussed. It is emphasized repeatedly that it is necessary to prevent contamination with water.

SĂNDERA, K., and ZEMAN, J. (89)
THE USE OF SUGAR AS A MOTOR FUEL. Listy Cukrovar. 49: 147–149. 1930.

In a mixture of ethyl and methyl alcohols (57 and 13 parts respectively) 30 parts of sugar was dissolved under pressure. It was then filtered through activated charcoal and admixed with NH_4NO_3, 0.2-percent benzene, and 3 to 8 percent ethanol to increase the calorific value which became 5940 cal./gm. Fuel thus prepared has kept for 3 years. Changes in motor are necessary to adapt it to the internal combustion engine.

SWIĘTOSŁAWSKI, WOJCIECH, ET AL. (90)
PHYSICO-CHEMICAL RESEARCHES ON ALCOHOLIC MIXTURES. Przemysł Chem. 14: 337–529. 1930.

A very comprehensive study of the physical properties of ethanol fuels. The following topics are discussed: (I) introduction, pp. 337–338; (II) the phenomenon of azeotropy in polycomponent mixtures, pp. 339–345; (III) fractional distillation of liquid fuels, pp. 385–391; (IV) measurement of vapor pressure of alcoholic mixtures, pp. 409–412; (V) ebullioscopic and tonometric study of gasoline and alcoholic liquid fuels, pp. 433–437; (VI) heat of combustion of liquid fuels containing alcohol, pp. 457–461; (VII) vaporization of the mixtures in bubbling air, pp. 481–485; (VIII) dependence of the temperature of clouding of the mixtures on the amount of added water, pp. 497–501; (IX) flash points and burning temperatures of alcoholic fuel mixtures, pp. 501–503; (X) temperatures of spontaneous ignition of alcoholic mixtures, pp. 515–517; and (XI) rate of vaporization of the alcoholic mixtures from heated metallic surfaces, pp. 518–529.

USPENSKII, S. P., and LADUIZHNIKOVA, N. I. (91)
METAL CORROSION BY FUEL. Neftyanoe Khoz. 19: 264–277. 1930.

The experimental results expressed in milligrams per square centimeter, are given in the accompanying table:

Fuel	Corrosion								Duration
	In liquid of—				In vapor of—				
	Pb	Cu	Brass	Fe	Pb	Cu	Brass	Fe	
	Milligrams per square centimeter				*Milligrams per square centimeter*				*Months*
Krasnodar gasoline	9.4	......	......	......	......	......	......	......	7
Motor benzene	48.9	3.2	5.7	10.9	......	......	......	......	8
Grozny II	12.2	......	......	......	......	......	......	......	7
Acetone	28.3	37.2	20.2	9.8	5.0	......	......	......	8
Carbon disulfide	23.9	18.0	......	......	5.0	......	......	......	10
Ethanol (purified)	90.1	......	......	......	24.0	......	......	......	9
Methanol (purified)	706.9	5.4	5.6	......	127	......	......	6.7	9
Ethanol (commercial)	191.3	13.6	36.4	2909	12.0	......	......	......	9
Methanol (commercial)	1148	1013	1292	43.6	194	4	3	7	9

VAVRINECZ, G. (92)
SIMPLE AND RAPID METHOD FOR THE EXAMINATION OF GASOLINE-ALCOHOL MIXTURES. Vegyi Ipar 29(4): 3–4. 1930.

Add 10 to 30 gm. dried K_2CO_3 or $CuSO_4$ to 0.25 to 0.5 liter of the mixture and filter the liquid after it has stood for 1 day. The water content of the mixture can be calculated from the densities of the original and treated liquids by using the formula: Percentage H_2O = $(d-d^1)/(1-d^1)$ where d is the specific gravity of the original and d^1 that of the treated liquid.

WAWRZINICK, OTTO (93)
NEW METHOD FOR TESTING THE CORROSION OF METALS BY MOTOR FUELS. Automobiltech. Ztschr. 33: 28–30, 58–60, 112. 1930.

Previous experiments in which metal specimens had been suspended in quiescent liquids were criticized because they do not represent actual conditions. Author has modified his previous procedure and the new set-up is described. It was found that, for all practical purposes, an exposure of 12 days in the new apparatus was equivalent to an exposure of 150 to 200 days in quiescent liquids. A general discussion of the results is included.

——— (94)
CORROSION OF "SILUMIN" STRIPS BY MOTOR FUELS. Automobiltech. Ztschr. 33: 110. 1930.

Corrosion of Silumin (aluminum alloy) is more rapid in agitated than in quiescent liquids. A 30-day exposure to the former resulted in greater weight loss than an exposure of 150 days in a quiescent solution. Absolute ethanol remained clear though the specimen showed a loss in weight. A number of gasolines as well as benzene, gasoil, and Diesel oil were investigated, some of which showed discoloration and deposits.

——— (95)
TWO IMPORTANT PHYSICAL PROPERTIES OF FUEL PERTAINING TO THE FORMATION OF MIXTURES IN CARBURETOR ENGINES. Automobiltech. Ztschr. 33: 292–294, 317–318, 364–366, 408–410, 478–480. 1930.

——— (96)
LATENT HEAT OF VAPORIZATION OF FUELS AND METHODS OF MEASURING SAME. Automobiltech. Ztschr. 33: 618–620, 644–646, 764–766. 1930.

Effect of heat of vaporization on engine performance is discussed and new apparatus described for measurements of heat of vaporization of liquids such as alcohol-benzene blends. Various German motor fuels are compared.

YANNAQUIS (97)
LIMITS OF INFLAMMABILITY OF FUELS CONTAINING ALCOHOL. [France] Ann. de l'Off. Natl. des Combustibles Liquides 5: 175–178. 1930.

The inflammability of a mixture of benzene, methanol, and ethanol is compared with that of a mixture of benzene, ethanol, and gasoline. The latter mixture has a lower limit at ordinary temperature; however, at about 250° C. the limits are the same for both. Replacing part of ethanol and methanol with benzene lowers the inflammability without modifying the temperature coefficient. Replacement with gasoline modifies the temperature coefficient.

1931

BARON, CHARLES (98)
THE USE OF TERNARY (FUEL) MIXTURES IN AVIATION. [France] Ann. de l'Off. Natl. des Combustibles Liquides 6: 155–168. 1931.

The detrimental effect of detonation and the means of preventing detonation either through addition of T.E.L. or through blending with benzene and ethanol, are discussed. The latter method is advocated because gasoline-benzene-ethanol blends not only prevent detonation but also prevent carburetor icing, while the use of T.E.L. is considered too harmful. In connection with de-icing, reference is made to successful experiments with gasoline-ethanol mixtures. Temperatures at which benzene or water would crystallize (critical solution temperatures) were determined for various compositions of the following blends: gasoline-benzene; gasoline-ethanol (99 percent); gasoline-benzene-ethanol (99 percent); gasoline-benzene-ethanol (98 percent); and gasoline-benzene-ethanol (97 percent). It is concluded that blends of gasoline-benzene-ethanol containing 70 percent gasoline and at least 10 percent ethanol are absolutely stable to below —30° C. and may be used as aviation fuels. The amounts of benzene and ethanol necessary can be produced in France.

——— BOULANGER, C., and LEGRAIN, R. (99)
MIXTURES OF GASOLINE, ALCOHOL AND BENZENE. [Paris] Acad. des Sci. Compt. Rend. 192: 1383–1385. 1931; Jour. des Usines à Gaz. 55: 412–413. 1931.

Gasoline-benzene blends are excellent aviation fuels. However, there is a danger of crystallization of benzene at low temperatures. Data show that the addition of ethanol suppresses the formation of crystals. A blend consisting of 70:20:10 gasoline-benzene-ethanol is recommended.

DIETRICH, K. R. (100)
THE MIXING OF MOTOR ALCOHOL FUELS. Petrol. Ztschr. 27 (28) : 9. 1931. Motorenbetrieb u. Maschinen-Schmierung 4 (7) : 2. 1931.

Three methods of mixing alcohol and gasoline for the purpose of preparing fuel blends are described briefly.

——— and CONRAD, C. (101)
DETERMINATION OF WATER IN ALCOHOLIC MOTOR FUELS. Ztschr. f. Angew. Chem. 44: 532–534. 1931.

A simple apparatus and procedure are described for the determination of water in ethanol blends by means of Mg_3N_2. The ammonia formed is absorbed in acid. Calcium and aluminum nitrides were not satisfactory reagents. The method gave excellent results for various ethanol concentrations in benzene, gasoline, and methanol in which the ethanol contained from 0.1 to 9.9 percent of water.

JACQUÉ, LEON (102)
THE INFLUENCE OF HYDROGENATED PRODUCTS ON THE STABILITY OF ALCOHOL-GASOLINE MIXTURES. [Paris] Acad. des Sci. Compt. Rend. 193: 1185–1187. 1931.

It is shown that the addition of light synthetic gasoline fractions derived from the hydrogenation of tar will reduce the critical solution temperatures of ethanol blended with ordinary gasoline. The action is similar to that of benzene. Data are presented.

KREMER, M. (103)
THE WATER CONTENT OF MOTOR FUELS AND ITS ESTIMATION. Petrol. Ztschr. 27: 443–445. 1931.

Various methods for the determination of water in ethanol blends are reviewed. The method worked out by F. Henle (Berichte 53: 719. 1920) is considered very suitable for water contents between 0.2 and 0.6 percent. Dehydrated, de-ethoxylated products of aluminum ethylate such as $Al_2(OC_2H_5)_4O$ are made to react with traces of water in organic solvents to give aluminum hydroxide. Preparation of the above types of compounds is described. Another possible method is the formation of sodium formate when an alcoholic solution of sodium ethylate and formic acid ester is added to ethanol containing water.

LOUIS, MARCEL (104)
THE USE OF METHANOL AND ETHANOL AS FUELS IN INTERNAL-COMBUSTION ENGINES. Chim. & Indus. [Paris] Special No., pp. 405–409. March 1931.

Further studies on corrosion of metals are reported. (See No. 80 for previous work by same author.) The corrosive effect of methanol in blends of ethanol-methanol-benzene on an alloy of 94 percent Mg, 2 percent Al, and 4 percent Cu is greatest when concentration of methanol is above 41 percent and it is very small when concentration is 5 percent. Couples are attacked more strongly by pure alcohols than are single metals. Experiments were performed with pure methanol, pure ethanol, and methanol with 2 percent water.

SUWA, TETSURO (105)
FUEL ALCOHOL. Imp. Fuel Res. Inst. [Japan] Bul. No. 8, 87 pp. 1931.

A general review and discussion.

WAWRZINIOK, OTTO (106)
THE SATURATION PRESSURE OF MOTOR FUELS AND METHODS FOR ITS DETERMINATION. Automobiltech. Ztschr. 34: 653–654, 724–726. 1931.

Apparatus is described and saturation pressures given covering a temperature range from —10° to +60° C. for four gasolines, crude and pure benzene, petroleum ether, four blends of gasoline with benzene or ethanol, absolute ethanol, and 99.2-percent ethanol.

ZDÁRSKÝ, JOSEPH (107)
DETERMINATION OF ETHYL ALCOHOL AND WATER IN MOTOR FUELS CONTAINING ALCOHOL. Chem. Obzor 6: 297–298, 326–328. 1931.

This is a modification of gravimetric method of K. Dietrich and H. Jeglinski (see No. 73). Individual componets are determined volumetrically is a separatory funnel with aqueous $CaCl_2$ solution. Mixtures of gasoline with absolute ethanol are tested by using distilled water instead of $CaCl_2$ solution. The lower layer of $CaCl_2$ containing ethanol is transferred quantitatively and the ethanol is distilled off; the volume percent of ethanol is obtained from the specific weight determination. Gasoline or mixture of gasoline and benzene are shaken with $CaCl_2$ solution for 1 minute. The quantity of this residue measured at a given temperature gives the volume percentage of gasoline or mixture of gasoline and benzene.

ZHURAVLEV, D. I. (108)
MUTUAL SOLUBILITY OF CHEMICALLY DIFFERENT LIQUIDS. Jour. Appl. Chem. (U.S.S.R.) 4: 511–519. 1931.

Mutual solubility of aqueous alcohol and aviation gasoline, motor gasoline, and benzene is discussed and data given.

1932

BALADA, ADOLF (109)
CZECHOSLOVAKIAN ALCOHOL-GASOLINE MIXTURE. Chem. Obzor 7: 240–244. 1932.

Volume changes on mixing gasoline and ethanol were studied. The starting ability of blends as a function of the 10-percent-point distillation temperature was investigated. Octane numbers of Czechoslovakian gasolines and blends are given.

BAUER, O., and SCHIKORR, G. (110)
ACTION OF ALCOHOLIC FUELS ON ALUMINUM AND ALUMINUM ALLOYS. Automobiltech. Ztschr. 35: 583–589. 1932.

The purpose of the work was, first, to determine the ease with which water was taken up by ethanol blends as well as the amounts, and second, to investigate corrosion of ordinary and clad aluminum by water-containing blends. If ethanol-gasoline blends containing 10 to 20 percent ethanol are exposed in an open vessel (700 cc. in glass cylinders 170 cm. high and 8 cm. in diameter) at 25° C. to an atmosphere saturated with water vapor, separation will take place in 3 to 12 days. Data are also presented for critical solution temperatures at 20° and the volume of the phase separating. The water-free gasolines and blends (up to 20 percent ethanol) did not attack either type of aluminum for all practical applications. With increasing water content up to 0.5 percent, a small but uniform attack was noticeable. No local pitting was observed. If separation occurred, the amount of corrosion increased. Aluminum protected by means of the Bauer-Vogel process was not attacked under any circumstances; in the other cases no particular difference was observed. Authors conclude that aluminum or aluminum alloys mentioned in this article may be safely used with blends containing up to 20 percent of ethanol, since no weakening of the metal will take place.

BONNIER, M. C., and JUGE-BOIRARD, G. (111)
PHYSICAL ANALYSIS OF MIXTURES OF MOTOR SPIRIT-ALCOHOL AND MOTOR SPIRIT-ALCOHOL-BENZENE. [France] Ann. de l'Off. Natl. des Combustibles Liquides 7: 799–809. 1932.

A method is described which uses the addition of water to the mixtures and the observation of the point of turbidity on cooling.

DIETRICH, K. R. (112)
METHOD FOR THE IMPREGNATION OF CORK FLOATS RESISTANT TO MOTOR FUELS. Ztschr. f. Spiritusindus. 55: 226. 1932. (Identical in content with "Impregnation of cork floats." Automobiltech. Ztschr. 35: 487. 1932.)

Cork floats coated with gelatin and treated with formaldehyde (formalin) can be used with ethanol blends.

FERGUSON, J. B. (113)
THE SYSTEM METHYL ALCOHOL-N-HEXANE AT 45° C. Jour. Phys. Chem. 36: 1123–1128. 1932.

Compositions of the coexistent liquid and vapor phases in the system methanol-n-hexane were determined at 45° C. The densities of hexane vapor and of the two component vapors were studied and results on total and calculated partial pressures are given and discussed.

JELENCKÝ, VÁCLAV (114)
THE VOLUME INCREASE IN MIXING GASOLINE WITH MOTOR ALCOHOL. Chem. Obzor 7: 263–264. 1932.

A method is suggested for the preparation of gasoline-alcohol mixtures which takes care of the effect of volume increase upon mixing.

KARPIŃSKI, B. (115)
EFFECT OF ETHANOL ON IGNITION TEMPERATURE OF GASOLINE. Prxemysł Chem. 16: 25–31. 1932.

Spontaneous ignition temperatures of pure gasolines and of mixtures of gasolines and anhydrous ethanol were studied in a modified form of Jentsch apparatus. The addition of .08 percent of T.E.L. to gasoline decreases the zone of premature ignition. The effect of ethanol is similar and with concentrations of ethanol over 60 percent by volume the zone of premature ignition disappears completely.

LIESEGANG, W. (116)
THE TOXICITY OF MOTOR FUELS AND THEIR COMBUSTION PRODUCTS. Angew. Chem. 45: 329–330. 1932.

Composition of fuels, hydrocarbons or benzene with or without alcohols, has no effect on the toxicity of normal exhaust gases. Gasoline, considered as a mixture of paraffin hydrocarbons, has a narcotic effect. The latter increases with increase of chain length (decrease in volatility). The following quantities of hydrocarbons have the same toxic effect on mice: 0.377 gm. pentane, 0.147 gm. hexane, 0.064 gm. heptane, 0.037 gm. octane. The narcotic effect of benzene is approximately the same as that of octane; however, methanol is more poisonous and therefore more dangerous as a fuel constituent. Its use is contemplated as a fuel component in Germany.

SCHILDWÄCHTER, H. (117)
COURSE OF COMBUSTION, EXCESS AIR RATIO, EXPLOSION LIMITS, WASTE-GAS COMPOSITION AND CALORIFIC VALUE OF FUEL-AIR MIXTURES. Petrol. Ztschr. 28 (32): 1–4. 1932.

SPAUSTA, FRANZ (118)
THE STABILITY OF 95-PERCENT ETHANOL, BENZOL AND GASOLINE MIXTURES IN THE PRESENCE OF WATER. Erdöl. u. Teer 8: 282–286. 1932.

Tables of water tolerance (at 20° C.), hygroscopicity, and of the distillation characteristics of several ethanol-gasoline blends are shown.

WAWRZINIOK, OTTO (119)
COURSE OF COMBUSTION, EXCESS AIR NUMBER, EXPLOSION LIMITS, EXHAUST GAS COMPOSITION AND HEATS OF COMBUSTION OF FUEL-AIR MIXTURES. Automobiltech. Ztschr. 35: 236–240, 263–266, 310–314, 335–340, 358–362. 1932.

Combustion of hydrocarbon and alcohol fuels was investigated in a stationary bomb and results were applied to combustion in engines. An interferometer was used to determine the fuel-air ratio, and the excess air number was obtained from exhaust gas analysis. Much richer mixtures can be used than had been assumed hitherto.

1933

ANONYMOUS (120)
FUEL PROBLEMS. Automobiltech. Ztschr. 36: 126–132, 157–162. 1933.

Fuel properties of benzene, gasoline, ethanol, and methanol such as octane numbers, volatility, physical properties, and production are discussed.

AUDIBERT, ETIENNE (121)
GENERAL PROPERTIES OF MOTOR FUELS AND LUBRICANTS. [France] Ann. de l'Off. Natl. des Combustibles Liquides 8: 385–449. 1933.

The effect of compression ratio and structure of chemical compounds on knock, and the properties of benzene, alcohols and Diesel fuels as well as gum formation are discussed. The characteristics and action of lubricants are described. Brief reference is made to vegetable oil lubricants.

BRIDGEMAN, O. C. (122)
ALCOHOL-GASOLINE BLENDS AS MOTOR FUELS. Indus. and Engin. Chem. News Ed. 11: 139–140. 1933.

Anhydrous ethanol must be used for blending with gasoline, and contamination with water during storage avoided. Fuel consumption of, *e.g.*, a 10-percent blend will be 4 percent higher than when gasoline is used. Performance will be practically the same and corrosion reported is probably due to the sulfur found in the benzene used for blending. A 10 percent blend may increase the octane number 2 to 10 units, depending on the base gasoline.

——— and QUERFELD, D. W. (123)
CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF GASOLINE, ETHYL ALCOHOL, AND WATER. [U.S.] Natl. Bur. Standards Jour. Res. 10: 693–704. 1933.

Data were obtained on the critical solution temperatures of mixtures of eight gasolines in proportions from 10 to 90 percent gasoline, with each of eight alcohol solutions containing from 1 to 8 percent of water by volume. The critical solution temperature, while differing considerably from the various gasolines, decreased markedly as the concentration of the water in the alcohol and the percentage of gasoline in the mixture decreased. It is indicated that addition agents will be required to increase the mutual solubility if gasoline-alcohol mixtures that will not separate in service are to be obtained.

——— and QUERFELD, D. W. (124)
THE EFFECT OF GASOLINE VOLATILITY ON THE MISCIBILITY WITH ETHYL ALCOHOL. [U.S.] Natl. Bur. Standards Jour. Res. 10: 841–850. 1933.

Data are presented on the effect of the volatility of gasoline on its miscibility with ethanol containing various amounts of water. Samples of gasoline having different volatilities were obtained by two methods—

first, fractional distillation of an original gasoline and second, blending of refinery and natural gasolines. The more volatile gasolines were found to be more miscible with alcohol, in that they produced mixtures having lower critical solution temperatures than similar mixtures containing less volatile gasoline. Comparatively small differences were found in the miscibility with ethanol of gasolines having the same volatility but different compositions.

——— and QUERFELD, D. W. (125)
SOLUBILITY OF ETHYL ALCOHOL IN GASOLINE. Indus. and Engin. Chem., Indus. Ed. 25: 523–525. 1933.

For straight-run fuels of similar volatility, the source of petroleum from which the gasoline is distilled appears to have a comparatively minor effect. Cracked gasolines may, however, show a much lower critical solution temperature than straight-run products even of the same volatility. Topping the fuel, as well as increasing the volatility at the lower end, produced a marked lowering of the critical solution temperature.

BUCHTALA, JEAN (126)
ANALYSIS OF HYDROCARBONS AND OF MINE GASES BY MEANS OF THE MICRO-DYNAMOGRAPH. Chim. & Indus. [Paris] 29, and Special No. 6: 599–600. June 1933.

The application of the micro-dynamograph to the analysis of ethanol-gasoline blends is discussed.

CHRISTENSEN, L. M., HIXON, R. M., and FULMER, E. I. (127)
THE PHYSICAL-CHEMICAL PROPERTIES OF ALCOHOL-GASOLINE BLENDS. I. INFLUENCE OF CONCENTRATION AND OF TEMPERATURE ON WATER-HOLDING CAPACITY OF BLENDS. Iowa State Col. Jour. Sci. 7: 461–466. 1933.

The water-holding capacity of alcohol-gasoline blends has been determined for a wide range of temperatures. A general relationship has been formed between the water-holding capacity W, and concentration of alcohol a, as $\log (W \times 10^2) = m \log a + \log b$, where W = cc. of water required per 100 cc. of the blend at alcohol concentration a, to produce turbidity, and m and $\log b$ are characteristic of a given gasoline. For a given concentration of alcohol, the water-holding capacity is a linear function of the temperature. Reports of the water accumulation in bulk storage tanks both in Iowa and in other states in the course of a year, have never exceeded 10 gallons of water for a 10,000-gallon tank. In larger tanks, of about 50,000 gallons capacity, accumulations have been claimed of 20 gallons per year. It is safe to assume that such tanks are emptied and filled 10 times per year. That is, the water absorbed will be about 0.01 percent by volume of the fuel which passes through them. This amount of water will raise the separation temperature of a 10-percent blend about 2° C. Such a change is of very little significance. In this consideration it has been assumed that the blend will absorb water no more rapidly than will gasoline. This should be practically the case, since the water accumulation results from tank breathing and condensation of the moisture thus introduced into the tank. If such alcohol blends are allowed to stand for 1 year they might absorb 0.1 percent of water. This would raise the separation temperature of a 10-percent blend about 20°, of a 5-percent blend about 35°, and of a 2-percent blend over 120°. Such long storage is of course quite unusual. Blends prepared with commercial gasoline and commercial anhydrous alcohol show separation temperatures of —50° to —60° due to small amounts of water found in the gasoline and in the alcohol. It is evident from the above consideration that a 10-percent blend will remain miscible at the lowest winter temperatures even if stored for as long as 1 year. On the other hand, storage of 2 to 5 percent blends should be limited to about 1 month in severe winter weather.

——— HIXON, R. M., and FULMER, E. I. (128)
THE PHYSICAL-CHEMICAL PROPERTIES OF ALCOHOL-GASOLINE BLENDS. II. THE INFLUENCE OF ANHYDROUS ETHYL ALCOHOL CONCENTRATION UPON WATER ABSORPTION. Iowa State Col. Jour. Sci. 8: 175–179. 1933.

Three types of data were obtained. In the first series 50 cc. samples of 10 blends containing from 1 to 50 percent of ethanol were kept alternately for 12 hours at 0° and 38° C., first at 50 percent and then at 100 percent humidity. Breathing was effected by means of 2 mm. capillaries. At 50 percent humidity, the cloud point changed from —60° to —6° in 15 days and at 100 percent to +34°. For the 20-percent blend the corresponding temperatures were —10° and —8°. A second series attempted to simulate more nearly actual storage conditions. Samples of 500 cc. of 10 blends containing from 1 to 50 percent of ethanol were placed outdoors in 1000-cc. flasks; breathing was provided for as before. For blends containing more than 8 percent of ethanol, no measurable absorption was found after 30 days and the cloud point remained at —60°. In the third series 84,000 and 5500 gallons of a 10-percent blend were prepared. In both cases, when the final amount was withdrawn after 66 and 13 days, respectively, the cloud temperatures were —59° and —58°.

EGERTON, A., and PIDGEON, L. M. (129)
ABSORPTION SPECTRA OF BURNING HYDROCARBONS. Roy. Soc. London, Proc. Ser. A. 142: 26–34. 1933.

Neither ethanol nor isobutyl alcohol vapor alone or with nitrogen showed any appreciable absorption between approximately 2000 and 4000 Å. Even at 360° C., a 2-percent isobutyl alcohol-air mixture did not exhibit any "extinction" (general absorption beyond 2300 Å) or bands. Higher concentrations of alcohol and higher temperatures were needed before absorption was observed, under which conditions both "extinction" and the formaldehyde bands were obtained, owing to oxidation.

FERGUSON, J. B., FREED, M., and MORRIS, A. C. (130)
THE SYSTEM ETHYL ALCOHOL-N-HEPTANE AT 30° C. Jour. Phys. Chem. 37: 87–91. 1933.

A new determination of the composition of the coexisting phases of the system of ethanol-*n*-heptane was made. No evidence was found to support the curious partial pressure curves previously reported. Partial pressures were calculated from measured total pressures.

GORDON, K. (131)
BLENDING AGENTS FOR PETROL-METHANOL MIXTURES. World Petrol. Cong. Proc. [London] 2: 788–794. 1933.

After a brief statement that methanol-gasoline blends with 15 to 20 percent of methanol give performance equal to that of gasoline, a very extensive survey of possible blending agents for methanol-gasoline blends is presented. All figures refer to a temperature of —10° C. for a 10 percent methanol blend. The amounts of blending agents are: 22 to 23 percent motor benzene; 10.3 percent ethanol; 4 percent *n*-propanol; 5 percent isopropanol; 3.5 percent *n*-butanol, lower values for many of the higher alcohols; 10.6 percent ethyl acetate; 3.3 percent triethylamine. A large number of additional compounds of these and other classes, such as halides, ketones, ethers, and phenols were investigated.

HAGIWARA, S. (132)
ALCOHOL MOTOR FUELS. Fuel Soc. [Japan] Jour. 12: 46–48. 1933.

The commercial alcohol fuel consists of 180 liters of 94-percent ethanol, 2 kg. of mineral oil distillate (boiling point under 280° C.), 30 gm. of formalin and 0.2 gm. of dye. Corrosion by exhaust gases can be avoided through use of leaner mixtures to give complete combustion, or through small additions of ammonia. The various raw materials for the manufacture of ethanol are discussed.

HERBRICH, J. (133)
A STUDY OF METHODS FOR THE ANALYSIS OF MIXTURES OF HYDROCARBONS AND ETHYL ALCOHOL. [France] Ann. de l'Off. Natl. des Combustibles Liquides 8: 1113–1133. 1933.

Stability diagrams for gasoline-alcohol mixtures for compositions of 90–10 to 84–16 percent are presented which permit reading of critical solution temperatures for various water concentrations. Numerical examples indicate the additive character of water concentrations at 0° C.

MAHLER, PAUL (134)
STUDIES ON ALCOHOLIZED GASOLINE MIXTURES. Rpt. 10 pp. The Industrial Alcohol Institute Inc. New York. April 25, 1933.

MORA, A. (135)
GENERAL CONSIDERATIONS ON FUELS. Rev. de Ingen. Indus. [Madrid] 4(33): 42–49. 1933.

Physical properties and methods of testing of gasoline, benzene, and alcohol are described.

OSTWALD, C. O. (136)
ALCOHOL MOTOR FUEL. Automobiltech. Ztschr. 36: 129–132, 157–158. 1933.

Author discusses advantages of using alcohol blends as aviation fuel. Relationship between alcohol content and water tolerance in mixtures with gasoline at various temperatures was studied. The claim that alcohol causes corrosion and greater wear of pistons and cylinders is denied.

PIETERS, H. A. J., and KOOPMANS, H. (137)
THE BLENDING OF GASOLINE OR BENZENE WITH ALCOHOL. Chem. Weekbl. 30: 328–331. 1933.

Since the solubility of water is greater in ethanol-benzene blends than in ethanol-gasoline blends, separation may occur if the two are mixed in a tank. Critical solubility data are given.

SCHMIDT, A. W. (138)
INVESTIGATION ON THE USE OF METHANOL AS A SUPPLEMENTARY MOTOR FUEL. Erdöl u. Teer 9: 74–77. 1933.

A number of blends containing methanol, ethanol, benzene, and various kinds of gasolines, but particularly the newly proposed "standard" fuel (Einheitskraftstoff) composed of 70:10:10:10 gasoline-ethanol-methanol-benzene, were studied. Octane numbers were determined and results showed little difference between the effect of ethanol and methanol. Since methanol alone is only slightly soluble in gasoline, a stable gasoline mixture can be obtained only in combination with ethanol and benzene which act as stabilizers. The very low heat of combustion of methanol militates against its use as fuel and it would be economical only when used in high-compression engines.

SMALL, JAMES (139)
THE THERMAL ASPECTS OF CARBURETION WITH SPECIAL REFERENCE TO THE VAPORIZATION OF ETHYL ALCOHOL. Phil. Mag. and Jour. Sci. 16: 641–656. 1933.

Total heat-fuel content charts for ethanol and ethanol-air mixtures are shown which may be used to calculate the amount of preheat necessary to effect complete vaporization of the fuel. An analysis is made of factors controlling the rate of evaporation.

SPAUSTA, FRANZ (140)
THE DISTRIBUTION EQUILIBRIUM BETWEEN ALCOHOL, BENZENE AND WATER. Mitt. Tech. Versuchsamtes [Wien] 22: 9–17. 1933.

Mixtures of alcohol and benzene with varying amounts of water were analyzed and the Nernst law of distribution was applied.

1934

ARAKI, T., and NAKABAYASHI, M. (141)
THE SOLUBILITY OF TECHNICAL ALCOHOL AND BENZENE IN GASOLINE FOR AERO-ENGINE FUEL. Soc. Chem. Indus. [Japan] Jour. 37: 310–311. Sup. Binding. 1934.

Solubility data were obtained on 23 mixtures of alcohol and gasoline, 37 mixtures of alcohol and benzene, and 239 mixtures of alcohol, gasoline, and benzene. A ternary equilibrium diagram is presented.

——— and NAKABAYASHI, M. (142)
THE MISCIBILITY OF GASOLINE AND TECHNICAL ALCOHOL FOR AERO-ENGINE FUEL. Soc. Chem. Indus. [Japan] Jour. 37: 685–686. Sup. Binding. 1934.

Critical solution temperature at —15° C. of gasoline-denatured ethanol-butanol was studied.

BAILEY, C. H., and HOPKINS, C. Y. (143)
WATER TOLERANCE OF MIXTURES OF GASOLINE WITH ETHYL ALCOHOL, ISOPROYL ALCOHOL, AND BENZENE. Canad. Jour. Res. Sect. B., Chem. Sci. 11: 505–519. 1934.

The present investigation deals with the determination of the critical solution temperatures of mixtures of gasoline and isopropanol, and of gasoline and benzene with ethanol containing small amounts of water. Two aviation and automotive type gasolines were used. Data show that for a given total water content of the mixture, there is a slight though regular increase in the extent to which the critical solution temperature is lowered when ethanol is progressively replaced by isopropanol. For a given temperature the critical water content increases rapidly as the percentage of gasoline in the mixture is decreased. Both increase in volatility and the use of cracked gasoline (unsaturated compounds) lower the critical solution temperatures, *i.e.*, the critical water contents are higher for a given blend. Benzene will increase moderately the critical water content of ethanol-gasoline mixtures when it is substituted for part of the gasoline. The existence of optimum ratios of benzene to ethanol for maximum water tolerance is shown; however, its effect in increasing water tolerance appears to be too slight to be of practical value. On the other hand, mixtures of reasonably high water tolerance may be prepared by the addition of isopropanol to ethanol-gasoline blends.

BOISSELET, L., and RACHKANI (144)
DETERMINATION OF WATER IN LIQUID FUELS BY MEANS OF MAGNESIUM NITRIDE. 14^{me} Cong. Chim. Indus. 5 pp. Paris. October 1934.

A method of K. R. Dietrich and C. Conrad (see No. 101) for determination of water by means of magnesium nitride is discussed.

CHRISTENSEN, L. M., HIXON, R. M., and FULMER, E. I. (145)
THE PHYSICAL-CHEMICAL PROPERTIES OF ALCOHOL-GASOLINE BLENDS. III. THE A.S.T.M. DISTILLATION CURVES AND REID VAPOR PRESSURE. Iowa State Col. Jour. Sci. 8: 237–244. 1934.

The initial temperature of distillation and the temperature of the first 10-percent distilling point are not appreciably changed until alcohol concentrations of 40 percent or more are reached. As far as volatility is concerned, additions of 10 to 20 percent of ethanol should cause no appreciable difference in starting nor show a greater loss in storage than the original gasolines. Easier starting qualities reported for the ethanol blends, particularly in winter weather, may be due to these blends forming explosive mixtures over a wider range of concentrations. The A.S.T.M. 30 percent distillation temperature is much lower for the ethanol blends than for the original gasoline and should account for the better acceleration observed, particularly in cold weather. In case of a 10-percent blend, the 60 percent distillation temperature is only slightly affected and for a 20-percent blend this temperature is depressed approximately 30° F. This agrees with results that little difference can be observed in road performance of the hot motor. The temperatures of the last 10 percent are lowered by addition of 20 percent of ethanol; however, the decrease of oil dilution reported is probably because of better combustion and lower flame temperatures rather than greater volatility of this fraction of the fuel. A.S.T.M. distillation data are given also for 10 percent of butanol and 10 percent of acetone in gasoline, as well as for a 10 percent ethanol blend containing 0.4 percent water. Evaporation rates and Reid vapor pressures of a number of ethanol blends were determined. A qualitative test indicated that the addition of ethanol did not increase the tendency of a gasoline towards vapor lock. Data presented show that ethanol-gasoline blends can be stored under commercial conditions. No water was absorbed after several months and the blend still analyzed 10 percent ethanol.

——— Hixon, R. M., and Fulmer, E. I. (146)

THE PHYSICAL-CHEMICAL PROPERTIES OF ETHYL-ALCOHOL-GASOLINE SYSTEM. IV. INFLUNCE OF ALCOHOL CONCENTRATION UPON SPECIFIC VOLUME, FLUIDITY, AIR TO FUEL RATIO, CALORIFIC VALUE, LATENT HEAT, AND FALL IN TEMPERATURE ON EVAPORATION. Iowa State Col. Jour. Sci. 8: 245–250. 1934.

It is brought out that ethanol and gasoline expand on mixing. For 4 to 30 percent ethanol, the expansion is 0.2 to 0.3 percent. Viscosities and fluidities are not additive, being greater than calculated on an additive basis up to 20 percent ethanol and less from 20 to 50 percent ethanol. While the air-fuel ratio is about 4 percent lower for a 10-percent blend than for a given gasoline, the variation among different brands of gasoline may be 5 percent. The lowering of the calorific value of a 10-percent blend is likewise less than the variation of this value among several gasolines. These results indicate that the carburetor setting for a 10-percent blend should be the same as for straight gasoline.

Conrad, C. (147)

GERMAN MIXED MOTOR FUELS. Brennstoff-Chem. 15: 181–186. 1934.

The mixing and weighing plant of Reichskraftsprit-G.m.b.H., Berlin, is described. Data are given on volume increase with mixing of alcohol, gasoline, and benzene. Method and apparatus for testing corrosion tendency of mixed fuels and chart indicating influence of alcohol and benzene admixtures on anti-knock properties of gasoline are shown.

Formánek, Jaroslav (148)

THE COMPOSITION OF THE EXHAUST GASES FROM GASOLINE AND GASOLINE-ALCOHOL MIXTURES. Automobiltech. Ztschr. 37: 234–238. 1934.

The analysis of the exhaust gases from alcohol-gasoline blends show them to be generally the same as from gasoline. At high speed and full load, combustion is better than at lower speed and part load. Of various blends tested, Dynalkol (26 percent anhydrous alcohol, 4 percent benzene, and 70 percent gasoline) gave best combustion.

——— (149)

DETERMINATION OF BENZENE IN ALCOHOL-GASOLINE MIXTURE FOR AUTOMOBILES. Chem. Obzor 9: 41–43. 1934.

Determination of benzene, toluene, and xylene in alcohol-gasoline mixtures by means of algol red B or lacquer red Ciba B is described.

Ormandy, W. R., Pond, T. W. M., and Davies, W. R. (150)

MISCIBILITY OF GASOLINE AND SOME OF ITS COMPONENTS WITH ALIPHATIC ALCOHOLS OF VARIOUS STRENGTHS. Inst. Petrol. Technol. Jour. 20: 308–338. 1934.

In addition to description of method and procedure, results are given for the miscibility in the presence of water of ethanol, *n*-propanol, isopropanol, *n*-butanol, sec-butanol, tert-butanol, and iso-butanol in toluene, benzene, gasoline, heptane, and cyclohexane at 15° C. at concentrations from 95 to 10 percent of hydrocarbons present. The effect of temperature is also discussed. In the second part more detailed results are given for the commercial blending range (75 to 95 percent hydrocarbons). Acetone, as well as acetone-alcohol mixtures, blended with hydrocarbons are included. The miscibility is expressed as water tolerance in cubic centimeters per gallon.

——— Pond, T. W. M., and Davis, W. R. (151)
A METHOD FOR THE DETERMINATION OF THE ALCOHOL CONTENT AND WATER TOLERANCE OF ALCOHOL-GASOLINE BLENDS. Inst. Petrol. Tech. Jour. 20: 913–935. 1934.

By a procedure in which a definite quantity of water is added to samples of an alcohol-gasoline blend, the percent of alcohol in the blend and the residual water tolerance of the mixture can be found with the aid of the tables given. The degree of safety is the number of cubic centimeters of water than can be added to an Imperial gallon of the mixture without causing separation.

Roberti, G. (152)
FLASH POINTS OF THE MIXTURES OF FUELS CONTAINING ALCOHOLS. Ricerca Sci. [Roma] 5 (II): 8–13. 1934.

Flash points of gasoline and methanol, and of gasoline and ethanol blends are discussed. Diagrams show that the flash points of the blends are similar to those of pure gasoline.

Sabrou, L. G., and Marty (153)
SPONTANEOUS SEPARATION OF ALCOHOL-GASOLINE MIXTURES. 14^{me} Cong. Chim. Indus., 8 pp. Paris. Oct. 1934.

After a 6-day exposure of 2000 cc. of a gasoline called "essence de tourism" in an open beaker (132 cm^2), 4.5 percent separated. The lower layer consisted of 20 percent gasoline and 80 percent of 88-percent ethanol. A similar experiment in a more humid atmosphere gave a lower layer of 4.1 percent which consisted of 29 percent gasoline and 71 percent of 91.5-percent ethanol. Gradual addition of water gave an initial separation of a larger percentage of gasoline, which, however, diminished after further additions of water. It was finally concluded that, in practice, separation is not likely to occur, either in reservoirs or tanks, even those incompletely closed, since the tendency towards evaporation will always be greater than that of separation.

——— and Renaudie, M. (154)
THE INFLUENCE OF LOW TEMPERATURES ON MOTOR FUELS CONTAINING BENZENE. Jour. des Usines à Gas 58: 122–130, 148–154, 208–214. 1934; Chim. & Indus. [Paris] 32: 31–40. 1934.

Crystallization phenomena in motor fuels containing benzene was studied. The curves of crystallization points as a function of composition in the ternary system: Benzene, toluene, xylene by itself and with addition of 50, 70, and 85 percent of gasoline are given. The effect of admixture of ethanol to these fuels was studied. To prevent premature formation of free ice crystals, the constituents should be well dehydrated or ethanol should be added.

Salmoni, Renato (155)
VOLATILITY AT 20° OF MIXTURES OF HEPTANE-ALCOHOL–BENZENE. Ann. di Chim. Appl. [Rome] 24: 539–549. 1934.

The volatility at 20° C. of mixtures of heptane-ethanol-benzene have been determined by bubbling air through at such a rate that it is saturated with vapor (1 liter per hour) and determining the amount of each evaporated. A diagram of the system is shown. The results indicate that up to 30 percent of ethanol and 40 percent of benzene may be added to advantage.

Shepherd, F. M. E. (156)
THE MISCIBILITY OF METHYL ALCOHOL WITH PETROL AND BENZENE. Inst. Petrol. Technol. Jour. 20: 294–307. 1934.

The four-component system, methanol-water-gasoline-benzene, is treated as a ternary system, methanol-water being considered as a single component. A few data on acetone-ethanol-gasoline are also included.

Data at 20°, 0° and —20° C. plotted on triangular diagrams are given for gasoline-benzene-methanol containing 99.8 percent, 96 percent, 93.7 percent, 90 percent and 80 percent of methanol. The last-named is given only at 20°. Similar data were also obtained for gasoline-benzene-commercial methanol (containing acetone and 4 percent water, and 5.7 percent water). Finally the miscibility at 20° of the system gasoline-acetone-96-percent methanol is shown. Even absolute methanol is not completely miscible with gasoline at 20°, although ethanol is. Addition of benzene increases the mutual solubilities, but with mixtures containing considerable amounts of benzene, separation of a solid phase takes place at lower temperatures. Addition of acetone gives a wider range of miscibility.

SIEDLER, VIKTOR (157)
ECONOMICAL DEHYDRATION METHODS FOR MOTOR-FUEL ALCOHOL. Petrol. Ztschr. 30 (36) : 1–3. 1934.

Azeotropic and salting-out methods for absolute ethanol are described.

SPAUSTA, FRANZ (158)
THE WATER-SOLUBILITY AT 0° AND THE BOILING RANGE OF MIXTURES OF GASOLINE, MOTOR BENZENE, AND ALCOHOL. Erdöl u. Teer 10: 444–446. 1934.

Critical solubility of gasoline and alcohol, and of benzene and alcohol was determined at 0° C.

THOREN, T. R. (159)
THE PHYSICAL AND ANTI-KNOCK PROPERTIES OF GASOLINE ALCOHOL BLENDS. Iowa Univ. Studies in Engin. Bul. No. 4, 32 pp. 1934.

The critical solution temperatures of eight ethanol-gasoline blends for each of two gasolines were determined. In the more favorable case, 20 percent by volume of anhydrous ethanol was necessary to lower the critical solution temperature from 82° to 42° F. for a 5 percent blend. The anhydrous ethanol (0.79 percent) was prepared through dehydration over lime. A.S.T.M. distillation data for alcohol blends indicate a lowering of distillation temperatures, particularly in the lower range. Alpha-terpineol will lower the critical solution temperature of 95 percent ethanol-gasoline blends. It was found that the addition of 20 percent of ethanol to a gasoline raised the octane number of the blend from 61.5 to 77. Another gasoline, with the same percentage of ethanol, had its octane number increased from 55.5 to 70.5. The increases were almost directly proportional to the amount of ethanol.

VERDIER, J. (160)
A STUDY OF BINARY AND TERNARY FUELS FOR INTERNAL COMBUSTION ENGINES. Chim. & Indus. [Paris] Special No., pp. 364–373. April 1934.

Alcohol-gasoline and alcohol-gasoline-benzene blends were investigated from the standpoint of finding a blend which could be used without special carburetor adjustment. Ternary fuels should not contain more than 15 percent of alcohol and the calorific value must be raised by addition of at least 15 percent of benzene. For best power and economy the compression ratio must be at least 5:1.

1935

BALDESCHWIELER, E. L., MAVERICK, G. M., and NEUDECK, J. E. (161)
DEPOSITS IN WHITE METAL CARBURETORS. Soc. Automotive Engin. Jour. 37: 17–21. 1935.

This article does not deal directly with agricultural motor fuels. However, it is of importance in showing that, regardless of the type of fuel, water will cause corrosion when white metal or galvanized iron are present in the fuel system. A possible remedy suggested is the coating of metal parts. Reference to this is made in No. 195.

DIETRICH, K. R., and GRASSMANN, H. (162)
DETERMINATION OF ACIDITY IN ALCOHOL (FOR MOTOR FUEL). Ztschr. f. Spiritusindus. 58: 188. 1935.

A modified method using methyl red indicator for determining acidity in alcohol is suggested.

GROSSMAN, FELIKS (163)
HOMOGENIZERS IN ALCOHOLIC MOTOR FUELS. Przemsł Chem. 19: 245–247. 1935.

Different homogenizing agents for alcohol-gasoline-benzene mixtures were investigated. The maximum temperature and minimum amount of water which cause separation into phases were measured. α-Naphthol is the best homogenizer; β-naphthol and ether being somewhat weaker.

NAGAI, Y., and ISII, N. (164)
VOLATILITY OF FUELS CONTAINING ETHYL ALCOHOL. I. PARTIAL PRESSURES OF ETHYL ALCOHOL AND ETHYL ETHER IN THEIR MIXTURES AND CALCULATION OF HEAT OF MIXTURE THEREFROM.[4] Soc. Chem. Indus. [Japan] Jour. 38: 8–12. Sup. Binding. 1935; Imp. Acad. Japan, Proc. 10: 646–649. 1934.

Partial pressures were calculated from total pressures measured by E. A. Louder, T. R. Briggs, and A. W. Browne, (Indus. and Engin. Chem. 16: 932–935. 1924) from 0° to 50° C. Heat of mixing was calculated and values are in fairly good agreement with experimental results of Desmaroux (Mém. Poudres 23: 211. 1928).

——— and ISII, N. (165)
VOLATILITY OF FUELS CONTAINING ETHYL ALCOHOL. II. CALCULATION OF STARTING TEMPERATURES OF AN ENGINE WHEN USING ETHYL ALCOHOL-ETHYL ETHER MIXTURES AS ITS FUEL. Soc. Chem. Indus. [Japan] Jour. 38: 86–91. Sup. Binding. 1935; Imp. Acad. Japan, Proc. 10: 650–653. 1934.

From data in I, the mole fraction of ether necessary for starting at various temperatures and fuel-air ratios is calculated. A choked engine starts at 12° C. on alcohol; at —46° on ether.

——— and ISII, N. (166)
VOLATILITY OF FUELS CONTAINING ETHYL ALCOHOL. III. TOTAL AND PARTIAL VAPOR PRESSURES OF THE MIXTURES OF ETHYL ALCOHOL AND CYCLOHEXANE. Soc. Chem. Indus. [Japan] Jour. 38: 91–94. Sup. Binding. 1935.

Measurements were made at 0°, 10°, 20°, and 30° C. The azeotrope formation occurs at 0.75 mole fraction cyclohexane.

——— and ISII, N. (167)
VOLATILITY OF FUELS CONTAINING ETHYL ALCOHOL. IV. CALCULATIONS OF STARTING TEMPERATURE OF AN ENGINE WHEN USING ETHYL ALCOHOL-CYCLOHEXANE MIXTURES AS ITS FUEL. Imp. Acad. Japan, Proc. 11: 26–27. 1935.

Mixture may contain as much as 0.7 mole fraction alcohol and still have the same minimum starting temperature (—18° C.) as pure cyclohexane.

ISII, NAOJIRO (168)
VOLATILITY OF FUELS CONTAINING ETHYL ALCOHOL. V. TOTAL AND PARTIAL VAPOR PRESSURES OF MIXTURES OF ETHYL ALCOHOL AND METHYL CYCLOHEXANE. VI. TOTAL AND PARTIAL VAPOR PRESSURES OF THE MIXTURES OF ETHYL ALCOHOL, AND N-HEXANE. VII. TOTAL AND PARTIAL VAPOR PRESSURES OF MIXTURES OF ETHYL ALCOHOL AND PENTANE. Soc. Chem. Indus. [Japan] Jour. 38: 659–661. Sup. Binding. 1935; *Ibid.* 38: 661–664. Sup. Binding. 1935; *Ibid.* 38: 705–707. Sup. Binding. 1935.

Tables of total and partial vapor pressures at 0°, 10°, 20°, and 30° C. are given. Results are shown on graphs and can be expressed by means of equation: $\log p = A - B/T$. Values for A and B for even mole fractions are calculated. An azeotrope is formed in each case.

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[4] Sequence of annotations 164 to 169 is according to journal reference.

——— (169)
VOLATILITY OF FUELS CONTAINING ETHYL ALCOHOL. VIII. CALCULATIONS OF STARTING TEMPERATURES OF AN ENGINE WHEN USING ETHYL ALCOHOL-GASOLINE HYDROCARBON MIXTURES AS ITS FUEL. Soc. Chem. Indus. [Japan] Jour. 38: 707–710. Sup. Binding. 1935.

Minimum starting temperatures of pure hydrocarbons are: methylcyclohexane —6° C.; n-hexane —28°; pentane —55°. Because of azeotrope formation, the minimum starting temperature of mixtures with alcohol remains nearly unchanged up to a mole fraction of alcohol of 0.7 or more.

PADOVANI, C., and BAYAN, S. (170)
ALCOHOLIC FUELS. Energia Termica 3: 211–217, 246–252. 1935; Chim. & Indus. [Paris] 35: 1078. 1935.

The stability of various binary, ternary, and quaternary liquid fuels were studied including blends of benzene-methanol, tetralin-methanol-benzene, and methanol-ethanol and tetralin. Iso-butanol is considered to be the best stabilizing agent.

ROQUETTE, RUBEM (171)
ALCOHOL AND GASOLINE MIXTURES: STUDIES IN MISCIBILITY. Ministerio de Trabalho Indus. e Com., Inst. Nacl. de Tech. [Rio de Janeiro]. Separate publication 8 pp. 1935.

Curves are shown for solubility of gasoline in ethanol of different water contents at temperatures from —15° to 50° C. For automotive purposes the ethanol should be not less than 96° Gay-Lussac; in mixtures the proportion of gasoline should be not less than 40 percent to give a satisfactory fuel.

SEN, H. D., and GUPTA, G. N. (172)
METHODS OF DEHYDRATING ALCOHOL. Jour. Sci. and Technol. [India] 1: 69–83. 1935.

Ninety-five percent ethanol vapors are dehydrated by washing them with a solution of potassium acetate containing small amounts of potassium hydroxide. This procedure can be used by small distilleries making absolute ethanol for motor fuel purposes.

SPAUSTA, FRANZ (173)
THE VOLUME CHANGES OF MIXTURES OF GASOLINE AND PETROLEUM WITH ALCOHOL AND MOTOR BENZENE. Brennstoff-Chem. 16: 181–184. 1935.

Pyconometer measurements at 20° C. show an increase in volume on mixing alcohol with gasoline or kerosene. This increase varies with type of gasoline, being greatest (0.4 percent) for the most volatile, but it depends also on content of naphthenes and aromatics. Benzol and alcohol show very slight changes (0.08 percent). Benzene and gasoline give a large increase (0.45 percent). Ternary mixtures with low alcohol content show the greatest increases (0.5 percent).

VERDIER, J., and HUREL, L. (174)
THE VAPOR PRESSURES OF LIQUID FUELS. Jour. des Usines à Gaz 59: 35–41. 1935.

An apparatus similar to A.S.T.M. apparatus was used in determining the vapor pressures of fuels. Sets of curves are given for vapor pressure of liquids *vs.* volume of liquid used. Gasoline-ethanol mixtures have lower vapor pressures at high concentrations, and higher ones at low vapor concentrations than gasoline. In ternary mixtures of gasoline containing equal amounts of ethanol and benzene, the effect on the vapor pressure of these two components is additive; for low concentrations (0.5 cc. per 1,000 cc. of air) the ethanol mixtures have a maximum vapor pressure at about 10 to 30 percent (5–51 mm. Hg) as compared with 3.2 mm. Hg. for gasoline, 2.7 mm. for pure alcohol and a slight increase for benzene mixtures. Mixtures of gasoline and 50:50 ethanol-benzene have vapor pressures above that of either of the previous mixtures. At 0°, a 0.5:1000 ratio of liquid to air, the ethanol and benzene vapor pressures are relatively lower so that benzene mixtures are all below pure gasoline, while the ternary mixtures are well above gasoline. For ease in starting the engine in cold weather, ternary mixtures are the most suitable.

1936

ANONYMOUS (175)
GASOLINE QUALITY ON THE BRITISH MARKET. Petrol. Times 36: 675–677. 1936.

The motor method is entirely unreliable when applied to fuels containing benzene and ethanol since it neutralizes the entire effect of the differences of the heats of vaporization between these fuels and straight gasoline. A very large number of tests on alcohol blends has been made and differences between the research method and the motor method amounted to as much as 25 octane numbers in some cases. The use of a constant induction temperature by the research method makes this method a much superior indicator of anti-knock behavior for fuels with high heats of vaporization.

CHRISTENSEN, L. M. (176)
ALCOHOL-GASOLINE BLENDS. Indus. and Engin. Chem., Indus. Ed. 28: 1089–1094. 1936.

Anhydrous ethanol is miscible with gasoline in all proportions and such mixtures are stable to —60° C. or lower. The water-holding capacity is secondary in importance to the rate of water accumulation by blends under commercial storage and distribution conditions. Blends may actually lose water during storage through the distillation of an azeotropic ternary mixture of hydrocarbon, ethanol, and water resulting in dehydration. Blends containing up to 25 percent alcohol are of greatest value for use in present-day gasoline engines, and there is no fundamental difference in the physical properties between such blends and gasoline. Extensive tests have shown that under practical driving conditions with 10-percent ethanol-gasoline blends, there is on the average a gain in mileage which may amount to as much as 10 percent partly because of the rich mixture adjustment. No case of separation was reported at the time when alcohol blends were sold in this country.

DIETRICH, K. R., and LOHRENGEL, W. (177)
THE ATTACK OF FUELS ON VARIOUS MATERIALS. Oel Kohle Erdoel Teer 12: 91–92. 1936.

Previous investigations (see No. 72) had shown that the use of pure ethanol in blends gave no trouble with the majority of metals. However, the recent law requiring the admixture of 10 percent methanol has given rise to trouble. Pure iron, galvanized iron, tin-plated and lead-coated iron, pure aluminum and 12 aluminum alloys, and coated aluminum were tested. It was important to emphasize work an aluminum and alloys since it is known that Electron with protective coating will form magnesium methylate. The method of C. Conrad, (Brennstoff-Chem. 15: 181–186. 1934) was applied (see No. 147). Two mixtures were used: 95 parts of anhydrous ethanol and 15 parts by weight of methanol, and a 10-percent blend of the above mixture in cracked gasoline. The test lasted 10 weeks. Weighings were made at the end of every week. The ethanol-methanol blend attacked only iron, lead-coated iron, Silumin with MBV coating, and Electron with protective coating. After an initial attack on Electron metal and Silumin, a protective coat which formed prevented further attack. However, iron and lead-coated iron were attacked continuously, so their use is not practicable. The 10-percent blend shows approximately similar behavior. In addition to a continuous strong attack on galvanized iron and somewhat less on Electron AM and AZM, iron is stable after an initial attack. Since lead methylate is soluble in alcohol, the attack on the lead-coated iron was not so noticeable (except for the large loss in weight); however, when the iron layer became exposed, strong electrolytic action resulted, since lead behaves electro-positive toward iron. In presence of water, the ethylate and methylate may dissociate causing $Pb(OH)_2$ to precipitate out. Methanol acts more strongly on lead. Coated aluminum is a special case, since coating is the only protection and much loss cannot be tolerated. Tin plating or lacquer-coating (K. R. Dietrich, Oel Kohle Erdoel Teer 11: 703. 1935) is recommended. Use of aluminum may also be permissable.

DOLDI, SANDRO (178)

MOTOR FUELS AND CORROSION. Chim. e l'Indus. 18: 226–229. 1936.

The corrosion of aluminum, copper, bronze (83 percent Cu, 0.75 Fe, 0.45 percent Ni, 4.0 percent Sn, 2.12 percent Pb, 9.71 percent Zn), brass (61.76 percent Cu, 0.63 percent Fe, 0.20 percent Ni, 0.19 percent Sn, 1.89 percent Pb, 39.15 percent Zn), Monel, and soft and hard steel in the presence of the following liquid fuels were studied; synthetic fuel methanol (pure, denatured, anhydrous, hydrous); ethanol (pure, denatured, anhydrous, hydrous); gasoline; benzene (pure and crude); shale gasoline. No quantitative data are reported. It is concluded that: (1) Presence of water greatly increases corrosion; (2) methanol is more corrosive than ethanol; (3) denatured alcohols are more corrosive than when pure; (4) Monel is the most resistant, followed by bronze, brass, and hard steel, with aluminum least; (5) a 50:50 anhydrous ethanol-gasoline blend shows the least corrosion; (6) next to gasoline, benzene free from sulfur is best; and (7) in general, alcohols give very little trouble under practical conditions.

HAMMERICH, T. (179)

EXAMINATION OF METHANOL FOR ITS USE IN FUEL MIXTURES. Oel Kohle Erdoel Teer 12: 641–642. 1936.

The water content of methanol is determined quickly by finding turbidity points and using curves prepared from synthetic mixtures. Equal pipetted volumes of the methanol and a mixture of 80 percent by volume of heptane and 20 percent by volume of benzene in a small powder flask fitted with a thermometer are shaken in a slowly cooled water bath. Addition of 1 percent by volume of isobutanol depresses turbidity points 1.9° and stabilizes a water content of 0.1 percent.

HERSTAD, O. (180)

VOLATILITY AND THE ANTIKNOCK QUESTION. Oel Kohle Erdoel Teer 12: 1014–1015, 1111–1114. 1936.

A method of measuring volatility in a special type of evaporating bath equipped with a reflux condenser is described. Curves are plotted showing the vaporization times of a series of motor fuels at different temperatures, including a ternary mixture of gasoline, benzene, and alcohol.

KOBAYASI, R., and KAJIMOTO, S. (181)

INVESTIGATION ON KNOCK RATINGS. II. ETHYL EFFECTS OF ALCOHOL FUEL AND BENZENE FUEL. III. ETHYL EFFECTS OF PURE HYDROCARBONS. IV. ETHYL EFFECTS OF CRACKED GASOLINES. Soc. Chem. Indus. [Japan] Jour. 39: 647–654, 738–741, Sup. Binding 39: 304B–311B, 354B–356B. 1936.

The effect of T.E.L. on ethanol-gasoline blends, as well as on various hydrocarbon fuels, was investigated. With increasing ethanol concentration the effect of T.E.L. decreases and may become negative. It is also less than in the base gasoline.

LEVI, M. G., and BAYAN, S. (182)

LIQUID FUELS CONTAINING ALCOHOL AND ETHER. Studi Ric. Comb. 6: 275–297. 1936–1937.

Ethanol and ethanol-gasoline blends are improved through addition of diethyl ether. Ethanol containing 20 to 22 percent by volume of diethyl ether is recommended. Various properties of these blends are enumerated.

LÜHDER (183)
USE OF ALUMINUM IN THE ALCOHOL INDUSTRY. Aluminum 18: 62–63. 1936.
Successful substition of aluminum for bronze in the alcohol industry is described.

MARDER, M., and FRANK, J. (184)
SIMPLE PROCEDURE FOR DETERMING METHANOL IN MOTOR FUEL. Chem. Ztg. 60: 1013–1016. 1936.
A much simpler method for the determination of methanol and ethanol in blends than that proposed by K. R. Dietrich and H. Jeglinski (*Ibid.* 53: 177-178, 198-199, 1929. See No. 73) is described. One hundred grams of fuel is shaken with 50 gm. of water. The volume and refractive index of the solution are measured. By means of three diagrams, first the total amount of alcohols is determined and then the composition.

MININ, M. M. (185)
STABILIZERS FOR ALCOHOL-GASOLINE MIXTURES FROM A SPENT LIQUOR FROM SYNTHETIC RUBBER. Novosti Tekhniki 1936 (26): 17–18.
Spent liquors resulting from the manufacture of synthetic rubber contain butanol which can be recovered by fractionation. It was found that butanol from various sources was not of uniform quality (it had high acidity, high water content, and gum-forming constituents) and only one source was satisfactory. A 70:15:15 gasoline-ethanol-butanol mixture is stable and is suitable as aviation fuel.

TAYLOR, I., LARSON, L., and JOHNSON, W. (186)
MISCIBILITY OF ALCOHOL AND OILS. Indus. and Engin. Chem., Indus. Ed. 28: 616–618. 1936.
Miscibility of corn, linseed, tung (China wood), soybean, olive, peanut, rapeseed, sunflower, and other oils in absolute and 90-percent ethanol was determined.

1937

AFFERNI, ERNESTO (187)
THE EFFECT OF ACETONE ON ABSORPTION OF WATER BY MIXTURES OF GASOLINE AND ALCOHOL. Olii Minerali, Olii e Grassi, Colori e Vernici 17: 85–96. 1937.
Gasoline-acetone mixtures do not take up as much water without causing turbidity as do mixtures of gasoline with ethanol, isopropanol, or isobutanol. The water-absorbing power of mixtures of gasoline-acetone and any one of the above alcohols is intermediate between absorbing powers of gasoline-alcohol and gasoline-acetone mixtures.

BOISSELET, L., and FRIC, J. (188)
CAUSES OF CORROSIVE DEPOSITS IN MOTORS USING "HEAVY FUEL" ("POIDS LOURD"). II^{me} Cong. Mondial du Pétrole, Paris 3, (sec. 4): 708–711. 1937.
The corrosion of aluminum, iron, copper, galvanized and tin-coated sheet iron, brass, and two zinc alloys by a gasoline blend "poids lourds" (65 to 75 percent heavy gasoline, 35 to 25 percent absolute ethanol denatured and dyed) was investigated. It was found that the dye and the denaturant used were responsible for the corrosion and deposits observed in practice. The dye contained residual NaCl while the acidity of the denaturant amounted to 6 mg. of KOH per 100 cc. A large number of denaturants are enumerated which might replace the one used.

CASTILHO FREIRE, AFFONSO DE (189)
NEW METHOD OF INDUSTRIAL ANALYSIS OF ALCOHOL-GASOLINE MIXTURES. Ministerio do Trabalho, Indus. e Com. Inst. Nacl. de Tech., Bol. da Inform. [Rio de Janeiro] 2 (2): 6 pp. 1937.
The alcohol content may be determined by adding 100 ml. of water and 5 ml. of a saturated solution of NaCl to 100 ml. of blend. After the mixture is shaken it is heated for 3 minutes.

DOLDI, SANDRO (190)
ACETAL AS MOTOR FUEL. Chim. e l'Indus. 19: 369–372. 1937.

Both dimethyl- and diethylacetal can be used in fuel blends to replace part of the alcohol. The dimethylacetal has a high anti-knock value. With its use, motors can attain the same speed as with gasoline alone, which cannot be done when alcohol alone is added to the fuel.

FERRARI, DEMETRIO (191)
ETHERIZED ETHANOL "CRIMA" AND ETHANOL-ETHER (SULFURIC) BLENDS. III° Cong. Internaz. del Carbonio Carburante, 2 Session, Liquid Fuels, pp. 59–64. Rome. 1937.

The catalytic "Crima" process of making ether-ethanol blends is compared with the ordinary process of using ethanol and sulfuric acid. The former is said to be superior. Crima contains 77 percent ethanol and 23 percent ether. Ethanol-ether blended with gasolne appears to act as a slight gum inhibitor. No acetaldehyde or acetic acid was found as the result of incomplete combustion.

FRITZWEILER, R. (192)
METHODS OF MEASUREMENTS OF BLEND COMPONENTS IN ALCOHOL INDUSTRY. Ver. Deut. Ingen. Ztschr. 81: 407–408. 1937.

Outline of various methods for measurements of components in alcohol blends are given. Different physical and chemical methods applied in manufacture of alcohol fuels in Germany are discussed.

HOBBS, G. B. (193)
ALCOHOL—ITS USE AS A MOTOR FUEL. So. African Chem. Inst. Jour. 20: 33–43. 1937.

After giving a brief history of the use of ethanol blends in South Africa (Natal) and the composition of ethanol as produced in that country, author relates the results of various arguments made against the use of the ethanol blends. Exposure tests of 50:50, 70:30, and 85:15 gasoline-ethanol blends were made under drastic atmospheric conditions. Separation did not take place until 24 to 33 percent of the blended fuel had evaporated after a lapse of 15 to 30 days, indicating that the risk of spontaneous separation does not exist in the fuel or storage tank. Anhydrous ethanol will not corrode metals, neither will it form corrosive exhaust products. From the work of M. Clerget (see No. 368) and others, it is concluded that alcohol-fuel oil mixtures may be used in Diesel engines.

HOFMAN, E., LAPEYROUSE, M., and SWEENEY, W. (194)
NEW BLENDING AGENTS FOR AVIATION GASOLINE OF 100 OCTANE NUMBER. II^{me} Cong. Mondial due Pétrole, Paris 3 (Sect. 4): 812–819. 1937.

Diisopropyl ether can be blended satisfactorily with isooctane. A 40-percent blend has the correct distillation characteristics of a good aviation fuel, a low heat of combustion, and a latent heat of vaporization of 18,120 B.t.u. per pound compared with 19,550 B.t.u. per pound for a gasoline. It was found in practice, however, that there was no difference in the specific fuel consumption because of the richer mixtures used. Equivalence of specific output can also be obtained by increasing the octane number and it is stated that the ether blend should have an octane number of 105 in order to be equal in every respect to a gasoline of 100 octane number. Diisopropyl ether blends may be safely stored in presence of antioxidants. It was found that tri-acetone peroxide was found only in the unblended and uninhibited ether under certain conditions. A semi-quantitative test for peroxide detection is given.

JUGE-BOIRARD, GILBERT (195)
STUDY OF THE CORROSIVE EFFECT OF FUEL "POIDS LOURD" ON THE WHITE METAL CARBURETORS. II^{me} Cong. Mondial du Pétrole, Paris 3 (Sect. 4): 712–720. 1937.

The gum stability of cracked gasoline and a 25-percent blend of ethanol in the same gasoline was studied under artificial illumination and daylight. The oxygen absorption was taken to be an inverse measure of the gum stability and it was found that the ethanol in the blend appeared to act as an inhibitor, greatly reducing the absorption. The corrosive action on "white metal" (carburetor) (see No. 161), one zinc, and one aluminum alloy was studied in open and closed containers with the following fuels: Carburant "poids lourd" (an ethanol blend, denatured); the base gasoline of the latter; ordinary gasoline; 99.8-percent ethanol; denatured ethanol (98.7 per cent) with and without a dye (rhodamine B). The following results were obtained: (1) No corrosion was observed when the dye was absent and when no separation occurred. (2) Without separation but in presence of the dye, slight surface action was noticeable. (3) After separation, corrosive action took place in lower layer, which was aggravated if residual NaCl was present in the dye used. (4) When ethanol evaporated, corrosion was observed in the portion exposed to the atmosphere and became progressively greater. This was attributed to the increasing amount of water in the alcohol.

KANE, G. P., CHAMBERLAIN, E. A. C., and TOWNEND, D. T. A. (196)
THE SPONTANEOUS IGNITION UNDER PRESSURE OF THE SIMPLER ALIPHATIC HYDROCARBONS, ALCOHOLS AND ALDEHYDES. [London] Chem. Soc. Jour. 1937: 436–443.

The ease of ignition is correlated with the anti-knock properties. For the methanol series the order is formaldehyde > methanol > methane and similarly for the ethane series acetaldyde > ethanol > ethane. In both cases the time lags are greatest for the paraffin, less for the alcohols, and considerably smaller for the aldehyde. The propane series behaved similarly. It was not certain that ethanol-air mixtures gave rise to cool flames under pressure. The mixture was luminescent. With acetaldehyde, as well as with a number of the propane series, cool flames were observed.

KOBAYASI, RYONOSUKE (197)
INVESTIGATIONS ON KNOCK RATINGS. VII. UNSTABILITY PRODUCT AND OCTANE NUMBER OF THE ALIPHATIC HYDROCARBON. VIII. UNSTABILITY PRODUCT OF THE CHAIN HYDROCARBONS. Soc. Chem. Indus. [Japan] Jour. 40: 698–750, Sup. Binding pp. 317B–323B. 1937. (In English).

Calculations of octane numbers of aliphatic alcohols and of paraffins, olefins, and aromatic hydrocarbons are made. Computations are based on the geometrical structure of the molecule.

MCPHERSON, W. K., and CHRISTENSEN, L. M. (198)
REACTION OF ALCOHOL-GASOLINE BLENDS TO THE DOCTOR TEST. Indus. and Engin. Chem., Anal. Ed. 9: 433. 1937.

Tests of ethanol C. P., several denaturants, and all blends of gasoline with 40-percent or more ethanol gave a sour reaction to the doctor test. It is therefore recommended to use the A.S.T.M. method for the determination of sulfur in such blends.

PASTONESI, G. (199)
ANTI-KNOCK GASOLINES. Energia Termica 5: 240–244. 1937.

Antiknock properties of ethanol, benzene, and T.E.L., as well as gum formation in gasoline are discussed.

PREVOST, M. (200)
CORROSION IN THE ENGINES CAUSED BY THE USE OF FUELS. II^{me} Cong. Mondial du Pétrole, Paris 3, (Sect. 4): 879–883. 1937.

This is a discussion of two papers on corrosion by alcohol blends given at this meeting (G. Juge-Boirard, and L. Boisselet and J. Fric; see Nos. 188, 195). The most significant fact was brought out by Petrlik (Czechoslovakia). He stated that not a single complaint had been made in his country regarding the use of alcohol motor fuels. However, strict supervision or control is exercised over materials that are used in the blends, including ethanol itself.

RIBAGNAC, P. (201)

PHYSICO-CHEMICAL PROPERTIES OF GASOLINE, ALCOHOL, AND BENZENE FUELS AND THEIR MIXTURES. II^{me} Cong. Mondial du Pétrole, Paris 3, (Sect. 4): 615–635. 1937.

The following physical-chemical properties of gasoline, methanol, ethanol, and benzene are discussed and numerical values given for: Heat of vaporization, freezing points, specific volumes (contraction), corrosion, densities, antiknock values, distillation characteristics, gum formation, hygroscopicity, index of refraction, flammability, heats of combustion, stability, vapor pressure, vapor lock, viscosity, and volatility. The merits and demerits of ethonal, benzene, alcohol-gasoline blends, gasoline-benzene, benzene-alcohol, gasoline-alchohol-benzene, and ethanol-methanol-benzene mixtures are discussed.

SCHILDWÄCHTER, H. (202)

DETERMINATION OF ETHANOL IN THE PRESENCE OF METHANOL IN FUEL BLENDS. Angew. Chem. 50: 599–600. 1937.

Total alcohols are found by extracting with 0.5 parts of water by weight and weighing remaining hydrocarbon. Methanol and ethanol in extract are determined by chromic acid oxidation and titration of excess chromic acid. Experimental results show accuracy of about 0.5 percent of original mixture.

SILBERMAN, BOLESLAO (203)

UTILIZATION OF DIMETHYL ACETAL AS SUBSTITE FUEL. III° Cong. Internaz. del Carbonio Carburante, 2 Session Liquid Fuels, pp. 91–102. Rome. 1937.

Methanol is practically immiscible in gasoline and so far is used only for special purposes such as in racing blends. The catalytic reaction of methanol and acetylene results in dimethyl acetal. Its properties, such as miscibility with ethanol, methanol, and gasoline, as well as its production possibilities, are discussed. A table of physical properties is appended.

WILKE, W. (204)

METHANOL AS (MOTOR) FUEL. Oel Kohle Erdoel Teer 13: 1030–1038. 1937; II^{me} Cong. Mondial du Pétrole, Paris 3, (Sect. 4): 636–645. 1937.

A graphical comparison is made of the physical properties pertaining to engine performance of gasoline, benzene, ethanol, and methanol. The following comparisons were made: Heats of combustion per kilogram and for a theoretical mixture; air-fuel ratios, heats of vaporization and their effect on the temperature of the mixture; vapor pressures; amount of theoretical fuel per kilogram of air and in one combination of mixture; rates of vaporization; ignition limits; speed of flame propagation. Both single- and multicylinder engine tests showed higher outputs and thermal efficiencies for methanol compared with benzene. Optimum compression ratio found was approximately 12:1 for a Diesel engine in which a spark plug was substituted for the precombustion chamber. Use of two and three carburetors improved the distribution in six-cylinder Daimler-Benz Diesel engine and consequently power output and fuel economy. At 10.4:1 C. R. methanol gave an extraordinary increase in output of 150 horsepower against the normal output of 95 hp. Diesel performance.

1938

ALDRICH, E. W. (205)

CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF GASOLINE, N-PROPYL ALCOHOL, AND WATER. [U. S.] Natl. Bur. Standards Jour. Res. 20: 9–16. 1938.

Water tolerance of *n*-propanol-gasoline blends is greater than those containing ethanol but a solid phase is formed if separation occurs below —15° C.

BAYAN, SIMONE (206)
HYGROSCOPICITY OF ALCOHOL FUELS. Riv. Ital. del Petrol. 6(60): 9–12. 1938.

The hygroscopicity of an alcohol-gasoline blend was determined as a function of the alcohol concentration. The results for straight ethanol-gasoline blends showed a maximum at 10 percent ethanol. The addition of ether to an ethanol-gasoline blend shifted the maximum to a higher ethanol concentration. The presence of methanol also increased the hygroscopicity of the blend within the concentration range investigated. An 80:12:8 gasoline-ethanol-benzene blend had a nearly identical hygroscopicity with a straight 80:20 percent gasoline-ethanol blend. Addition of 10 percent of isobutanol improved stability. The alcohol-ether mixture was more hygroscopic than alcohol, while both alcohol and alcohol-ether were more hygroscopic in blends with gasoline than alone.

BRIDGEMAN, O. C., and ALDRICH, E. W. (207)
WATER TOLERANCES OF MIXTURES OF GASOLINE WITH ETHYL ALCOHOL. [U. S.] Natl. Bur. Standards Jour. Res. 20: 1–8. 1938.

Equations, based on 23 different gasolines, have been developed for calculating the water tolerance of any mixture of gasoline with ethanol from critical solution temperature measurements on a few mixtures with the particular gasoline. Conversely, it is also possible to compute critical solution temperatures of blends of known composition.

BURSTIN, H. (208)
SYNTHESIS OF FUELS FOR AIRPLANE MOTORS. Przegląd Chem. 2: 250–264. 1938.

Author discusses hydrocarbon fuels and gasoline substitutes, such as ethers and alcohols, anti-knock agents (alcohol, benzene, T.E.L.) and airplane lubricants.

DIETRICH, K. R., and LOHRENGEL, W. (209)
STORAGE STABILITY OF ALCOHOL FUELS. Oel Kohle Erdoel Teer 12: 419–422. 1938.

Storage tests of ethanol, 80:20 ethanol-methanol blends, gasolines, and two alcohol-gasoline blends containing 10 and 11 percent of power alcohol, respectively, for 12 months indicated no increase in gum content nor any discoloration.

EGLOFF, G., HUBNER, W. H., and VAN ARSDELL, P. M. (210)
FUELS FOR INTERNAL-COMBUSTION ENGINES. Chem. Rev. 22: 175–280. 1938.

Data for the following are given: alcohol consumed in foreign countries in 1934; octane blending value of ethanol; physical properties, octane numbers, and lead susceptibilities of ethanol, several butanols, and two pentanols. A few engine test data and quotations from various authors do not favor the use of alcohol blends. Physical data and octane ratings for several ethers and ketones are also given.

GABBANO, L., and BAGNOLESI, U. (211)
TOXICITY OF THE GAS ESCAPING FROM AUTOMOBILES WHEN GASOLINE CONTAINS ALCOHOL MIXTURES. Rass. Med. Appl. Lav. Indus. 9: 116–130. 1938.

The exhaust from a Fiat car running on various fuels was examined for its carbon monoxide content. Ethanol gave the minimum amount of CO (0.37 percent); gasoline alone, 4.29 percent CO; 80 percent gasoline plus 20 percent ethanol gave 3.53 percent CO; 60 percent gasoline plus 20 percent ethanol plus 20 percent methanol gave 3.04 percent CO; and 50 percent gasoline plus 50 percent ethanol gave 2.23 percent CO.

GULYAEV, P. (212)
ETHYL ALCOHOL AS MOTOR FUEL. Grazhdanskaya Aviatsiya (U.S.S.R.) No. 2:29–32. 1938; Khim. Referat. Zhur. 1 (11–12): 130. 1938.

A summary of the experiments performed with alcohol mixtures as fuel for airplane and for automobile motors is given. The alcohol-gasoline mixtures possessed good anti-knock properties, had satisfactory starting properties, and did not dilute lubricating oil. Well-selected mixtures are stable.

HEINZE, R., MARDER, M., and ELSNÉR, G. (213)
THE STABILITY OF ALCOHOL MOTOR FUELS TO LOW TEMPERATURES AND WATER-CARRYING CAPACITY. Ver. Deut. Ingen. Ztschr. Beihefte No. 30, Angew. Chem. 51: 524–526. 1938.

Ternary diagrams are shown for: critical solution temperatures, critical water concentrations at —10°, 0°, and 20° C. for hydrogenation gasoline-ethanol-methanol; naphthenic gasoline-ethanol-methanol; hydrogenation gasoline-benzene-methanol plus 9 percent ethanol; naphthenic gasoline-benzene and methanol plus 9 percent ethanol; and three diagrams giving stable mixtures at —20° for three of the above systems are presented. Experimental procedure is described.

HONDA, KIMOTO (214)
DETERMINATION OF ALCOHOL CONTENT OF GASOLINE MIXED WITH ALCOHOL. Fuel Soc. [Japan] Jour. 17: 532–540. 1938.

The addition of nigrosine (.001 to .005 gm.) to ethanol-gasoline blends containing from 1 to 20 percent of ethanol will produce a color change directly proportional to the ethanol concentration.

ISII, N., and AOKI, I. (215)
VOLATILITY OF GASOLINE MIXED WITH ALCOHOL. Fuel Soc. [Japan] Jour. 17: 489–503. 1938.

Contrary to Bridgeman's results (Indus. and Engin. Chem. 28: 1102–1112. 1936; see No. 413) the addition of ethanol to gasoline did not affect the behavior of the fuel and no difference in volatility between gasoline and the blends was noted.

PTASHINSKII, I. A., and SELEDZHIEV, Y. N. (216)
IMPROVING THE ANTIKNOCK PROPERTIES OF TRACTOR FUEL. Neftyanoe Khoz. 1938 (3): 35–40.

The additions of either 10 percent ethanol, 20 percent butanol, 30 percent benzene, or 2 percent aniline raised the octane numbers of tractor kerosene from 35 to 44–46. With the exception of the butanol blend, these mixtures were not stable for winter use. Other admixtures were also tried. The octane numbers of tractor naptha was raised to 55–60 by one of the following additions: 10 percent butanol, 15 percent benzene, 5 percent ethanol, or 1 percent aniline. These were suitable for winter use.

SCHLAGETER, A. (217)
PROPERTIES OF HIGH-OCTANE GASOLINE-ISOPROPYL ETHER FUELS. Assoc. Franç. des Tech. Pétrole Bul. No. 44: 55–67. 1938.

Solubility of water in gasoline-isopropyl ether blends as well as gum formation, tendency to vapor lock, and octane numbers are discussed.

SOGA, Y., and OGAWA, K. (218)
EXPERIMENTS WITH FUELS OF DIFFERENT OCTANE NUMBERS. Fuel Soc. [Japan] Jour. 17: 18–21. 1938.

An attempt is made to correlate fuel consumption, octane numbers, and heat of combustion. Two gasolines and two ethanol blends were used.

SPIRK, LUDVIK (219)
PROGRESS IN THE TECHNOLOGY OF MOTOR FUELS. Chem. Listy 32: 192–195, 225–226. 1938.

Various processes of making motor fuels are discussed. It is claimed that the addition of 10 cc. of ethanol containing enough radium chloride or bromide to give an activity of 1 millicurie to 10 liters of gasoline will greatly increase engine efficiency.

TANAKA, Y., KUWATA, T., and AOKI, M. (220)
STABILIZER FOR GASOLINE-ALCOHOL BLENDS. Soc. Chem. Indus. [Japan] Jour. 41: 226–277B. 1938.

Cyclohexanol and terpineol were found to be the most effective stabilizers. The critical solution temperature is lowered approximately 8° C. for each percent of stabilizer added. Experimental data for four ethanol blends are given.

TEODORO, A. L., and MAMISAO, J. P. (221)
CORROSION OF METALS BY SOME MOTOR FUELS. Philippine Agr. 26: 774–787. 1938.

Mild steel and cast iron were badly corroded by ether. Corrosion of these metals by the alcohol fuels showed that the higher the water content of the fuel the greater the corrosion. Alcohol fuels containing ether, therefore, were highly corrosive to these metals. Aluminum was heavily corroded by methyl alcohol, and was easily attacked by alcohol fuels and by fuels containing alcohol. When corroded, it formed a jelly-like substance which could clog the fuel passageways and carburetor jets. Lead was heavily attacked by ether and by methyl alcohol and was corroded by all the fuels used in the test. Copper was least affected by corrosion. Galvanized iron was corroded by all the fuels used except benzene. It was heavily attacked by ether and by alcohol fuels, especially those containing gasoline and ether.

WIDMAIER, O. (222)
THE SENSITIVITY TO LEAD SHOWN BY MOTOR FUELS CONTAINING ALCOHOLS AND ETHERS. Jahrb. Deut. Luftfahrtforsch. 1938, Abt. II. 350–355.

The following alcohols and ethers were blended in varying proportions with two gasolines of octane numbers 41.7 and 63.5, respectively; methanol-ethanol, ethanol, propanol, isopropanol, butanol, isobutanol, pantanol, isopentanol, diisopropyl ether and a mixture of isoamyl ethers. It was found that 20 to 40 percent of any alcohol and 0.05 percent of ethyl fluid blend gave the greatest increase in octane numbers.

WILK, ZDZISLAW (223)
SCARCITY OF FUELS. Kopalnictwo Naftowe w Polsce 5: 301–303. 1938.

This is a discussion on the overall usefulness of different components in aviation fuels. A table shows the relative importance of fuels based on their properties, such as: Octane numbers, anti-knock value, vapor pressure, lead susceptibility, source of origin, etc. Isooctane occupies the first place, followed by ketones, gasoline, aviation gasoline, isopropyl ether, etc. The manufacture of isooctane from natural gas and isopropyl ether from potatoes in Poland is advocated.

1939

ALLEN, B. B., LINGO, S. P. and FELSING, W. A. (224)
TOTAL AND PARTIAL PRESSURES OF BINARY SOLUTIONS OF THE BUTYL ALCOHOLS IN BENZENE AT 25°. Jour. Phys. Chem. 43: 425–430. 1939.

BECK, G., and KÜNZELMANN, R. (225)
CORROSION BY MOTOR FUELS. Deut. Kraftfahrtforsch. No. 21, 35 pp. 1939.

High-grade varnishes, both of the enamel and air-drying type, are practically immune against attack by well-refined motor fuels (gasoline, alcohol, benzene, mixtures thereof or Diesel oils) despite their low mechanical strength. Poor refining or the presence of substances, such as naphthenic acids or creosote, is responsible for extensive damage to varnishes. Heavy metals such as lead, tin, zinc, cadmium, or iron plate are easily attacked by light motor fuels as well as by Diesel oils. Galvanizing iron does not definitely prevent corrosion. Light metal alloys are generally resistant against attack by the light and heavy motor fuels, although some of them are subject to extensive damage by sulfur compounds and particularly by water in alcohol mixtures.

BOGNÁR, AURÉL (226)

ANTIKNOCK GASOLINES. Technika [Budapest] 20: 45–47. 1939.

Author discusses various methods of obtaining gasolines of high octane numbers and states that low octane gasolines are improved by addition of isopentanes, alcohols, ethers, and ketones.

EISENSTECKEN, F., and ROTERS, H. (227)

CORROSION AND PROTECTION OF CONTAINERS FOR MOTOR FUELS. Oel Kohle Erdoel Teer 14: 1057. 1938; *Ibid.* 15: 129–137. 1939.

Aside from damage to containers, etc., the corrosion products are also detrimental since they are likely to clog fuel and carburetor jets. Pure anhydrous ethanol does not attack iron and most other metals; however, it forms ethylates from aluminum and lead. Pure methanol is corrosive and the corrosiveness of ethanol-methanol is a function of the methanol content. Presence of water also induces corrosion. Galvanizing is not effective. Zinc acts catalytically to form acetaldehyde and the latter is corrosive. Tin plating is effective, certain lacquers also prove to be satisfactory. Other fuels are also discussed.

ERSHOV, N. V., and MEERZON, E. A. (228)

MUTUAL SOLUBILITY OF SHALE GASOLINE AND ETHANOL AT LOW TEMPERATURE IN THE PRESENCE OF STABILIZERS. Jour. Appl. Chem. (U.S.S.R.) 12: 50–54. 1939.

Critical solution temperature of blends of shale gasoline (Russian Gdov gasoline) and of 95-, 97-, 98-, and 99-percent ethanol were determined and it was found that a blend of 95-percent ethanol and from 30 to 50 percent shale gasoline had critical solution temperature from —10° to —18° C.; a similar blend containing 98-percent ethanol had critical solution temperature at —60°. Blends containing more than 1 percent water have a limited solubility at low temperatures; therefore, it is necessary to use stabilizers such as isopropyl, n-butyl, tertiary butyl, and n-hexyl alcohols. A phase separation is prevented at —60° by the addition of 2 to 5 percent of these stabilizers. Addition of 10 percent n-butyl alcohol to a blend consisting of 80 percent shale gasoline and 20 percent of 97-percent ethanol will lower the critical solution temperature to —65°; a blend containing 30 percent of 97-percent ethanol reaches a critical solution temperature at —45° and a blend of 40 percent lowers it again to —65°. Such examples are not uncommon.

FISCHER, FRANZ (229)

THE POSSIBILITIES OF BIOLOGICAL PRODUCTION OF FUELS. Kraftstoff 15: 5–8. 1939.

Electrolysis of butyric acid yields *n*-hexane; 65 percent of the theoretical yield was obtained. Experimental details are given. However. n-hexane is of no interest as a motor fuel. Thermal decomposition of butyric acid and butyrates results in the formation of di-n-propylketone. Research octane number is 93 and blending values are as high as 99. The ketone is miscible in 90-percent ethanol in ratios of 10:3, 10:5, and 10:10; for 80-percent ethanol the figures are 10:5 and 10:10. It is not miscible in the ratio of 10:3. Anhydrous ethanol is not necessary, therefore, for obtaining homogenous blends.

HAMMERICH, T. (230)

EVALUATION OF LIGHT MOTOR FUELS WITH REGARD TO THEIR TENDENCY TO FORM VAPOR LOCK. Oel Kohle Erdoel Teer 15: 569–577. 1939.

Author describes fractionating column for determining C_3 and C_4 hydrocarbons in gasoline. Measurement of vapor lock temperature in a diaphragm fuel pump shows that for gasolines this temperature is 4° to 10° C. higher than A.S.T.M. 10 percent point. For gasoline plus 15 percent ethanol, vapor lock occurs 1° to 2° below 10 percent point of mixture; for gasoline plus 40 percent motor benzene it occurs 5° above 10 percent point. Formula relating vapor lock temperature to A.S.T.M. distillation curve and Reid vapor pressure, accurate to 2° is given.

HEYDEN, E. VON, MARDER, M., and TSCHIRPIG, G. (231)
THE WATER SOLUBILITY AS A MEASURE OF ETHANOL AND METHANOL CONTENT OF MOTOR FUELS. Angew. Chem. 52: 168–171. 1939.

Since methanol lowers the solubility of water in blends, this is taken as the basis of a method for determining the amount of methanol and ethanol in fuels. Since the type of gasoline also influences the solubility, the method is best suited for control work where the type of gasoline either remains the same or is known.

IL'IN, D. A. (232)
GUM FORMATION IN GASOLINE-ALCOHOL MIXTURES. Neftyanoe Khoz. 1939 (3): 50–52.

Storage tests at 40° C. showed (1) that the presence of steel, copper, or aluminum accelerated gum formation; (2) that increase in ethanol content (10 to 45 percent) progressively retarded gum formation (expressed in mg. per 100 cc.); (3) that gum formation was accelerated by addition of 0.1 percent by volume of ethyl acetate, acetaldehyde, acetic acid, and furfural, in the presence of copper, and that steel and aluminum had the same effect only in presence of ethyl acetate and acetic acid; (4) that dilution of the cracked gasoline by straight-run reduced gum formation. The following conclusions are given concerning action of inhibitors: Inhibitors ordinarily used in cracked gasoline cannot always be used in alcohol-gasoline blends. Judging from the induction periods, the best inhibitors for blends are amino and oxy-compounds. Highly purified ethanol sometimes shows an inhibiting effect upon gum formation. An inhibitor concentration of .01 percent may stabilize the blend up to 6 months. The inhibitors are more efficient in freshly prepared fuel blends. On the basis of all data, it is concluded that ethanol has an inhibiting effect in cracked gasolines.

LAUER, GERARD (233)
TESTS ON FOUR FUEL MIXTURES. I. G. Farbenindustrie A. G. Ludwigshafen-Oppau Rpt. 378. March 28, 1939; A.D.I. (K) Microfilm, Reel 107, 48C–C67, Part II; Sum. of C.I.O.S. Docs., Ref. No. I 100.

Physical properties and research octane numbers of several gasoline-benzene-alcohol blends are given.

LOUIS, M., and ENTEZAM (234)
FUELS. [France] Ann. de l'Off. Natl. des Combustible Liquides 14: 21–24. 1939.

Inflammability limits in air of isopropyl alcohol, both pure and diluted with gasoline, are given.

MARILLER, CHARLES (235)
DENATURED AND FUEL ALCOHOL. Assoc. des Chim. Bul. 56: 600–606. 1939.

Denaturants as well as alcohol itself when used as motor fuel should be free from corrosive impurities, such as acids, esters, SO_2, and other sulfur compounds. Dyestuffs containing NaCl should not be used.

PESCHARD, MARCEL (236)
ACTIVATION OF HYDROCARBONS (INCLUDING ETHYL ALCOHOL) AND THE OCTANE NUMBER. [U.S.] Natl. Advisory Com. Aeronaut. Tech. Memo. No. 916, 28 pp. 15 figs. 1939; Pub. Sci. et Tech. du Ministère de l'Air. Rpt. No. 132. 1938.

The purpose of the work was to attempt to get a correlation between activation energy and octane number of various hydrocarbons as well as of ethanol. The experimental set-up consisted of a reaction chamber kept at constant temperature, having a centrally located spark ignition and thermocouple. Pressures were measured by means of a "Bourdon tube" arrangement. All fuels followed the logarithmic law below a certain temperature or temperature range

$$\log \frac{P}{T} = \frac{A}{T} + B$$

where P is the limiting pressure at which spontaneous ignition will occur and *T* the corresponding absolute temperature. *A* is related to the activation energy and *B* a constant characteristic of the substance involved. The activation energy of ethanol was found to be 34,000 cal.; however, since the activation energies of all fuels were of approximately the same magnitude, this factor does not appear important. The fuels studied were classed, in decreasing knock tendency, as follows: Heptane, pentane, cyclohexane, isooctane, and ethanol.

ROBERTI, G., BERTI, V., and SEMMOLA, E. (237)
CONTRIBUTION TO THE STUDY OF DIMETHYL ACETAL AS FUEL. Energia Termica 7: 152–153. 1939.

Extrapolated octane number of acetal equals 69.

ZEISE, H. (238)
A NEW METHOD OF CALCULATING COMBUSTION TEMPERATURE AND ITS APPLICATION TO THE MIXTURES OF ALCOHOL VAPOR, WATER VAPOR, AND OXYGEN. Ztschr. f. Elektrochem. 45: 456–463. 1939.

The article deals with the calculations of enthalpy, entropy, heat capacity, and the reduced thermodynamic potential of ethanol vapor.

1940

CHATTERJEE, N. G. (239)
POWER ALCOHOL, ITS USE AS MOTOR FUEL IN THE UNITED PROVINCES. 17 pp. United Provs. [India] Dept. of Indus. and Com. Allahabad. 1940. Reviewed *in* Current Sci. 10: 36-37. 1941.

Author describes production and gives cost of alcohol. Gum formation in gasoline is found not to be increased by blending with alcohol; Reid vapor pressure is slightly higher. Automobiles are operated satisfactorily on 18-percent blend in Mysore.

DIETRICH, K. R., and STÖSS, H. (240)
MEANS FOR DECREASING EVAPORATION LOSSES IN STORAGE OF POWER ALCOHOL. Oel und Kohle ver. Petrol. 36: 363–365. 1940.

Loss of ethanol due to repeated transfers as well as to temperature variations may amount to as much as .1 percent. The usual or possible methods, such as aluminum paint, water cooling, or pressure regulators, are either not sufficient or have certain drawbacks. A water absorption method is described which is said to reduce the loss by 75 percent.

GINDIN, L. G., AMBARZUMIAN, R. S., and BELCHIKOVA, E. P. (241)
CORROSION OF METALS BY NON-AQUEOUS SOLUTIONS Acad. des. Sci. U.R.S.S. Compt. Rend. (Dok.) 29: 44, 91–94, 208–209. 1940. (This annotation refers to pp. 91–94).

Magnesium, aluminum, and steel were exposed for 150 to 210 days to solutions of CO_2 in absolute and 99.7-percent ethanol. No changes in weight nor in appearance were found in case of aluminum and steel; however, magnesium showed marked corrosion and appreciable loss in weight. It was shown that CO_2 was responsible for the corrosion observed.

IL'IN, D. A. (242)
THE CORRODING EFFECT OF ALCOHOL-GASOLINE MIXTURES. Trudy Voennoi Akad. Mekhanizatsii i Motorizatsii 1940 (6): 74–79; Khim. Referat. Zhur. 1940 (9): 116.

Ethanol-cracked gasoline blends attack aluminum and steel only slightly; however, copper and brass are corroded to a greater extent. The corrosion of these metals in pure ethanol is less than in the blend.

INKINEN, MATTI (243)
THE USE OF MOTOR FUEL (CONTAINING ALCOHOL) IN AIRPLANES. Teknillinen Aikakauslehti 30: 91–92 (in English). 1940.

Ethanol-gasoline mixtures can be used in airplane motors under certain conditions. A homogeneous mixture stable at —50° to —70° C. is obtained by blending aviation gasoline (octane number 77) or ethyl gasoline (octane number 87) with 25 percent of absolute ethanol or 80 percent of 95-percent ethanol.

MININ, M. M. (244)

MIXTURES OF METHYL ALCOHOL WITH GASOLINE AND THEIR SEPARATION INTO LAYERS. Trudy Voennoi Akad. Mekhanizatsii i Motorizatsii 1940 (5): 10–37; Khim. Referat. Zhur. 1940 (9): 89.

The following stabilizers were tried: ethanol, n- and isopropanol, butanol, iso- and tert-pentanol, hexanol, and terpineol as well as several other compounds. Isomeric alcohols were less effective than normal ones and their effectiveness increased with increase in molecular weight. Propionic and oleic acids and dimethyl ketone were rather poor. Diethyl and dihexyl ethers were investigated and it was found that the effect decreased with increase in number of carbon atoms. The purity of stabilizers was very important. The mechanism of stabilization is attributed to the polarity of the molecules and to the formation of solvates and complexes.

——— and SOLODOVNIK, M. S. (245)

METHODS FOR ANALYZING ALCOHOL-GASOLINE MIXTURES. Trudy Voennoi Akad. Mekhanizatsii i Motorizatsii 1940 (6): 62–73.

Gasoline-ethanol-butanol blends may be analyzed by treatment with an aqueous solution of calcium chloride to extract the ethanol and with water to separate the butanol. The water content of the blend can be determined from its critical solution temperature.

——— and ULYANOVA, A. P. (246)

THE EFFECT OF STABILIZERS ON THE INTERFACIAL TENSION OF ALCOHOL AND GASOLINE. Trudy Voennoi Akad. Mekhanizatsii i Motorizatsii 1940 (5): 38–44.

It was found that stabilizers appear to decrease the interfacial tension while substances which raise the critical solution temperature increase this tension.

PENZIG, F. (247)

SOLUTION OF THE COMBUSTION EQUATION. Kraftstoff 16: 107–111. 1940.

Equation for the determination of air requirements, maximum CO_2, water of combustion, volume increase, and calorific value is given. Data include simple alcohols among other types of fuels suitable for motors.

PHILIPPOVICH, A. VON (248)

SO-CALLED RACING FUELS. Brennstoff-Chem. 21: 15–17. 1940.

Properties of typical racing fuels consisting of blends of benzene, methanol and/or ethanol and/or light petroleum doped with tetraethyl lead are presented in tables.

1941

BAYAN, S., and BEATI, E. (249)

FURFURAL AND ITS DERIVATIVES AS MOTOR FUELS. Chim. e l'Indus. 23: 432–434. 1941.

Furfural is not suitable as motor fuel. It has considerable tendency to polymerize; inhibitors such as hydroquinone and α-naphthol can suppress polymerization only to a limited extent. Tetrahydromethylfuran which has an octane number of 74 and good volatility is the only hydrogenated derivative suitable as motor fuel.

EGLOFF, G., and VAN ARSDELL, P. M. (250)

OCTANE RATING RELATIONSHIPS OF ALIPHATIC, ALICYCLIC, MONOMOLECULAR AROMATIC HYDROCARBONS, ALCOHOLS, ETHERS, AND KETONES. Inst. Petrol. Jour. 27: 121–142. 1941.

The authors state in summarizing the effect of chemical structures on octane ratings that "the combustion conditions under which the octane ratings have been made are the most vital factors in any octane rating given for a chemical compound. The octane ratings given for the various compounds and the generalizations made from them are specific for the test method indicated, and any change in the test method markedly alters the octane rating of the compound."

GARACH, JEAN (251)

STUDIES OF PHYSICAL PROPERTIES OF SULFUR COMPOUNDS IN FUELS. Thesis, 46 pp., Chap. IV. Absorption spectrum in infrared region of thiophene and its derivatives pp. 27–34. Paris, Gauthier-Villars. 1941.

Incidental to an investigation to determine the action of thiophene on tetraethyl lead, it was shown that the addition of 30 percent ethanol to leaded benzene produced no change in the lead content.

KNEULE, F. (252)

CONTROLLING THE VAPOR PRESSURE AND RESISTANCE TO COLD AND WATER OF MOTOR FUELS. Ver. Deut. Ingen. Ztschr. 85: 670. 1941.

To prevent phase separation and vapor lock which may result when methanol or ethanol are blended with hydrocarbon fuels, the use of higher alcohols is recommended. Critical solubility determinations were obtained and plotted. Lower alcohols and acetone when blended with gasoline increased the vapor pressure while higher alcohols decreased it. Isopropyl ether was especially effective in lowering the vapor pressure; benzene, toluene, and xylene were also effective.

LINCOLN, R. (253)

POWER ALCOHOL. A REPORT FROM THE CHEMICAL DIVISION. Mauritius Dept. Agr. Ann. Rept. 1941: 21. (Pub. 1942).

Samples of alcohol from six local distilleries were found to contain 92.9 to 95.1 alcohol, 0.001 to 0.006 total solids, and 0.010 to 0.028 percent aldehydes.

MARTRAIRE, MAURICE (254)

SULPHUR COMPOUNDS (AS CONTAMINANTS) OF ALCOHOLS. Assoc. des Chim. Bul. 58: 293–300. 1941.

If sulfur dioxide is used in the preparation of materials such as beet molasses, wine, and cider or other fruit juices for the manufacture of ethanol, the latter will frequently contain various sulfur compounds such as sulfur dioxide, hydrogen sulfide, mercaptans, and alkyl sulfides. Ethanol containing these compounds will corrode distillation equipment and metal containers as well as engines, if used as fuel. Analytical methods for detection and means to prevent contamination of the ethanol are discussed.

NISBET, H. B. (255)

THE BLENDING OCTANE NUMBERS OF FURAN AND FURFURYL ALCOHOL. Inst. Petrol. Jour. 27: 293–300. 1941.

The article is summarized as follows: Furan was added in various concentrations to motor spirit blends of different octane numbers. It was found that in blends of low octane number the addition of small proportions of furan caused a big rise in octane number. This relative rise decreased with increasing proportions of furan until, when 30 percent was reached, the rise became negligible. The addition of furan to blends of high octane number caused only a slight increase in octane number, and when added to commercial isooctane, a decrease in octane number was observed. Owing to the insolubility of furfuryl alcohol in motor spirit of an aliphatic nature, the investigation was limited to the comparison of the blending values of furfuryl and ethyl alcohols in 10 percent blends in spirit containing benzene. The blending octane numbers of furfuryl alcohol in these blends were not as high as those of ethyl alcohol.

ROTHROCK, A. M. (256)

FUEL RATING—ITS RELATION TO ENGINE PERFORMANCE. Soc. Automotive Engin. Jour. 48: 51–65. 1941.

Author assumes that for any given combustion temperature, there is a given density above which the end gas will knock and below which it will not knock. The end gas density function and end gas temperature are defined in terms of experimental values. It is shown that structurally similar fuels can probably be rated adequately regardless of engine condition. This is not the case, however, if widely different types of fuels such as aromatics, alcohols, etc., are used. Experience has shown that, given two fuels of the same or nearly the same octane number, one will knock under cruising conditions and the other at take-off. Preignition is probably a surface phenomenon and originates from the contact of the gases with the hot surface within the combustion chamber, whereas knock probably originates within the gas. It was found that benzene, toluene, and commercial isooctane were preignited at about the same temperature while the temperature for methanol was considerably lower. The data also indicate that the hot-spot temperature required to preignite any given fuel does not vary much with different engine conditions. Author does not believe that data have been published that any of the preigniting fuels, such as benzene, toluene, and methanol have ever been shown to knock.

SCHOORL, N., and VERWEY, C. P. (257)
IGNITION TEMPERATURES OF DIFFERENT CONCENTRATIONS OF ALCOHOL. Pharm. Weekbl. 78: 1005–1008. 1941.

Ignition temperatures (°C.) of ethanol-water mixtures at various volume percentages determined by means of the Abel-Pensky apparatus were as follows: 100/10°, 90/17.5°, 70/22°, 60/24.5°, 50/26.5°, 40/28.5°, 30/32.5°, 20/38°, 10/50°, 5/63°, 4/67°.

SERRUYS, MAX (258)
USE OF MOTOR FUEL SUBSTITUTES. Soc. des Ingén. de L'Auto. Jour. 14: 153–180. 1941.

A thermodynamic analysis of fuels for internal combustion engines is made. Methanol, ethanol, acetone, methylethylketone, and others are included. The simplest criterion of the quality of a fuel appears to be the ratio of the maximum external work to the minimum theoretical specific fuel consumption, ranging from 0.91 for ethanol to 1.38 for isooctane.

SPENCER, R. C. (259)
PREIGNITION CHARACTERISTICS OF SEVERAL FUELS UNDER SIMULATED ENGINE CONDITIONS. [U. S.] Natl. Advisory Com. Aeronaut. Tech. Rept. No. 710, 16 pp. 1941.

Preignition and knock are two distinct phenomena; therefore, a fuel may tend to preignite and still have great resistance to knock. Such fuels are diisobutylene, benzene, toluene, and methanol. Differences in ignition temperatures between preigniting and non-preigniting fuels, except for methanol and di isobutylene, were not strikingly great. The effect of jacket temperatures, speed, compression ratio, fuel-air ratio, initial temperature, and different hot spots were investigated; however, correlation is difficult. Data on isopropanol are also included.

SUEN, T. J., and LI, L. H. (260)
MISCIBILITY OF ETHYL ALCOHOL AND VEGETABLE GASOLINE. Chinese Chem. Soc. Jour. 8: 76–80. 1941.

Since the climate of Szechuan is not severe, 97- or 98-volume percent of ethanol can be used in gasoline blends containing presumably about 25 percent of ethanol. In summer the amount of water permissible may even be higher and 95- or 96-volume percent may be used for blending. It is stated that gasoline from vegetable oils has a somewhat greater water tolerance than gasoline from petroleum.

1942

BUSHROD, C. J. (261)
THE CORROSION OF MAGNESIUM AND MAGNESIUM CASE ALLOYS. Metal Indus. [London] 61: 324–326. 1942.

Methanol of high purity forms magnesium methylate. The latter acts as a catalyst and the initially slow recation becomes more vigorous with time. Small amounts of ammonium oleate inhibit corrosion completely. For aircraft carburetor de-icing, 50:50 solutions of methanol-ethanol are used. The presence of ethanol reduces the rate of attack; however, addition of 0.2 percent oleic acid and 1 percent of 0.880 ammonia will prevent corrosion.

CHATTERJI, N. G., and SAXENA, R. S. (262)
A STUDY OF PHYSICAL AND CHEMICAL CHARACTERISTICS OF SOME INDIAN PETROLS AND OF PETROL-POWER ALCOHOL BLENDS MADE WITH THEM. Indian Chem. Soc. Jour., Indus. and News Ed. 5: 30–40. 1942.

Ethanol-gasoline blends containing 20 to 25 percent ethanol are just as good as gasoline in present-day engines, and the physical and chemical properties of 10 commercial gasolines (both winter and summer grades) blended with power alcohols in the above proportion were examined. Results are shown for variation of specific gravity with temperature, change of volume with mixing, distillation characteristics, Reid vapor pressure, gum content, and water tolerance. It was found that ethanol reduces the tendency of gasoline towards gum formation.

PIAZZA, JOSÉ (263)
BUTANOL AS A STABILIZER OF MIXTURES OF ETHYL ALCOHOL AND HYDROCARBONS. An. de la Soc. Cient. [Argentina] 134: 130–1, 193–235. 1942; Indus. y Quim. 7: 7–18. 1945.

Since at present no facilities for making anhydrous ethanol exist in Argentina, it was decided to study the effect of butanol in stabilizing blends, since this alcohol is produced locally. The following conclusions were drawn: *n*-butanol is a practical stabilizer and the addition of 5 percent of butanol added to blends of naphtha with 96° G. L. (Gay-Lussac) ethanol (independent of ratio between ethanol and naphtha) results in mixtures stable at —15° C. For blends using 95.7° G. L. ethanol, 7 percent of butanol is necessary. Blends containing up to 50 percent of ethanol (94° G. L.) require 12 percent butanol. Ethanol-kerosene blends require appreciable amounts of butanol, for instance, a mixture consisting of 25 parts of 96.5° G. L. ethanol, 20 parts of *n*-butanol, and 55 parts of kerosene is stable at —15° C.

PLEETH, S. J. W. (264)
REID VAPOR PRESSURE OF ALCOHOL BLENDS. Inst. Petrol. Jour. 28: 113–114. 1942.

A method for determining vapor pressure ot ethanol-gasoline blends by the Reid method is described. Precautions should be taken to avoid separation of ethanol from the blend.

——— (265)
THE EXAMINATION OF ETHYL ALCOHOL AND ALCOHOL BLENDS FOR USE AS MOTOR FUEL. Inst. Petrol. Jour. 28: 240–255. 1942.

The paper discusses tentative methods for testing ethanol and ethanol blends insofar as these methods differ from standard procedures in either Britain or the United States. Procedures may have to be modified if legal denaturants are required. The following headings will give the scope of the paper: Pure Ethanol; Power Methylated Spirits (specific gravity, distillation range, water content); Alcohol Blends (specific gravity, distillation, vapor pressure, water tolerance, analysis of constituents); Crankcase Dilution.

RIMBAUT (266)
ENERGY CONSIDERATIONS ON SUBSTITUTE FUELS. Soc. d'Éncouragement pour Indus. Natl. Bul. 141: 57–82. 1942.

Author defines R as the total efficiency of conversion for any fuel. This factor includes the efficiency of manufacture as well as the efficiency of energy conversion in the engine (mechanical, thermal efficiency, losses by evaporation, etc.). Detailed discussion and results are given. The values of R for the following fuels are given in parenthesis: Illuminating gas (21.3), anthracite for gas producer (19.0), wood for gas producer (17.7), ethanol from beets (13.0), synthetic methanol from coal (7.0), synthetic gasoline, Fischer-Tropsch process (7.7).

SIEBALD (267)
QUANTITATIVE DETERMINATION OF THE COMPOSITION OF LIQUIDS (MANY COMPONENT MIXTURES) ON THE BASIS OF THE SELECTIVE ABSORPTION IN THE INFRA-RED SPECTRUM RANGE. German Aviation Research Institute Res. Rpt. No. 1607, June 8, 1942; A.D.I. (K) Microfilm, Reel 102, 48-(C-64) Part I; Sum. of C.I.O.S. Docs., Ref. No. F. 16.

Infrared absorption technique is applied to analysis of fuels and fuel blends. Alcohol and acetone are included.

WIEBE, RICHARD, SCHULTZ, J. F., and PORTER, J. C. (268)
MOLLIER DIAGRAMS FOR THEORETICAL ALCOHOL-AIR AND OCTANE-WATER-AIR MIXTURES. Indus. and Engin. Chem., Indus. Ed. 34: 575–580. 1942. Correction, *Ibid.* 36: 672. 1944.

Charts are presented to show the thermodynamic quantities necessary to calculate the temperatures, pressures, m.e.p., work, and efficiences for the possible cycles for mixtures of alcohol-air and octane-water-air (35 pounds of water for each 100 pounds of fuel). Sample calculations show that lower temperatures prevail during the combustion of alcohol-air and octane-water-air than with octane-air mixtures when full advantage is taken of the heat of vaporization of alcohol and water. Maximum temperatures during combustion give no indication regarding preignition. According to the data presented there is no reason why water injection alone should be more beneficial than the injection of an alcohol-water mixture with the identical amount of water as shown by M. S. Kuhring. Additional experimental and theoretical work will be required to give more information regarding the behavior of alcohol-air and octane-water-air mixtures in engines.

1943

BASTER PILAR, F. A., and SILVA DE ARAUJO, A. (269)
ANTIDETONATING PROPERTIES OF ALCOHOL. Rev. Brasil. de Quím. (Sci. & Indus.) 15: 120, 122–124. 1943.

The following topics are discussed: Detonation and autoignition; factors influencing detonation; anti-detonants; ethanol as antidetonant; and ethanol as fuel, including statistics of ethanol production and gasoline importation.

DEPASSE, E. (270)
KETONES FOR MOTOR FUEL. Assoc. des Chim. Bul. 60: 400–409. 1943.

Ketones are readily obtained from a large variety of raw materials containing hydrocarbons. Equipment and process for a method are suggested and yields shown. Ketones have a high heat of combustion and good volatility, good miscibility with hydrocarbons and alcohols, good antiknock properties, and are therefore excellent fuels for internal combustion engines.

GRABE, ELSA (271)
CONTRIBUTION TO THE METHOD OF DETERMINING THE WATER CONTENT OF MOTOR FUELS CONTAINING ALCOHOL. Svensk. Kem. Tidskr. 55: 75–79. 1943.

The water content is determined by weighing the precipitate of sodium formate formed when the sodium and ethyl formate are added to the blend containing water. Benzene and acetone interfere somewhat with the test, and in presence of methanol the test is not applicable.

SERRUYS, MAX (272)
PRINCIPAL CHARACTERISTICS OF LIQUID AND GASEOUS FUELS. Ann. des Mines et Carburants Mém. [14] 2: 91–101, 187–193. 1943.

A table of the physical properties of interest in connection with engine performance are given for a number of pure aliphatic and aromatic hydrocarbons, ketones, ethers, alcohols, acetals, esters, aldehydes, and gases. Charts showing heats of vaporization and vapor pressures of these fuels as a function of temperature are included. Similar data are given for various fuel mixtures containing the above-mentioned fuels. Diagrams of infrared absorption spectra of various blends containing ethanol, as well as of engine performance for ethanol blends are shown.

TESSIER, R. (273)

DEW POINTS OF COMBUSTIBLE LIQUID MIXTURES. Ann. des Mines et Carburants Mém. [14] 3: 326–344. 1943.

A hygrometric method, similar to the one by Alluard, consisting of two highly polished nickel surfaces, and one using the surface tension method of Leconte de Noüy were tried but found unsuitable. However, a procedure based on the principle of electrical conductivity was satisfactory. The effect of alternating and of direct current, as well as variation in voltage and resistance, were investigated. Surface tensions of ethanol, propanol, butanol, acetone, ethers, and blends are given.

WERNER, A. E. A. (274)

AUTOXIDATION IMPURITIES IN ETHANOL. Analyst 68: 365–366. 1943.

Ethanol produced from molasses and potatoes contains some impurity, which is present in small amount and not removable by distillation. It induces autoxidation with formation of aldehydic and peroxidic impurities.

1944

AUBERT, MARIUS (275)

LIMITS OF INFLAMMABILITY. France Énergetique 3: 141–146, 203–208. 1944.

In discussing experimental method for the determination of limits of inflammability, author believes that the method of Mallard and LeChatelier is the most suitable since it appears to give the most precision. By this procedure the limits are defined when the speed of propagation is zero at the lower and upper concentration limits. Unfortunately, however, extrapolation to zero velocity is, with the exception of hydrogen, difficult. For vertical, cylindrical tubes of approximately minimum inside diameters of 2 to 3 cm., the lower limit is a linear decreasing function of temperature, while the upper limit is an increasing function. The slope of the straight lines varies slightly with the diameter of the tubes. This relationship is true only if the mixture is exposed to the inflammation temperature for an extremely short time; otherwise, parabolic curves result. The effect of pressure is more complicated. At pressures less than atmospheric, the two limits approach each other until a "critical pressure P_c" is reached below which only slow combustion takes place. At pressures above atmospheric the limits do not follow a single rule. Nature of surface and dimension of reaction vessel are important. Other factors influencing the limits of inflammability are energy initiating inflammation, turbulance, direction of propagation, and water vapor. LeChatelier's formula for composition and inflammation limits of binary and ternary mixtures holds reasonably well for ethanol-methanol-benzene (maximum error 10 percent); cyclohexane-benzene-ethanol (maximum error 3 percent); gasoline-isopropanol (error 2 and 4 percent for lower and upper limits). For descending propagation at atmospheric pressure, equations are given for the two limits as a function of temperature and a relation between the limits of inflammability and composition (atmospheric pressure temperature in the neighborhood of 100° C.). The following components were considered: Methane to n-octane, ethylene, benzene, toluene, cyclohexane, cyclohexene, methanol, ethanol, propanol, acetone, acetylene.

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THE VAPOR PRESSURE OF PURE SUBSTANCES. Ann. des Mines et Carburants, Mém. [14] 4: 174–208. 1944.

Vapor pressures obtained by means of equations of Dupré and Antoine as well as by means of Ramsay-Young's and of Dühring's rules are compared with observed values. Among the compounds investigated were methanol, ethanol, propanol, butanol, isopentanol, n-heptanol, ether, acetone, and ethyl acetate.

AUBONE, EDUARDO (277)

METHOD OF DETERMINING THE CONTENT OF WATER IN ALCOHOLS AND MIXTURES OF ALCOHOL WITH NAPHTHA. Bol. de Inform. Petrol. [Buenos Aires] 21 (236): 15–18. 1944.

The water content of ethanol-hydrocarbon mixtures is determined by measuring the volume of acetylene liberated when calcium carbide is added to the sample. The method may also be used with other alcohols.

GUILLEMIN, ALAIN (278)

THE CORROSION OF METALS BY METHANOL. Ann. de Chim. 19: 145–201. 1944.

Aluminum, copper, tin, lead, zinc, cadmium, antimony, bismuth, chromium, iron, nickel, and cobalt were exposed at room temperature for 4 months to anhydrous methanol; methanol with 20 percent water; methanol with 2 percent formaldehyde, methanol with 1 percent formic acid; and methanol with 1 percent aqueous formic acid. Pure methanol attacked only lead, antimony, aluminum, and tin. When 20 percent water was present, aluminum and tin were protected by an oxide film and were not attacked; corrosion of lead was reduced; zinc, cadmium, iron, and cobalt were attacked. Only lead and antimony were attacked by methanol containing 2 percent formaldehyde. Methanol containing 1 percent formic acid corroded most metals, particularly lead, zinc, cadmium, iron, nickel, colbalt, and antimony. Aluminum was hardly attacked and chromium, tin, and bismuth were not affected. In a 1-percent aqueous formic acid solution, copper was not attacked; lead was attacked much less than in methanol solution, the corrosion of aluminum was much stronger; antimony and bismuth were slightly affected. Results are expressed in weight loss per 100 gm. and per 100 $cm.^2$. The mechanism of formic acid corrosion was studied in detail.

JUGE-BOIRARD, GILBERT (279)

STABILITY OF MIXTURES OF GASOLINE AND ALCOHOL. Ann. des Mines et Carburants, Mém. [14] 4: 254–262. 1944.

The stability of ethanol-gasoline blends is defined as the number of cubic centimeters of water that may be added to 100 cubic centimeters of the blend before turbidity occurs at a given temperature. Curves are given for the stability of blends containing 5 to 40 percent of ethanol in terms of tenths of a cubic centimeter per 100 cubic centimeters of the blend. An equation for the approximate calculations is also included.

JUST, J. S. (280)

HYDROGEN AS A SUBSTITE FUEL. Inst. Engin. Austral. Jour. 16: 49–54. 1944.

Incidental to the discussion of hydrogen as a possible fuel for internal combustion engines, comparative results previously obtained by H. R. Ricardo and H. S. Glyde on 95-percent ethanol, gasoline, and hydrogen are given. Except for full power, hydrogen shows the highest thermal efficiency, with ethanol coming next. With hydrogen it was possible to reduce the power output over a wide range by controlling the fuel only.

PIPPARELLI, E., and SIMONETTI, A. (281)

DETERMINATION OF WATER IN LIQUID FUELS BY MEANS OF MAGNESIUM NITRIDE. Ann. di Chim. Appl. [Rome] 34: 40–42. 1944.

The method of K. R. Dietrich and C. Conrad (see No. 101) for determination of water by use of magnesium nitride gives low results owing to the formation of a certain amount of $Mg(OH)_2 \cdot \frac{1}{2}H_20$. This can be prevented by keeping the reaction tube at 100° C.

STAUB, SERGE (282)

THE PRESENCE OF SULPHUROUS AND SULPHURIC ACIDS IN DISTILLERY PRODUCTS. Rev. Agr. de l'Ile Maurice 1944. 157–161.

It was found that serious corrosion trouble, formerly attributed to water, pyridine, or fatty acids, was due to sulfurous acid. The latter is present in ethanol made from "sulfo-defecation" molasses. The chemistry of the process is explained. A small quantity of dilute solution of sodium carbonate, introduced near the bottom of the concentration column, overcame the difficulty.

VICHNIEVSKY, R. (283)
CALCULATION OF THE EXPLOSION TEMPERATURE IN MOTORS. Ann. des Mines et Carburants, Mém. [14] 4: 340–380. 1944.

A thermodynamic study has been made of the combustion of benzene, hydrogen, acetylene, isooctane, ethanol, methanol, and producer gas.

WORLICZEK, J. (284)
IGNITION TESTS IN A CHAMBER WITH A STREAM OF FUEL-AIR MIXTURE. I. G. Farbenindustrie, A. G. Ludwigshafen-Oppau Memo. 385 Jan. 5, 1944; Sum. of C.I.O.S. Docs., Ref. No. B. 99.

Since preignition of methanol is encountered when using methanol as fuel or coolant, an apparatus was set up to measure the ignition temperature of any fuel at different fuel-air ratios. Methylaniline, carbon disulfide, iron pentacarbonyl, tetraethyl lead, and ammonia had no appreciable effect on the ignition temperature; however, the addition of approximately 50 percent DHD-gasoline increased the ignition temperature from 620° to 740° C. The ignition temperatures of normal alcohols increase with chain length: Methanol 620° at A/F 6.46; ethanol 720° at A/F 8.97. For acetone the values were 730° at 9.65 A/F. Ignition temperatures for aromatic, naphthenic, paraffinic, and nitro compounds are also given.

1945

GALLEGOS, S. V., and SAHLI, R. N. (285)
THE IGNITION POINT OF ALCOHOL-WATER MIXTURES. Scientia (Valparaiso, Chile) 12:(3/4) 86–87. 1945.

Apparatus is described and data are given for the ignition temperatures of 14 ethanol-water mixtures covering the range from 5- to 96-percent ethanol. For the latter concentrations the ignition temperatures are 63° and 135° C., respectively.

HARDY, J. K. (286)
KINETIC TEMPERATURE OF WET SURFACE. A METHOD OF CALCULATING THE AMOUNT OF ALCOHOL REQUIRED TO PREVENT ICE, AND THE DERIVATION OF THE PSYCHROMETRIC EQUATION. [U.S.] Natl. Advisory Com. for Aeronautics, Wartime Rpt. ARR. No. 5G13, 22 pp. 1945. (Unclassified).

A method is presented for calculating the temperature of a surface wetted either by a pure liquid, such as water, or by a mixture, such as alcohol and water. Calculations were made for the case in which ice is prevented by supplying methanol and ethanol to the blades of the propeller. The calculations were repeated for a nonvolatile fluid having the same depressant effect on the freezing point as the alcohols. The difference in the quantity of fluid required gives the excess alcohol that must be supplied in order to neutralize the refrigerating effect caused by its evaporation. Calculations were also made for carburetor icing conditions, using ethanol as an example.

KRETSCHMER, CARL B., and WIEBE, RICHARD (287)
SOLUBILITY OF WATER IN ALCOHOL-HYDROCARBON MIXTURES. Indus. and Engin. Chem., Indus. Ed. 37: 1130–1132. 1945.

Critical solubility data for a number of ethanol-hydrocarbon-water mixtures are presented. A study of various statistics is also included. If sufficient care is taken, blends containing 10 percent or more of ethanol should remain stable under all operating conditions. However, fuel blends should be investigated before use, since ethanol may not be soluble in high boiling fuels such as kerosene.

PERRYMAN, P. W. (288)
DETERMINATION OF WATER BY MEANS OF CALCIUM HYDRIDE. Analyst 70: 45–47. 1945.

The determination of water in small samples by means of calcium hydride is often advantageous. Absolute ethanol as an intermediary liquid also evolves hydrogen when in contact with calcium hydride. Anhydrous dioxane is more sasisfactory.

PITESKY, I., and WIEBE, RICHARD (289)
IRON PENTACARBONYL AS ANTIKNOCK AGENT IN ALCOHOL MOTOR FUELS Indus. and Engin. Chem., Indus. Ed. 37: 577–579. 1945.

Small amounts of iron pentacarbonyl greatly increased the octane number of ethanol and blends containing ethanol. An addition of approximately 10 ml./gal. raises the octane number of ethanol from 90 to 99. In order to prevent decomposition of the pentacarbonyl in blends, stabilizers were necessary. Palmitic acid, stearic acid, and triethanolamine stearate appeared to be good stabilizers. Previous experience and a few engine tests indicated that because of deposits of iron, iron pentacarbonyl oxide was not a suitable antiknock agent.

WILLICH (290)
CHEMICAL AND PHYSICAL DATA ON FUELS USED FOR ADDITIONAL INJECTION IN AIRCRAFT ENGINES. Rpt. 40 pp. 1945. Published as Rpt. PB L 70665, U. S. Dept. Com. Off. of the Pub. Bd.

Important chemical and physical data on liquids used for increasing power and cooling of aircraft engines (water, methanol, ethanol, 95 octane fuel and mixtures). Data are given about: (1) Corrosion factors, (2) mixing qualities, (3) inflammability, (4) vapor pressure, (5) latent heat of vaporization, (6) volatility, (7) boiling point curve.

Abstract *in* Bibliog. Sci. and Indus. Rpt. 5(1): 12. 1947.

1946

CATTANEO, A. G., BOLLO, F. G., and STANLY, A. L. (291)
A PETROLEUM ENGINEER LOOKS AT AIRCRAFT FUELS. Soc. Automotive Engin. Jour. 54: 55–63. 1946.

A diagram shows the detonation-limited power with water, water plus alcohol, and water plus some detonation suppressing additive on modern aircraft engines.

EATON, D. C. (292)
CRUISING ECONOMY BY USE OF WATER INJECTION. Soc. Automotive Engin. Jour. 54: 81–87, 92. 1946.

If the water to be used for cooling does not displace an equivalent weight of pay load, a maximum saving of 7 percent at sea level and 18 percent at 25,000 feet can be realized in direct operating cost.

GUINOT, H., and AUGÉ, H. (293)
ETHYL ACETATE AS A FUEL AND AS AN ANTIKNOCK AGENT IN ETHYL GASOLINES. Chim. & Indus. [Paris] 55: 167–173. 1946.

The manufacture of ethyl acetate from pyroligneous acid as raw material for acetic acid and ethanol, as developed by H. Guinot and Les Usines de Melle, is described in detail. Density, heat of vaporization, melting point, boiling point, and flash point are 0.89453, 102 cal./gm., —83.6° C., 77.15° and 3°, respectively. Ethyl acetate is completely miscible with gasoline, benzene, alcohols, and ketones. Since it is only slightly soluble in water, ethyl acetate-gasoline blends do not separate because of accidental presence of water in the blend. Blends are stable in storage. Presence of water and formic acid esters results in acid reaction and will cause hydrolysis of the acetate. High heat of combustion is 6,100 cal./gm. (537,500 cal./mol.). Its blending octane number (depending on base) is between 105 and 115. Lead susceptibility curves are shown for various blends. Performance of pure ethyl acetate was compared with commercial isooctane and a leaded gasoline (100 octane number) in a single-cylinder supercharged engine. Maximum power, boost pressure, thermal efficiency, and richness (theoretical = 1.0) for the three fuels are: Ethyl acetate: 7.5; 1,315 mm. Hg; 24.85 percent; 0.91. Commercial isooctane: 5.5; 1,045 mm. Hg; 21.3 percent; 1.04. One hundred octane number gasoline: 5.9; 1,137 mm. Hg; 22.7; 0.9 percent. Ethyl acetate did not knock; however, cylinder temperatures increased too rapidly.

LOUIS, MARCEL (294)

THE HEAT OF SOLUTION OF HYDROCARBONS. Ann. des Mines et Carburants Mém. 135: 159–171. 1946.

Data on ethanol-gasoline, isopropyl ether-gasoline, and on mixtures of various types of oil with toluene and benzene indicated that the magnitude of the heat effect may at times be of importance. A theoretical interpretation is at present difficult, since not only is our knowledge of solutions insufficient but also the heat of solution is the result of several factors.

McLARREN, ROBERT (295)

ROCKET ENGINE FUELS. Automotive and Aviation Indus. 95(4): 20–23, 76. 1946.

Data on the specific impulse, both actual and theoretical, are tabulated for various fuels, including liquid oxygen-ethanol. A general discussion of the various fuels is given.

MENNUCCI, ARTURO (296)

ALCOHOL-NAPHTHA FUEL. Bol. de Inform. Petrol. [Buenos Aires] 23(257): 1–3. 1946.

Preliminary results show the possibility of obtaining a satisfactory fuel by combining the supernatant layer of the overhead portion with the discharge from the first plate in the continuous azeotropic distillation of commercial ethanol with naphtha in a laboratory bubble-plate column (34 plate, Brun type).

NISBET, H. B. (297)

BLENDING OCTANE NUMBERS OF 2, 5-DIMETHYLFURAN. Inst. Petrol. Jour. 32: 162–166. 1946.

Blending octane numbers (B.O.N.) of and the effect of T.E.L. on 2, 5-dimethylfuran with three fuels of octane numbers 40.5, 56.0, and 99.8 (commercial isooctane) were determined. For a 10-percent blend the B.O.N. of 2, 5-dimethylfuran on the three blends were 205, 191, and 83, respectively, and its octane number was tentatively found to be 90. The data suggest a negative lead susceptibility for 2, 5-dimethylfuran.

ROBERTI, G., MINERVINI, C., PIPPARELLI, E., and SEMMOLA, E. (298)

A COMPARISON OF TETRAETHYL LEAD WITH THE NITROGEN-CONTAINING ORGANIC ANTIKNOCK COMPOUND, AND THE INCREASE OF THE OCTANE NUMBER BY ADDITION OF BOTH. Riv. Ital. del Petrol. 14(161): 10–12. 1946.

Butanol will increase the stability of mixtures of methyl aniline-gasoline. Addition of an amine to gasoline containing T.E.L. will raise the octane number further.

VELDE, H. (299)

RELATION OF OCTANE NUMBER AND PEROXIDE CONTENT OF CATALYTIC GASOLINES. Petrol. Refiner Proc. 25: 285–288. 1946.

Storage tests were made on three synthetic gasolines: a straight-run gasoline, a vapor-phase-cracked stock, and a third-grade gasoline composed of a mixture of 1:1 of straight-run and cracked stock. Tests conducted in transparent and brown flasks, covered and uncovered, showed that the combined action of light and air effected a large increase in the peroxide number, particularly in case of the cracked and third-grade gasoline. Additional tests showed that the octane number decreased significantly while the other properties changed only slightly. The same gasolines were placed in 200-liter iron and galvanized iron drums in order to test the effect of the following inhibitors: cresol 0.2 gm. per liter, power alcohol 11.5 percent by volume: T.E.L. 0.5 cc. per liter, power alcohol; power alcohol plus cresol; T.E.L. plus cresol; T.E.L.; power alcohol plus cresol plus T.E.L. Cresol was an excellent inhibitor; power alcohol was good, keeping the octane number practically constant; T.E.L. was affected by the iron surface (giving good results, however, in galvanized drums). Attempt is made to show a quantitative relationship between peroxide number and octane number. Removal of the peroxides improved the octane number but did not restore the original value.

1947

ELDER, C. F., TRUBY, F. R., and WIEBE, RICHARD (300)
OCTANE RATING OF AGRICULTURAL MOTOR FUELS. Indus. and Engin. Chem., Indus. Ed. 39: 508–510. 1947.

A.S.T.M.-motor method of octane number determinations were made of a large number of blends containing methanol, ethanol, isopropanol, butanol, acetone, ethers, olefins, aromatic and paraffin hydrocarbons, and gasolines with and without T.E.L.

KRETSCHMER, CARL B., NOWAKOWSKA, JANINA, and WIEBE, RICHARD (301)
DENSITIES AND LIQUID VAPOR EQUILIBRIA OF THE SYSTEM ETHANOL-ISOOCTANE (2,2,4 TRIMETHYLPENTANE) BETWEEN 0 AND 50°. Amer. Chem. Soc. Jour. 70: 1785–1790. 1948.

Equations are given for the densities of ethanol and isooctane as a function of temperature based on the experimental values obtained. Plots of excess volume *vs.* mol. fraction of ethanol (x) show a maximum that moves towards lower values of x with increase in temperature. Liquid-vapor equilibria at 25° and 50° C. and total vapor pressures at 0° were measured. The system exhibits large deviations from Raoult's law and shows the formation of the azeotrope. Agreement between observed total pressures and those determined by means of the Gibbs-Duhem equation were within 0.5 percent except for three points at 25°. The excess free energy and entropy, as well as the heat of mixing, were calculated.

RONGE, GRETE (302)
REPORT ON THE THERMODYNAMIC CALCULATION OF THE STATE OF COMBUSTION GASES. XXII METHANOL-CHLORTRIFLUORIDE REACTION. U.S. Army Air Forces. Translation No. F–TS–1027–RE, 6 pp. 1947 from Peenemünde ZWB/PA/20/22, Oct. 1943; VII Ethyl alcohol of various percentages of water and methyl alcohol plus pure oxygen. U.S. Army Air Forces, Translation No. F–TS–1030–RE, 14 pp. 1947 from Peenemünde Heeresversuchstelle, ZWB/PA/20/7.

Study was made in connection with their use as rocket propellants. Abstract *in* Aeronaut. Engin. Rev. 6 (5) : 42. 1947.

II. ENGINE PERFORMANCE; BENCH AND ROAD TESTS

1907

DAVIDSON, J. B., and KING, M. L. (303)
COMPARATIVE VALUES OF ALCOHOL AND GASOLINE FOR LIGHT AND POWER. Iowa Agr. Expt. Sta. Bul. 93, 24 pp. 1907.

When 94-percent ethanol is used in a gasoline engine, fuel consumption is 18 to 47 percent greater than with gasoline. Engine will not start readily with ethanol. Exhaust odor is not as unpleasant as with gasoline and there is less danger of fire.

LUCKE, C. E., and WOODWARD, S. M. (304)
TESTS OF INTERNAL-COMBUSTION ENGINES ON ALCOHOL FUEL. U. S. Off. of Expt. Sta., Bul. 191, 88 pp. 1907.

Any gasoline engine of the ordinary types can be run on alcohol fuel without any material change in the construction of the engine. The only difficulties likely to be encountered are in starting and in supplying a sufficient quantity of fuel; however, it is easily possible for the fuel consumption per hp.-hr. to be increased to double the best value either by running the engine on a load below its full power or by an improper setting of the fuel-supply valve. Alcohol showed a slightly higher thermal efficiency; however, the ratio of fuel consumption of alcohol to gasoline was 1.66:1 by weight or 1.44:1 by volume.

——— and WOODWARD, S. M. (305)
USE OF ALCOHOL AND GASOLINE IN FARM ENGINES. U. S. Dept. Agr. Farmers' Bul. 277, 40 pp. 1907.

Any engine, operating on kerosene or gasoline, with proper manipulation, can operate on alcohol without any structural change whatever. According to the particular experiments, a small engine required 1.8 times as much ethanol (95 percent) as gasoline per hp.-hr. This corresponds closely to the relative heating values of the fuel. Suitable carburetor changes will reduce fuel consumption. Engines operated with alcohol give about 10 percent more power than with gasoline. No detrimental effects were observed; the engine had no carbon deposits. The use of alcohol in engines is entirely a matter of economic conditions.

1909

STRONG, R. M. (306)
COMMERCIAL DEDUCTIONS FROM COMPARISONS OF GASOLINE AND ALCOHOL TESTS ON INTERNAL-COMBUSTION ENGINES. U. S. Geol. Survey Bul. 392, 38 pp. 1909. [Reprinted as U. S. Bur. Mines Bul. 32, 1911.]

Higher C. R. can be used. The performance of an alcohol engine can be made equal to that of one using gasoline. Eighty-percent ethanol will perform as well as 90-percent. Hazard in handling denatured ethanol is much less than in handling gasoline and kerosene. The price of denatured ethanol is greater than the price of gasoline, and the quantity of denatured alcohol consumed by an alcohol engine as ordinarily constructed and operated is, in general, relatively greater than the quantity of gasoline consumed by a gasoline engine of the same type.

1911

——— (307)
GASOLINE AND ALCOHOL TESTS ON INTERNAL-COMBUSTION ENGINES. U. S. Bur. Mines, Bul. 32, 38 pp. 1911.

Results are given of tests performed with 10 to 15 hp. 4-cycle stationary engines using gasoline and 95-percent ethanol. The use of high C. R. is advocated when using ethanol as fuel.

——— and STONE, L. (308)
COMPARATIVE FUEL VALUES OF GASOLINE AND DENATURED ALCOHOL IN INTERNAL-COMBUSTION ENGINES. U. S. Bur. Mines, Bul. 43, 243 pp. 1912.

A detailed account of the experimental conditions is given. Alcohol shows a higher thermal efficiency than gasoline. The beneficial effect of increase of compression pressure is emphasized.

1913

ORMANDY, W. R. (309)
SOME EXPERIMENTS ON MIXED FUELS WITH SPECIAL REFERENCE TO ALCOHOL MIXTURES. Inst. Auto. Engin. Jour. 8: 49–106. 1913.

Engine tests are described with gasoline, benzene, and benzene-ethanol blends as fuels. A 50:50 ethanol-benzene blend will give the same performance as gasoline with only slight carburetor adjustments, increase of size of jet, and of weight of float.

WATSON, W. (310)
EXPLOSIVE MIXTURES AT DIFFERENT PRESSURES. Inst. Auto. Engin. Jour. 9: 73–102. 1914–1915.

Difference of vapor pressures between alcohol and benzene is not sufficiently great to account for the fact that the engine will start easily from cold with benzene and not with alcohol, but that proportion alcohol/air for formation of explosive mixture is greater than benzene or gasoline/air ratio. To overcome starting difficulty (1) heat carburetor and induction pipe externally or locally in carburetor by electricity; (2) inject a small quantity of fuel into cylinder through the compression tap (heat of compression is high enough to vaporize fuel and form explosive mixture); (3) start with gasoline.

1915

——— FROST, C. W., LLOYD, W. C., RICHARDS, F. F., STERN, W. J., SHAW, H., and WILSON, J. (311)
BENZENE, ALCOHOL, AND MIXTURES OF THESE LIQUIDS WITH PETROL AS FUELS FOR INTERNAL COMBUSTION ENGINES. Soc. Chem. Indus. Jour. 34: 266–267. 1915; Inst. Auto. Engin., Dec. 1914, 20 pp. [Separate copy].

Mean effective pressures obtained with ethanol (denatured with methanol) were slightly higher than with either gasoline or benzene. Richer mixtures could be used without loss of power; however, thermal efficiency was lowered. Starting difficulties in cold weather were encountered.

HUMBOLDT, E. (312)
NEW FUEL MIXTURES FOR INTERNAL COMBUSTION ENGINES. Power 50: 418–420. 1919.

The efficiency of various gasoline and benzene blends containing alcohol and ether were studied. Good performance was obtained with 1 part ether, 2 parts ethanol and 24 parts benzene. It is estimated that a blend of gasoline, alcohol, and ether should cost less than 18 cents per gallon in order to compete with gasoline.

1920

CHALONER, J. L. (313)
ALCOHOL AS FUEL. Auto. Engin. 10: 183–185. 1920.
Design and construction of alcohol engines is discussed.

GAGE, V. R., SPARROW, S. W., and HARPER, D. R., 3d. (314)
COMPARISON OF ALCOGAS AVIATION FUEL WITH EXPORT AVIATION GASOLINE. [U.S.] Natl. Advisory Com. Aeronaut. Tech. Rpts. No. 89, 14 pp. 1920.

A blend of approximately 40:35:17 ethanol-gasoline-benzene gave a performance superior to that of aviation gasoline in a 12-cylinder Liberty engine.

1921

ANONYMOUS (315)
PROGRESS IN TESTS OF ALCOHOL AS FUEL. Power Wagon No. 197: 20. 1921.

Report of British Empire Motor Fuels Committee is mentioned. See No. 322.

FREELAND, E. C., and HARRY, W. G. (316)
ALCOHOL AS A COMBUSTION FUEL. Sugar 23: 432–434, 474–476, 536–538. 1921.

In one set of tests with tractors, with a mixture of 100 gallons of alcohol, 8 gallons of gasoline, and 0.5 gallons of pyridine, full power was obtained and no difficulty in cold starting was experienced. Fuel consumption, however, was 50 percent higher.

HUBENDICK, E. (317)
INVESTIGATIONS ON ALCOHOL ENGINES. Tek. Tid. Uppl. D. Mekanik 51: 25,45,69. 1921.

KETTERING, C. F. (318)
FUEL RESEARCH DEVELOPMENTS. Soc. Automotive Engin. Jour. 9: 291. 1921.

Problems involved in fuel combustion, such as cylinder distribution, chemical constitution, and tendency to knock are discussed. Indicator cards are shown for ethanol, ether, butanol, carbon disulfide, kerosene, gasoline, fuel oil, benzene, and a cyclohexane-benzene mixture.

NORMAN, C. A. (319)
THE ECONOMICAL UTILIZATION OF LIQUID FUEL. Ohio Engin. Expt. Sta., Bul. 19, 206 pp. 1921.

Aside from petroleum fuels, sources and properties of ethanol and ethanol blends are discussed. A few road-test data for ethanol, methanol, and various benzene-alcohol blends are tabulated. Other subjects discussed are carburetion, compression, ignition, and thermodynamics of combustion.

RICARDO, H. R. (320)
THE INFLUENCE OF VARIOUS FUELS ON ENGINE PERFORMANCE. Automotive Indus. 45, Part I: 804–807; Part II: 856–862; Part III: 1003–1007; *Ibid.* 46, Part IV: 8–13, 17; Part V: 211–216; Part VI: 465–470, 477; Part VII: 516–519. 1921, (condensed *from* Auto. Engin. Vol. 11, 1921); [Gt. Brit.] Empire Motor Fuels Committee, Rpt. pp. 51–154, London, Sessions 1923–1924.

Part I. After a brief statement of the purpose of the investigation, general conclusions drawn from the work are given. Only those in which alcohol is specifically mentioned will be presented here: Owing to the high heat of vaporization and low boiling point of alcohol and certain other fuels, the weight of charge per cycle is greater and a higher power output is obtained in consequence. The thermal efficiency of alcohol is slightly higher than that of other fuels when burnt under identical conditions. Physical properties of alcohols are also given.

Part II. In this report the results of effect of C. R. on detonation, relative merit of various fuels in respect to power and thermal efficiency, and toluene value of various fuels are given. In all cases ethanol was outstanding in its characteristics.

Part III. The importance of the maximum temperatures and pressures at the end of compression is stressed in connection with detonation. A table shows for each fuel the C.R. at which detonation just occurs, the corresponding compression pressures and temperatures, as well as the self-ignition temperatures obtained by two methods. This is quite certainly due to increased volumetric efficiency with rich mixtures because of the high heat of vaporization of ethanol. At about the mixture strength giving complete combustion, the ignition timing required was very nearly the same for all fuels from heptane to toluene or alcohol. The tendency to detonate was at a maximum at or about the mixture strength giving complete combustion and this, in practice, was almost coincident with that giving maximum economy.

Part. IV. A table shows heats of combustion per pound, per U. S. gallon, and per standard cubic inch of mixture; change in specific volume after combustion; heats of vaporization; fall of temperature of mixture because of heat of vaporization, and relative power output allowing for increase in density. Relative power-output values for ethanol and methanol are 120 and 143, respectively, when the octane number is 100. Data are given for m.e.p. with and without preheating at C.R. 5:1, as well as similar data for the highest useful C.R. (H.U.C.R.) for each fuel. Ethanol with an H.U.C.R. of 77.0 had the highest i.m.e.p. of 153.8 p.s.i. at 7:1 except for "methylated spirits," which preignited at 6.5:1 but whose i.m.e.p. was 155.5 p.s.i. Benzene, toluene, and xylene are preignited at 7.5:1 with i.m.e.p. of approximately 150 p.s.i.

Part V. The theoretical deductions of Tizard and Pye agree with the author's later work. The maximum temperature obtained with economical mixture strengths is substantially the same for all hydrocarbons but is perceptibly lower in the case of alcohol. All tests showed that the gain in efficiency with increase of compression was almost exactly the same with all fuels tested; however, alcohol gave a higher thermal efficiency though the curve showed practically the same proportional variation. A table shows for various fuels, including alcohols, lower heats of combustion, minimum fuel consumption at 5:1 and at the H.U.C.R. thermal efficiencies and heats of vaporization. Curves of i.m.e.p. *vs.* s.f.c. are quite similar for all fuels but again in the case of ethanol, the power continues to rise with mixture strength to an important extent.

At higher jacket temperatures, the gain in mechanical efficiency generally more than outweighed any gain in indicated thermal efficiency. Carburetor heating decreased power output; however, in case of 95-percent alcohol it decreased s.f.c. because of better manifold distribution. The indicated thermal efficiency for all fuels, including alcohol, went through a slight maximum at 70 percent of full load if the ignition was adjusted properly. The thermal efficiency obtained for 95-percent ethanol at all compression ratios was about 2.5 percent higher than that obtainable with hydrocarbons, due to the reduction in the temperature of the cycle caused by the evaporation of the alcohol within the cylinder. For the same reason more heat was given off to the cylinder walls by gasoline than by alcohol.

Part. VI. Factors entering into the problem of starting are fully discussed. A small proportion of ether made starting with alcohol quite easy. The uniformity of manifold distribution depended primarily on the design of the manifold and only slightly on the type of fuel. It is shown that the volumetric efficiency of 95-percent ethanol is greater than that of gasoline but the increase of maximum power for alcohol is greater than when caluclated on the basis of greater volumetric efficiency.

Part VII. The various engines employed in the previous work are described.

SCARRATT, A. W. (321)

THE CARBURATION OF ALCOHOL. Soc. Automotive Engin. Jour. 8: 328–330. 1921.

The company with which the author is associated was interested in exporting tractors to countries using ethanol as fuel. Tests were therefore undertaken to investigate the optimum conditions under which commercial ethanol (containing approximately 10 percent water) can be used in a tractor engine. After overcoming initial difficulties, good economy and excellent operation were attained. The following points are emphasized: Fuel consumption varies in inverse ratio to the heats of combustion only under conditions most favorable for gasoline; otherwise it is more favorable for ethanol; intake manifold should be well designed; intake heating is essential; starting should be with a gasoline-ethanol mixture; practically no carbon is found after severe operations; valve and valve seats remain in surprisingly good condition. Author believes that alcohol may ultimately become a fuel in this country.

1922

ANONYMOUS (322)

ALCOHOL FOR INTERNAL COMBUSTION ENGINES. Engineer 133: 534. 1922; Motor Transport 34: 600–601. 1922; Automotive Indus. 48: 876–877. 1923.

A report is given of tests made by the Empire Motor Fuels Committee, in cooperation with British Government authorities. At all speeds and with high and low compression, greater efficiency was obtained with 95-percent ethanol in Ricardo engine than with gasoline or benzene. Fuel consumption was greater with ethanol. Power output and efficiency decreased with increasing water-jacket temperature. No corrosion was observed in the engine. In high-compression engines it is advantageous to use ethanol containing up to 10 percent water by volume.

——— (323)
ALCOHOL MOTOR FUEL RESEARCH. Petrol. Times 7: 711–712. 1922.

Four series of engine tests showed that thermal efficiency obtained with alcohol was higher than that obtained with gasoline or benzene.

NAVARRO, O. (324)
THE USE OF BENZENE AND ALCOHOL AS FUEL FOR AUTOMOBILES. Soc. de Fomento Fabril [Santiago, Chile] Bol. 39: 487–497, 634–641. 1922.

ORMANDY, W. R. (325)
INTERIM REPORT OF THE ENGINEERING COMMITTEE OF THE EMPIRE FUELS COMMITTEE. Soc. Chem. Indus. Jour. 41: 223–224R. 1922.

This is a brief summary of the work done by H. R. Ricardo (see No. 320). A large number of comprehensive tests indicated that ethanol (95 percent) offered certain advantages over gasoline. Preignition was observed at C.R. 7:1 with the particular engine used. At low compression, ethanol consumption particularly will be higher; however, thermal efficiency is greater. Engine ran cooler with ethanol. Preheating decreased output somewhat but increased thermal efficiency. No corrosive action was observed anywhere.

RICARDO, H. R. (326)
RECENT RESEARCH WORK ON THE INTERNAL-COMBUSTION ENGINES. Soc. Automotive Engin. Jour. 10: 305–336, 347. 1922.

The importance of the heat of vaporization in case of alcohols (ethanol and methanol) on volumetric efficiency is stressed and the effect of preheating is discussed. The paper deals extensively with such questions as detonation, stratification (for the purpose of using weaker mixtures), turbulence, combustion chamber design, and air measurement.

1923

DUNSTAN, A. E., and THOLE, F. B. (327)
AVIATION SPIRIT, PAST, PRESENT AND FUTURE. Inst. Petrol. Technol. Jour. 9: 249–259. 1923.

A general survey of the work on the use of substitutes for gasoline, tetraline, cyclohexene, alcohol, and their blends. The works of H. R. Ricardo (see Nos. 320 and 326) on detonation and of J. Midgley and T. A. Boyd (see No. 22) on antiknock compounds are reviewed.

FERROUILLAT (328)
ECONOMICAL INTERNAL COMBUSTION ENGINE FUELS. Acad. d'Agr. de France, Compt. Rend. 9: 817–822. 1923.

The results of actual tests of internal-combustion engines run on alcohol, vegetable oils, and producer gas from charcoal are briefly discussed.

GARDNER, H. A. (329)
ALCOHOL AS A MOTOR FUEL CONSTITUENT. Indus. and Engin. Chem., 15: 483–485. 1923; Sugar 25: 607–608. 1923.

Even the highest grade aviation gasoline has caused corrosion troubles, and detonation prevents higher C.R. (7:1) for greater economy. Ethanol (95-percent) does not appear satisfactory for aviation purposes; however, anhydrous ethanol presents possibilities since it answers most of the requirements for a good aviation fuel. A 30:70 ethanol-gasoline blend is suggested for further experimentation. Purity requirements for ethanol and gasoline are outlined. It is probable that special alcohol permits could be obtained under formula 28A from the Bureau of Internal Revenue.

LEE, S. M., and SPARROW, S. W. (330)
TESTING FUELS FOR HIGH-COMPRESSION ENGINES. Soc. Automotive Engin. Jour. 12: 11–16. 1923.

Power and fuel consumption of benzene and ethanol and of their blends with gasoline at various C.R. (5.4 to 14) were measured in a single-cylinder Liberty engine. The importance of fuel-consumption runs are emphasized, since tests indicated a variation of more than 20 percent with only 1 percent variation in power. Results show an increase in power and a decrease in s.f.c. with increase in C.R. The increase in power and efficiency, using the lowest ratio (5.4) as the basis of comparison, is practically equal to that predicted by the "air cycle," even with the peculiar shape of combustion chamber used. With the use of ethanol, power output increased with increase of C.R.; however, there was not the same fuel economy as in the case of benzene.

1924

FOTH, G. (331)

THE UTILIZATION OF ALCOHOL AND BENZENE AS MOTOR FUEL. Ztschr. f. Spiritusindus. 47: 259. 1924.

Formulas and the results of a number of experiments are given.

HOLTAN, E. (332)

ALCOHOL AS MOTOR FUEL. Papir-Jour. 12: 13–19, 26–31, 37–42. 1924.

Motor-fuel tests with alcohol, benzene, and gasoline, separately and mixed, are given.

1925

DUMANOIS, PAUL (333)

INTERNAL COMBUSTION ENGINES AND THE LIQUID-FUEL PROBLEM (IN FRANCE). Soc. d'Encouragement pour Indus. Natl. Bul. 137: 730–736. 1925.

The author investigates the possibility of raising the present low compression ratio (approximately 5:1) to the 7:1 level for the purpose of a greater all-round efficiency, particularly in connection with the use of alcohols. The addition of water to methanol will prevent preignition of methanol. Ethanol will neither preignite nor detonate at 7:1. The use of tetraethyl lead for raising the octane number of gasoline is discussed.

——— (334)

UTILIZATION OF LIQUID FUELS. [Paris] Acad. des Sci. Compt. Rend. 181: 26–28. 1925.

Since large-scale production of synthetic methanol may be a possibility, road tests were made using methanol, 50:50 ethanol-gasoline, 80:20 gasoline-kerosene plus 0.2 percent of T.E.L., and a 70:30 mixture of the same composition. Methanol showed a fuel consumption per 100 km. almost twice that of the other fuels. The C.R. of the engine had been changed from 4.6:1 to 6:1 and a larger jet for methanol (and the 50:50 mixture) was installed. Preignition of anhydrous methanol can be prevented easily through addition of 5 percent of water.

FOUQUE, ROBERT (335)

THE FUTURE ALCOHOL ENGINES. Chaleur et Indus. 6: 159–165. 1925.

As the supply of ethanol increases (partly through importation from the colonies), the amount of ethanol in blends should also become greater. At the same time the compression ratios of engines should be increased gradually until the optimum for pure ethanol is attained.

FREELAND, E. C., and HARRY, W. G. (336)

ALCOHOL MOTOR FUEL FROM MOLASSES. II. USE OF ALCOHOL AND ALCOHOL-ETHER MIXTURES AS MOTOR FUELS. Indus. and Engin. Chem. 17: 717–720. 1925.

Advantages and disadvantages of 95-percent ethanol as motor fuel are pointed out. For more satisfactory performance, 10 to 25 percent high-grade gasoline and 0.5 to 0.75 percent pyridine should be added. The latter acts not only as denaturant but also as corrosion inhibitor. Aniline is apparently in the same class. Engine should be carefully cleaned before changing over to ethanol; cork floats must be coated with paraffin, gum arabic, etc., or better, replaced by metal floats; larger carburetor jets are needed; preheating of air should not be excessive, and starting below about 27° C. (80° F.) may be difficult. Directions for operation are given. When using 95-percent ethanol, lack of low-speed flexibility may be overcome by careful operation; fuel consumption will be from 33.3 to 50 percent higher. Ethanol-ether blends will give superior performance; however, carburetor must be adjusted carefully. Test results are given for an ethanol-ether-gasoil-pyridine blend (59.5, 39.0, 1, and 0.50 percent, respectively). No corrosion was found after 9 months of operation and fuel consumption was slightly less than with gasoline. For improving lubrication, 1 percent lubricating oil should be added to the blend.

Great Britan Fuel Research Board (337)
report for the period ending december 31, 1924. [Gt. Brit.] Dept. Sci. and Indus. Res. H. M. Stationary Office. 78 pp. 1925.

The report deals principally with the coal, coke, and gas industry; however, there is a brief section on motor-fuel blends and a discussion on power alcohol. Brake horsepower *vs.* specific fuel-consumption curves for 40:30:30 and 20:50:30 gasoline-ethanol-benzene, and for 25:75 gasoline-ethanol are shown. Specific fuel consumption for the 40:30:30 blend was only slightly greater than for straight gasoline; for the others it was higher in proportion to the percentage of ethanol they contained. The following memoranda on power alcohol were issued during 1920: "1st—19th April, 1920, dealing with the possibilities of home production; 2nd—29th April, 1920, dealing in general terms with production in the Dominions and Colonies, and pointing out the necessity for research as to the possibilities of making alcohol from waste cellulosic materials; 3rd—26th June, 1920, dealing with production in Australia; 4th—25th November, 1920, a record of the position as regards production, utilization, denaturing, etc." An Interim Memorandum on Fuel for Motor Transport was published in July, 1920. The latter outlines briefly the history of power alcohol and gives results of work by the Department.

The "Second Memorandum on Fuel for Motor Transport" was published in December, 1921, and deals with possibility of production of power alcohol in Dominions and Colonies (from molasses, etc.). Brief mention is made of experiments on acid hydrolysis of cellulose materials. The surtax of 5d. a proof gallon on all imported alcohol has been removed, and power alcohol can now be handled with a minimum of trouble and expense.

Sparrow, S. W. (338)
fuels for high compression engines. [U.S.] Natl. Advisory Com. Aeronaut. Rpt. No. 232, 20 pp. 1925.

Author considers possibility of using ethanol-gasoline blends in aircraft engines under certain conditions, despite the high specific fuel consumption. No corrosive tendency was observed. Fuel lines should be rinsed with alcohol before using alcohol blends because alcohol will dislodge accumulated deposits and thus clog the fuel system. Author believes that if these blends are used extensively it is probable that little difficulty would be experienced in keeping the fuel free from injurious amounts of water.

Carreon, P. R. (339)
a study of substitute fuels for gas engines. Agr. Engin. 9: 289–291. 1928.

Studies conducted at the California Experiment Station on the use of commercial alcohol mixed either with gasoline or kerosene as fuel for gas engines are reported. Most farm engines can be run with mixtures of gasoline and alcohol without structural changes. The engine tested started easily with the mixture of gasoline and 190-proof alcohol with a ratio as low as 1 part of gasoline to 10 parts of alcohol at 60° F. To obtain economical results it was necessary to keep the circulating water as hot as possible and to advance the ignition timing as the percentage of alcohol in the blend was increased. Less tendency to deposit carbon was noticed with the blend and also less tendency to dilute the oil. The engine ran smoother on the mixtures of alcohol blends than when operated on gasoline or kerosene alone. A bibliography is included.

DEPASSE, E. (340)
"KETOL" A NEW MOTOR FUEL. Assoc. des Chim. de Sucr. et Distill. Bul. 43: 409–414. 1926.

Acid hydrolysis of sawdust yields sugars which are fermented to butyric acid. Dry distillation of calcium butyrate yields a mixture of ketones, principally butyrone. This mixture, called "ketol," can be used straight or blended, preferably the latter since it is expensive. Engine tests showed it to be satisfactory. Fuel consumption was 7 to 8 percent better than its heat of combustion would indicate when compared to gasoline.

DUMANOIS, PAUL (341)
UTILIZATION OF METHANOL AS POSSIBLE AUTOMOBILE FUEL. Oil and Gas Jour. 25(28): 142. 1926. (Internatl. Conf. on Bituminous Coal Proc.)

Objections to the use of methanol as fuel are its low calorific value and the tendency to form aldehydes on incomplete combustion and to preignite at the higher compression ratios. (See also No. 334.)

FRANK, FRITZ (342)
MOTOR PLOWING TESTS WITH MONOPOLIN AND BENZOL. Tech in der Landw. 7(7): 45–47. 1926.

Plowing tests with tractors and motor plows under identical conditions to compare alcohol-benzene mixtures with straight benzene are reported. The conclusion was drawn that mixtures of alcohol may be successfully used in tractor plowing.

HUBENDICK, E. (343)
ENGINE DRIVE WITH ALCOHOL FUEL. Auto.-Rundschau 28 (13 & 14): 299–302, 318–322. 1926.

Stability of ethanol blends and principles of carburetion and engine testing are discussed. It is shown that a 25-percent blend appears to give the most favorable mixture for engine operation. For high ethanol-gasoline blends, e.g., 80:20, the following changes are necessary for proper operation: (1) Inlet air must have temperatures from 120° to 150° C., (2) carburetor float weight must be increased to conform to higher density of blend, (3) spark must be advanced, (4) size of carburetor jet must be made larger. These recommendations are discussed in detail. Higher C.R. for alcohol engines is advocated and benefits briefly stated.

ROSS, J. D., and ORMANDY, W. R. (344)
EXPERIENCES WITH ALCOHOL MOTOR FUELS. Soc. Chem. Indus. Jour. Trans. 45: 273T–280T. 1926; Inst. Chem. Engin. [London] Trans. 4: 104. 1926.

The utilization of alcohol as motor fuel is entirely an economic problem. In view of the higher cost of alcohol, its use in blends would appear most reasonable. A blend consisting of 100 parts gasoline and 10 parts "methylated spirits No. 1" was used for the test described. The mixture was stable to —24° C. From the results of Buick tests, the following conclusions were drawn: (1) With variable ignition, average fuel consumption of the blend was 2.3 percent (by volume) greater than that for gasoline; (2) greater ignition advance and higher induction temperatures were required for best results, maximum power, regardless of economy, being somewhat greater; (3) starting and general running conditions were satisfactory; (4) alcohol addition to a lower octane fuel greatly improved its performance. Greater ignition advance would have improved economy at fractional loads. Road tests made by the London General Omnibus Company showed that the average ton-mileage was slightly higher (2 to 3 percent) with the blend than with the ordinary gasoline used by the company; however, the blend was superior in respect to starting, nonknocking, and hill climbing. A blend of 50:50 alcohol (95-percent) and gasoline (Discol) was tested in a Ricardo variable compression engine. Results indicated the improvement in economy and power obtainable with increased C.R. For satisfactory cold starting either higher hydrocarbons or ether should be used. The increased economy with increase of C.R. was also borne out in full-scale tests. The importance of the engine as a variable is pointed out. The large-scale alcohol motor-fuel experiment carried out in Queensland is mentioned.

1927

BROWN, G. G. (345)
THE RELATION OF MOTOR FUEL CHARACTERISTICS TO ENGINE PERFORMANCE. Mich. Univ. Engin. Res. Bul. No. 7, 129 pp. 1927.

The two important characteristics of motor fuels, volatility and antiknock properties, are considered and ethanol is discussed in this connection. The probable cause of fuel or engine knock is shown to be a complex chemical reaction involving autoignition of the unburned gases ahead of the flame initiated by the spark.

DUMANOIS, PAUL (346)
LIQUID FUELS IN THEIR RELATION TO MOTORS. [France] Ann. de l'Off. Natl. des Combustibles Liquides 2: 9–20. 1927.

Auto-ignition by compression, preignition, and detonation are discussed. Ethanol is not subject to any one of the three, while methanol has a tendency to preignite in presence of "hot spots" at higher compression ratios. This can be remedied by using blends of methanol and ethanol.

JACKSON, H. Y. V. (347)
MOTOR SPIRIT, WITH SPECIAL REFERENCE TO ITS USE IN INTERNAL COMBUSTION ENGINES. Inst. Petrol. Jour. 13: 855–874. 1927.

Alcohols are only briefly mentioned. According to the author, methanol is ruled out because it is poisonous. The chief features of alcohol are low volatility, low calorific value, and nondetonation. It has been shown that engines can be run on an alcohol-gasoline blend at C.R. of 7:1 without detonating and with reasonable fuel consumption.

1928

DUMANOIS, PAUL (348)
UTILIZATION OF METHYL ALCOHOL AS FUEL. Assoc. des Chim. de Sucr. et Distill. Bul. 45: 605–608. 1928.

The use of methanol in automobile engines is discussed. (See Nos. 334 and 346.)

HUBENDICK, E. (349)
THE USE OF ETHYL ALCOHOL AS A MOTOR FUEL. World Power Conf., London 1928, Fuel Conf. Trans. 3: 724–748. 1929.

The large production of cheap ethanol from sulfite liquor has made ethanol blends of prime economic importance in Sweden. Methanol is unsatisfactory as a denaturant and 0.19 percent of crotonaldehyde is being used instead. It is shown that the thermal efficiency of 10, 15, and 20 percent ethanol blends is the same for minimum fuel consumption and greater than that of gasolines when power is increased, but this is not true for blends containing somewhat more than 20 percent of ethanol. The latter represents the optimum condition. A 25-percent blend, however, was found completely satisfactory. If blends with more than 25 percent of ethanol are used, the intake air must be sufficiently preheated (100° to 150° C. or 220° to 272° F.), the float must be adjusted to compensate for the higher specific gravity, ignition advanced, and larger jet installed. For blending, 99.5- to 99.7-percent ethanol is used and no trouble with separation has been experienced. Separation was induced through addition of water and the composition of the lower layer (7.3 percent) was found to contain 40.9 percent of gasoline. Even though the engine may continue to run, separation is, of course, undesirable. The amount of preheating is largely a function of air humidity, and it is essential to preheat sufficiently to evaporate the fuel completely in order to prevent fuel losses.

1929

KING, J. G., and MANNING, A. B. (350)

ALCOHOL FUELS FOR USE IN INTERNAL COMBUSTION ENGINES. Inst. Petrol. Technol. Jour. 15: 350–368. 1929.

The following fuels were used: 95-percent ethanol; "Power Methylated Spirits" containing 92-percent ethanol (ethanol 87.4, water 4.6 percent), 5.0 percent benzene, 2.5 percent methanol, 0.5 percent pyridine; benzene (99.5 percent); "Power Benzol"; three ordinary gasolines, and a product from the low-temperature distillation of bituminous coal. Various critical solution temperatures of binary and ternary mixtures were determined and phase diagrams constructed. Limiting percentage of gasoline (by volume) in mixtures of gasoline and 95-percent ethanol at 15° C. varied from 31.5 to 72.5 percent and at —10° from 44 to 41 percent. The wide variation was due principally to the highly aromatic gasoline from Borneo. A few bench tests were made on a four-cylinder engine with gasoline, 40:30:30 gasoline-ethanol-benzene, 20:50:30 gasoline-ethanol-benzene, and 25:75 gasoline-ethanol. The blends containing benzene behaved satisfactorily; however, the blend containing 75 percent of ethanol gave poor results under the conditions. The latter would be improved by heating the incoming air or by "hot-spotting." The volumetric fuel consumption increased with the volume of alcohol in the fuel. The thermal efficiency at maximum economy was similar to that of gasoline.

PAHL, H. (351)

EFFECT OF OXYGEN ON THE IGNITION OF LIQUID FUELS. [U.S.] Natl. Advisory Com. Aeronaut. Tech. Memo. No. 497, 13 pp., 12 figs. 1929.

Ignition temperatures, ignition lags, and ignition strengths of benzene, allyl alcohol, gasoline, and American gas oil were determined in a modified Krupp ignition tester. It is pointed out that the standard tests would give entirely different results and that, therefore, the results depend greatly on the type of apparatus.

WAWRZINIOK, OTTO (352)

SPEED OF COMBUSTION OF VARIOUS FUEL-AIR MIXTURES IN INTERNAL COMBUSTION ENGINES. Institut für Kraftfahrwesen an der Sächsichen Technischen Hochschule, Dresden. Mitteilungen, Sammelband 6: 7–22. 1929.

The reaction velocity (rate of combustion) as a function of spark advance and speed was studied in a single-cylinder engine (C.R. 5.2:1) with six different fuels including ethanol plus 5 percent Stellin and two ethanol blends (approximately 30 percent ethanol). It is emphasized that the results depend greatly on the engine set-up. The reaction time, defined as the time between ignition and pressure maximum, was shorter with ignition advance (e.g., 35° B.T.C.) than when ignition took place at T.C. The reaction time for 95:5 ethanol-Stellin blend was considerably longer than for the other fuels, and higher compression ratios are recommended. At 35° B.T.C., reaction velocities for gasoline, benzene, and 95:5 ethanol-Stellin were 15.5, 14.2, and 10.2 m/sec, respectively. Reaction velocity increased with engine speed. The influence of increase of piston velocity was less on ethanol-air mixtures than on the other fuel-air mixtures.

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METHODS AND MEANS FOR THE INCREASE OF OUTPUT AND ECONOMY OF INTERNAL COMBUSTION ENGINES IN VEHICLES. Institut für Kraftfahrwesen an der Sächsichen Technischen Hochschule, Dresden. Mitteilungen, Sammelband 6: 23–37. 1929.

Increasing the charge density by means of blowers or compressors not only increases output but also efficiency. The latter is due partly to the elimination of the residual charge because of better scavenging. It is not due to the inherent increase in theoretical thermal efficiency. Increase in compression will increase the thermal efficiency. Experiments were conducted with a Mercedes engine rated at 25 hp. and 38 hp. without and with blower, respectively, with 60:40 gasoline-benzene, 63.5:33.5:3 ethanol-gasoline-ether, 45:45:10 ethanol-gasoline-benzene. Slightly higher maximum outputs and thermal efficiencies were noted for the ethanol blends, changing the C.R. of two Daimler engines from 4.2:1 to 8:1. Aside from gasoline, a gasoline-benzene blend, a motor benzene, and two ethanol blends were used. It was concluded that the performance of a 50:50 ethanol-gasoline blend was approximately equal to that of benzene, and effective thermal efficiencies of fuels containing ethanol were higher. A motor must be designed for a higher C.R., a single changeover is not possible. This is shown particularly in additional experiments with an Elite engine at various compression ratios.

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RESEARCH STUDIES ON THE KNOCKING OF MOTORS. Institut für Kraftfahrwesen an der Sächsischen Technischen Hochschule, Dresden. Mitteilungen, Sammelband 6: 38–44. 1929.

It is shown that separate injection of either water or ethanol will prevent engine knock. Less ethanol than water is required. Slight increase in output was noted when injection was used. Good atomization is necessary.

1930

GREBEL, A. (355)

CHARACTERISTICS OF INTERNAL-COMBUSTION ENGINES AND FUELS. Trav. Soc. Ingén. Civils [France] Mém. et Compt. Rend. 83(1–2): 35–168. 1930.

1931

DIETRICH, K. R. (356)

ALCOHOL AS AUTOMOBILE FUEL. Chem. Ztg. 55: 245–246. 1931.

The properties of ethanol as motor fuel are discussed. It is concluded that a 20- to 30-percent blend is at least equivalent to gasoline, and benzene may be added as third component. Higher ethanol additions are not satisfactory in present-day engines because of too high fuel consumption.

DUMANOIS, PAUL (357)

THE USE OF ALCOHOL AS MOTOR FUEL. Rev. Pétrol. 1931: 1323–1324, 1326–1328, 1375; Assoc. des Chim. de Sucr. et Distill. Bul. 49: 329–341. 1932; Soc. Indus. de l'Est Bul. 204: 11–30. Jan./Mar. 1932.

After a discussion of the principle of carburetion, results are presented showing that a 10-percent ethanol blend used in a 180 Hispano and a 300 Renault aviation engine gave somewhat higher output at approximately the same specific fuel consumption. Two graphs showing octane numbers of ethanol-gasoline and ethanol-gasoline-benzene blends are given. Ethanol-gasoline blends reduce the danger of carburetor icing. Reasons for the unpopularity of the 50:50 ethanol-gasoline blend in spite of its good quality as fuel were: (1) Filling stations had to install extra pumps; (2) amount of ethanol available was insufficient to make more than a small quantity of the blend; and (3) since a larger jet had to be installed in the carburetor, this change was unsatisfactory if the ethanol fuel was not generally available. The new blend containing between 20 to 26 percent of ethanol has become more popular and consumption has surpassed that of the "essence poids lourd." A graph shows the effect of jet size on specific fuel consumption for gasoline and the blend, indicating that a larger jet size must be used for the blend than one giving best economy with gasoline. A ternary blend of 65 percent gasoline, 15 percent ethanol, and 20 percent benzene (by volume) shows a fuel economy equal to or better than that obtainable with gasoline and is considered a better way to utilize ethanol. This tenary blend is a stable as a 25 percent ethanol blend.

MIKI, KICHIHEI (358)

EXPERIMENTAL RESEARCH ON THE UTILIZATION OF ALCOHOL AND CHARCOAL PRODUCER GAS FOR ORDINARY GASOLINE AUTOMOBILE ENGINES. World Engin. Cong. Tokyo, Proc. 28: 243–270. 1931.

Performance tests with ethanol and ethanol-water mixtures in a Ricardo and a Buda engine show that a higher C.R. is desirable for fuel economy. For the same power output it would then be possible to use a smaller engine. Ninety-percent ethanol appears to give maximum thermal efficiency, but a variation of the water content within certain limits affects thermal efficiency only very slightly.

TEODORO, A. L. (359)

A COMPARATIVE STUDY OF ALCOHOL, GASOLINE, AND KEROSENE AS FUELS FOR TRACTOR ENGINES. Philippine Agr. 20: 295–327. 1931.

Two McCormick-Deering, one Cletrac, and one Fordson were tested in the laboratory, the following fuels being used: gasoline, kerosene, and denatured and nondenatured ethanol-water mixtures ranging from 94.3 to 59.29 percent by volume of ethanol. Greatest fuel economy for gasoline and kerosene lies between three-quarter load and full normal capacity, while for ethanol it is located at normal load or at maximum power. Maximum s.f.c. for gasoline, kerosene, and 94-percent ethanol for the two McCormick-Deering tractor engines were 0.65, 0.72, 1.11 and 0.66, 0.64, 1.02, respectively. The maximum power that can be developed with use of ethanol is materially higher than that when either gasoline or kerosene is used. Improper carburetor setting will greatly increase fuel consumption, particularly of ethanol, since a richer mixture may be used with this fuel. Starting difficulties may be encountered below 70° F. and priming with gasoline is recommended. Operation with ethanol is smooth; there is a steady pull with no overheating, preignition, or knocking. No corrosion was observed. External heating of ethanol with air before mixing with air may be beneficial; too great heating of the fuel-air mixture may result in decreased volumetric efficiency.

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EFFECT OF VARIABLE COMPRESSION RATIO ON THE PERFORMANCE OF TRACTOR ENGINE USING ALCOHOL. Philippine Univ. Nat. and Appl. Sci. Bul. 1 (3): 187–221. 1931.

Dynamometer tests were carried out with a McCormick-Deering engine at compression ratios of 4.28:1, 5.03:1, and 6.43:1 using gasoline, kerosene, denatured ethanol (approximately 80 percent), diluted denatured ethanol (approximately 64 percent), and ethanol-water solutions containing 94.3, 77.69, 69.3, and 59.29 percent of ethanol. The only change necessary for running on ethanol was enlargement of the fuel passages. The engine operated more smoothly on ethanol than on either the particular gasolines or kerosene, except at a too-lean mixture. No evidence of preignition, knock, or corrosion was found. Specific fuel consumption of ethanol increased greatly at low loads; greatest economy was at full load. Maximum power was usually higher with ethanol than with gasoline. Higher C.R. will reduce specific fuel consumption. At 6.43:1 and normal load, specific fuel consumption of 94.3-percent ethanol was only 15 percent higher than that of gasoline at 4.28:1. With both denatured ethanol and 94.3 percent-ethanol the engine would not start below 70° F. at C.R. 4.28:1. At a C.R. of 5.03:1, the engine started at 70° F. but responded more quickly at 75° F. With 94.3-percent ethanol and at a C.R. of 6.43:1, no difficulty was experienced below 60° F. The price of ethanol given is that at which its use would be economical in the Philippines.

ZUCK, H. E. (361)
ENGINE PERFORMANCE AT HIGH COMPRESSION RATIOS. Mich. Univ. Engin. Res. Cir. No. 6, 33 pp. 1931. Ann Arbor.

Power output is not lowered when detonation is first encountered but increases slowly until severe knocking takes place. Engines should be run, however, under nonknocking conditions except in rare instances, since detonating conditions put severe strains on the engines. At constant detonation intensity, no increase in power can be obtained by increase in compression ratio unless the fuel is changed. If the C.R. is increased and the spark reset to this constant detonation intensity, the power output will be approximately the same as at the lower ratio with higher spark advances. Curves of thermal efficiency *vs.* C.R. for ethanol, benzene, and the gasoline are shown and compared with "theoretical efficiencies," assuming different "c_p/c_v" values.

1932

JACQUÉ, LÉON (362)
MODERN CONCEPT OF THE EVALUATION OF LIQUID FUELS FOR INTERNAL COMBUSTION ENGINES. Chim. & Indus. [Paris] 28: 524–537. 1932.

The general characteristics of motor fuels, including methanol and ethanol, are described. The following topics are discussed: Fuel energy and its utilization, engine performance, and factors influencing carburetion (including gum formation and influence of sulfur).

MEEKER, W. H., BROWN, L. T., and CHRISTENSEN, L. M. (363)
THE USE OF ALCOHOL AS MOTOR FUEL. KNOCK RATING TESTS OF ALCOHOL-GASOLINE MIXTURES. Iowa State Col. Dept. of Mech. Engin. and Dept. of Chem. Progress Rpt. No. II, 3 pp. 1932.

Octane ratings of three blends containing 10, 15, and 20 percent ethanol are discussed. With a 56 octane number base gasoline, a 20-percent blend has an octane number of 80.
Abstract *in* Petrol. World [London] 30: 103–104. 1933.

RAUSCH, ERICH (364)
THE ADVANTAGE OF THE ADMIXTURE OF ALCOHOL TO THE MOTOR FUEL. Ztschr. f. Spiritusindus. 55: 225–226. 1932.

After discussing indicator diagrams, the author gives a few data on the use of ethanol blends, particularly of Monopolin. Road tests with a 5-ton truck indicated that Monopolin was slightly more economical than a 70:30 gasoline-benzene blend. Fuel lines and tanks should be cleaned before using ethanol blends. The latter appear also to have a cleansing action inside the combustion chamber. A method is described for coating cork floats for use with ethanol blends.

SCHWEITZER, CHARLES (365)
PRESENT STATUS OF THE FUEL-ALCOHOL PROBLEM. Chim. & Indus. [Paris] 28: 12–22. 1932.

Using a Ricardo engine at C.R. 4.9:1 it was found that gasoline blends containing up to 35 percent ethanol gave higher outputs and lower specific fuel consumption. Similar tests with an Adler engine (5:1 C.R.) showed that gasoline blends containing up to 50 percent ethanol gave progressively greater outputs. For blends with more than 20 percent of ethanol, specific fuel consumption increased with increase of ethanol content. Less carbon formation was observed when alcohol blends were used. Even 5-percent blends should be stable. Engines will start and accelerate readily on ethanol blends.

TEODORO, A. L., and BANZON, J. (366)
TRACTOR ENGINE TESTS USING GASANOL, GASTARLA, PURE KEROSENE, AND MIXTURES OF PURE KEROSENE AND CRUDE OIL AS FUELS. Philippine Agr. 21: 370–413. 1932.

The purpose of the article is to discuss the use of Gasanol (50 percent by volume of 89.5-percent ethanol, 5 to 10 percent by volume of commercial ether, 40 to 50 percent by volume of gasoline); Gastarla (60 percent by volume of 89.5-percent ethanol, 40 percent by volume of gasoline); three kinds of kerosene; and two groups of Diesel fuel in the laboratory, from the standpoint of economy, crankcase dilution, steadiness of operation, carbon deposits, corrosion, and wear. The use of the alcohol-gasoline blends resulted in a most satisfactory operation of the engine as far as steadiness, silence, and knocking were concerned. Higher maximum power and thermal efficiencies were obtained. Pick-up was rather slow, however, and there was a tendency for carbon deposits to accumulate in cylinder and piston heads. Wear was not excessive and dilution very small. Lubricating-oil consumption was high and a thickening of the used oil was observed, although lubrication along cylinder walls and piston rings was good. In general, evidence of corrosion was slight but a tendency toward corrosion of exhaust valve stem and muffler was noticed. Since very rich fuel-air mixtures may be used with ethanol without drop in power, it was easily possible to double the consumption by slight maladjustment of the carburetor setting.

1933

AMERICAN AUTOMOBILE ASSOCIATION CONTEST BOARD (367)
OFFICIAL TESTS OF REGULAR AND ALCOHOL-BLENDED GASOLINE MOTOR FUELS. Joint Com. Rept. on performance characteristics of these fuels 7 pp. App. to the Rept. 34 pp. American Automobile Association Contest Board. Washington. June 1933.[5]

Four cars were run at constant speed 10 times over a level road for 10 miles using gasoline and a 10 percent ethanol blend. Large variations in fuel consumption were found, whether a different carburetor adjustment (jet size) or in check runs, the same adjustment, was used. In a 1932 Ford V-8 coupe (Jet No. 57) the increase in fuel consumption by volume of the blend over that of gasoline amounted to 36.16 percent in run No. 4 and only 0.52 percent in run No. 10. For a 1932 Rockne eight-cylinder sedan, the increase varied from 0.18 to 5.34 percent. A constant-throttle test with one car over a One-Mile course gave 1.77-percent decrease in miles per hour and 1-percent increase in fuel consumed for the blend (a total of 12 runs, 2 for each 6 carburetor adjustments). Dynamometer tests were made at 750, 1,000 and 1,500 r.p.m. with a G.M. truck engine. Various test difficulties were encountered and it is not known to what extent these affected the results. Partial separation of the blend took place during the run. This was ascribed to the time of measurement and the head in the fuel measuring column and the carburetor float bowl. In the same engine, about 3 percent greater fuel flow was required for the blend (richer mixtures) to obtain acceleration equal to that from gasoline. Gasoline and the ethanol blends were placed in open copper dishes and beakers and exposed to the atmosphere (82° F., relative humidity 47 percent). Separation took place within an hour.

AMERICAN AUTOMOBILE ASSOCIATION (368)
THE FACTS ABOUT AN ALCOHOL-GASOLINE BLEND AS MOTOR FUEL. Tests conducted by the Contest Board of the Amer. Auto. Assoc. in cooperation with the U.S. Bureau of Standards. American Automobile Association. 12 pp. Washington. Sept. 1933.

For details see No. 367. Official tests of regular and alcohol-blended gasoline motor fuels.

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[5] Sequence of annotations 367 and 368 is according to date of publication.

Brown, G. G. (369)

AGRICULTURAL ALCOHOL IN AMERICAN MOTOR FUELS. Paper presented at third mid-year meeting of the American Petrol. Inst. Tulsa, Okla., 11 pp. May 18, 1933; Oil, Paint and Drug Rptr. 1933: 28, 36–38. July 1933.

The use of ethanol in motor fuel, owing to its low-energy content, which is only two-thirds that of gasoline, increases the fuel consumption about 5 percent for every 10 percent of alcohol included when carburetors are adjusted for equivalent performance on the two types of fuel. Knock rating is improved, but approximately 20 percent of alcohol is necessary to improve the knock rating of regular gasoline to that of premium antiknock fuel. Even if it were possible to increase the C.R. of our motors and use high-alcohol blends, the gain in efficiency due to higher compression is not enough to compensate for the decreased energy content of alcohol, and increased consumption is always required with alcohol fuels. The high solvent action of alcohol loosens dirt and scale in fuel tanks and lines, causing stoppage of carburetor screens, and attacks the diaphragms of fuel pumps and the lacquer on cork floats even when specially prepared. Small quantities of water, always present in tanks, cause separation of the alcohol from the blend, and present serious difficulties, particularly in cold weather. One-half gallon of water in a full 1,000-gallon tank is enough to cause separation of a blend with 2 percent of anhydrous alcohol. When used in higher percentages, particularly with rich mixtures required for maximum power and performance equivalent to that obtained from gasoline, acetic acid or similar corrosive materials are formed, which rapidly attack mufflers. Burning corn as alcohol in motor fuel, as proposed, would use only one-third of its heating value as compared with burning the corn on the cob; would require the immediate expenditure of huge sums for distilleries; and would cost the public more than six times as much, with the same return to the farmer.

Clerget, M. (370)

TESTS OF SEVERAL FLUIDS ON INJECTION MOTORS. [Paris] Acad. des Sci. Compt. Rend. 196: 1645–1647. 1933.

Table shows the improvement in the performance of a high-speed Diesel engine. (C.R. 15:1.)

Item	Test run[1] No. 1	Test run[1] No. 2	Test run[1] No. 3
R.p.m.	1,900	2,000	1,960
B.hp.	38.6	38.9	54
B.s.f.c. in gm./hp.-hour, gas oil	199	108.9	132
B.s.f.c. in gm./hp.-hour, ethanol	0	89.1	98
Total	199	198.0	230
Calories per hp.-hr.	2,089	1,620	1,960
Percent thermal efficiency	30	39.2	32.4

[1] Exhaust smoke was hardly noticeable in (2) and less in (3) than in (1).

Cruz, S. R., and Ang, I. R. (371)

USE OF ALCOHOL AS FUEL FOR SMALL GAS ENGINES. Philippine Agr. 21: 613–627. 1933.

Four engines ranging from 1½ to 6 hp. were run on kerosene, two gasolines, Gasanol (50 percent of 95-percent ethanol, 5 to 10 percent ether, 40 to 45 percent gasoline), and denatured ethanol. Ethanol and Gasanol developed higher maximum power in the engines than either gasoline or kerosene. In general, fuel consumption was higher when ethanol and gasanol were used. No corrosive effects were observed during the test. The current market price will determine the use of the fuel. For the three International engines, kerosene was most economical fuel while for the Cushman engine, Gasanol was most economical

Dietrich, K. R. (372)

ETHANOL AS FUEL. Ztschr. f. Spiritusindus. 56: 213–214. 1933.

Blends up to 20 percent of ethanol are very satisfactory and no increased fuel consumption is noticeable. Starting is not difficult, nor does gum formation take place. Anhydrous ethanol blends are not corrosive except in presence of galvanized or lead-coated iron.

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ETHYL ALCOHOL MOTOR FUEL. Automobiltech. Ztschr. 36: 519–520. 1933.

The author refutes in some detail various arguments put forward against the use of ethanol blends. The article deals exclusively with blends containing approximately 20 percent ethanol. Specific fuel consumption of such blends containing, in addition, 20 to 30 percent benzene is actually lower than that of gasoline. No cold-starting difficulties are encountered. Because of azeotropic mixture formation of ethanol with gasoline, starting is easier with ethanol blends. Experiments show that ethanol does not promote gum formation. No phase separation has been observed. Lower engine temperatures and smooth performance result when using blends. No corrosion is found when using anhydrous ethanol in blends. Initial troubles encountered were due to the solvent action of the blends which loosened previous rust and gum deposits and caused clogging of filters and jets. To avoid that, fuel systems should be cleaned before use of blends.

Doldi, Sandro (374)

MOTOR FUELS CONTAINING HIGH PERCENTAGES OF ALCOHOL. Gior. di Chim. Indus. ed Appl. 15: 593–598. 1933.

Dumanois, Paul (375)

CLASSIFICATION OF LIQUID FUEL FOR INTERNAL-COMBUSTION ENGINES WITH MECHANICAL INJECTION. [France] Ann. de l'Off. Natl. des Combustibles Liquides 8: 490–492. 1933.

It was found that the following fuels could be used without necessitating any change in the engine (C.R. 6:1) except for an adjustment of the carburetor. Methyl alcohol; 50 percent ethyl alcohol—50 percent gasoline (carburant national); 20 percent kerosene—80 percent gasoline plus 0.2 percent T.E.L.; 30 percent kerosene—70 percent gasoline plus 0.2 percent T.E.L. Fuel consumption in case of methanol was twice that of the other fuels used. In this case, too, auto-ignition was observed which, however, was readily avoided through addition of 5 percent of water.

Formánek, J., and Dvořák, J. (376)

COMPOSITION OF GASES OF COMBUSTION FROM THE ALCOHOL-GASOLINE MIXTURES AT VARIOUS COMPRESSION RATIOS. Chem. Obzor 8: 107–108, 129–131. 1933.

In general, no essential difference was found by analysis of exhaust gas between gasoline and gasoline-alcohol blends. At low speeds combustion was quite incomplete, but improved with increase of speed. At higher C. R., combustion was improved and temperatures were lower. At low speeds more oxides of nitrogen were formed; however, after a decrease above 1,000 r.p.m., amounts of oxides again increased at above 2,000 r.p.m. No acetic acid was found in the combustion gas.

GRAY, R. B. (377)
PERFORMANCE TESTS OF ALCOHOL-GASOLINE FUEL BLENDS. Agr. Engin. 14: 185. 1933.

Octane rating of gasoline was raised from 67 to 74, then to 80, and to 85 when blended with 10, 20, and 30 percent ethanol, respectively. Road tests with trucks showed that blends reduce carbon formation; they give about 5 percent less mileage (per gallon) at light loads and 8 percent more mileage for extremely heavy loads. Belt tests on tractors showed an increase in maximum power and improvement in fuel economy for the blends.

HOWES, D. A. (378)
THE USE OF SYNTHETIC METHANOL AS A MOTOR FUEL. Inst. Petrol. Technol. Jour. 19: 301–331. 1933.

At the same C.R. and over-all efficiency, the relative fuel consumptions for a given power for gasoline, ethanol, and methanol will be in the ratio 100:161.4:221.6, respectively. However, under special conditions when high output is desired or when blends are employed, methanol may be used to advantage. Contrary to Ricardo (and others) methanol will not preignite if adequate cooling is provided (jacket temperatures not exceeding 150° C.). This has been the result of experience with many different types of engines from air-cooled motorcycle engines to supercharged six-cylinder racing car engines of C.R. up to 15:1.

Overheating of engines, when cooling was expected, is not due to preignition but to overloading the engine because of greatly increased charge density. "Roughness" resulted from inadequate cooling. In adequately cooled engines methanol has been used with perfect satisfaction at C.R. up to 15:1 and also at 8.5:1 with 18 pounds gage boost pressure. Heats of vaporization of methanol, ethanol, "motor" benzene, and gasoline are 263, 204.5, 83.0, and 75.0 cal./gm. at boiling point, respectively. The high values for the alcohols are responsible for the marked increases in power obtainable with these fuels. Graphs are shown giving i. m. e. p. vs. i. s. f. c. and vs. fuel-air ratio for 95-percent ethanol, gasoline, and benzene. Distribution of total heat in engine is also shown.

Results on four motorcycle air-cooled engines showed higher output with methanol than with ethanol. For example, the C. R. of one engine was raised from 7.7:1 to 9.7:1 and b.hp. values for methanol and ethanol were higher by 23.3 and 13.7 percent, respectively, than the values for gasoline at C. R. 7.7:1. The principal problem when using methanol (more so than in case of ethanol) in multicylinder engines is distribution. Optimum air speed through carburetor and manifold is greater for methanol than for gasoline. In use, benzene-methanol blends have given good performance. Plots of b.hp. and b. m. e. p. vs. r. p. m. and of b. m. e. p. vs. b. s. f. c. are given.

Passenger cars were used for road test, operating on a 10-percent methanol-gasoline blend. No difference in fuel consumption (miles per gallon) was found. Data on octane numbers, miscibility of methanol with other fuels, blending agents, effect of addition of water to methanol-gasoline blends, and a list of constant boiling mixtures of methanol with hydrocarbons are presented. A 10 percent methanol-gasoline blend stabilized with benzene was sold for a time at the Billingham works. The critical solution temperature of this blend is —28° C. and its water tolerance at 0° is 3.5 ml./gal.

MILLER, HARRY (379)
RESULTS FROM ALCOHOL-GASOLINE FUEL BLENDS. Agr. Engin. 14: 274–276, 278. 1933.

If 95-percent ethanol is used in combination with gasoline to the extent of approximately 20 percent, two methods are proposed: Use of higher alcohols as stabilizers or a dual-bowl carburetor. No difficulty is experienced when anhydrous ethanol is used. In connection with experiments with 95-percent ethanol, lubrication troubles were encountered, and 0.5 percent of oleic acid, obtainable from corn oil, overcame this difficulty.

MOYER, R. A. and PAUSTIAN, R. G. (380)
THE USE OF ALCOHOL IN MOTOR FUELS. VII. ROAD TESTS ON ALCOHOL-GASOLINE MIXTURES. Iowa State Col. Div. of Engin., Dept. of Civil Engin., Progress Rept. No. VII, 11 pp. 1933.

The following conclusions may be drawn from the series of tests: (1) The use of a blend of 10 percent alcohol and 90 percent gasoline results in a fuel mileage as good as that obtained with straight gasoline. At speeds of 10 to 20 miles per hour, a 4-percent increase in mileage is evident when the blended fuel is used. At the higher speeds of 40 and 50 miles per hour, this advantage disappears and equal mileage is obtained with both fuels. The foregoing conclusions are borne out in practically all of the tests made. (2) Improved acceleration and better performance are noted with the use of the blended fuel. Again, the tests show that these increases in acceleration are greatest at the lower speeds. Throughout the tests the observers very carefully noted the performance of the engine. Their conclusions indicate two advantages for the alcohol-gasoline mixture, these being smoother operation, especially at idling speeds, and elimination of any knocking that would occur if ordinary gasoline were used. (3) A careful study of all mileage tests indicates that the speed at which a car is driven has more effect on fuel consumption than any other item. On the average, a 10-mile decrease in speed is accompanied by a 10-percent increase in fuel mileage. It must be apparent, therefore, that comparable results from tests on both types of fuels can be obtained only when the same speed is maintained. (4) Comparing the two fuels, it is apparent that the blended fuel has a slight advantage over regular gasoline. Both fuels are burned with the same ease, equal mileage is obtained in each case, but better performance is noted when the blended fuel is used.

RAFFAELLI, I. (381)
ALCOHOL AVIATION ENGINES. Riv. Aeronautica 9(4): 1–3. 1933.

Operation of alcohol-burning airplane engines is discussed. Author concludes that alcohol aviation engines should be of Diesel type.

STEFANOWSKI, B., and SZCZENIOWSKI, B. (382)
EFFECT OF DEGREE OF COMPRESSION ON BEHAVIOR OF TERNARY MIXTURES. Warszawskie Towarzystwo Politechniczne (Warsaw Politechnic Society) No. 16:29–63. 1933.

The effect of C.R. on the performance of ethanol-benzene-gasoline blends in engines was studied.

TEODORO, A. L. (383)
ALCOHOL AS A POSSIBLE MOTOR FUEL. Sugar News 14: 81–83. 1933.

Results of engine tests at part and full load, at C.R. of 4.22–6.43 for gasoline, kerosene, 59.3- to 94.3-percent ethanol, and mixtures of ethanol, ether, and gasoline are summarized.

UNITED STATES NATIONAL BUREAU OF STANDARDS (384)
SUMMARY OF BUREAU OF STANDARDS ALCOHOL-GASOLINE BLEND ROAD TESTS, MAY 8–24, 1933. Mimeo. sheet. [U.S.] Natl. Bur. Standards. Washington. June 7, 1933.

When a blend of gasoline with 10 percent anhydrous ethanol is substituted for the same gasoline without ethanol and without any change in carburetor adjustments, there is, on the average, no significant change in the miles per gallon under normal operating conditions. Small individual variations in mileage were found in both directions. The substitution of the 10 percent ethanol blend under the above conditions resulted on the average in a small loss (1 percent) in acceleration, or get-away.

WAWRZINIOK, ERWIN (385)

PERFORMANCE OF MOTOR VEHICLES WITH CARBURETED CHARCOAL PRODUCER GAS. Automobiltech. Ztschr. 36: 546–549. 1933.

The introduction of alcohol improved the efficiency of an automobile gas producer operated with charcoal. Diagrams showing the performance of the motor are given.

1934

ANONYMOUS (386)

METHANOL AS A MOTOR FUEL. I. G. Farbenindustrie A. G. Ludwigshafen-Oppau Rpt. (unnumbered) July 27, 1934; A.D.I. (K) Microfilm, Reel 106, 48 C—C 67, Part I; Sum. of C.I.O.S. Doc., Ref. No. I. 33A.

Principal advantages of methanol are possible use of high compression with consequent higher efficiency as well as higher power output. Its chief disadvantages are its low heat of combustion and difficulty of starting at low temperatures. The latter can be overcome by starting with gasoline.

AVICE, R. (387)

ALCOHOL AND ALCOHOL-PETROL MIXTURES AS MOTOR FUELS. Mauritius Dept. Agr. Leaflet 37; Internatl. Sugar Jour. 36: 347–349. 1934.

Cernite (60:30:6 ethanol-ether-kerosene) and ethanol (94.96 percent by volume) are manufactured locally. The former presents no difficulties in starting or running and demand for it now exceeds supply. In order to be sufficiently stable, an ethanol-gasoline blend must contain at least 70 to 94 percent ethanol. Starting difficulties were encountered with blends containing less than 10 percent gasoline. Carburetor adjustments must be made in all cases. The use of anhydrous ethanol is advocated since it can be blended with gasoline in any proportion. Higher C.R. may be used. Rusty tin cans should not be used for storage of ethanol, and cork floats (in old cars) must be treated with glue and formaldehyde. Best results were obtained with Cernite and a 25 to 30 percent gasoline-ethanol blend. The blends are more economical under local conditions.

CLERGET, M. (388)

CHEMICAL ACTION IN WATER INJECTION MOTORS USING OTHER AUXILIARY FLUIDS. Technique Automobile et Aérienne 25:45-49. 1934.

A brief, historical résumé of water injection is given. In addition to water, author has tried a large number of compounds for the purpose of improving combustion. Among the many materials studied were amyl acetate saturated with acetylene, and certain amyl alcohols. A few test results are given.

COOPERATIVE FUEL RESEARCH STEERING COMMITTEE (389)

TECHNICAL ASPECTS OF THE UTILIZATION OF ALCOHOL-GASOLINE BLENDS AS MOTOR FUEL. Rpt. 11 pp. including App. I, II, III and IV. 1934. New York. Coordinating Research Council Inc. 1934.

The report deals with the use of a 10-percent blend. It is concluded that such a blend is totally unsuitable as a fuel in automotive engines. The following difficulties will be experienced: Clogging of fuel lines, deterioration of fuel-pump diaphragms, separation of blend, hard starting, vapor lock, poor acceleration, corrosion, crankcase dilution, and others. Bureau of Standards tests given in Appendix II indicate that 10-percent ethanol blends can be produced which will give the same freedom from vapor lock as the average gasoline. Another report by the same Bureau (Appendix III) indicates that any difference in ease of starting would probably pass unnoticed in service use provided there is no separation.

FORMÁNEK, JAROSLAV (390)

EFFECT OF THE ADDITION OF BENZENE TO ALCOHOL-GASOLINE MIXTURE ON THE ENGINE EFFICIENCY AND CONSUMPTION OF THIS MIXTURE. Chem. Obzor 9: 1–2, 27–29 (In English 29–30). 1934.

Author states that the use of ternary mixtures of ethanol-gasoline-benzene, containing between 25 and 30 percent benzene, require smaller carburetor jets than ethanol-gasoline blends without the addition of benzene. The result is not only lower fuel consumption for the ternary blends but also greater stability in regard to separation.

Koo, E. C., Chien, N. C., Chu, Y. T., and Cheng, S. M. (391)
EXPERIMENTS ON ALCOHOL-GASOLINE MIXTURES AS FUEL. Indus. Center [China] 3: 112–118. 1934.

Ninety-five-percent ethanol may be blended with gasoline if stabilizers such as acetone, ether, *n*-butanol or isopentanol are added. Output and fuel consumption data are given.

Kuhring, M. S. (392)
EXPERIMENTS ON THE USE OF MIXTURES OF GASOLINE WITH ETHYL AND ISOPROPYL ALCOHOLS IN INTERNAL COMBUSTION ENGINES. Canad. Jour. Res. 11: 489–503. 1934.

The octane numbers (Cooperative Fuel Research and Motor Method) and the highest useful compression ratio were determined for three gasolines containing up to 15 percent of ethanol or isopropanol, or a mixture of the two. The effect of lead and ethanol addition to gasoline is not an additive function, so that ethanol added to leaded gasoline will not show the same increase as when added to the same unleaded gasoline. Curves were plotted for full-throttle power and fuel consumption when a single-cylinder Armstrong-Whitworth engine was run between speeds of approximately 400 to 900 r.p.m. Fuel consumption and power output were generally higher with the blends. In mixtures with less than 30 percent alcohols, the ethyl-isopropyl-gasoline gave the lowest fuel consumption.

Miller, Harry (393)
ALCOHOL-GASOLINE ENGINE FUELS. Idaho Agr. Expt. Sta. Bul. No. 204, 29 pp. 1934.

Results of laboratory engine tests are reported with use of 6 to 30 percent ethanol of various water content blended with gasoline. Fuels were tested in two engines, a 1931 Ford Model A and a 1934 V-8, each with two different heads, giving C.R. from 5.1:1 to 6.35:1. Ethanol containing water was fed separately into the engine by means of a dual carburetor, since these alcohols could not be blended with gasoline without causing separation. Fuel consumption for the 10-percent blends decreased with increase of C.R. and at higher load it was less than for gasoline. At present there are available annually in Idaho 8 million bushels of cull potatoes. Since 1 ton of potatoes yields approximately 30 gallons of 95-percent ethanol, 7.2 million gallons could be produced.

Teodoro, A. L. (394)
EFFECTS OF PRE-HEATING ON THE OPERATION OF A HIGH COMPRESSION TRACTOR ENGINE USING ALCOHOL AND ALCOHOL-GASOLINE BLENDS AS FUELS. Philippine Agr. 22: 625–652. 1934.

The purpose of the work was (1) to investigate the effect of preheating on power, fuel consumption, and operation and (2) to study the effect of carburetor changes and C.R. on these variables when kerosene, gasoline, and six different alcohols and alcohol blends were used. The author's conclusions are (1) that without any alteration in the size of the original fuel jet and using the C.R. adapted for either gasoline or kerosene, only those fuels containing 35 percent or more of gasoline could run the engine at its rated capacity; (2) that alcohol and alcohol-gasoline blends did not require as much preheating as did kerosene; and (3) that with increased C.R. the drop in power with much increase in heat was less in nearly straight alcohol fuels than in the blended ones. With little preheating, a small gain in fuel economy was observed.

——— and MAMISAO, J. P. (395)
REPORT ON TRUCK FIELD TESTS IN CANLUBANG, LAGUNA, USING A-ALKOHL MOTOR FUEL NO. 1, B-DEHYDRATED ALCOHOL AND GASOLINE AS FUELS. Philippine Agr. 22: 720–744. 1934.

Six Chevrolet trucks were used in field tests with the following fuels: A-alkohl motor fuel No. 1 (99 percent of 95-percent ethanol, 0.5 percent gasoline, and 0.5 percent aniline), and B-dehydrated alcohol (approximately 98.5 percent by volume) and gasoline. The use of updraft and downdraft carburetors resulted in an extraordinary difference in relative fuel consumption. With use of the updraft type, the fuel consumption for gasoline, A-blend, and 98.5-percent ethanol were in the ratio of 100:103:110, respectively, while in case of the downdraft the same ratio was 100: 150–178:145–160. Use of the same engine with the two types of carburetors also showed other differences Carbon deposit was least with A-fuel and greatest with the 98.5-percent ethanol. Gasoline was a little better in flexibility of operation than either of the alcohol fuels. There was hardly any difference in ease of starting.

VILLIERS, F. J. de (396)
POWER ALCOHOL. So. African Chem. Inst. Jour. 17(1): 24–36. 1934.

Road tests with blends containing up to 50 percent anhydrous ethanol were carried out in three passenger cars and one motorcyle. Starting on the 50:50 mixture was facilitated through addition of ether, and the latter improved performance of 30- to 50-percent blends beyond that obtainable with gasoline. Fuel consumption for blends up to 35 percent ethanol is either the same or less than for gasoline. It is concluded that ethanol blends show practically no carbon formation, do not corrode engine parts nor tin-lined fuel tanks, show high thermal efficiencies, do not separate, may be used without any changes in engine parts, stand higher compression ratios, and give, in general, complete satisfaction.

1935

CAMPBELL, J. F. (397)
FUEL INJECTION AS APPLIED TO AIRCRAFT ENGINES. Soc. Automotive Engin. Jour. 36: 77–88. 1935; Automotive Indus. 72: 118–119. 1935.

The possibility of using a bifuel system such as alcohol and water or gasoline and water is mentioned.

FORMÁNEK, J., and HOFFMANN, H. (398)
A COMMENT ON THE INFLUNCE OF THE ADDITION OF BENZENE TO GASOLINE-ALCOHOL MIXTURES. Automobiltech. Ztschr. 38: 574–575. 1935.

Hoffmann contends that there is no practical difference in fuel consumption and power between 80:20 gasoline-ethanol mixtures and ternary mixtures containing, e.g., 50:30:20 gasoline-benzene-ethanol, to warrant the use of the latter, particularly since, at least in Germany, they would be more expensive. Formánek, however, insists they are better and contends that Hoffmann did not use the correct jet sizes. Benzene is also cheaper in Czechoslovakia than in Germany.

GAY, WILLIAM (399)
ALCOHOL BLENDS FOR MOTOR FUEL. Wis. Engin. 40: 3–4, 18–19. 1935.

Experience and extended tests have shown that blends containing from 2 to 10 percent of anhydrous ethanol are stable. Care must be taken to remove gum and dirt from fuel lines since ethanol is a solvent for such deposits. Engine performance of blends up to 10 percent is practically identical with that of gasoline. The use of blends would benefit not only the farmer but also the nation in general, including the oil industry, because of increased buying power of the farmer.

KOBAYASI, R., MINAO, F., and KAJIMOTO, S. (400)
INVESTIGATIONS ON KNOCK RATINGS. I. SOME CONSIDERATIONS ON ETHYL (T.E.L.) EFFECT. Soc. Chem. Indus. [Japan] Jour. 38: 654–657, Sup. Binding. 1935 (In English).

The antiknock efficiency of ethyl fluid, ethanol, and benzene, expressed as change in octane number/volume percent, was determined for a straight-run and a cracked gasoline. It was less for the cracked gasoline for all three agents at all concentrations tested. The maximum efficiencies found were: For straight run, ethyl fluid 355, alcohol 0.780, benzene 0.3; for cracked gasoline, ethyl fluid 160, alcohol 0.425, benzene 0.2. Ethyl fluid has greatest efficiency at lowest concentrations; that of alcohol passes through a maximum at 20 percent; benzene is most effective at highest concentration. Authors conclude the differences between gasolines are due to the different hydrocarbons they contain.

PENZIG, F. (401)
ON THE BEHAVIOUR OF SPARK PLUGS USING METHANOL AS A FUEL. I. G. Farbenindustrie A. G. Ludwigshafen—Oppau Rpt. 294. Sep. 2, 1935; A.D.I. (k) Microfilm, Reel 106, 48C–C67, Part I; Sum. of C.I.O.S. Docs., Ref. No. I. 43.

The influence of spark-plug type, and of amyl and butyl nitrate, T.E.L., various carbonyls, benzene, and isobutyl alcohol on preignition of methanol were investigated. The time of running before preignition sets in was the criterion used in the experiment. Ethanol showed less tendency towards preignition than methanol.

——— (402)
STARTING OF ENGINES RUNNING ON METHANOL. I. G. Farbenindustrie A. G. Ludwigshafen-Oppau Rpt. 288. Apr. 25, 1935; A.D.I. Microfilm, Reel 106, 48C–C67 Part I; Sum. of C.I.O.S. Docs., Ref. No. I.38.

In order to improve starting with methanol or to enable low-temperature starting at all, the following methods were investigated: Use of gasoline, preferably in an auxiliary carburetor; addition of highly volatile components; and electric heating (load was too great for standard battery). Catalytic decomposition of methanol gave good results; evaporation by partial combustion was also effective.

SAIJO, S. (403)
TESTS OF ALCOHOL FUELS. Fuel Soc. [Japan] Jour. 14: 133–134. (in English). 1935.

Use of 94-percent ethanol mixed with 10 percent of ether showed a fuel consumption 50 percent greater than that of gasoline, owing to lower calorific value. For blending with gasoline the ethanol must be 99.8 percent pure. No great difference in behaviour was noted among blends and pure gasoline.

SUWA, TETSURO (404)
ALCOHOL MOTOR FUEL. Fuel Soc. [Japan] Jour. 14: 1361–1379. (In English 129–132). 1935.

Ten-, twenty-, and thirty-percent-by-volume blends of absolute ethanol and commercial gasoline were studied in a C. F. R. engine. A 20-percent blend can be used without carburetor adjustment.

TEODORO, A. L. (405)
ALCOHOL AND ALCOHOL-GASOLINE BLENDS AS FUELS FOR AUTOMOTIVE ENGINESS I. PEFORMANCE TESTS OF NEARLY STRAIGHT ALCOHOL OF DIFFERENT GRADES USING A SIX-CYLINDER AUTOMOBILE ENGINE. Philippine Agr. 24: 180–218. 1935.

A 10-hour performance test with a Chevrolet engine at 2,000 r.p.m. = 33.4 m.p.h.) using A-alkohl fuel (99 percent of 95-percent ethanol, 0.5 percent gasoline, 0.5 aniline), dehydrated ethanol (99 percent of 99.6-percent ethanol, 0.5 percent gasoline, 0.5 percent aniline), and gasoline gave the following figures: Torque 101.2, 100.8, 102.2; b.hp. 38.65, 38.40, 39.95; gallons/hour 6.027, 5.751, 5.244; oil consumption gallons/100 miles 0.137, 0.113, 0.131, dilution percent none, none, 3.54; total carbon deposit in grams 7.33, 6.18, 9.63, respectively. The thickening of crankcase oil and ring wear observed were greatest with the dehydrated ethanol.

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ALCOHOL AND ALCOHOL-GASOLINE BLENDS AS FUELS FOR AUTOMOTIVE ENGINES: II. PERFORMANCE TESTS OF NEARLY STRAIGHT ALCOHOL OF DIFFERENT GRADES USING A FOUR-CYLINDER AND AN EIGHT-CYLINDER AUTOMOBILE ENGINE. Philippine Agr. 24: 296–325. 1935.

A series of performance tests was made with a four-cylinder Waukesha and an eight-cylinder Ford engine using A-alkohl fuel (99 percent of 95-percent ethanol, 0.5 percent gasoline, 0.5 percent aniline), B-dehydrated ethanol (99 percent of 99.6-percent ethanol, 0.5 percent gasoline, 0.5 percent aniline), and gasoline. It was shown that higher power was developed without preheating than with preheating; peak of torque curves for all fuels appeared between 1,200 and 1,400 r.p.m.; beyond 1,300 r.p.m. operation of the engine at higher loads was steadier with A-alkohl fuel, especially with a slightly rich mixture; maximum fuel economy was at about 1,500 r.p.m.; by enlarging fuel jets the fuel consumption could be increased greatly but with very little increase in power; the approximate ratio of fuel economy with gasoline as unity at 2,000 and 1,500 r.p.m. varied from 1.276 to 1.737. In another series of tests with a high compression head, only A-alkohl fuel was used since the particular gasoline could not be used. Conclusions were similar to those above. Without preheating, at light loads and at low speeds the engine missed occasionally, this being caused probably by poor distribution. At full load at 1,500 and 2,000 r.p.m. without preheating, approximately 20-percent greater power was obtained with the A-alkohl fuel than with gasoline at the lower ratio. When an upper cylinder lubricant was used with alcohol fuels, total ring wear was less than with gasoline. The amount of carbon deposit varied considerably with the crankcase oil used, but was approximately 14 to 17 percent greater with gasoline than with alcohol fuels. In another test it was shown that fuel consumption could be decreased considerably with alcohol fuels if a lowering of about 2 percent in maximum power were permissible.

——— (407)

ALCOHOL AND ALCOHOL-GASOLINE BLENDS AS FUELS FOR AUTOMOTIVE ENGINES: III. PERFORMANCE TESTS OF ALCOHOL, GASOLINE AND ALCOHOL-GASOLINE MIXTURES AS FUELS FOR AN EIGHT-CYLINDER AUTOMOBILE ENGINE. Philippine Agr. 24: 352–387. 1935.

The author's conclusions are: (1) The engine of the Ford V-8 showed a very satisfactory performance when ethanol, gasoline, and ethanol-gasoline combinations were used as fuels. (2) The engine adjustment best suited for gasoline was found ideal for operation on mixtures containing as high as 15 percent ethanol. To obtain a very satisfactory performance, part choking of the carburetor was needed for mixtures containing 20 percent alcohol. (3) To produce the same power as gasoline without changing the size of the venturi tube or of the air passage area, jets larger than the one adapted for gasoline were used for mixtures containing at least 15 percent ethanol. (4) At speeds below 500 r.p.m., very economical adjustments with mixtures containing at least 20 percent ethanol were often characterized by jerky and uneven operations. (5) Engine detonation was much in evidence with gasoline at full throttle. Pinking was minimized as the percentage of ethanol in the mixture was increased.. No sign of detonation was noted at any load and speed when the mixture used contained at least 20 percent ethanol. (6) In general, constancy in operation at higher loads could be maintained for a longer time with the mixtures than with gasoline. (7) If desired, greater maximum power could be developed with mixtures than with straight gasoline. This is especially true for mixtures containing a large amount of ethanol. (8) As the percentage of ethanol in the mixture was increased, the engine pickup was slightly slowed down. Engine starting with almost straight ethanol was not always easy when the engine was cold. (9) At full load and at some points at three-quarter load, the mixtures containing as high as 20 percent ethanol were more economical than gasoline. The greater the percentage of ethanol in the mixtures the higher the fuel consumption per b.hp.hr. The increases varied from an average of 4 to 6 percent for every 10 percent of ethanol added. The mixture containing the least amount of gasoline had the highest efficiency. At full load, gasoline had the lowest efficiency on all speeds. (10) A mixture containing 10 percent ethanol gave greater mileage than gasoline under the conditions in which both were tested.

UBBELOHDE, A. R., DRINKWATER, J. W., and EGERTON, A. (408)
PRO-KNOCKS AND HYDROCARBON COMBUSTION. Roy. Soc. London, Proc. Ser. A. 154: 103–115. 1935.

Experiments with ethanol and butanol (600 r.p.m., firing at every other suction stroke) in a single-cylinder engine showed aldehyde formation similar to that experienced with hydrocarbons but without characteristic peak and a little later in the cycle. Addition of 14 percent of amyl nitrite produced violent knock in gasoline but not in ethanol. Increase to 40 percent gave heavy knock with ethanol.

WENGLER (409)
DESCRIPTION OF A HANOMAG ENGINE RUNNING WITH METHANOL INJECTION. I. G. Farbenindustrie A. G. Ludwigshafen-Oppau Rpt. (unnumbered) Apr. 5, 1935; A. D. I. (k) Microfilm, Reel 106, 48C–C67, Part I; Sum. of C.I.O.S. Docs., Ref. No. I. 36.

Direct injection of methanol gave better results than that of gasoline. Experimental conditions were unfavorable and still better results might be expected with a more suitable engine.

——— (410)
EFFECT OF COMPRESSION RATIO WHEN RUNNING METHANOL IN A SINGLE CYLINDER CARBURETOR ENGINE. I. G. Farbenindustrie A. G. Ludwigshafen-Oppau Rpt. 290. June 3, 1935; A. D. I. (k) Microfilm, Reel 106, 48C–C67, Part I; Sum. of C.I.O.S. Docs., Ref. No. I. 40.

Using a converted Diesel engine at C.R. 13:1, thermal efficiencies of 38 percent were obtained. Compared with a normal gasoline engine, output was 40 percent higher. Above C.R. 13:1 no further increase of efficiency was obtained.

——— (411)
THE SPARK PLUG VOLTAGES NECESSARY WHEN USING METHANOL AND GASOLINE. I. G. Farbenindustrie A. G. Ludwigshafen-Oppau Rpt. 295. Dec. 13, 1935; A. D. I. (k) Microfilm, Reel 106, 48C–C67, Part I; Sum. of C. I. O. S. Docs., Ref. No. I. 44.

Increasing the pressure or lowering the temperature requires increased voltage to produce the spark. A number of plots are shown.

1936

ALDINGER (412)
THE CONVERSION OF A DAIMLER-BENZ DIESEL ENGINE TYPE OM. 59 TO RUN ON METHANOL WHEN FITTED WITH A CARBURETOR. I. G. Farbenindustrie A. G. Ludwigshafen-Oppau Rpt. 317. Nov. 16, 1936; A.D.I. (k) Microfilm, Reel 106, 48C–C67, Part I; Sum. of C.I.O.S. Docs., Ref. No. I. 62.

Performance data for various inlet manifolds, venturis, and jet sizes are given. Thermal efficiency of methanol is better than that of benzene.

BRIDGEMAN, O. C. (413)
UTILIZATION OF ETHANOL-GASOLINE BLENDS AS MOTOR FUELS. Indus. and Engin. Chem., Indus. Ed. 28: 1102–1112. 1936.

When gasoline and a 10 percent ethanol-gasoline blend is used in the same engine, particularly with the carburetor and spark set for the mean of the optimum values for the two types of fuels, little difference in power, acceleration, or fuel consumption is observed. This may even be true for a 20-percent blend under many operating conditions. A 10-percent blend is likely to give more vapor-lock trouble than the gasoline with which the alcohol is blended when used in the same car. This can be obviated through use of gasoline for blending which has a Reid vapor pressure lower by approximately 1 p.s.i. than that considered permissible for the gasoline. Little difference would be expected from a 20-percent blend. Engine starting will be easier above 0° F. with 10-percent blends than with the same unblended gasoline. However, the reverse is true at temperatures below —10°. For preventing phase separation in ethanol-gasoline blends it is shown that higher alcohols are much more effective than benzene or toluene.

BROWN, L. T., and CHRISTENSEN, L. M. (414)
GASOLINE AND ALCOHOL-GASOLINE BLENDS. Indus. and Engin. Chem., Indus. Ed. 28: 650–652. 1936.

Experiments conducted with a six-cylinder truck engine (C.R. 4.85:1) at fuel-air ratios between 11:1 and 16:1 with a 10 percent alcohol-gasoline blend showed that except at higher speeds and with the highest air-fuel ratios, the blend gave a greater power output than did the gasoline. The data indicate that the carburetor setting with the gasoline and the 10-percent blend should be the same for practical operation. Operations at low speed and at part throttle were particularly favorable for the blend. Under these conditions the 10-percent blend gave slightly greater power output, appreciably lower specific fuel consumption, and 30 to 50 percent lower carbon monoxide formation than was obtained with the gasoline alone.

CATAMBAY, A. B., and NERA, E. C. (415)
COMPARATIVE PERFORMANCE OF ALCOHOL AND KEROSENE AS FUELS WITH OR WITHOUT PREHEATING FOR A FORDSON TRACTOR. Philippine Agr. 25: 357–372. 1936.

A four-cycle Fordson tractor engine of 267 cu. in. displacement was used in the experimental work. Results on fuel consumption show that without preheating: kerosene, 7.94 liters/hour or 55.3 liters/hectare; alcohol 8.84 liters/hour or 64.3 liters/hectace. With preheating: kerosene 7.32 liters/hour or 52.3 liters/hectare; alcohol 8.14 liters/hour or 69.6 liters/hour. Preheating kerosene decreased the time of plowing somewhat, while no significant difference was noted in case of alcohol. To operate the tractor with alcohol at the same fuel cost as with kerosene, the price of alcohol should be approximately 0.76 times the prices of kerosene. The present price is 0.55 times that of kerosene. Alcohol gave better performance at heavier load, especially when preheated. There was no difficulty in starting the engine with alcohol, especially on hot days. With kerosene as a fuel, gasoline is required to start the engine.

KAJIMA, SEIZABURO (416)
FUEL VALUE OF SYNTHETIC METHANOL. Fuel Soc. [Japan] Jour. 15: 543–558. 1936 [in English 57–59].

Methanol and blends of methanol with benzene and gasoline were tested in an airplane and a truck engine. The s.f.c. of a 50:50 crude methanol (93 percent)-benzene blend was only slightly higher than that of gasoline. Easy starting was achieved through choking.

KOO, E. C. (417)
USE OF ALCOHOL AS A GASOLINE SUBSTITUTE. Indus. Res. [China] 5: 161–168. 1936.

On the basis of its heat of combustion the price of 95-percent ethanol should be 62 percent less than that of gasoline. Starting and accelerating with 95-percent ethanol is poorer, especially in winter. If 95-percent ethanol is used, carburetor jets should be enlarged. For low ethanol-gasoline blends no changes need be made; however, blending agents are necessary to prevent separation, particularly at lower temperatures because of the high water content. Butanol and pentanol were found most effective. Results of bench tests giving b.hp. and fuel consumption for various alcohol blends containing various percentages of water and/or butanol and pentanol are shown in a table. Ten and twenty percent anhydrous ethanol blends showed very little difference in performance. A blend composed of 70 percent of gasoline, 30 percent of 95.15-percent ethanol, and 6.5 percent of pentanol gives the same b.hp. but 10 percent higher fuel consumption. When a similar blend was used in road tests, only 4.3 percent more of the blend than of gasoline was consumed and no difficulties in acceleration and hill climbing was noticed. For a 25-percent blend, 6 million gallons of ethanol would be required; the present annual production in China is 3 million gallons.

LICHTY, L. C., and ZIURYS, E. J. (418)

ENGINE PERFORMANCE WITH GASOLINE AND ALCOHOL. Indus. and Engin. Chem., Indus. Ed. 28: 1094–1101. 1936.

Only a slight increase in indicated power is possible by substituting 190-proof ethanol for gasoline as a fuel in an internal combustion engine. This checks the theoretical analysis. Approximately 60 to 65 percent more ethanol by weight is required to produce the same power as gasoline in a given engine. This represents about 50 percent more fuel on a gallon basis, for the same power output. It follows that considerably larger fuel orifices are required in carburetors for ethanol. Higher C.R. can be used with 190-proof ethanol than with the standard grade of gasoline, even when treated with 3 c.c. of tetraethyl lead per gallon. C.R. as high as 7:1 could be used with the C.F.R. engine, using the treated standard gasoline; no detonation was observed using 190-proof ethanol with a C.R. of 8:1. The use of higher C.R. with 190-proof ethanol does not lower the specific fuel consumption sufficiently to offset the effect of the lower heating values of the ethanol. The specific fuel consumption with maximum power air-fuel ratios is 43 percent higher for ethanol used with a C.R. of 8:1 than with untreated standard gasoline used with a C.R. of 5:1. Thus, the advantage of higher C.R. with ethanol is more than offset, both theoretically and practically, by the lower heating value of alcohol compared with gasoline.

LIU, MING (419)

ALCOHOL AS MOTOR FUEL. Jour. Chem. Engin. [China] 3: 379–385. 1936.

Fuel consumption, power output, and performance of ethanol and various blends were obtained in road tests.

MANZELLA, GUISEPPE (420)

POSSIBILITY OF USING METHYL ALCOHOL IN INJECTION ENGINES. Energia Termica 4: 62–69. 1936.

The performance of methanol (94.5 percent) was compared with gasoline in a single-cylinder, two-stroke 16 hp. engine at 520 r.p.m. Preliminary heating of the intake air by means of the exhaust was found necessary. Data are given on the influence of intake temperature and ignition advance on performance. Thermal efficiency of methanol compared favorably with that of gasoline.

PENZIG, F. (421)

THE CONVERSION OF A DIESEL MOTOR VEHICLE ENGINE, TYPE DAIMLER-BENZ, OM. 67, TO RUN ON METHANOL. I. G. Farbenindustrie A. G. Ludwigshafen-Oppau Rpt. 302. Mar. 9, 1936; A.D.I. (k) Microfilm, Reel 106, 48C–C67, Part I; Sum. C.I.O.S. Docs., Ref. No. I. 50A.

In this particular instance it was possible to insert a spark plug in the injector hole; however, in new cylinder heads, an extra hole should be provided so that fuel injection may be used in connection with spark ignition. Above C.R. of 10.4:1 (at 13:1 approximately) standard ignition practice is insufficient since either no spark is produced or if produced, breakdown of insulation results. Using a two-carburetor system, an output of 150 hp. was obtained at a specific energy consumption of 1800 Cal./hp.-hr. Mean effective pressures were considerably higher than those of the Diesel engine (95-hp.) but no difficulties were encountered. Spark advance for best performance was practically the same as that required for benzene. Carburetor jets must be enlarged, and it was found that existing carburetors could not handle the necessary quantities of fuel.

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FURTHER EXPERIMENTS WITH A MOTOR VEHICLE DIESEL ENGINE TYPE DAIMLER-BENZ OM. 67 CONVERTED TO RUN ON METHANOL. I. G. Farbeindustrie A. G. Ludwigshafen-Oppau Rpt. 302a. June 23, 1936; A. D. I. (k) Microfilm, Reel 106, 48C–C67, Part I; Sum. of C.I.O.S. Docs., Ref. No. I. 50.

Work of Report No. 302 was extended. Data are given for insertion of spark plugs without alteration. Attempts were made to improve engine performance in the low speed range and to provide starting facilities.

SCHNEIDER, J. Z. (423)

A CRITICAL STUDY OF ALCOHOL-GASOLINE MOTOR FUEL (DISSCUSSED BY L. A. HELWICH). Indus. and Engin. Chem., News Ed. 14: 413–414. 1936.

Twenty, 25, 35, and 50 percent ethanol-gasoline blends were tested in two different Praga engines. Results obtained with the 1930 model (C.R. 5.3), and with carburetor set for gasoline, indicated a decrease in power output and increase in s.f.c. with increase of ethanol content. The power output of the 1931 model (C.R. 5.9) with similar carburetor adjustment did not change with blends up to 25 percent ethanol at low speeds; however, power output decreased significantly at higher speeds. If the carburetor is set for maximum power output for each fuel, results for the ethanol blends are improved.

SCHWEIZER (424)

DODECANE AS A DIRECT-INJECTION MOTOR FUEL. I. G. Farbenindustrie A. G. Ludwigshafen-Oppau Rpt. 316. Sept. 27, 1936; A.D.I. (k) Microfilm, Reel, 48C–C67, Part I; Sum. of C.I.O.S. Docs., Ref. No. I. 61.

Data for methanol are included.

SEEBER, F. (425)

EMPLOYMENT OF ALCOHOL CONTAINING FUELS IN AIRCRAFT ENGINES. First and Second intermediate Rpts. ZWB166, 104 pp. 1936. Published as Rpt. PB40036, U.S. Dept. Com. Off. of the Pub. Bd.

The first report deals with antiknock properties of alcohol blended with 11 fuels of German and foreign origin. A C.F.R. engine was used. In the second report the work was extended to three and four component blends with ethanol in combination with other antiknock agents. Storage stability of blends was also investigated.

Abstract *in* Bibliog. Sci. and Indus. Rpts. 4(4):291 1947.

SWAN, ANDREW (426)

FREEZING IN CARBURETORS. Aircraft Engin. 8(83): 3–6. 1936.

Methanol, ethanol, and propanol have been used successfully to prevent or dislodge carburetor ice. Preliminary experiments with a glass induction pipe showed that the effect of alcohol addition on the removal of ice was both rapid and efficacious. Many bench and flight tests were made and it was found that the de-icing fluid should be introduced into the fuel from a separate tank by means of an automatic device. Suitable fluids are 80:20 methanol-isopropanol; 75:25 methanol-hexanol, or denatured ethanol. A list of suitable metals to prevent corrosion in the fuel system is given.

TEODORO, A. L., CATAMBAY, A. B., ONGSANSOY, E. K., and MAMISAO, J. P. (427)

ALCOHOL AND ALCOHOL-GASOLINE BLENDS AS FUELS FOR AUTOMOTIVE ENGINES. IV. PERFORMANCE CHARACTERISTICS OF ALCOHOL, ALCOHOL-GASOLINE MIXTURES, AND GASOLINE AS MOTOR FUELS UNDER DIFFERENT ROAD CONDITIONS. Philippine Agr. 24: 763–775. 1936.[6]

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[6] Sequence of annotations 427 and 428 is according to journal reference.

Road tests were performed with a Ford truck using gasoline and Alkohl motor fuel No. 8 (100 parts by volume of 95-percent ethanol and 3 parts by volume of gasoline). The mileage obtained varied from 6.08 to 7.75 miles per gallon for gasoline and from 7.84 to 10.48 for Alkohl. Crankcase-oil consumption averaged 19.8 cc. per 100 ton-km. for Alkohl and 17.9 for gasoline. In another test with a Ford 1934 sedan running on gasoline and four ethanol-gasoline blends ranging from 5 to 20 percent ethanol, results indicated greater economy with blends when a power jet was used. With an economy jet, the performance was with one exception, either the same or better. Performance with ethanol blends was generally better than with gasoline.

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ALCOHOL AND ALCOHOL-GASOLINE BLENDS AS FUELS FOR AUTOMOTIVE ENGINES. V. PERFORMANCE OF AN EIGHT-CYLINDER ENGINE USING GASOLINE, DEHYDRATED ALCOHOL, AND DEHYDRATED ALCOHOL-GASOLINE MIXTURES. Philippine Agr. 24: 839–853. 1936.

Gasoline and 10 different alcohol blends were used. The author's conclusions are: Dehydrated alcohol of strength 98.5 percent by volume, denatured with about 5 percent sulfuric ether, proved to be an efficient and an excellent fuel for an eight-cylinder automobile engine having a C.R. of 6.33:1. Mixtures of this alcohol and of gasoline in different proportions by volume were found miscible under the conditions in which they were tested. No sign of separation of the fuels was noted when the temperature of the liquid was lowered to 15° C. Mixing dehydrated alcohol with gasoline minimized if it did not entirely suppress the tendency of gasoline to detonate. Engine operation at full throttle on gasoline showed evidence of detonation at all speeds. With the mixture containing 10 percent dehydrated alcohol, detonation at this load was heard at the lowest running speed only. No difficulty in starting from cold was experienced with any of the fuels used. When the engine was not yet warmed up, in order to maintain a steady running operation with the use of mixtures containing more than 40 percent dehydrated alcohol, it was found necessary to partly close the choke for a few seconds. Relatively greater power could be developed with the use of dehydrated alcohol and with mixtures containing at least 60 percent dehydrated alcohol than with the use of gasoline. At speeds below 400 r.p.m., operation on mixtures containing at least 30 percent dehydrated alcohol was characterized by jerky movements and by decreasing load after 3 minutes of running. Fuel mixture containing 10 percent dehydrated alcohol gave just as much fuel economy as, if not more than, gasoline at all loads, except at one-half, where an increase in consumption was noted as the percentage of dehydrated alcohol in the mixture was increased. Using the mixture containing 10 percent dehydrated alcohol as a basis, the percentage increase in fuel consumption per every 10-percent increase of dehydrated alcohol in the mixture was about 4 to 5 percent at full load, 5 to 6 percent at ¾ load, about 6 percent at ½ load, and from 5 to 7 percent at ¼ load.

——— and ONGSANSOY, E. K. (429)

ALCOHOL AND ALCOHOL-GASOLINE BLENDS AS FUELS FOR AUTOMOBILE ENGINES. VI. STUDIES ON THE USE OF ALCOHOL-GASOLINE MIXTURES AS FUELS FOR A HIGH COMPRESSION EIGHT-CYLINDER AUTOMOBILE ENGINE. Philippine Agr. 25: 479–492. 1936.

Gasoline and six ethanol blends containing from 10 to 95 percent of ethanol were tested in the laboratory and on the road in a 1935 Ford V-8 engine at C.R. of 6.3:1 and 7.5:1. Several blends showed lower fuel consumption than the gasoline used and higher or equal mileage.

1937

BANKS, F. R. (430)

SOME PROBLEMS OF MODERN HIGH-DUTY AERO-ENGINES AND THEIR FUELS. Inst. Petrol. Technol. Jour. 23: 63–177. 1937.

The use of methanol and ethanol as aviation fuels is discussed briefly.

The principal objections are the low heat of combustion, instability of blends, corrosion troubles, and possible danger of preignition. Favorable and unfavorable experiences with use of alcohol blends in aviation engines are cited and the engine itself appears to be the main variable. Air-cooled engines are more severe on alcohols and aromatic fuels than liquid-cooled.

CAPETTI, ANTONIO (431)

SPECIAL RESEARCH REGARDING THE USE OF ETHANOL IN HIGH-SPEED ENGINES USING DIRECT INJECTION OR CARBURETION. III° Cong. Internaz. del Carbonio Carburante, 2nd Session, Liquid Fuels, pp. 173–190. Rome. 1937.

No greater wear was observed with use of ethanol than with gasoline. Engines will not start with pure ethanol below 24° C. unless gasoline is added or the engine is heated. If 10 percent of ether is added the engine will start as satisfactorily as or better than with gasoline.

DUMANOIS, PAUL (432)

POWER ALCOHOL IN FRANCE. Cong. Internatl. Tech. et Chim. des Indus. Agr. Holland. Compt. Rend. V^e Cong. 2: 632–639. 1937.

Alcohol consumption of ethanol in blends has almost doubled during the past 2 years and amounts to 4.2 million hectoliters. Three blends are in use: "Essence tourism" (octane number 62 ±1), containing 11 to 15 percent anhydrous ethanol; "surcarburant," with more than 15 percent ethanol and an octane number greater than 75; and "carburant poids lourd" (octane number 62 ±1), with 20 to 26 percent of ethanol. Ethanol used for the first blend must be at least 99.5° G.L. at 15° C. and must remain clear and homogeneous at approximately 0° after the addition of 0.2 percent of water. The maximum 10, 50, and 95 percent (including loss) French "A.S.T.M. distillation" temperatures are 65°, 120°, and 185°, respectively. The surcarburant must fulfill the same conditions except for its greater ethanol content. The 10, 50, and 95 percent by volume (including loss) "A.S.T.M. distillation" temperatures for carburant poids lourd are 70°, 120°, and 215°, respectively. A 10-percent blend will show an increase in fuel consumption in the laboratory by or under carefully controlled conditions of approximately 2.8 percent. However, in practice no increase may be noticed because of absence of detonation. Since 1934 the following denaturant per hectoliter of ethanol has been added: 1.0 liter of benzene "90," 0.3 liter of gasoline (type regis), 6 grams of crude anthracine, and 0.2 grams of ethyl borate. The author discusses the price differentials among various blends as well as between the blends and gasoline and hopes that finally an economic solution becomes feasible in which ethanol may be utilized to its best advantage. Both the instability of blends as well as vapor lock are problems which have been solved.

FRANCHI, E. F. (433)

INSPECTION OF THE COMBUSTION IN INTERNAL COMBUSTION ENGINES BY MEANS OF THE ANALYSIS OF THE EXHAUST GASES. Bol. de Inform. Petrol. [Buenos Aires] 14(158): 41–63. 1937.

Data are given on the analysis of the exhaust gas, using A.S.T.M-C.F.R. engine. Fuels used were: pure alcohol, a blend of aviation gasoline and alcohol, benzene, a blend of aviation gasoline and benzene, pure aviation gasoline, and Supergas No. 1 (propane). The results show that a blend of aviation gasoline and alcohol burns with a higher thermal efficiency than straight gasoline.

HALDER (434)

THEORETICAL PERFORMANCE OF THE OTTO ENGINE. CALCULATIONS FOR METHANOL AND BENZENE AS FUELS. I. G. Farbenindustrie A. G. Ludwigshafen-Oppau Rpt. 341. Nov. 30, 1937; A.D.I. (k) Microfilm, Reel 106, 48C–C67, Part I; Sum. of C.I.O.S. Docs., Ref. No. I. 81.

Three methods are described, including the graphical one by Pflaum which takes into account both variation of specific heats and dissociation equilibria.

HERON, S. D., and GILLIG, F. (435)
SUPERCHARGED KNOCK TESTING. Ethyl Corp. Res. Lab. Rpt. No. A. R. 14, 16 pp. Detroit, Mich. 1937; Second World Petrol. Cong. Paris. June 14–19, 1937.

The relative ratings of the preigniting fuels tested (benzene, toluene, methanol, 70 percent methanol-30 percent benzene, diisobutylene) proved to be exceedingly sensitive to mechanical changes in the cylinder and its associated parts. The methanol blend showed a negative lead response under all test conditions (900 and 1800 r.p.m., 212° and 350° F. jacket temperature), while the data for methanol alone indicate a negative response only at 1,800 r.p.m. and 212° jacket temperature. Silent preignition occurred with methanol at 212° jacket temperature and 900 r.p.m. Preignition was preceded by steady operation with thudding, but with a clean cut on the ignition switch the thudding suddenly disappeared and was accompanied by an instant drop in power, a very large increase in temperature of the thermal plug, and continuous firing after cutting the ignition switch. The permissible i.m.e.p. of aromatics, diisobutylene, and methanol tends to decrease with increase of engine speed in contrast to that experienced with the reference fuels used. Increase in jacket temperature decreases the permissible boost for all fuels; however, more so for methanol, aromatics, and diisobutylene. Under the test conditions, latent heat had no effect on volumetric efficiency (i.m.e.p.).

HUBENDICK, E. (436)
TRIALS OF A PRODUCT CALLED "LÄTTBENTYL" USED FOR TEN YEARS AS A MOTOR FUEL IN SWEDEN. Cong. Internatl. Tech. et Chim. des Indus. Agr. Holland. Compt. Rend. V[e] Cong. 2: 640–670. 1937.

Lättbentyl is gasoline blended with 25 ±3 percent ethanol denatured with crotonic aldehyde. Ethanol must contain less than 1 percent of water. This blend has given full satisfaction in Sweden for the past 10 years. The choice of the above percentage depended on several factors, principally its excellent stability at low temperature. The blend has neither increased wear nor caused corrosion. The use of the blend in Ford Model A and V-8 engines resulted in higher output and lower fuel consumption when proper jets were installed than obtainable with gasoline. When changing over to alcohol blends it is necessary to eliminate gum deposits from fuel lines by rinsing with alcohol.

LICHTY, L. C., and PHELPS, C. W. (437)
CARBON MONOXIDE IN ENGINE EXHAUST USING ALCOHOL BLENDS. Indus. and Engin. Chem., Indus. Ed. 29: 495–502. 1937.

The relations between the exhaust products and air-fuel ratios for both the gasoline and the alcohol blends are practically identical, except that the values for the alcohol blends occur at lower air-fuel ratios, as would be expected from the different air requirements for combustion of alcohol and gasoline. The carbon monoxide present in exhaust gases will be practically the same for both gasoline and alcohol blends if comparable air-fuel ratios are used.

MEDICI, MARIO (438)
FINAL RESULTS ON THE BEHAVIOR OF CARBURETOR ENGINES WITH FUEL MIXTURES (ETHANOL-ACETYLENE). III° Cong. Internaz. del Carbonio Carburante, 2nd Session, Liquid Fuels, pp. 191–231. Rome. 1937.

Diagrammatic sketches of the experimental set-up, including the acetylene generator and feeding valve, are given. Results were obtained at various speeds, loads, and blending ratios with some ethanol-acetylene blends; higher thermal efficiencies were found than with either ethanol or gasoline. Carbon deposits were noted in one type of engine (Fiat-52B) which, however, were not noticeable in another. A Fiat-Balilla engine (C.R. 6.3:1) was used for most of the tests. At full load, preignition frequently was experienced. Mixtures had high flame speeds.

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MOTOR FUEL. EXPERIMENTS MADE IN THE ENGINE LABORATORY OF UNIVERSITY OF PADUA. Energia Termica 5: 175–177. 1937; Szénkisérleti Közlemények 3: 116–121. 1937.

A blend of 50 percent methanol, 25 percent acetal, and 25 percent gasoline tested in a variable C.F.R. engine (C.R. 4.5:1 to 8.7:1) gave best results.

MENNUCCI, A., and FRANCHI, E. F. (440)
MIXTURES OF ALCOHOL-AVIATION GASOLINE AND BENZOL-AVIATION GASOLINE AS AVIATION FUELS. Bol. de Inform. Petrol. [Buenos Aires] 14 (159): 73–80. 1937.

The work was carried out at the laboratories of the Argentine government distillery of LaPlata. Using a Waukesha variable compression engine, it was found that the performance of aviation gasoline blends containing 30 percent anhydrous ethanol was equal to that of the aviation gasoline.

MOSCARINI, FLAVIANO (441)
THE CARBURETON OF ETHANOL. III° Cong. Internaz. del Carbonio Carburante, 2nd Session. Liquid Fuels, pp. 43–68. Rome. 1937.

Ethanol may be used as fuel for internal-combustion engines in two ways: (a) The engine is modified so as to use ethanol in the state it is produced; (b) the ethanol is transformed so as to resemble gasoline more closely. Author discusses both, and believes that the second is economically preferable, particularly if the Crima process of etherification is used.

OGSTON, A. R. (442)
ALCOHOL MOTOR FUELS. Inst. Petrol. Technol. Jour. 23: 506–523. 1937.

Author believes that blends containing from 10 to 20 percent ethanol and about an equal amount of benzene would be the most suitable for automotive use. Such blends would require no change in carburetor settings. Zinc and zinc alloys seem to be slightly affected by ethanol and some trouble may be experienced through its solvent action on lacquers and resins. Author found no abnormal cylinder wear. The increase in octane number of the blend will offset the lowering of the heat of combustion. Ketones and higher alcohols may play an important part in future aviation and motor fuels.

PREVER, V. S. (443)
POWER AND FUEL CONSUMPTION TESTS OF SUBSTITUTE MOTOR FUELS IN FIAT ENGINES. III° Cong. Internaz. del Carbonio Carburante, 2nd Session, Liquid Fuels, pp. 147–167. Rome. 1937.

Author gives data on power and fuel consumption obtained in tests over a period of several years on a large number of blends and with several Fiat engines in the laboratory and on the road. Among the fuels tested were ethanol containing from 1 to 40 percent water, ethanol-methanol-gasoline, benzene blends, and a large number of gasoline-ethanol blends. Results showed that, with up to 30 percent of ethanol in gasoline, fuel consumption rose only slightly and maximum power decreased slightly. Increasing the water content of ethanol from 1 to 40 percent decreased maximum power only 10 percent. Road tests showed that fuel consumption of anhydrous ethanol and of ethanol containing 10 percent of water were in the ratio of their alcohol content.

SOKOLIK, A., and VOINOV, A. (444)
ISOPROPYL ETHER AS A MOTOR FUEL. Tech. Phys. [U.S.S.R.] 4: 638–660. 1937. (In English).

Flame propagation was measured and found to be lower than that of isooctane. The octane rating of diisopropyl ether changes with speed and if kept in storage.

SZCZENIOWSKI, B. (445)
BUTYL ALCOHOL AS FUEL FOR INTERNAL COMBUSTION ENGINES. Prezegląd Mech. 3: 596–598. 1937.

Results of tests carried out in the engine laboratory at the University of Warsaw are given.

TATTI, EDMONDO (446)
A DIRECT INJECTION AT LOW COMPRESSION (HESSELMAN) AS A MULTI-FUEL ENGINE. III° Cong. Internaz. del Carbonio Carburante, 2nd Session, Liquid Fuels, pp. 3–19. Rome. 1937.

Favorable results were obtained with ethanol (anhydrous and containing water) in a Hesselman-type engine.

WALKER, W. J. (447)
FUELS FOR INTERNAL COMBUSTION ENGINES. So. African Jour. Sci. 33: 121–126. 1937.

Author reviews briefly the work of the Mechanical Engineering Laboratory of the University of the Witwatersrand on ethanol motor fuels. Single-cylinder tests at five speeds and at two or more C.R. in the neighborhood of the highest useful compression ratio were made. The following general conclusions are drawn from the tests: (1) Binary mixtures are, in general, inferior, both as regards hp. development and fuel consumption, to straight fuels, while ternary mixtures are superior to both. (2) Binary mixtures of petrol and benzol yield a lower hp. than either constituent alone. (3) The addition, up to 40 percent, of a third constituent to a binary mixture invariably improves the hp. yield. (4) Ternary mixtures with high absolute alcohol percentages yield high hp. (5) Consumption curves to a mixture base always tend to form minima which, however, are not sharply defined. (6) Mixtures with high absolute alcohol percentages, i.e., over 60 percent, result in high consumption; those with high benzol percentages result in low consumption. (7) The best ternary mixture from the point of view of both power and consumption is 40 percent absolute alcohol, 40 percent benzol, and 20 percent petrol. This applies to all the speeds tested. (8) The highest useful compression ratio for all ternary mixtures with less than 50 percent petrol, lies between 10.5 and 11.5 under Johannesburg altitude conditions. Author states that the addition of lead, either colloidal or chemically combined, had a greater effect on fuels containing ethanol than on straight fuels. Incomplete tests (Diesel engines) appear to indicate that absolute ethanol up to 25 percent when injected with crude oil will increase the m.e.p. by 20 to 25 percent over normal values. Author's 7 years of experience with anhydrous ethanol blends indicates no more corrosion or deposit trouble than with straight fuel.

WITSCHAKOWSKI (448)
INVESTIGATION ON THE USE AND KNOCK BEHAVIOUR OF DIFFERENT FUELS IN THE HESSELMAN ENGINE WITH SUCTION STROKE AND COMPRESSION STROKE INJECTION AS WELL AS WITH CARBURETOR OPERATION. I. G. Farbenindustrie A. G. Ludwigshafen-Oppau Rpt. 331. June 25, 1937; A.D.I. (k) Microfilm, Reel 106, 48C–C67, Part I; Sum. of C.I.O.S. Docs., Ref. No. I. 73.

The Hesselman engine will run on both low- and high-boiling fuels under approximately the same conditions. Compression ratio is limited by fuel quality, being directly proportional to octane number in case of light fuels and inversely to the cetane number in case of heavy fuels. Intake-stroke injection gave better performance for light fuels but at the cost of increased oil dilution, while heavier fuels such as gas or coal oil performed better with compression-stroke injection. Carburetion was better than compression-stroke injection because of better mixing through induced swirl, but with direct injection lower octane fuels could be used.

1938

HERON, S. D., and BEATTY, H. A. (449)

AIRCRAFT FUELS. Jour. Aeronaut. Sci. 5: 463–479. 1938.

In the United States in general, only three components are permitted in aviation gasoline: Straight-run gasoline, isoparaffins such as isopentane or isooctane, and T.E.L. If cracked gasolines, branched-chain olefins, aromatics, alcohols, ethers, and ketones with or without T.E.L. or aniline addition were permitted as components of aviation gasolines, the situation with respect to full-scale engine-knocking behavior would probably become chaotic. In aircraft engines audible effects produced by combustion are significant only if they are indications of actual or potential engine damage. Aromatics, alcohols, and some completely olefinic fuels when used in high-output engines with high cylinder-wall temperatures, do not produce audible knock but rather go directly into preignition. Preignition in high-output engines usually produces extremely destructive cylinder effects in a very short period. At engine speed of 900 r.p.m., benzene, toluene, methanol, and diisobutylene are all either equal or superior to isooctane plus 6 ml. of T.E.L. At 1,800 r.p.m. and 385° to 400° F. jacket temperatures, however, the antiknock values of these fuels vary between approximately 90 octane number and 100 plus 1.0 ml. T.E.L. Toluene was found to have the highest antiknock value of any single compound tested at 900 r.p.m. and 212° F. jacket temperature. Blending octane numbers for a fuel often bears no relation to the octane number of the same fuel when tested straight. Methanol, ethanol, propanol, isopropanol, and acetone are all completely water-soluble and have possibilities as de-icing fuels. Alcohols, because of their high heat of vaporization, have possibilities as take-off fuels since they reduce mixture temperatures the same as a supercharger intercooler without the continuous handicap of weight and drag due to the intercooler. Water addition reduces the tendency of alcohols towards preignition. Blends of isopropanol with water may be equal to methanol, both as to gross heating value and to latent heat. These blends have a slight positive lead response in contrast to methanol which is strongly negative. For take-off, alcohols have the advantage that mixture strength can be made abnormally rich for engine-cooling purposes without a serious reduction in output which would be experienced with hydrocarbons when operating about 50 percent rich. Experimental data on isopropanol-water addition to 100 octane number leaded fuels are presented. Alcohols and alcohol-water mixtures are said to be very corrosive toward some magnesium alloys. Tables of physical and antiknock properties of various fuels are given.

HUBNER, W. H., and EGLOFF, G. (450)

AIRCRAFT FUELS OF HIGH OCTANE RATING. Oil and Gas Jour. 36(46): 103–104, 106, 108, 112. 1938.

Octane numbers and lead response of alcohols and ketones as well as blends of gasoline with Anilol, aniline, and ethanol are given. A mixture of water and alcohol would have possibilities both as a de-icing fluid and as a take-off fuel.

KUHRING, M. S. (451)

WATER AND WATER-ALCOHOL INJECTION IN A SUPER-CHARGED JAGUAR AIRCRAFT ENGINE. Canad. Jour. Res., Sect., A, Phys. Sci. 16: 149–176. 1938.

Tests have been carried out to determine the effect of water injection on the operation of a full-scale aircraft engine. A Jaguar Mk IV supercharged aircraft engine was used and quantities of water as great as 83 pounds per 100 pounds of fuel were injected. As would be expected, the use of water permitted large gains in power without increase in cylinder temperature and apparent detonation. An increase of approximately 90 b.hp. was obtained. Quite appreciable cooling of the charge was noted. The specific fuel consumption remained the same or slightly lower with injection. Results on ethanol showed higher s.f.c. and were generally less favorable than water alone; however, the tests were admittedly incomplete.

LICHTY, L. C., and PHELPS, C. W. (452)
GASOLINE-ALCOHOL BLENDS IN INTERNAL COMBUSTION ENGINES. Indus. and Engin. Chem., Indus. Ed. 30: 222–230. 1938.

On the basis of fuel consumption, ethanol should cost less than gasoline to warrant its use in 10- and 20-percent blends in engines with optimum C.R. for present standard gasolines; it should cost about the same as standard gasoline if both the blend and the gasoline are used in engines with optimum C.R. suitable for each of the fuels; and the blends should cost less than gasoline with sufficient T.E.L. to permit operation in engines with optimum C.R. for the blends.

TEODORO, A. L., and MAMISAO, J. P. (453)
DISTILLATION CHARACTERISTICS OF SOME ALCOHOL MOTOR FUELS. Philippine Agr. 27: 385–395. 1938.

A.S.T.M. distillation data indicated that the temperatures of the 10-, 30-, and 60-percent evaporated portions were lower for ethanol ($d^{15}_{15} = .797$) and for nine blends ranging from 10 to 90 percent of ethanol than for the gasoline used in these blends. Low compression engines (C.R. 4.8:1 to 5.4:1) using nearly straight motor ethanol lost power and acceleration on climbing hills, particularly when run by an inexperienced operator. Most of the modern cars and trucks show much better performance on hills when run on ethanol or on alcohol-gasoline mixtures than on gasoline alone. Under Philippine conditions, satisfactory starting and smooth performance were observed in a hot motor run on ethanol or on blends. On rainy days a longer warming-up period and slightly more choking were necessary with blends containing a larger proportion of ethanol than with gasoline.

WHATMOUGH, W. A. (454)
RATING MOTOR SPIRITS. Auto. Engin. 28: 16–22. 1938; Fuel in Sci. and Pract. 17: 134–144. 1938.

Tests conducted in a 10-hp. Coventry Climax test engine using standard British motor fuels showed that (1) maximum power attainable with different fuels varied less than 1 percent; (2) fuel efficiencies ranged from —3 percent (commercial gasoline) to +6 percent (benzene mixture); (3) over-rich mixtures caused fuel wastes from 10 to 25 percent; (4) high antiknock value did not increase power output in a non-knocking engine. Unsaturated hydrocarbons reduced fuel efficiency because of lower hydrogen content. However, benzene increased efficiency when added in sufficient amount since its hydrogen deficiency is compensated by high specific gravity. Alcohol reduced fuel efficiency but this could be compensated in part by addition of an equal amount of benzene and by slight gain in output with rich mixtures.

1939

ANONYMOUS (455)
AN ITALIAN MULTI-FUEL ENGINE. Auto. Engin. 29: 358–360. 1939; Automotive Indus. 82: 26. 1940.

The article describes a new Fiat multifuel tractor engine (C.R. 7.2:1) using direct-cylinder injection with spark ignition. Since there is no throttle control (full admission of air at all loads), fuel consumption at part load resembles that of a Diesel engine, giving, therefore, excellent economy under most operating conditions. Curves for hp., m.e.p., and fuel consumption vs. r.p.m. are shown for both gas oil and ethanol. Part-load fuel consumption vs. r.p.m. is also given and best economy is obtained between one-half and full load.

BANKS, F. R. (456)
AVIATION FUELS AND ENGINES—SOME OBSERVATIONS ON THEIR PRESENT AND FUTURE DEVELOPMENT. Soc. Automotive Engin. Jour. 45: 389T–406T. 1939.

British engines operate very well on the so-called temperature and pressure-sensitive fuels such as benzene and alcohol blends. Data are given on the composition and physical properties of fancy or stunt fuels containing gasolines, benzene, methanol, ethanol, acetone, and T.E.L. Direct fuel injection is favored. Fuel consumption, b.hp., and b.m.e.p. plotted against engine r.p.m. are shown for a Rolls Royce R engine using three different stunt fuels. The beneficial effect of high heat of vaporization, for increasing power output by lowering temperatures and boost pressures is clearly demonstrated. The effect of T.E.L. on a 20:70:10 gasoline-benzene-methanol blend is compared with that on 100 octane-number gasoline. Same b.m.e.p. at slightly less boost pressure was obtained with lower lead content when using the blend.

BLACKWOOD, A. J., KASS, C. B., and LEWIS, O. G. (457)
MULTICYLINDER ENGINE DETONATION AND MIXTURE DISTRIBUTION. Soc. Automotive Engin. Jour. 44: 125–140. 1939.

Data show that the distribution spread of an alcohol racing fuel is approximately the same as that of regular-grade gasoline. Various premium-grade, aviation, and reference fuels showed a lower spread. Butane had perfect distribution.

FERRARI, DEMETRIO (458)
ALCOHOL FUELS. X° Cong. Internaz. di Chim. Atti 3: 706–715. 1939.

The use of etherized ethanol made by the Crima process assures the same engine performance as does gasoline, necessitates no change of the engine, and causes no trouble in cold starting. Chemical and physical, as well as performance data, are given.

[FRANCE]. COMMITTEE FOR THE STUDY OF ICE FORMATION (459)
REPORT ON ICE FORMATION ON AIRCRAFT. Bul. Serv. Tech. No. 85. Publication Scientifiques et Techniques du Ministère de l'Air. May 19, 1938. [U.S.] Natl. Advisory Com. Aeronaut. Tech. Memo. No. 919, 20 pp. 1939.

Carburetor icing may be prevented by injecting alcohol with the fuel but the best solution is the heating of the inlet air.

GOLDMAN, B., and CLARKE-JONES, N. (460)
THE MODERN PORTABLE GAS-PRODUCER, THEORY, DESIGN, FUELS, PERFORMANCE UTILIZATION AND ECONOMICS. Inst. Fuel London Jour. 12: 103–131. 1939.

On page 124 author quotes work of E. Wawrziniok (see No. 385) on the enrichment of producer gas by means of ethanol. At a compression ratio of 8.29:1, a gain in power of 22 percent was obtainable.

HELDT, P. M. (461)
RECENT EUROPEAN DEVELOPMENTS IN HIGH-SPEED DIESEL ENGINES. Soc. Automotive Engin. Jour. 44: 77. 1939.

The development of a Diesel aircraft engine by Clerget is briefly mentioned. Double injection (two pumps rigidly coupled) is used. In order to reduce ignition lag, one of the pumps injects a small amount of high-octane fuel while the other injects fuel containing an admixture of alcohol. The latter reduces the maximum pressure due to the cooling effected by the high heat of vaporization. Flight tests are being made with a small series of Clerget engines recently completed. In these, double injections of gas oil is employed. No supercharger is being used at present.

HERSEY, D. S. (462)
FUEL ECONOMY POSSIBILITIES OF OTTO CYCLE AIRCRAFT ENGINES. Soc. Automotive Engin. Jour. 44: 235–242. 1939.

Rich gasoline-air mixtures and retarded spark settings may be used to suppress detonation; however, little or no improvement in output is gained under present conditions of operation. The use of secondary fuels appears promising. The results obtained through enrichment of 87-octane gasoline with methanol and aniline-alcohol (No. 5 Anilol) indicated greatly increased i.m.e.p. without detonation. The author recommends the use of secondary fuels as detonation suppressors when high output is needed.

ILIEFF, B. (463)
VEGETABLE OILS AS DIESEL FUEL. Ann. de l'Univ. de Sofia 15. 1936/1937; Osterr. Chem. Ztg. 42: 353–356. 1939.

The author discusses principally the use of vegetable oils (sunflower, cottonseed, castor) in Diesel engines. It was not possible to obtain good atomization of castor oil unless ethyl alcohol (15 percent is satisfactory) or gas oil was added. A 30 percent ethyl alcohol-castor oil blend caused stoppage in the injector. The exhaust was dark and contained castor oil. Good results were obtained with a mixture consisting of 36 percent castor oil, 60 percent cottonseed oil, and 4 percent ethanol (95 percent).

MOORE, C. S., and FOSTER, H. H. (464)
COMPRESSION-IGNITION ENGINE PERFORMANCE WITH UNDOPED AND DOPED FUEL OILS AND ALCOHOL MIXTURES. [U. S.] Natl. Advisory Com. Aeronaut., Tech. Notes No. 707, 14 pp. Sup. pages include 17 figs. and 2 tables. 1939.

Alcohol as an auxiliary fuel, in general, decreased power output as the proportion of alcohol increased. Any increase in power obtained by double injection did not exceed 4 percent and was obtained at the expense of increased fuel consumption. Alcohol increased the ignition lag, the rate of pressure use, and roughness of operation.

NOEGGERATH, W. (465)
HYPERGOL AS FUEL FOR JET PROPULSION ENGINES. Deut. Luftfahrtschung Forschungsbericht F. B. 160, 27 pp. 1939. Published as Rpt. P.B. 19978, U. S. Dept. Com. Off. of the Pub. Bd.

Hypergol, a jet fuel developed in Germany, consists of a mixture of hydrogen peroxide, hydrazine hydrate, and methanol.
Abstract *in* Bibliog, Sc. and Indus. Rpts. 4(2): 99. 1947.

PHELPS, C. W., and LICHTY, L. C. (466)
CHASSIS-DYAMOMETER AND ROAD TESTS OF ALCOHOL-GASOLINE BLENDS. Amer. Petrol. Inst. Proc., 9th mid-year meeting, Sect. III, 20: 53–76. 1939.

In general, the blending value of ethanol decreases as the octane number of the base gasoline increases and as the lead susceptibility of the gasoline decreases. Ethanol and T.E.L. are substantially independent in their action in 10 percent blends when both are mixed with a given gasoline. Between 0.5 to 1.0 ml of T.E.L. per gallon will produce the same antiknock effect as a 10-percent blend, but ethanol blends usually rate higher on the road than the motor method indicates. Since richer gasoline-air mixtures may be required for smooth performances at light loads (passenger vehicles), rich mixture jets are used which appear to give superior performance with a 10-percent blend compared to gasoline. Data for standard, lean, and very lean carburetor adjustments are given. Lean carburetor adjustment is recommended for altitudes from 5,000 to 10,000 feet and the "very lean" for use above 10,000 feet. Under these conditions blends show 2.4 to 6.6 percent higher fuel consumption (miles per gallon). With the standard carburetor adjustment, fuel consumption of the blend was less at speeds up to 30 m./hr. and greater at 50 and 70 m./hr.

Total averages showed that the fuel consumption with the blend was less than 1 percent greater than with gasoline (0.9 percent). Percentage variations fluctuated from an increase of 10.8 percent to a decrease for the blend of 13.4 percent, indicating wide variations among engines. With open throttle and either standard or very lean adjustments, power output averaged slightly greater for gasoline (0.2 to 0.8 percent). In two of eight cases no difference was found. B.s.f.c. (standard carburetor) was 1.1 percent less for the blend than for gasoline at 30 m./hr., and it was 2.2 and 1.5 percent higher at 15 and 50 m./hr., respectively (the value given in the article for 15 m./hr. includes an erroneous value and should be 2.2 percent). Results for very lean adjustments were somewhat similar. Mileage obtained on summer and winter road tests gave, with one exception, results in favor of the blend; however, in half the cases the number of runs for gasoline were greater while the same was true for the number of stops for the blend. Starting was more difficult with the blend.

PREVER, V. S. (467)
AN INVESTIGATION OF THE PERFORMANCE OF FIAT ENGINES WITH VARIOUS SUBSTITUTE FUELS. Energia Termica 5: 248–255. 1939.

SIMOYAMA, KÔITI (468)
RESEARCHES ON FUEL OF ALCOHOL-GASOLINE BLENDS. I. Soc. Mech. Engin. [Japan], Trans. 5 (18): 56–62, S13–S14. 1939. (In Japanese with English abstract).

Experiments were carried out with 10-, 20-, and 30-percent ethanol-gasoline blends in both a 1936 Toyata and a 1934 Chevrolet engine to determine the best carburetor adjustment. With simple engine adjustment, gasoline gave a 3 percent greater economy than a 20-percent blend.

TEODORO, A. L. (469)
FIFTY THOUSAND KILOMETERS ON ALCOHOL AS A MOTOR FUEL. Philippine Agr. 28: 99–119. 1939.

A De Soto De Luxe sedan, 1929 model, was run 50,000 kilometers over a period of 5 years. Eleven different blends were used at various times. Corrosion was very much in evidence in those parts of the fuel passageways which were made of galvanized iron and cast iron. Materials made of copper were not affected. The author's final conclusions are: The De Soto De Luxe sedan (1929 model) used in this study performed very satisfactorily when run more than 50,000 kilometers on alcohol fuels for a period of 5 years. No difficulty in starting was encountered except when the carburetion and ignition systems were faulty and when the driver used the choke improperly. Constant operations were maintained at various loads and speeds. As much power was obtained from alcohol fuels as could be produced from gasoline. No sticking of the valves or of the piston rings was noted. Fuel passageways that were made of galvanized iron rusted. The mileage increased as the amount of gasoline in the mixture was increased. The decrease in mileage due to extra fuel consumed for starting the car, idling, and backing and to losses by evaporation and leakage, if any, varied from 5 to 16 percent. Proper utilization of nearly straight alcohol as motor fuel demands care not only in properly adjusting the carburetion and ignition systems of an engine but also in manipulating the parts which control these systems so as to bring about smoothness in engine operation, greater power, and maximum fuel economy.

1940

DAVID, W. T., and LEAH, A. S. (470)
FUEL ECONOMY IN GASOLINE ENGINES. Inst. Mech. Engin. [London] Jour. & Proc. 143: 289–312P. 1940.

Engine efficiencies and fuel consumption at various speeds at an intake temperature of 100° C. are shown by charts for octane, benzene, and ethanol from 20 percent rich to 20 percent lean at C.R. from 4:1 to 9:1.

HIVES, E. W., and SMITH, F. LL. (471)
HIGH-OUTPUT AIRCRAFT ENGINES. Soc. Automotive Engin. Jour. 46: 106–117. 1940.

The paper deals principally with structural features of high-output aircraft engines. The b.m.e.p. of a 20:60:20 benzene-straight aviation fuel-methanol plus 4 cc. T.E.L./gal. is very much higher than that of 100 octane number gasoline. It is also shown that water injection increases greatly the b.m.e.p. at knock-free operation.

OSTWALD, WALTER (472)

INJECTION, ADJUSTMENT AND MIXING OF FUELS FOR ENGINE COMBUSTION. Kraftstoff 16: 99–100. 1940.

A new method of operating compression-ignition engines is proposed, in which fuel is injected into a precombustion chamber by a low-pressure pump equipped with check valve. Thus fuel enters during low-pressure part of cycle and is ignited by subsequent compression. A slight excess of fuel is used. No timing or metering devices are needed in injection system. Engines were successfully run by this method.

SIMÔYAMA, KÔITI (473)

RESEARCHES ON THE FUEL OF ALCOHOL-GASOLINE BLENDS. II. THE AUTOMOBILE ENGINE REGULATIONS AND CHARACTERISTICS. Soc. Mech. Engin. [Japan] Trans. 6 (22): S10–S11. 1940. (English abstract).

Spark timing for various ethanol-gasoline blends was determined. With blends up to 30 percent ethanol performance is the same as that of gasoline.

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RESEARCHES ON FUEL OF ALCOHOL-GASOLINE BLENDS. III. EXHAUST GAS COMPOSITION AND ITS LOSSES. Soc. Mech. Engin. [Japan] Trans. 6 (25): S9–S12. 1940. (English abstract).

The composition of exhaust gas of gasoline (A/F = 14.48) and of gasoline-ethanol blends (ethanol A/F = 9.0) is the same regardless of the composition of the blend (up to 50 percent ethanol). Equations are given for the calculation of the air-fuel ratios from exhaust gas composition. Curves are shown giving composition of exhaust gas vs. mixture strength as well as CO_2 as a function of carbon monoxide and of oxygen. A table giving the heat balance for gasoline and five blends at two speeds shows approximately identical distribution.

TEODORO, A. L. (475)

EFFECTS OF DIFFERENT CARBURETOR SETTINGS ON THE PERFORMANCE CHARACTERISTICS OF SOME MAKES OF AUTOMOBILE ENGINES USING ALCOHOL MOTOR FUEL. Philippine Agr. 29: 465–477. 1940.

There was no evidence of detonation when the ethanol-gasoline mixtures were used under any carburetor settings. Acceleration was slightly sluggish when the 20-percent mixture was tested with the most economical jet. Better results in fuel economy and power were obtained with ethanol and gasoline mixtures at a high C.R. Gasoline, on the other hand, detonated badly, developed less maximum power, but gave slightly better fuel economy at certain loads with a high C.R. than with a low one. The present trend of C.R. used in automobile engines favors the utilization of ethanol and ethanol-gasoline mixtures as fuel.

1941

BERTHELOT, CHARLES (476)

ALCOHOL FOR MOTOR FUEL. Nature [Paris] 1941: 236–239, 261–265.

Various possible French and colonial raw materials for the production of alcohol, as well as conversion cost and method for making anhydrous ethanol are discussed. Starting with pure ethanol at low temperatures is not possible and auxiliary meassures are being used. Electrical heating of fuel lines, starting with gasolines, or use of ether or acetone blends will give satisfactory starting. Manifold distribution is also poor and can be overcome through exhaust gas heating and reduction of venturi area. This, however, causes a reduction of 10 to 20 percent in power, but is of slight importance for most driving. With gasoline as fuel, the differences in fuel consumption between optimum economical carburetor setting and maximum power setting are approximately 5 to

8 percent at full throttle and 1 to 3 percent at fractional loads. The difference in power developed hardly exceeded 3 percent. Detonation was more evident in adjustments giving lean mixtures than those giving rich. Maximum power setting with nearly straight ethanol gave about 10 percent more power than the maximum that could be developed with gasoline. This was done at the expense of a fuel consumption ratio (compared with gasoline by weight) varying from 1.4:1 to 1.7:1. It was easily possible to double the consumption of ethanol without increasing the power developed when a certain maximum load was reached. The most economical adjustment that could be obtained was one giving a fuel consumption ratio of 1.27:1 (compared with gasoline by weight) and a maximum load of about 5 percent less than the standard set by the engine manufacturer. There was no evidence of detonation when nearly straight ethanol was used. The 10 percent ethanol-gasoline mixture gave as efficient running as gasoline and developed about 5 percent more power with the same economical adjustment. With medium setting, the engine not only developed 10 percent more power but also consumed 5 to 7 percent less fuel than when gasoline was used. With the 20 percent ethanol-gasoline mixture less fuel was consumed than with gasoline at economical setting, but about 3 percent less power was developed. The difference in fuel economy varied from 3 to 20 percent, depending on the jet used. It was desirable to keep the radiator temperature at about 80° C. (176° F.) and to have a manually controlled spark advance. The latter, incidentally, facilitated low temperature starting. Various carburetor installations, including fuel systems and manifold heaters, are shown.

CATAMBAY, A. B., and KULTHONGKHAM, S. (477)
THE USE OF ALCOHOL AS FUEL FOR FARM ENGINES. Philippine Agr. 29: 672–686. 1941.

Three single-cylinder farm engines and one four-cylinder tractor engine (C.R. 4.15:1 to 4.30:1) designed for kerosene were run with kerosene, mixture A (50 parts kerosene, 50 parts ethanol and 25 parts of castor oil, by volume), mixture B (25 parts kerosene, 75 parts ethanol and 25.8 parts of acetone), and Alkohl motor fuel (100 parts 95-percent ethanol and 5 parts of gasoline, by volume). Mixture A was unsatisfactory, particularly because of the disagreeable exhaust. In all cases, fuel consumption of the blends was higher than that of kerosene; however, three of the engines exceeded their rated power by as much as 15 percent in one case.

JAVILLIER (478)
ALCOHOL MOTOR FUEL. A DEVICE FOR ITS UTILIZATION IN ENGINES. ITS USE IN AGRICULTURE. Acad. d'Agr. de France, Compt. Rend. 26: 1051–1060. 1941.

In order to overcome the effects of poor manifold distribution when using ethanol as fuel, due to the lowering of inlet temperature (high value of heat of vaporization) and the consequent lowering of efficiency because of necessity of preheating, author recommends use of direct injection into the cylinder, similar to Diesel practice, using at the same time, however, spark ignition and ordinary C.R. A description of results obtained by J. R. Retel, [Paris] Acad. des Sci. Compt. Rend. 213: 685–687. 1941. (see No. 481), indicated that with direct injection of 95-percent ethanol not only the same power output but a notably higher output may result than one obtainable from the carbureted standard engine. In laboratory experiments at 2,000 r.p.m., gasoline gave 46.6 hp. compared to 60.3 hp. with ethanol injection; the m.e.p. were 7.93 kg./cm.^{2} and 10.3 kg./cm.^{2}, respectively. The principal reasons for this increase are (1) greater volumetric efficiency (5 percent); (2) better utilization of air, lower peak temperatures, etc. (6.6 percent); (3) better manifold distribution, no preheating (5 percent); (4) increase of thermodynamic efficiency due to increase of C.R. from 6:1 to 8:1 (11.5 percent). The installation of the injection equipment is described. Road tests indicated that fuel consumption of gasoline dropped from 14 to 12 liters/100 km. while that of 95-percent ethanol was 16 liters/100 km., representing an economy of 20 percent. In the discussion it is pointed out that the ethanol does not act as a lubricant for injection pumps and, consequently, causes rapid wear unless special lubrication is provided. If such an engine is designed for running on gasoline, ethanol will be at a disadvantage since it needs a higher C.R. for better efficiency.

LAMAU, Y. (479)

THE USE OF HYDRATED ALCOHOL AS FUEL. Prog. Agr. et Vitic. 115: 41. 1941.

Directions are given for use of hydrated ethanol in engines. It may be employed without changes in standard engines; however, best results are obtained with high-compression engines. Modern engines are more suitable than old ones. Fuel consumption will be higher. If the C.R. is increased, practically the same performance as with gasoline can be obtained. Since cold starting with alcohol is not possible at much below room temperature, an extra carburetor and fuel tank must be installed, the alcohol being used after the motor is warm. While the engine is running, the incoming air is heated by means of exhaust heat. Hydrated ethanol will not mix with gasoline; the old "national fuel" consisted of a 50:50 mixture of "dehydrated alcohol" and gasoline. A test with a five-hp. engine gave good results. However, a "superhuileur" must be supplied while the engine is running in order to prevent seizing, etc.

MEDLAND, P. (480)

TESTS ON A BOSCH PETROL-INJECTION PUMP. RPT. NO. 205/1 OF THE HESSELMAN MOTOR CORPORATION (SWEDEN) A/B MAR. 1941 (R.T.P. TRANSLATION BY L. J. GOODLET, 3 PP.). New York Institute of Aeronautical Sciences. 1941.

Distribution and endurance test data are given in connection with direct injection of a 50:25:25 gasoline-benzene-ethanol plus 0.09 percent T.E.L. (bentol) using a nine-cylinder aircraft engine. After adjustment, the difference between cylinder deliveries reached a maximum of 1.5 percent for a 350 $mm.^3$ stroke volume at 1,100 r.p.m. After a total of 150 hours, no ill effect was observed in the vital parts of the pump. Volumetric efficiency is identical with that of other fuels.

RETEL, J. R. (481)

THE USE OF ETHYL ALCOHOL IN DIRECT INJECTION ENGINES WITH SPARK IGNITION. [Paris] Acad. des Sci., Compt. Rend. 213: 685–687. 1941.

Power output of 75-percent ethanol (0.816) was compared with gasoline in a single-cylinder four-cycle direct injection engine with C.R. variable between 6:1 and 8:1. At 2000 r.p.m. and C.R. 6:1 the output with gasoline was 46.6 hp. and further increase was limited by detonation. For ethanol the value was 60.3 hp. The m.e.p. were 7.93 $kg./cm.^2$ and 10.3 $kg./cm.^2$, respectively, showing an increase of 29.9 percent for ethanol. The increase is due to the higher charge density, greater thermal efficiency, perfect distribution, and increase in C.R. In spite of the much higher m.e.p., the maximum pressure for ethanol rose only 11 percent above that registered for gasoline. Direct injection was beneficial for both gasoline and ethanol.

ROGOWSKI, A. R., and TAYLOR, C. F. (482)

COMPARATIVE PERFORMANCE OF ALCOHOL-GASOLINE BLENDS IN A GASOLINE ENGINE. Jour. Aeronaut. Sci. 8: 384–392. 1941.

The authors' conclusions are as follows: (1) When used in a typical motor-car engine without any change except spark adjustment, the addition of 10 percent and 25 percent of ethyl alcohol to a 70-octane gasoline resulted in (a) increased full-throttle power with C.R. over 5.5:1; and (b) increased part-throttle s.f.c., as compared with the unblended gasoline. Under these conditions, the addition of 3 cc. of T.E.L. per gallon to the unblended gasoline resulted in about the same increase in full-throttle power as was realized with the 25-percent blend. The part-throttle s.f.c. was the same as that of the unblended gasoline.

(2) When used in a typical motor-car engine with fuel-air ratio and spark adjusted for each blend, the addition of 10 percent and 25 percent of ethyl alcohol to a 70-octane gasoline resulted in (a) increased full-throttle power and (b) increased part-throttle s.f.c., as compared with the unblended gasoline. Under these conditions, the addition of 3 cc. of T.E.L. per gallon to the unblended gasoline resulted in about the same increase in full-throttle power as was realized with the 25-percent blend. The part-throttle s.f.c. was the same as that of the unblended gasoline.

(3) When used in a typical motor-car engine with optimum C.R., fuel-air ratio, and spark timing for each blend, the addition of 10 percent and 25 percent of ethyl alcohol to a 70-octane gasoline resulted in (a) increased full-throttle power and (b) a slight increase in s.f.c., as compared with the unblended gasoline. Under these conditions, the addition of 3 cc. of T.E.L. per gallon to the unblended gasoline resulted in (a) an increase in full-throttle power intermediate between those realized with the 10 and 25 percent alcohol blends and (b) a part-throttle s.f.c. lower than with any of the other fuels.

(4) When used in a series of similar engines specifically designed and adjusted for each blend, and of such sizes as to develop the same full-throttle b.hp., the addition of 10 and 25 percent ethyl alcohol to a 70-octane gasoline resulted in slightly lower part-throttle s.f.c. as compared with the unblended gasoline. Under the same conditions, the addition of 3 cc. of T.E.L. per gallon to the unblended gasoline resulted in a lower part-throttle s.f.c. than with any of the other fuels.

(5) The optimum C.R. for the multi-cylinder engine used, based principally on good low speed power, is approximately 6:1 for the gasoline, 7:1 for the 10-percent blend, 8:1 for the 25-percent blend and 7:1 for gasoline plus 3 cc. of T.E.L. per gallon.

(6) No operating or starting trouble was encountered in the use of the alcohol blends, but no tests were made with the atmospheric temperature below 60° F. Further tests should be made to determine relative cold-weather starting ability.

(7) Alcohol blends would be uneconomical, compared with gasoline, under any engine-operating condition, unless the price of the blends was at least as low as that of gasoline. The specific gravity of the 10-percent and 25-percent blends is near enough to that of gasoline (1 to 1½ percent difference) that this conclusion is valid on either a volume or a weight basis.

SHESTA, J., and HEALY, R. (483)

REPORT ON [ROCKET] MOTOR TESTS OF JUNE 8, 1941 AT MIDVALE, N. J. Astronautics No. 49: 3–5. 1941.

Ethanol and liquid air were used as propellants.

SKOGLUND, V. J. (484)

ICING OF CARBURETOR AIR INDUCTION SYSTEMS OF AIRPLANES AND ENGINES. Jour. Aeronaut. Sci. 8: 438–464. 1941.

The author states: "Preheated carburetor air at a temperature of 60° F., with a relative humidity of 100 percent or less, is a more rapid de-icing agent than well distributed alcohol flowing at a rate of 80 pounds per hour, except where the engine has almost stopped. The rate of removal of ice by alcohol seemed to be limited by the ability of the supercharger impeller to dispose of large chunks of ice dislodged by alcohol."

THIEMANN, A. E. (485)

SOME EXPERIMENTAL RESULTS OBTAINED WITH FUELS OF HIGH OCTANE NUMBER. Automobiltech Ztschr. 44: 99–100. 1941.

This is principally a review of the article by Banks in Soc. Automotive Engine. Jour. 45: 389T–406T. 1939. (See No. 456).

WITSCHAKOWSKI (486)

THE INFLUENCE OF AROMATIC, NAPHTHENIC, ISOPROPYL ETHER AND ALCOHOL ADDITIONS TO A BASE GASOLINE ON THE KNOCK-LIMITED OUTPUT. I. G. Farbenindustrie A. G. Ludwigshafen-Oppau Rpt. 304. Feb. 19, 1941; A.D.I. (k) Microfilm, Reel 106, 48C–C67, Part I; Sum. of C.I.O.S. Docs., Ref. No. B–34.

Methanol and ethanol are included. Minimum brake mean effective pressures appear to be a good indication of the motor octane number.

1942

IYENGAR, G. N. (487)

POWER ALCOHOL, ITS ADVANTAGES AND DISADVANTAGES. Indian Sugar 5: 288–292. 1942.

Disadvantages are lower volatility and difficulty of starting, hygroscopicity of absolute alcohol, high cost of production, corrosive action of the products of combustion. Advantages are high antiknock value of alcohol and higher yield of power with lower fuel consumption. Absolute alcohol has been stored in steel tanks during the rainy season with no reduction of strength.

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ROAD TESTS OF AUTOMOBILES WITH PETROL-ALCOHOL MIXTURES. Current Sci. [India] 11: 55–56. 1942.

Since little gasoline was available during the war at the Mysore Sugar Comp., Ltd., Mandya, India, and trucks had to be kept running, tests were made with 14 ethanol-gasoline blends as well as with pure gasoline and ethanol. A new Ford V-8 truck (1940 model) was used. The road had a macadam surface and grades of 1 in 22 and 1 in 30. The average speed was 10 to 15 miles per hour. Blends up to 15 percent ethanol showed superior performance at less cost (in ton-miles per gallon) than gasoline, and with a blend containing 30 percent ethanol performance again equalled that of gasoline but at lower cost. For blends between 30 and 50 percent the ton-miles per gallon dropped somewhat lower in all cases; starting was easy; hills were negotiated in high gear (top); and acceleration was good. Performance with blends containing more than 50 percent ethanol was not satisfactory; starting was slow, acceleration poor, and hills had to be negotiated in either second or third gear.

J. L. (489)

THE USE OF ALCOHOL AS FUEL FOR AUTOMIBILES. Génie Civil 119: 9–11. 1942.

In order to prevent excessive fuel consumption and obtain satisfactory performance when using 95-percent ethanol in a standard gasoline engine, two points are stressed: (1) A heater, preferably electric (for a 2-liter engine, 120 watts for 2 minutes), or a more volatile fuel than 95-percent ethanol, such as an ethanol-acetone-gasoline blend, is needed when starting at temperatures below 25° C. (2) During operation, the heat supplied to the carburetor and intake manifold must be approximately six times greater than that necessary when running on gasoline. Excessive use of fuel causes lubrication and corrosion troubles, owing to liquid (ethanol, water, acetic acid) left in cylinders because of incomplete combustion. Fuel consumption is much improved when the engine is specially adapted to the use of straight ethanol. Results are quoted. Reference is also made to the work of J. R. Retel on direct injection of ethanol [Paris] Acad. des Sci., Compt. Rend. 213: 685–687. 1941. (see No. 481).

KIMBALL, L. B. (490)

ICING PROBLEMS IN AIRCRAFT INDUCTION SYSTEMS. Soc. Automotive Engin. Jour. 50: 40–51. 1942.

Results on carburetor ice formation are given and recommendations made with regard to the construction of the induction system. Heat and alcohol are the most common de-icing mediums; however, both have disadvantages, namely, loss in power and increased weight, respectively.

MARTRAIRE, MAURICE (491)
AQUEOUS ALCOHOL AS MOTOR FUEL. Carburants Nat. 3: 237–239. 1942.

Because of present conditions in France, 90- to 95-percent ethanol is replacing gasoline (l'essence tourism). After briefly reviewing the properties of ethanol, author states the following rules which must be obeyed when using 90-to 92-percent ethanol if the engine is to run satisfactorily. The carburetor and air must be heated to 60° and 110° C., respectively, the air supply reduced (richer mixtures), and the size of carburetor jets increased. With no change in the engine, fuel consumption will be increased approximately inversely to the respective heats of combustion (25 to 40 percent). If the C.R. is increased to 9:1, fuel consumption will be only 15 to 25 percent greater. For 95- to 96-percent ethanol, similar modifications must be made, but at C.R. 9:1 the efficiency will be 90 percent of that obtainable from gasoline.

PAUSTIAN, R. G. (492)
ROAD TESTS OF AUTOMOBILES USING ALCOHOL-GASOLINE FUELS. Iowa State Col. Engin. Expt. Sta. Bul. 158: 56 pp. 1942.

The following conclusions are based upon the results of extensive road tests with two completely equipped test cars. Throughout these tests, no changes were made in the ignition timing, and carburetors remained set for everyday operating conditions. (1) On the basis of fuel mileage and accelerating ability, alcohol-gasoline blends containing not more than 20 percent of anhydrous ethyl alcohol were found to be satisfactory motor fuels. (2) Fuel mileages obtained with a 10 percent alcohol-gasoline blend were as good as and, in some cases, better than the average mileage obtained with regular, leaded gasoline. (3) The use of a 20 percent alcohol-gasoline blend resulted in fuel-mileage values well within the range of those for regular gasoline; however, full-mileage values for the 20-percent blend were consistently below those obtained with the 10-percent blend. (4) On a fuel-mileage basis, blended fuels containing 30 percent or more of alcohol compared unfavorably with regular leaded gasoline. (5) From the standpoint of either fuel mileage or accelerating ability, no combination of anhydrous ethyl alcohol with leaded or unleaded gasoline was markedly superior to regular leaded gasoline. (6) Accelerating ability with blends containing not more than 20 percent of alcohol differed little from that observed with regular leaded gasoline. (7) Operation with alcohol-gasoline blends did not change measurably the engine temperatures observed with regular leaded gasoline. (8) In this investigation, oil consumption was unaffected by the type of fuel used. (9) The use of alcohol-gasoline blends had no measurable adverse effect upon the composition of the crankcase oils. (10) Results of laboratory tests with small single-cylinder engines corroborated the findings of the road tests in that the use of either a 10- or 20 percent alcohol-gasoline blend was found to have no measurable adverse effect upon the composition of the crankcase oils and such use was not conducive to corrosion of any part of the test engines.

PETIT, HENRI (493)
USE OF ALCOHOL IN AUTOMOTIVE GASOLINE ENGINES. Soc. des Ingén. de l'Auto. Jour. 15: 40–44. 1942.

The important differences between the physical properties of ethanol and gasoline in engine performance are: lower volatility of ethanol affects starting; higher heat of vaporization influences distribution; lower heat of combustion increases fuel consumption; combustion is slower—this necessitates more spark advance; the antiknock value of ethanol is much higher—this permits the use of higher compression ratios. Starting on straight ethanol may be effected in one of two ways: preheating, or the use of gasoline or alcohol-ether blends until engine is warmed up. Exhaust-gas heating is desirable for good distribution in cold countries. Carburetor-jet and float adjustments must be made. Compression ratio should be increased if this is practicable. Top-cylinder lubrication by means of additions of castor oil, peanut oil, or by means of a special attachment is desirable. Advice and various precautions are given. If possible a small quantity of gasoline or benzene should be added to the alcohol.

Rothrock, A. M., Krsek, A. Jr., and Jones, A. W. (494)
SUMMARY REPORT ON THE INDUCTION OF WATER TO THE INLET AIR AS A MEANS OF INTERNAL COOLING IN AIRCRAFT ENGINE CYLINDERS. [U. S.] Natl. Advisory Com. Aeronaut., 47 pp. 1942.

Tests conducted with a Wright single-cylinder aircraft engine for the purpose of determining the cooling effect of water when inducted to the inlet air gave the following results: Water injection raised the maximum permissible performance limits of a fuel, which is equivalent to raising its octane number. Higher i.m.e.p., lower i.s.f.c., or both were permitted with water injection than without the coolant. Engine head and cylinder temperatures were markedly lower. Water injection gave no fuel economy, however, when fuel was operating well below its maximum permissible performance. In extreme cases water injection may cause crankcase oil dilution.

Singer, E. (495)
RESULTS OF CORRELATION TESTS BETWEEN THE OPPAU AND DVL METHODS. I. G. Farbenindustrie A. G. Ludwigshafen-Oppau Rpt. 491. Oct. 24, 1942; A.D.I. (k) Microfilm, Reel 109, 48E–C68; Sum. of C.I.O.S. Docs., Ref. No. A. 33.

Unleaded fuels and blends with ethanol, diisopropylketone, and diisobutylene gave poor correlation.

Thiemann, A. E. (496)
ADDITIVES FOR DIESEL FUELS. Automobiltech. Ztschr. 45: 454–457. 1942.

Discusses results obtained by C. S. Moore and H. H. Foster [U.S.], Natl. Advisory Com. Aeronaut., Tech. Notes No. 707, 14 pp. 1939. See No. 464.

Walker, W. J., Scholes, E. H., and Swanepoel, A. C. (497)
ROAD TESTS ON FUEL MIXTURES OF ETHYL ALCOHOL, PETROL AND BENZOL. So. African Inst. Engin. Jour. 40: 106–137. 1942.

Results of a carefully conducted road test with a 1941 Chevrolet coupe on a fairly level 3 to 4 mile test course were obtained. All possible ternary mixtures of ethanol, gasoline, and benzene were tested, in 10-percent variations. In addition, two well-known brands of South African fuel mixtures were used (composition given only as carbon, hydrogen, and oxygen percentages). Specific gravity, kinematic viscosity, vapor pressure (Ramsay-Young method). and distillation characteristics were determined for each fuel. Corrections were made for wind velocity, air temperature, and barometric pressure. Detailed data are given in 44 tables. No apparent influence of viscosity or flow was noticeable (reduced flow of the lower calorific value mixtures) with most ternary mixtures, except those of high ethanol content. There was an improvement in fuel consumption in miles per gallon over that obtained from any of the gasolines. The greater fuel economy of the ternary mixtures in spite of their lower heats of combustion is attributed to improved combustion (e. g., lower combustion temperatures, consequently lower dissociation); however, conclusions were indefinite in this respect. It was estimated that 10 million gallons of ethanol and benzene could be produced in South Africa and the use of a 30:40:30 ethanol-gasoline-benzene blend would reduce importation of gasoline by 20 million gallons per year.

Witschakowski (498)
KNOCK RATINGS OF LEADED AND UNLEADED HYDROCARBON BLENDS IN THE BMW. 132 SUPERCHARGED ENGINE. I. G. Farbenindustrie A. G. Ludwig-

shafen-Oppau Rpt. 498. May 2, 1942; A.D.I. (k) Microfilm, Reel 107, 48C–C67, Part II; Sum. of C.I.O.S. Docs., Ref. No. I. 137.

Ethanol and diisopropylketone were included.

1943

BERTHELOT, CHARLES (499)

ALCOHOL AS MOTOR FUEL. Génie Civil 120: 99–102, 112–115. 1943.

As the result of certain conferences, it is recommended to increase ethanol production from 6 million (1938) to 17.5 million hectoliters and utilize 95-percent ethanol in direct injection engines. Author believes that direct injection is most favorable for both ethanol and methanol. Preignition does not take place even at C.R. between 10:1 and 12:1 because of the cooling effect of the high heat of vaporization. Starting presents no difficulty. Compared with carburetion fuel, consumption dropped 26 percent, exhaust temperature dropped by 100° to 200° C., and power output exceeded that of gasolines by 20 percent. Thermal efficiencies of the order of 42 to 45.5 percent were obtained. In road tests, consumption was equal to that of gasolines when the latter was used in a standard engine. Sources for and production of alcohols in France are discussed.

CARBONARO, M. (500)

ENGINES WITH DIRECT INJECTION AND THE FUTURE OF ALCOHOL AS A MOTOR FUEL. Carburants Nat. 4: 249–262. 1943.

A comparison was made between the Retel and the Brandt direct-injection engines. It is claimed that direct injection has great advantages over carburetion when ethanol is used.

DOSS, M. P. (501)

FUEL INJECTION IN SPARK-IGNITION. OTTO CYCLE ENGINES. Literature Survey, 136 pp. Library of the Tech. and Res. Div. The Texas Co. New York. 1943.

Since fuel injection plays an important part in the use of ethanol and other agricultural motor fuels, this survey is a convenient means to obtain more detailed information on the problem.

ESSEX, H. A. (502)

DE-ICING OF AN AIRCRAFT-ENGINE INDUCTION SYSTEM. [U.S.] Natl. Advisory Com. Aeronaut. Wartime Rpt. ARR. No. 3H13 27 pp., 34 figs. 1943. (Unclassified).

The following de-icing fluids were tested in a system consisting of a simulated air scoop, a Holley 1375-F carburetor, a carburetor adapter, and a Wright R-1820, G-200 supercharger rear section: Solox D-I (90 percent ethanol and 10 percent methanol to which a corrosion inhibitor and 1 gallon of gasoline per 100 gallons of mixture has been added), isopropanol, anhydrous ethanol, S.D. 30 (90:10 ethanol-methanol with no inhibitor or denaturant), and Shellcol (ethanol denatured with methanol, ethyl acetate, methyl isobutyl ketone, and aviation gasoline). It was tentatively determined that S.D. 30 and ethanol were roughly equivalent to Solox D-I and isopropanol in air-flow recovery but inferior in restoring operable fuel-air ratio. Except Solox D-I all showed a slight corrosive effect towards aluminum alloy, and S.D. 30 also towards brass and copper. Heated air properly applied was fully as effective in restoring air flow and operable air-fuel ratios as any of the de-icing fluids tested.

GÖSCHEL (503)

INJECTION OF METHANOL-WATER MIXTURE MW50 IN UNSPECIFIED DB ENGINE. 3 pp. 1943. Published as Rpt. PB54589, U.S. Dept. Com. Off. of the Pub. Bd.

Injection of MW 50 gave boost of 100 hp. on the ground, and gains up to 50 hp. in 10,000 m. altitude. Reducing the temperature of air charge to 120° C. required induction of MW 50 at 60 liters/hr. Substitution of MW 50 injection for boost intercooling would be acceptable for operations of short duration, as in fighters and interceptors. Induction of MW 50 on suction side, with a saving of 50 kg. resulting from removal of pressure system, is contingent on elimination of corrosion and cavitation effects.

Abstract *in* Bibliog. Sci. and Indus. Rpts. 4(7): 583. 1947.

KIMBALL, L. B. (504)

ICING TESTS OF AIRCRAFT-ENGINE INDUCTION SYSTEMS. [U.S.] Natl. Advisory Com. Aeronaut., Wartime Rept. ARR. Jan. 1943. 25 pp. 41 figs. 1943. (Unclassified).

Ice formation in the intake systems may be classified as of three types: (1) Atmospheric impact, i.e., due to ingestion of snow, sleet, or supercooled water particles which freeze or impact; (2) throttling ice formed as a result of change in kinetic energy of the air in the throttle; (3) refrigeration, i.e. resulting from cooling of intake air through evaporation of fuel. The last is encountered most frequently and may occur at temperatures considerably above 32° F. The two major icing factors are carburetor air temperature and moisture content of air. The report is limited to a description of the icing tests and a brief sudy of the possibility of preventing icing by design modifications. It is stated that tests have also been made on methods of eliminating ice formation in induction systems by means of the injection of alcohol into the intake air.

KOENIG, R. J., and HIESER, G. (505)

THE EFFECT OF WATER INJECTION ON THE COOLING CHARACTERISTICS OF A PRATT & WHITNEY R-2800 ENGINE. [U. S.] Natl. Advisory Com. Aeronaut. ARR. No. 3K09, 13 pp. 1943. (Unclassified).

In order to evaluate the cooling characteristics of a Pratt & Whitney R-2800 engine with water injection, tests were made over a range of fuel-air ratios from 0.057 to 0.110. Increased amounts of water were injected until operation became rough because of flooding of cylinders. Calculated values of the lowering of the mean effective gas temperatures checked closely with the experimental values. Water is considerably less effective (at 0.08 only about 52 percent) than fuel as an internal coolant on a weight basis; however, it is possible to obtain a combined effect greater than that for fuel alone.

KU, P. M. (506)

CARBURETOR ICING AND ITS PREVENTION. Chinese Inst. Engin. Jour. 1: 92–100. 1943.

Fuel vaporization and atmospheric humidity are causes of carburetor icing. Automatic warm- and cold-air intake offers a solution to combat ice hazards successfully. Addition of an ice inhibitor has produced more satisfactory results than other methods.

Abstract *in* Aeronaut. Engin. Rev. 2(7): 51. 1943.

MARILLER, CHARLES (507)

MOTORS WITH ALCOHOL INJECTION. Assoc. des Chim. Bul. 60: 294–302. 1943.

Results of tests with two types of direct-injection engines indicate that s.f.c. of alcohol is greatly improved, and particularly at higher C.R. 95-percent ethanol or ethanol containing more water may be used.

1944

ANONYMOUS (508)

DE-ICING CONTROL. Modern Transport 51: 7. June 1944.

The best method of induction-system de-icing is by the aid of an inhibitor, usually an alcohol mixture, injected into the carburetor at the rate of 40 pints per hour per 1,000 hp. An automatically operated injection is illustrated.

Abstract *in* Aero. Engin. Rev. 3(9): 59. 1944.

ADAIR, P. F. (509)

LOW OCTANE FUEL + WATER = HIGH ENGINE PERFORMANCE. Aviation Maintenance Feb. 1944. 43–45.

Engines designed for the higher octane fuels can be operated on lower octane fuels when water is injected during full-power operations such as take-off and combat action. The injection of water also has the beneficial effect of removing carbon. The removal of carbon reduces oil sludging, spark-plug fouling, and improper valve seating. The lowering of cylinder-head temperatures also reduces other maintenance troubles; alcohol must be added to prevent freezing at low operating temperatures.

BELL, A. H. (510)

CONTINUOUS USE OF INTERNAL COOLING TO SUPPRESS KNOCK IN AIRCRAFT ENGINES AT HIGH POWER. [U. S.] Natl. Advisory Com. Aeronaut. Wartime Rpt. ARR. No. E4H15. 8 pp. 13 figs. 1944. (Unclassified).

The object of this work was to investigate the possibility of using internal cooling instead of fuel enrichment to suppress knock. Ammonium hydroxide, water, 70:30 methanol-water, and 80:20 ethanol-water were used. Laboratory and flight test data were obtained. Results showed that at engine powers which required fuel-air ratios from 0.08 to 0.09 to suppress knock, 20 percent or more of gasoline was saved when the fuel-air mixture was lowered to 0.06 and the knock suppressed by water injection. Ammonium hydroxide ranked close to water in regard to fuel economy, but mixtures of water and either methanol or ethanol were unable to suppress knock with any fuel saving except at high-power operation.

CARBONARO, M. (511)

ALCOHOL FUEL AND FRENCH AGRICULTURE. Assoc. des Chim. Bul. 61: 122–141. 1944.

The article is divided into three main parts: (1) French agriculture and mechanization; (2) possibilities of fuel-alcohol production at home; (3) use of alcohol in engines. In the first part, farm mechanization is discussed as it affects agricultural labor, lower production costs, and fuel supply. Under the second heading the production of alcohol from grapes, apples, beets, Jerusalem artichokes, potatoes, and corn is investigated. In the third part a comparison is made of the physico-chemical properties of ethanol and methanol with those of gasoline. With a carbureted engine, cold starting is best accomplished by means of gasoline, manifold heating is essential for good distribution, and C.R. must be increased to 8:1. If direct injection is adopted, all these disadvantages disappear and considerable advantages accrue, viz. fuel consumption is less, volumetric efficiency is greater, icing and backfiring are suppressed. Results with direct injection obtained by Retel, Brandt, and Jalbert are briefly mentioned. The following conclusions are drawn: Mechanization will not only solve the agricultural labor problem, but also increase production and decrease cost. In order to insure success of the use of ethanol as motor fuel, two requirements must be fulfilled: (1) Large production of ethanol and methanol (possibly 15.5 million hl.), and (2) employment of special high-compression engines which may be either carburetor type or direct-injection types.

ENGELMAN, H. W., and WHITE, H. J. (512)

USE OF WATER INJECTION TO DECREASE GASOLINE CONSUMPTION IN AN AIRCRAFT CRUSING AT HIGH POWER. [U. S.] Natl. Advisory Com. Aeronaut. R. B. No. E4H12, 8 pp. 1944. (Unclassified).

Results obtained from water-injection tests on a Wright R-2600-8 engine at ground-level conditions indicated that the use of water instead of excess fuel to maintain engine temperature limits at powers normally requiring a fuel-air ratio of about 0.09 resulted in a decrease of approximately 26 percent in b.s.f.c. with a brake specific liquid consumption increase of about 3 percent. Water injection in aircraft engines would permit temperature-limited cruising powers to be reached at reduced engine speeds and increased b.m.e.p. with fuel-air mixtures.

JALBERT, JEAN (513)

THE MULTI-FUEL ENGINE. Soc. des Ingén. de l'Auto. Jour. 17: 109–113. 1944.

The differences in the physical properties of hydrocarbon fuels and alcohols as far as they affect fuel behavior are discussed—namely, volatility, heat of vaporization and consequently distribution, etc. On the basis of relatively simple assumptions, various engine-cycle data are given for methanol, ethanol, gasoline, and gasoil using carburetion, direct cylinder injection with spark ignition, and compression ignition. Thermal efficiencies of alcohols under all conditions are superior, particularly in spark-ignition engines, partly because of higher compression ratios used. A novel type of four-cycle engine with injection is described. To each engine cylinder there is joined an injection cylinder with a piston moving at half engine speed. A rich fuel-air mixture is drawn through a carburetor into the injection cylinder and is compressed into the engine cylinder through an automatic valve. Tests were performed on a single-cylinder unit (bore 132 mm., stroke 160 mm., displacement 2183 cc., r.p.m. 2000), using both compression (gas and peanut oil) and spark ignition (methanol and gasoline). Compression ratios used and resulting thermal efficiencies are noted in parenthesis after each fuel. Gas oil (13:1, 0.360); peanut oil (19:1, 0.310); methanol (13:1, 0.435); methanol (7:1, 0.330); gasoline (7:1, 0.328). The use of straight alcohol is advocated, but in new and more efficient engines, not in present-day types.

KIMPFLIN, GEORGES (514)

SUBSTITUTE FUELS FOR RAILROADS. Génie Civil 121: 149–151. 1944.

Alcohol and alcohol blends, one of which was Nabol (50 percent anhydrous ethanol, 25 percent benzene and 25 percent coal oil rich in naphthalene) were satisfactory but were available only in small amounts. Nabol, when used in a specially modified engine (Bugatti), gave encouraging results.

PENZIG, F. (515)

METHANOL AS AN ENGINE FUEL. I. G. Farbenindustrie A. G. Ludwigshafen-Oppau Rpt. 557. Jan. 3, 1944; A.D.I. (k) Microfilm, Reel 109, 48E–C67; Sum. of C.I.O.S. Docs., Ref. No. A. 89.

Aside from a review of the physical properties of methanol which are of importance in connection with its use as fuel, single-cylinder engine tests with a DB6001 cylinder are reported. Because of the high heat of vaporization of methanol, higher power output is obtainable than with gasoline, but at approximately twice the specific fuel consumption, since the heat of combustion of methanol is considerably lower than that of gasoline. Below 15° C. the engine must be started with a more volatile fuel. When methanol is used as a fuel, power output is less affected by air-intake temperature than when gasoline is used. Preignition is the chief trouble and is due to the lower ignition temperature of methanol.

RETEL, J. R. (516)

UTILIZATION OF ALCOHOL AS MOTOR FUEL BY DIRECT INJECTION. Vie Auto. No. 1279/1280, pp. 122–125. July 10–25, 1944; No. 1281/1282, pp. 139–144. Aug. 10–25, 1944; No. 1283/1284, pp. 32–35. Sept. 10–25, 1944; Soc. des Ingén. Civils de France Mém. et Compt. Rend. des Trav. 98 (1–3): 16–38. 1945; Engin. Digest 2: 598–603. 1945.

Author enumerates the following four advantages gained by direct-cylinder injection when a comparison is made with carburetion: (1) Perfect distribution with gain in output of 5 to 6 percent; (2) possibility of scavenging the clearance volume resulting in possible increase in power by 5 to 10 percent; (3) no restricted air passages with gain in output of 3 to 4 percent; (4) possibility of having richer mixtures than in the remaining portion near the spark plug, reducing s.f.c. by 15 to 20 percent. The maintenance of constant mixture composition is discussed and some results obtained with a single-cylinder engine at 2,000 r.p.m. using solid injection are given.

Fuel:	*C.R.*	*Output*	*i. m. e. p. kg./cm.*[2]
95-percent ethanol	6.1	51.2	7.93
	7.1	55.2	
	8.1	60.3	10.3

The same engine at C.R. 6:1 with a carburetor, using gasoline, delivered 46.6 hp. at the same speed.

SCHERRER, R., and YOUNG, C. F. (517)
AN INVESTIGATION OF THE CHARACTERISTICS OF ALCOHOL-DISTRIBUTION TUBES USED FOR ICE PROTECTION ON AIRCRAFT WINDSHIELDS. [U.S.] Natl. Advisory Com. Aeronautics. Wartime Rpt. Arr. No. 4B26, 9 pp., 8 figs. 1944. (Unclassified).

The most economical flow rate of isopropanol to provide adequate prevention of icing has been determined through flight tests. The optimum location and size of the alcohol distribution tube as well as procedure by which economical and effective distribution can be obtained are described.

TAUB, ALEX (518)
CARBOHYDRATE-BASE MOTOR FUELS. Automotive and Aviation Indus. 91 (2): 28–30. 1944.

This is a résumé of the work done by the [U.S.] Bur. of Standards for the Foreign Economic Administration. The results will be found in more detail in the publications by D. B. Brooks, Automotive and Aviation Indus. 93(5); 18-21, 60, 62, 66. 1945 (see No. 523). D. B. Brooks, [U. S.] Natl. Bur. Standards Jour. Res. 35 1-37. 1945 (see No. 524). D. B. Brooks, [U. S.] Natl. Bur. Standards Jour. Res. 36: 425-439. 1946 (see No. 535). J T. Duck and C. S. Bruce, [U. S.] Natl. Bur. Standards Jour. Res. 35: 439-465 (see No. 526). And A. D. Puckett, [U. S.] Natl. Bur. Standards Jour. Res. 35: 273–284. 1945 (see No. 532).

WEAR, J. D., HELD, L. F., and SLOUGH, J. W. (519)
SOME EFFECTS OF INTERNAL COOLANTS ON KNOCK-LIMITED AND TEMPERATURE-LIMITED POWER AS DETERMINED IN A SINGLE-CYLINDER AIRCRAFT TEST ENGINE. [U. S.] Natl. Advisory Com. Aeronaut. ARR. No. E4H31, 36 pp. 1944. (Unclassified).

The following internal coolants were used in a Wright C9GC cylinder mounted on a CUE crankcase: water; 30:70 methanol-water; 70:30 methanol-water; methanol; and 80:20 ethanol-water. On the basis of the results it is estimated that temperature-limited take-off power may be increased 60 percent, knock-limited rated power increased 50 percent and knock-limited cruising power increased 60 percent through the use of internal coolants; 70:30 methanol-water addition was the most effective. At knock- or temperature-limited i.m.e.p., the i.s.f.c. was less with internal coolants than the i.s.f.c with fuel alone above 250 i.m.e.p. at 2,500 r.p.m. and a cooling-air pressure drop of 20 inches of water. This is also true above 230 i.m.e.p. at 1,830 r.p.m. and a cooling-air pressure drop of 10 inches of water. Lowering the inlet-air temperature or retarding the ignition timing within practical limits did not permit as high knock-limited or temperature-limited power as the addition of suitable amounts of internal coolants.

1945

ANONYMOUS (520)
DISCUSSION ON ALCOHOL-WATER INJECTION. Natl. Petrol. News 37 (14): R249. 1945.

The introduction mentions that preliminary calculations appear to indicate that on the basis of fuel cost, no advantage could be gained through use of ethanol-water injection. The extra servicing, aside from initial cost, might be a drawback. Truck operators are cautioned that injection may result in overloading of engine. Hunter, H. C., "Obstacles seen to a two-fuel system for general use on automobiles." *Ibid.*

37(14): R249. 1945. This is a more detailed discussion of the paper on "water-alcohol injection." Studies made by the "oil company laboratories" indicate that the economic benefit of auxiliary injection is greatest at low-load factor operation and that injection, therefore, would not be so attractive for truck and bus engines, which would be the most promising field. Extra cost and higher s.f.c. are the principal drawbacks.

Test, L. J., "Water injection alone suppressed detonation but excessive engine rusting was found." *Ibid.* 37(14): R250. 1945. Continuous water injection eliminated preignition, decreased octane requirements greatly, removed some of the old carbon deposits, and altered the remainder to a soft, sooty type but caused excessive rusting. It was emphasized, however, that water injection had been continuous and if only injected at open throttle, certainly less rusting would have taken place. Less ethanol (10 percent) is required to obtain the same reduction of octane requirements than with water alone (16 percent).

——— (521)
INJECTION OF ANTI-DETONATION FLUIDS IN AIRCRAFT ENGINES. Automotive and Aviation Indus. 93 (11): 34–36, 38, 76, 78, 80, 84. 1945.

In this article the work of M. R. Rowe and G. T. Ladd [Soc. Automotive Engin. Jour. 54: 26-37, 44. 1946. See No. 538] and German experiments conducted with water, alcohol, alcohol solutions, and nitrous oxide are discussed. The injection equipment is briefly described. The antidetonant fluid is delivered to the fluid meter from within a manifold pressurized tank or from a motor-driven water pump. The latter is specially designed to prevent electrolytic action and the steel parts of the standard pump are replaced by nonferous metals and carbon vanes. Higher outputs may be obtained through engine cooling by means of extra-rich mixtures at the expense of lower thermal efficiencies. Only through higher boost pressures (5 to 10 percent) with water (or water-methanol) injection and lean mixtures, fuel consumption at high outputs may be as much as 25 percent lower than with rich mixtures. A mixture of 50 percent (larger volume) water, 49.5 percent methanol, and 0.5 percent rust inhibitor was used successfully by the Germans. Even at constant boost pressure, a 4-percent increase in output was obtained. It is stated that the increased output is permissible only for 10 minutes at a time and at least 5 minutes must be allowed successive periods of injection. It appears that water-methanol is the best detonation inhibitor and insures maximum altitude performance at high power operation, and that injection is more efficient in lean mixtures than in rich mixtures. Low octane fuel (87 to 91) plus coolant may be a distinct possibility in the operation of commercial aircraft.

BIERMANN, A. E., HENNEBERRY, H. M., and MILLER, G. A. (522)
CONTROL OF CYLINDER TEMPERATURES BY THERMOSTATICALLY OPERATED INTERNAL-COOLANT VALVES. [U. S.] Natl. Advisory Com. Aeronaut. Memo. Rpt. E5G16, 8 pp., 11 figs. 1945.

Two thermostatically controled internal-coolant valves were tested in two single cylinders from two different radial-cooled aircraft engines. The chief advantage of water or water-ethanol as a coolant at rich mixtures is the possibility of using greater quantities than is feasible with gasoline. Both the temperature-limited and the knock-limited power range can be extended in this case. However, the unsatisfactory lean-mixture characteristics of the water-ethanol mixture precludes its use as a coolant in these tests. The two valves provided accurate control of temperatures at the control points when either water or fuel was used as an internal coolant. The valve response was insufficient to prevent the extremely rapid rate of temperature rise acompanying severe preignition.

BROOKS, D. B. (523)
ENGINE PEFORMANCE OF SUBSTITUTE MOTOR FUELS Automotive and Aviation Indus. 93 (5): 18–21, 60, 62, 66. 1945.

This is a brief summary of tests conducted by the National Bureau of Standards. Details will be found in publications by the Bureau. (See Nos. 524, 526, 532 and 535.)

——— (524)
SINGLE-CYLINDER ENGINE TESTS OF SUBSTITE MOTOR FUELS. [U. S.] Natl. Bur. Standards Jour. Res. 35: 1–37. 1945.

Single-cylinder engine tests of nonhydrocarbon fuels and 70-octane number gasoline at a fixed C.R. and at a C.R. giving trace knock for each fuel show no material differences in performance other than those associated with differences in heats of combustion and vaporization. All the nonhydrocarbon fuels could be operated at C.R. higher than was permissible with the gasoline, with corresponding increases in power and thermal efficiency. The following nonhydrocarbon fuels were used: 190-proof ethanol; 200-proof ethanol; 75 percent ethanol and 25 percent diethyl ether; 50 percent acetone and 50 percent butanol; 27 percent acetone, 6 percent ethanol, 67 percent butanol; and 28.5 percent acetone, 71.5 percent butanol.

COLWELL, A. T., CUMMINGS, R. E., and ANDERSON, D. E. (525)
ALCOHOL-WATER INJECTION. Soc. Automotive Engin. Jour. 53: 358–372. 1945; Natl. Petrol. News 37 (6): R88–R96. 1945.

The use of an auxiliary carburetor (Vita-meter) is advocated for the purpose of fuel economy. Under ordinary driving conditions the octane requirement of an engine is much lower than when running at or nearly full load (hill-climbing acceleration). Tests show that with alcohol or alcohol-water "injection" by means of the Vita-meter, gasolines can be used having an octane number from 10 to 12 units lower than the requirement of the particular engine for nonknocking operation. A 50:50 ethanol-water mixture was found most effective.

DUCK, J. T., and BRUCE, C. S. (526)
UTILIZATION OF NONPETROLEUM FUELS IN AUTOMOTIVE ENGINES. [U. S.] Natl. Bur. Standards Jour. Res. 35: 439–465. 1945.

The following fuels were used: Anhydrous ethanol; 95-percent ethanol; acetone; *n*-butanol; 50:50 acetone-butanol; 67:27:6 butanol-acetone-ethanol; 71.5:28.5 butanol-acetone; 20:80 diethyl ether-ethanol (95 percent); ethanol with various amounts of water; and gasoline. Full-throttle performance tests (1,500 r.p.m.) were made on two 1942 Plymouth, one 1942 Chevrolet, and one 1940 Ford V-8 engines. Ethanol and ethanol blends might develop from 2 to 4 percent more power than gasoline; however, fuel consumption was roughly inversely proportional to the heat of combustion of the fuel used. Road-load power and economy tests were made on four fuels at "four speeds." Fuel mileages are given for best economy and minimum throttle. Ethanol-water mixtures were tested at full throttle and 1,500 r.p.m., and spark-plug, fuel-supply, and crankcase-dilution difficulties were experienced with blends containing 35:65 ethanol-water. Mixture distribution was somewhat less uniform with fuels containing ethanol and butanol than with gasoline.

FOCKE-WULF (527)
METHANOL-WATER AND NITROUS OXIDE INJECTION SYSTEM. 68 pp. 1945. Published as Rpt. PB 54981, U.S. Dept. Com. Off. of the Pub. Bd.

Schematic diagrams and part lists for methanol-water and nitrous oxide injection systems for FW 190 and TA 152 with Jumo 213 and DB 603 engines are given.

Abstract *in* Bibliog. Sci. and Indus. Rpts. 4(7): 583. 1947.

FOSSETT, H. (528)
PETROL—ITS DEVELOPMENT, PAST, PRESENT, AND FUTURE—WITH SOME NOTES ON POTENTIALITIES OF HIGH-OCTANE FUELS FOR ROAD VEHICLES. Inst. Auto. Engin., Jour. 14 (3): VII–XXXVI. 1945. (This is a discussion on the paper by the same title published in Inst. Auto. Engin. Jour. 12: 89–131. 1944.)

In the discussion of the paper by Harold Moore the point is made that the higher the octane number of the hydrocarbon fuel, the greater the heat loss experienced in its manufacture, and that a better yardstick would be the maximum power output or mileage from the original raw material. The fact that oxygen-containing fuels have been ignored is criticized. Heats of combustion of the higher ketones are considerably higher than, for example, that of ethanol. The beneficial effect of blends on engine efficiency is mentioned. The economic side of the picture may not be so unfavorable to the use of ethanol.

GAISNE, A. (529)
LUBRICATING OIL CONSUMPTION OF ENGINES USING ALCOHOL FUEL. Assoc. des Chim. Bul. 62: 215–218. 1945.

Practical experience has shown that oil consumption is aproximately equal to 1.75 percent of the fuel consumed when gasoline is used. The author's conclusion, based on certain calculations for stationary engines using 93-percent ethanol is that the oil requirement would be 1.8 percent of the fuel consumed.

JALBERT, JEAN (530)
PRACTICE AND THEORY OF THE MULTI-FUEL ENGINE. Assoc. Franç. des Tech. du Pétrole Conf., Paris. pp. 51–72. April 27, 1945.

Results previously given in "The multi-fuel engine," Soc. des Ingén de l'Auto. Jour. 17: 109–113, 1944, are discussed (see No. 513). A more extended discussion of the thermodynamics of combustion processes is given.

PFENDER, J. F., DUDUGJIAN, C., and LIETZKE, A. F. (531)
EFFECT OF ENGINE-OPERATING VARIABLES AND INTERNAL COOLANTS ON SPARK-ADVANCE REQUIREMENTS OF A LIQUID-COOLED CYLINDER. [U.S.] Natl. Advisory Com. Aeronaut. Wartime Rpt. MRNo. E5E18, 8 pp., 16 figs. 1945.

The effect of engine-operating variables and of two internal coolants (water and a 50:50 ethanol-water mixture) by spark-advance requirements for maximum take-off power and maximum cruising economy were determined for a single cylinder of a liquid-cooled, 12-cylinder aircraft engine. It is concluded that of the variables tested only fuel-air ratio and internal coolant-fuel ratio have great effect on the peak-power spark timing. With no coolant, an increase of 10 performance numbers is required to maintain the same knock-limited power at a fuel-air ratio of 0.060 if spark timing is advanced to peak power. The gain in take-off power is aproximately 4 percent. Water, when injected before the vaporization tank and allowed to mix thoroughly with the fuel-air mixture, slowed the flame speed more than when injected into the intake elbow. On the other hand, for a 50:50 mixture the flame speed was slowed to about the same degree regardless of injection position.

PUCKETT, A. D. (532)
KNOCK RATING OF GASOLINE SUBSTITUTES. [U. S.] Natl. Bur. Standards Jour. Res. 35: 273–284. 1945; *Ibid.* Tech. News Bul. No. 342: 80. 1945.

The conclusions drawn from the tests reported are as follows: (1) The knock ratings of carbon monoxide and of the normally gaseous paraffins indicate that they can be used successfully as fuel in either supercharged engines or in normally aspirated engines of considerably higher C.R. than those currently available in automotive equipment. (2) The antiknock properties of the normally gaseous olefins are such that they can be used satisfactorily in present automotive engines. (3) Ethyl alcohol-diethyl ether blends containing less than 45 percent by volume of ether should give relatively knock-free performance under conditions of steady operation. (4) Acetone, ethyl alcohol, and normal butyl alcohol, either separately or in blends, are satisfactory fuels as far as antiknock value is concerned. (5) Acetone or ethyl or butyl alcohol can be used to extend supplies of gasoline or can be blended with suitable petroleum naphthas to make motor fuels of satisfactory knock rating. (6) When up to 30 percent by volume of ethyl alcohol is blended with gasoline of 40 to 60 A.S.T.M. motor octane number, the improvement in knock rating is of the order of one octane unit for each percent of alcohol. (7) Acetone, though higher in octane number when tested neat, is less effective in blends than is ethyl alcohol.

1946

ANONYMOUS (533)
DE-ICING FOR TODAY. Flight 49: 364–365. 1946.

The T.K.S. system of protection against icing by the use of fluids is considered tq be an improved version of the Dunlap system. The initials are derived from the names Tecalemit, Kilfost, and Sheepsbridge Stokes. The fluid is described as being a mixture of alcohol, glycerin, glycol, and glucose.

BARBER, E. M., MALIN, J. B., and MIKITA, J. J. (534)
THE ELIMINATION OF COMBUSTION KNOCK. Jour. Franklin Inst. 241: 275–298. 1946.

Direct-injection (cylinder) experiments were carried out in a single-cylinder engine in which the location of the injector and of the spark-plug was arranged in such a way that the fuel-air mixture was exposed to engine temperature and pressure only for an extremely short period. Under such conditions it was found that operation was independent of octane or cetane number and that knockfree operation could be obtained at high-boost pressures and compression ratios regardless of the type of fuel. Ethanol, isopentane, benzene, kerosene, Diesel fuel, treptane, isooctane, *n*-heptane, cetane, and α-methyl naphthalene were used.

BROOKS, D. B. (535)
AN ANALYSIS OF THE EFFECT OF FUEL DISTRIBUTION ON ENGINE PERFORMANCE. [U. S.] Natl. Bur. Standards Jour. Res. 36: 425–439. 1946.

In conventional multicylinder engines, distribution of substitute fuels, especially 190-proof alcohol, is very poor, indicating that it might be profitable to design a special intake manifold for them. To investigate this possibility, the author uses his previous data on single-cylinder engines to calculate the effect of a given maldistribution. For a given mean-square relative error in distribution, the worst situation occurs when one cylinder is lean. S.f.c. is more sensitive to poor distribution than other performance variables. With one fuel investigated, namely, alcohol, optimum distribution would give a 2-percent gain in power and more than a 10-percent gain in fuel economy.

CROSS, W. E. (536)
THE USE OF ALCOHOL AS FUEL IN ENGINES. Agr. Mexicano 62 (3): 9–11. 1946.

A 20- to 30-percent blend of absolute ethanol in gasoline has, among others, the following advantages: No detonation, no formation of deposits, cooler operation, and greater economy. Higher compression ratios are advocated.

MASI, F., FIOCK, E. F., and GROSSELFINGER, R. A. (537)
OXYGEN BOOST OF ENGINE POWER AT ALTITUDE. Paper presented at the Soc. Automotive Engin. Natl. Aeronaut. meeting, Los Angeles. Oct. 3–5, 1946; Soc. Automotive Engin. Quarterly Trans. 1: 76–86. 1947.

In connection with ground work and flight tests in which liquid oxygen was used to incrase permissible power of aircraft engines, flight tests also were conducted on the combined use of liquid oxygen and water injection. The latter had many advantages over either system alone.

ROWE, M. R., and LADD, G. T. (538)
WATER INJECTION FOR AIRCRAFT ENGINES. Soc. Automotive Engin. Jour. 54: 26–37, 44. 1946.

This paper deals with water and water-alcohol injection in aircraft engines. The observed cylinder-head cooling is equivalent to the heat of vaporization of 30 to 40 percent of the water present, but the authors believe that this is not the whole explanation. A plot of fuel-air ratio vs. detonation limited i.m.e.p. indicates that in single-cylinder supercharged C.F.R. engines at lean mixtures the order of effectiveness is gasoline, ethanol-water (50:50), water and methanol-water (50:50); whereas at rich mixtures ethanol-water is second only to methanol-water. At engine outputs above 70 percent rated power only slight differences in brake thermal efficiency were observed. Water injection in excess of 50 percent of fuel weight has a tendency to drown out combustion and is overcome by using alcohol-water mixtures and by operating at best power fuel-air ratios. Under full-scale operation, methanol-water is best, then water alone, and finally ethanol-water mixtures. A disadvantage of the use of fuel as an internal coolant, aside from increased fuel consumption, is the loss in critical altitude because of 5- to 10-percent increase in manifold pressure. If 87-octane-number gasoline can be used at low cruise powers through the increased fluid, weight might easily be justified by a large saving of fuel at high loads. Experiments conducted with 50:50 ethanol-water actualy indicated a total fluid weight saving aside from the large saving in fuel cost. The experimental setup is described. The authors sum up their conclusion as follows: (1) Water provides the greatest degree of cooling at high power output. (2) Water-methanol mixtures are superior to water-ethanol mixtures. (3) Water-methanol mixtures provide the greatest increase in detonation limited hp. output. (4) Water-methanol mixtures provide the greatest saving in engine critical altitude. (5) Pure-alcohol addition should not be used for aircraft engines—it will cause a decrease in detonation-limited output when using 100-octane fuel. (6) Water injection will permit the use of 91- and 87-octane fuels in place of 100-octane for equivalent power output up to take-off hp. (7) Water injection can be used most efficiently at lean fuel-air mixtures.

SERRUYS, MAX (539)
CARBURETION IN THE INTERNAL COMBUSTION ENGINES. PART II—ORDINARY CARBURETION BY MEANS OF A CARBURETOR. PART III.—MECHANICAL AND PNEUMATIC CARBURETION. France Énergétique 5: 129–156. 1946.

Part II. After the principles of carburetion have been explained and the action of various standard carburetors (Zenith, Solex, Schmitt-Barriquand, Cozette, etc.) described, various means of obtaining better fuel distribution are discussed. Data given for the "Pulverisateur réchauffeur Defrance" show that this device increases the output and lowers the specific fuel consumption considerably when used with ethanol. The same effect was observed when using the air-preheater model Ziembinsky. Part III. The following injection systems are discussed: Stromberg injection carburetor; Rochefort system (low-pressure injection at inlet valve and insulated air passage); air-injection system, method of Jalbert (data for ethanol and methanol shown; see also No. 1426); manifold injection; direct-cylinder injection systems of Bosch, Junkers, Daimler-Benz, Brandt and Retel. A few experimental data for ethanol and methanol are given.

UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF MINES (540)
REPORT ON THE INVESTIGATION BY FUELS AND LUBRICANT TEAMS AT THE I. G. FARBENINDUSTRIE A. G., LEUNA WORKS, MERSEBURG, GERMANY. U. S. Bur. Mines Inform. Cir. I.C. 7370, 135 pp. 1946; Part III, Morley, R. J., Methanol and higher alcohol synthesis, pp. 15–17; Part XIII, Howes, D. A., Allen, J. G., and Schindler, H., Aviation fuel manufacture and engine testing, pp. 84–86.

It was stated in part III that water-free methanol was used instead of ethanol in motor fuels. In part XIII the statement was made that hydrogenation gasoline with 2 percent of methyl aniline and 7.5 ml. T.E.L./gal. was used in conjunction with methanol-water injection. This combination gave satisfactory results in a regular BMW test engine; however, full-scale tests appeared to indicate that full power could not be obtained with this type of fuel in DB and BMW engines.

VERMAN, L. C., and NAIR, K. A. (541)
RECTIFIED SPIRIT AS FUEL FOR MOTOR VEHICLES. Sci. and Indus. Res. [India] Jour. 4: 601–605. 1946.

Fuel alcohol (denatured rectified spirit) in the United Provinces is not only more expensive than gasoline but in addition gives less mileage per gallon because of its lower heat of combustion. Large amounts of waste sugarcane molasses are available and a large production of ethanol is possible. It is proposed to reduce the tax on fuel alcohol in proportion to the mileage obtainable compared with gasoline. The purpose of the work is to establish such a ratio. A 1943 Chevrolet and a 1941 Ford truck were used for the tests. The ratio of the mileages obtained of fuel alcohol to gasoline was between 0.60 and 0.68, depending on type of vehicle, operating conditions, etc. Normal or slightly above-normal power could be obtained through adjustment of jets. In order to obtain from 90- to 100-percent gasoline power, main carburetor-jet areas were increased by a factor of 2.0 to 2.2 for the Chevrolet and of 1.5 to 1.7 for the Ford. For temperatures below 70° F., either heating or gasoline must be used for starting. Idling performance must be improved, possibly through enlargement of idling jets.

WIEGAND, E. J., and MEADOR, D. W. (542)
ADVANTAGES OF WATER INJECTION. Aero Digest 53: 84–86, 152, 154, 157. Oct. 1946.

Data for methanol-water and water injection are given. Increasing the water-methanol flow from 0 to 4 lbs./b.hp./hr. will increase the detonation-limited b.m.e.p. by approximately 50 percent. At the same time, cylinder temperature is reduced by more than 100° F. and air consumption increased by approximately 10 percent. Cost data are included. A general discussion of injection and other detonation-control methods are given.

1943

COLWELL, A. T., and TAUB, A. (543)
THE TREND IN COMBUSTION CHAMBERS AND FUEL SYSTEMS. Soc. Automotive Engin. Quarterly Trans. 1: 345–358, 414. 1947. Presented at the annual meeting of the Soc. of Automotive Engin., Detroit, Jan. 6–10, 1947.

Data show appreciable increase in power output with alcohol-water injection over that obtainable with supercharging alone.

GOODALE, W. R. (544)
FRIGID STARTING AND OPERATION. Paper presented at the annual meeting of the Soc. Automotive Engin., 5 pp., 10 figs. Detroit, Mich. Jan. 6–10, 1947.

To prevent ice formation in fuel lines and filters of gasoline and Diesel engines, ice preventives are employed. Composition of these is not given but in the discussion of the paper methanol, ethanol, and isopropanol were mentioned as possible components.

Abstract *in* Soc. Automotive Engin. Jour. 55: 51–53. 1947.

GREGORY, A. T. and POMEROY, A. L. (545)
FUTURE TRENDS IN AIRCRAFT-ENGINE DESIGN. Soc. Automotive Engin. Quarterly Trans. 1: 529–548. 1947.

Incidental to the discussion appears the following quotation (pp. 543–544): The injection of water as an internal coolant for the suppression of knock was found to be a successful means of increasing the output of aircraft engines during the war. As a result of this experience, the use of water injection offers much attraction as a substitute for higher octane fuels and a means of satisfying peak cooling requirements. Primarily, because of freezing considerations, the coolant consists of a mixture of water and alcohol. Although not definitely established, it appears that the alcohol not only depresses the freezing point of the solution, but also imparts a chemical action which makes the mixture a more potent antidetonant. From the information at hand, it is apparent that such liquid injection will increase in popularity for take-off and emergency operation. Such short bursts of power produce an increase in octane requirements which can be adequately satisfied by the injection of water and alcohol. While such an expedient will introduce some complications in the form of additional metering equipment, the complexities involved are apparently offset by the price differential of the higher-grade fuel. The use of continuous water injection for cruise operation does not appear likely. The rate of consumption under such prolonged operation will no doubt require the transportation of large weights of water at the expense of payload, with the result that a penalty is experienced. Therefore, while water injection does definitely appear in the picture, its use will be restricted primarily to take-off and emergency high-power operation. In this connection, it should be pointed out that CAA has, at this date, approved certain commercial equipment for the use of water injection.

LEWIS MACCLAIN, A. (546)
FACTORS PRODUCING ERRATIC ENGINE OPERATION. Soc. Automotive Engin., Quarterly Trans. 1: 29–55, 86. 1947.

Water-methanol injection is also reviewed; however, briefly. Water-alcohol is superior to the use of rich mixtures for engine cooling. Water-alcohol injection is of no value when engine is operating with cruising power and lean fuel-air mixture, because excessive cooling may cause rough operation.

STREETS, R. E. (547)
COLD STARTING ABILITIES OF VARIOUS SUBSTITUTE MOTOR FUELS. [U. S.] Natl. Bur. Standards Jour. Res. 39: 39–47. 1947.

A 1939 Ford V-8 engine was used to test the starting abilities of ethanol; of ethanol blended with diethyl ether, acetone, isooctane, naphtha, a "tailored gasoline"; of 95-percent ethanol; of isooctane; and of a tailored gasoline. A few altitude tests were included. A table of suitable alcohol blends for starting is given. The most effective and desirable additive appears to be diethyl ether. More information is needed for an adequate theoretical study. Warming up with ethanol and high ethanol blends is much slower. The effect of altitude in lowering minimum starting temperatures is quite pronounced and should compensate partly for the lower average temperatures encountered.

. VERMAN, L. C., NAIR, K. A., DAS GUPTA, S. K., and KHANNA, M. L. (548)
PRODUCER GAS-RECTIFIED SPIRIT MIXTURES AS FUEL FOR MOTOR VEHICLES. Sci. and Indus. Res. [India] Jour. 6: 137–145. 1947.

Purpose of this work was to test the suitability of a charcoal producer gas-ethanol (90 percent by volume) combination as fuel in automotive engines while making the least possible change and still obtaining satisfactory performance. The use of producer gas alone limits maximum power output to about 50 to 60 percent of that obtainable with gasoline and adversely affects the general performance unless the engine is specially designed or supercharged, in which case the power obtainable with gasoline may be exceeded. Enrichment of producer gas with gasoline has been a common procedure and the use of ethanol had been tried previously by E. Wawrziniok. (See No. 385.) Three gas-alcohol carburetors are discussed and the action of throttle and choke controls as well as a fuse-control fuel valve is described in detail. With the final carburetor arrangement, engine power could be boosted from 47 percent with gas alone to 85 percent with a rich mixture of gas and alcohol with normal fuel consumption. The latter was considered normal if $[C_m/C_o + S_m/S_o]$ equalled unity where C_o and S_o are pounds of charcoal per mile and gallons of alcohol per miles, respectively, while C_m and S_m are the corresponding values for the mixture. Reduction of charcoal consumption to less than 30 percent produced no further increase in power. Both road and bench tests were made.

WEIDER, R. L. (549)
SOME PROBLEMS INCURRED IN SUPERCHARGING GASOLINE ENGINES. Soc. Automotive Engin. Quarterly Trans. 1: 680–686. 1947. Presented at the annual meeting of the Soc. Automotive Engin. Detroit, Jan. 6–10, 1947.

Data show that alcohol-water injection will increase appreciably power output of a supercharged truck engine (451 cu. in. displacement equipped with 237 cu. in. displacement/revolution ROOTS supercharger).

YAMAGITA, ITSURO (550)
IGNITION TIME LAG VS. IGNITION TEMPERATURE OF AVIATION FUELS. PART I. STUDIES IN AIR. n.d. 48 pp. Published as Rpt. PB54003, U.S. Dept. Com. Off. of the Pub. Bd.

Study on lag and flash point of pure hydrocarbons, standard fuels, gasolines, alcohols, ketones, and ethyls by the crucible method under normal pressure in air. Results shown in graphs.
Abstract *in* Bibliog. Sci. and Indus. Rpts. 4 (4): 291. 1947.

III. PRACTICAL EXPERIENCE WITH POWER ALCOHOL

1920

ANONYMOUS (551)
ALCOHOL-BENZOL MIXTURES. Motor Traction 30: 572. 1920; Power Wagon No. 191: 22. 1920.

Results of experiments made by London General Omnibus Company with 50 percent alcohol-benzene blends are given. (See No. 556.)

——— (552)
ALCOHOL-FUEL MIXTURES. Soc. Automotive Engin. Jour. 7: 345. 1920.

Experiences with Natalite and with a 50:50 ethanol-benzene blend (London Omnibus Co.) are mentioned briefly.

——— (553)
FUEL FOR INTERNAL-COMBUSTION ENGINES. Engineering 109: 150. 1920.

This is principally a discussion of the successful use in South Africa of Natalite which is 54 percent ethanol (95 percent by volume), 45 percent ether, and 1 percent triethylamine.

——— (554)
MOTOR FUEL FROM WASTE MOLASSES. Sugar 22: 335–337. 1920.

All the disadvantages of alcohol as a motor fuel can be overcome by an admixture of 40 parts ether to 60 parts alcohol denatured by formula No. 3 for completely denatured alcohol. Equipment for manufacture of both alcohol and ether from Hawaiian waste molasses is described and yields given. Tables are given showing percentage of ether in ether-alcohol mixtures of specific gravity 0.720 to 0.756.

HUBENDICK, E. (555)
SULFITE LIQUOR AS MOTOR FUEL. Papir Jour. 8: 109. 1920.

SHAVE, G. J. (556)
BENZOLE-ALCOHOL EXPERIMENTS ON OMNIBUSES. Engineering 110: 623–624. 1920.

Bench and service data on use of various mixtures of benzene and 95-percent ethanol are given. Some corrosion troubles were encountered; however, many of the blends gave excellent performance. Motor starting difficulties can be overcome by using a small percentage of ether.

1921

ANONYMOUS (557)
STARTING ON ALCOHOL. Soc. Automotive Engin. Jour. 9: 319. 1921.

With proper precautions and manipulation, engines will start on straight ethanol, even at 0° C.

CHASE, HERBERT (558)
ALCOHOL FOR AUTOMOBILES. Sugar 23: 345–346. 1921.

Power alcohol is briefly discussed, and the desirability of higher C.R. and need for carburetor adjustments is cited. Brazilian experiences are mentioned and it is concluded that ethanol is an excellent fuel substitute. Further discussion on the subject is in Automotive Indus. 46: 771–773. 1922. (See No. 713.)

FOSTER, J. P. (559)
MOTOR ALCOHOL; ITS THEORY AND USE. Sugar Cent. and Planters News 2: 521–526. 1921.

In order to prevent the possible corrosive action of ethanol-ether blends, author recommends the addition of either primary, secondary, or tertiary amines, but particularly pyridine. Greater spark advance (25° to 30°) as well as a warming up period after starting are advocated. The Hawaiian mixture mentioned consists of 55.55 percent of 95-percent ethanol, 42.79 percent ether, 1.11 percent kerosene, and .56 percent pyridine.

OSTWALD, WALTER (560)
THE GERMAN MOTOR FUEL PROBLEM. Brennstoff Chem. 2: 321–325. 1921.

Because of the economic conditions, partly as a consequence of the peace treaty (Versailles), author recommends the use of blends of ethanol (95 percent), benzene, and tetralin. To improve stability the addition of isopropanol is advocated. To improve engine performance a close study of carburetion and increase in compression from approximately 4.5 to 7 kg/cm^2 is suggested.

PETCHELL, W. (561)
ALCOHOL FUELS FOR INTERNAL-COMBUSTION ENGINES. So. African Jour. Sci. 18: 143–146. 1921.

This is principally an account of the author's personal experiences. Early corrosion troubles of tanks were due to the denaturant (wood naphtha) used; the later use of pyridine eliminated all corrosion. Aldehydes should not be present in alcohol. No corrosion was found after 25,000 miles on Natalite, and the mileage obtained on the average at full load, ⅔, ½ and ⅓ load was 80.6 percent of that of gasoline. With higher compression and better carburetion this may be improved.

TUNISON, B. R. (562)
SIGNIFICANCE OF ALCOHOL IN THE MOTOR FUEL PROBLEMS. Automotive Indus. 44: 14. 1921.

Engine performance data are given for ethanol used as fuel. Advantages and need of ethanol blends are outlined.

1922

ALDEN, ROY (563)
MOTOR TESTS WITH ALCOHOL. Rept. of Imp. Motor Transport Council of India.

Tests in India conducted on single-cylinder engine show that alcohol makes better motor fuel than gasoline.
Abstract *in* Oil News 10 (17): 37. 1922.

BRADLEY, W. F. (564)
TESTING ALCOHOL-BENZOLE FUEL. Motor Transport 35: 29–30. 1922.

The experience of the Paris Omnibus Company using a 50:50 ethanol-benzene blend is cited. The fuel was "accidentally" available since the ethanol was from accumulated stocks of the war and the benzene constituted reparation payments from Germany. In order to simplify marketing, the French Government agreed to deliver the total amount available (5 million gallons so far) to the Company. Price not disclosed. Corrosion was observed in the fuel system but not in the engine proper.

ECKART, HANS (565)

NEW FUELS FOR COMBUSTION ENGINES. Illus. Motorztg. 1922: 384–387; Dinglers Polytech. Jour. 338: 29–30. 1923.

The use of tetralin (hydrogenated naphthalene prepared by use of a nickel catalyst) as a motor fuel constituent is discussed. A blend consisting of 50 percent benzene, 25 percent tetralin, 25 percent ethanol (95 percent) is a suitable motor fuel.

GODCHOT, PASQUET, ROBERT, and GAY (566)

SCIENTIFIC CONTEST ORGANIZED BY THE AGRICULTURAL COMMISSION OF BEZIERS FOR PROMOTION OF NATIONAL (FRENCH) FUEL. Oil Engin. and Finance 2: 438. 1922; Chim. and Indus. [Paris] Special No., pp. 714–717. May 1923.

Authors recommend using 10 to 15 percent of 95-percent ethanol in gasoline to which a certain amount of one of the following stabilizers must be added: cyclohexanol, cresol, butanol. In addition, acetone, ether, benzene, etc., may also be added to the blend. Blends containing terpenes will foul the engines and should be avoided. Road and bench tests are discussed.

——— and GAY (567)

SOME LABORATORY TESTS WITH THE (FRENCH) NATIONAL FUEL. Oil Engin. and Finance 2: 484–485. 1922; Chim. & Indus. [Paris], Special No., pp. 731–732. 1923.

MAILHE, A. (568)

THE NATIONAL (FRENCH) FUEL FOR INTERNAL COMBUSTION ENGINES. Jour. des Usines à Gaz 46: 257–259. 1922.

According to figures given, the greater part of French gasoline requirements (600,000 tons) may be obtained from domestic sources. A blend consisting of 10 parts gasoline, 2 parts ethanol (95 percent) and 1 part cyclohexane (stabilizer) has only a slightly lower heat of combustion than gasoline alone. A 49.5:49.5:1 ethanol-benzene-ether blend gives excellent results, and good mileage is obtained with ethanol-benzene-tetralin mixtures.

MARILLER, CHARLES (569)

A (FRENCH) NATIONAL MOTOR FUEL AND THE DISTILLATION INDUSTRY. Chim. & Indus. [Paris] 7: 1071–1077. 1922.

Three methods of obtaining anhydrous alcohol are discussed: for a "national motor fuel" a 10 percent ethanol blend is recommended. This blend also contains 4.95 percent methanol, 0.5 diethyl ether, 2.5 percent butanol.

ORMANDY, W. R., and CRAVEN, E. C. (570)

PHYSICAL PROPERTIES OF MOTOR FUELS. Engineering 113: 234–235. 1922.

This is a summary of a paper presented by W. R. Ormandy and E. C. Craven; Inst. Auto. Engin. Proc. 16: 143–175. 1921. (See No. 11.) Heats of combustion, freezing points, separation temperatures of blends, distillation characteristics, flash points, knocking, and viscosities, are briefly discussed. Experiences of the London General Omnibus Company with benzene-ethanol blends are given. Terneplate should be used in tanks instead of iron; however, the use of pyridine, the official denaturant, is said to be alkaline enough to suppress all corrosion.

VOLZ (571)

NATIONAL (GERMAN) FUEL IN WINTER. Auto. Tech. 11 (9): 7. 1922.

No difficulty in the use of ethanol blends was experienced by the author if instructions were followed. In all cases, troubles were traced to the nonobservance of directions.

1923

ANONYMOUS (572)
"DYNALKOL" NEW FUEL IN CZECHOSLOVAKIA. Oil and Gas Jour. 22 (2): 133. 1923.

Dynalkol is a blend of 45 percent of alcohol with benzene to which is added 1 percent naphathalene, 1 percent tetralin or 5 percent ether. It is reported that much difficulty has been experienced from fouling the engine with this fuel.

——— (573)
NAVY HAS ANTI-KNOCK FUEL FOR AIRPLANES. Natl. Petrol. News 15 (31): 80. 1923.

A blend containing 70 percent aviation gasoline, 28 percent absolute ethanol and 2 percent benzene was used satisfactorily without detonation at the Naval air stations.

——— (574)
PARIS BUSES TEST EFFICIENCY OF ALCOHOL AS ENGINE FUEL. Automotive Indus. 49: 257. 1923.

Experiments were carried out using 50:50 ethanol-benzene blends which should be of highest purity to reduce oxidation and formation of carbon deposis.

BAUME, GEORGES (575)
REPORT ON THE WORK OF THE SCIENTIFIC COMMITTEE OF THE (FRENCH) NATIONAL FUEL. Chim. & Indust. [Paris] Special No., pp. 706–713. 1923.

CHAMBIGE, M. (576)
RESULTS OBTAINED IN SPAIN WITH VARIOUS ALCOHOL, NAPHTHALENE, AND TURPENTINE FUELS. Chim. & Indus. [Paris], Special No., pp. 702–705. 1923.

A solution of naphthalene in an ethanol-ether blend was found unsuitable as motor fuel since the engine had to be completely overhauled after 1500 to 2000 km. A blend containing 65 percent ethanol, 25 percent turpentine, 10 percent ether, and 2 percent castor oil appeared to give satisfactory results; however, castor oil must be used to prevent corrosion. The engine had to be cleaned after approximately 20,000 km.

DUMANOIS, PAUL (577)
UTILIZATION OF AN ALCOHOL-GASOLINE MIXTURE OF HIGH ALCOHOL CONTENT. [Paris] Acad. des Sci. Compt. Rend. 176: 1449–50. 1923.

A trip from Paris to Toulouse (720 km.) on a 70:30 ethanol-kerosene mixture is described. Total fuel consumption was 300 kg. at an average speed 40 km./hr. and was only 10 percent above that of gasoline.

GREEN, C. C. (578)
ALCOHOL, THE MOTOR FUEL OF THE FUTURE. SOME DETAILS OF ITS USE IN SOUTH AFRICA. Chem. Age [London] 9: 84–85. 1923.

After discussing briefly the manufacture of Natalite, the writer states his experiences with this fuel. Since Natalite dissolves deposits left by gasoline, fuel lines and tank must be cleaned to prevent choking of jets and filters. Aluminum is attacked but copper can be used. Very rich mixtures of ethanol can be burned and care must be exercised to prevent excess fuel consumption. The latter will be from 10 to 25 percent higher than that of gasoline. Intake manifold heating and greater spark advance are advocated. Practically no carbon deposits were found. Since ordinary lubricating oil is insoluble in Natalite, carbonization takes place and lubrication is unsatisfactory. CastrolR, a vegetable lubricant, was tried with great success.

HADDON, E. (579)
ALCOHOL AS FUEL. Rev. Agr. de l'Ile Maurice 1 (9): 129–130. 1923.

After comparing the properties of ethanol, ether, and gasoline, author believes that a mixture of 20:80 ether-ethanol (Clairine) is an excellent fuel and can stand compression pressures of 180 p.s.i. In ordinary, well adjusted engines, fuel consumption of the blend will be 10 to 15 percent higher than that of gasoline.

LAVEDAN, L. J. (580)
MOTOR SPIRITS AND ETHYLITE. La. Planter 70: 348. 1923.

The use of Ethylite in place of Natalite is to be preferred for the following reasons: It has a lower ether content and is, therefore, more economical; presents less difficulty in cylinder lubrication; is more alkaline and will, therefore, neutralize any acidic compounds formed.

SCARRATT, A. W. (581)
CARBURETION OF ALCOHOL. Sugar 25: 662–663. 1923.

SMALLWOOD, J. C. (582)
BLENDED FUELS FOR AUTOMOTIVE ENGINES. Mech. Engin. [New York] 45: 577–578. 1923.

Results of numerous tests have not proved so far that any blended fuel is far superior to good gasoline. It is estimated that on the basis of cost of operation per mile, including cost of fuel, carbon removal, valve grinding, etc., the cost of blended fuel would not be worth more than an additional 2 cents per gallon.

WATSON, O. W. (583)
THE FUEL QUESTION FROM THE STANDPOINT OF COMMON CARRIERS IN THE CITY OF LONDON. Chim. & Indus. [Paris], Special No., pp. 675–679. 1923.

Information is given in the article by G. J. Shave "Benzole-Alcohol Experiments on Ominbuses." Engineering 110: 623–624. 1920. (See No. 556.)

1924

PETRLIK, KAREL (584)
THE NATIONAL CARBURANT (DYNALKOL) IN CZECHOSLOVAKIA. Chim. & Indus. [Paris] Special No., pp. 281–282. 1924.

A 40:60 ethanol (96.6 percent)-benzene blend is successfully replacing gasoline as fuel in internal combustion engines.

SCARRATT, A. W. (585)
CARBURETION OF ALCOHOL. Sugar 26: 58–59. 1924.

WATSON, O. W., and ORMANDY, W. R. (586)
BENCH TESTS WITH ALCOHOL AND HIGH BOILING POINT GASOLINE MIXTURES. Chim. & Indus. [Paris], Special No., pp. 276–280. 1924.

Article deals with laboratory engine experiments conducted by the London General Omnibus Company in cooperation with Distillers. Co., Ltd., using blends containing gasoline and power methylated spirits (ethanol plus 2.5 percent methanol plus 0.5 percent pyridine plus 5 percent benzene plus trace of dye). The laboratory experiments were sufficiently satisfactory that road tests are being made, the results of which are not yet complete.

1925

DAL PRATO, LUIGI (587)
THE PROBLEM OF THE NATIONAL [ITALIAN] MOTOR FUEL WITH ALCOHOL AS A BASE. Rass. Min. e Metall. Ital. 63: 136–140. 1925; Industria 39: 638–640. 1925.

Details of national competition arranged by Turin club are described. Engine tests using six different fuels containing: (1) 40 percent ethanol and 60 percent gasoline; (2) 38 percent ethanol, 40 percent gasoline, 20 percent benzene, and 2 percent ether; (3) 40 percent ethanol, 30 percent gasoline, 25 percent benzene, and 5 percent ether; (4) 50 percent ethanol, 44 percent gasoline, and 6 percent ether; (5) 76 percent ethanol, 20 percent gasoline, and 4 percent ether; (6) 100 percent gasoline. The tests showed that fuel (4) gave practically the same performance as gasoline and was superior to other blends.

FRITZWEILER, R. (588)
THE USE OF ALCOHOL IN MOTOR FUELS. Ztshr. f. Spiritusindus. 48: 207. 1925.

Comparison is made between efficiency of ethanol-gasoline blends and of gasoline. Curves are shown.

HUBENDICK, E. (589)
SULFITE ALCOHOL AS A MOTOR FUEL. Svensk Motor Tidning. 19: 530, 557, 604, 663, 712, 809, 873, 911, 972, 1091. 1924; *Ibid.* 20: 22, 70, 175, 247, 380, 458, 504. 1925.

The amount of ethanol available in Sweden amounts to about 20 percent of gasoline consumption, accordingly blends used contain from 20 to 25 percent ethanol. These blends are stable under all practical conditions. Even if separation occured, analysis showed that the lower layer contained 40 percent gasoline and should burn in the engine without trouble. Stabilizers are not considered economical and it is much cheaper to use anhydrous ethanol.

1926

NOVÁK, HUGO (590)
DYNALKOL. Chem. Obzor 1: 89–91. 1926.

Advantages of using Dynalkol (60 percent benzene and 40 percent alcohol) are discussed. It can be used with high compression and will start easily.

QUEVEDO, J. C. (591)
ALCOHOL FOR INTERNAL COMBUSTION ENGINES. Sugar 28: 201–202. 1926.

Author defends the use of ethanol as fuel for internal combustion engines and quotes from actual experience over a period of years.

1927

ANONYMOUS (592)
ETHYL ALCOHOL MAKES GOOD SHOWING IN FRENCH FUEL TESTS. Automotive Indus. 57(9): 302–303. 1927.

At a demonstration of domestic fuels the following fuels were used in various French cars: ethanol (anhydrous), carburant national (50:50 tourist grade gasoline and 99.7-percent ethanol), ketol (a mixture of various ketones), cosmoline-alcohol (65 percent of 95-percent ethanol and 35 percent of a mixture principally naphthalene oils), various gasolines, and a gasoline-naphtha blend. Performance with ethanol was similar to gasoline except that starting was more difficult.

DUMANOIS, PAUL (593)
AVIATION FUELS (WITH ESPECIAL REFERENCE TO "WHITE SPIRIT"). "La Technique Aeronautique," pp. 105–109. 1927; [U. S.] Natl. Advisory Com. Aeronaut. Tech. Memo. No. 451, 12 pp. 1928.

The successful use of ethanol with 30 percent kerosene is briefly mentioned.

NEUMANN, H. (594)
EXPERIENCES WITH THE USE OF ETHANOL BLENDS IN SILESIA (GERMANY). Ztschr. f. Spiritusindus. 50: 376. 1927.

Results of a survey throughout the province disclose only favorable comments (smooth running, clean engine, no separation, no starting difficulties in winter, etc.) in regard to the use of the ethanol blend, Monopolin.

RAOUS, M. (595)
NATIONAL FUELS SHOW OF 1927. Indus. des Voies Ferrées et des Transports Auto. 21: 362–369. 1927.

Various automobile engines using fuels other than gasoline are described. Discussion on alcohol, alcohol-gasoline blends, various patented mixtures such as Cosmoline, Ketol, etc., is included.

1928

ANONYMOUS (596)
ALCOHOL-GASOLINE BLEND SHOWS ADVANTAGES IN ROAD TESTS. Chem. & Mettall. Engin. 35: 95. Feb. 1928.

——— (597)
BRITAIN EXPERIMENTS WITH ALCOHOL FOR MOTOR FUEL. Oil, Paint and Drug Rptr. 114: 32. Oct. 15, 1928.

KIMPFLIN, GEORGE (598)
A SURVEY OF THE RESULTS OF THE THIRD ANNUAL ROAD TEST TO EVALUATE NATIONAL FRANCE-BELGIAN FUELS. [France] Ann. de l'Off. Natl. des Combustibles Liquides. 3: 959–984. 1928; Soc. d'Éncouragement pour Indus. Natl. Bul. 127: 890–913. 1928.

The performance of the car using the national fuel (50:50 ethanol-gasoline) was satisfactory. However, ethanol contributes little to the domestic fuel supply since production is very small. The use of synthetic methanol is advocated as a supplement. Benzene and gaseous fuels are discussed also.

PETRLIK, KAREL (599)
MOTOR ALCOHOL. Chem. Obzor 3: 337–338. 1928.

Dynalkol, consisting of 50 percent of 96-percent alcohol, 30 percent gasoline, and 20 percent motor benzene is a satisfactory fuel for Czechoslovakia.

ZDÁRSKÝ, JOSEPH (600)
FUELS FOR MOTOR VEHICLES WITH REGARD TO THE SITUATION IN CZECHOSLOVAKIA. Chem. Obzor 3: 15–17, 44–44, 79–84. 1928.

Dynalkol is widely used in Czechoslovakia. It consisted originally of 60 percent benzene and 40 percent of 96-percent alcohol. At present (1928) is consists of 50 percent of 96-percent alcohol, 30 percent gasoline, and 20 percent motor benzene. Carburetor adjustments are necessary when this blend is used. Dynalkol with absolute alcohol was used successfully in airplane motors. Other motor possibilities are briefly discussed.

1929

ROSE, J. G. and MCMILLAN D. (601)
ALCOHOL MIXTURES AS MOTOR FUELS IN SOUTH AFRICA. Engineering 128: 305–307. 1929.

The results of road tests with ethanol blended with 25 to 30 percent ether, 10 to 20 percent gasoline or benzene, and 1 percent lubricating oil are given. A mixture of 30 percent ethanol (95 percent), 20 percent ether and 50 percent gasoline has been put on the market.

1930

GIRARDVILLE (602)
PRESENT STATUS OF THE PROBLEM OF THE USE OF NATIONAL FUELS FOR USE IN INTERNAL-COMBUSTION OR EXPLOSION ENGINES. Chim. & Indus. [Paris] Special No., pp. 176–184. 1930.

A discussion of the respective merits of the various fuels which have been proposed and tried out to date with some degree of success.

PETRLIK, KAREL (603)
NATIONAL LIQUID FUEL BASED ON ABSOLUTE ALCOHOL. EXPERIMENTS IN CZECHOSLOVAKIA WITH THE RICARD, ALLENET AND CIE. PROCESS. Chim. & Indus. [Paris] Special No., pp. 211. 1930.

The following ethanol blend, stable from —37° to —40° C. has been used successfully in Czechoslovakia:

	Kilograms	*Liters*
Ethanol (96.6 percent)	50	50
Gasoline	30	31.8
Benzene	20	18.2
	100	100

Later, however, the following blend was introduced after bench and road tests had been performed: anhydrous ethanol, 30 kg. or 28.85 percent and gasoline, 70 kg. or 71.15 percent. The anhydrous ethanol used was obtained by means of the patented azeotropic process of Ricard, Allenet and Cie.

SORS, PAUL (604)
MOTALKO IN HUNGARY. Chem. Ztg. 54: 933–934. 1930.

An ethanol-gasoline blend called Motalko is used in Hungary. The chief reason for its use seems to be a necessity of finding markets for alcohol. A mixture containing 20 percent ethanol can be used without change in the carburetor system. A 50:50 mixture requires considerable changes in the motor.

UHLMANN, P. W. (605)
ALCOHOL AS MOTOR FUEL. REPORT ON ROAD TESTS. Chem. Ztg. 54: 818–819. 1930.

Author recalls briefly the experiences with ethanol fuels in Brazil in 1916.

1931

BONAVOGLIO, F. (606)
THE USE OF ALCOHOL AS FUEL. Politecnico [Italy] 79: 651–662. 1931.

Combustion characteristics of alcohol-gasoline and alcohol-benzene mixtures for use in internal combustion engines are discussed. Government regulations in principal European countries are given.

CROSS, W. E. (607)
USE OF ALCOHOL AS FUEL FOR AUTOMOBILES. Rev. Indus. y Agr. de Tucumán 21 (1–2): 5–19. 1931.

After giving a brief review of recent progress in the use of ethanol blends, author believes that these blends show a definite superiority over plain gasoline. The use of ether in blends is discussed and if impure 95-percent ethanol is used, it is necessary to add a basic substance (pyridine, ammonia) to neutralize the acids formed. The Merck process of dehydrating ethanol vapor under pressure by means of lime or potassium carbonate has never found commercial application. Criticisms of the process are mentioned. Finally, the use of ethanol blends in various countries is described.

HUBENDICK, E. (608)
EXPERIENCES WITH ALCOHOL FUELS IN SWEDEN. Mech. Engin [New York] 53: 292–293. 1931.

This is an abstract of a paper by Hubendick published in Petroleum Ztshr. 26 (50): 3–9. 1930.

KOSTUK, E. (609)
DYNALKOL, NATIONAL FUEL OF CZECHOSLOVAKIAN REPUBLIC. Assoc. des Chim. de Sucr. et Distill Bul. 48: 408–415. 1931.

Dynalkol is a 50:30:20 ethanol (96.6 percent)-gasoline-benzene blend.

LOSKOT, KAREL (610)
THE USE OF ALCOHOL FOR MOTOR FUEL MIXTURES. Chem. Listy 25: 37–44. 1931.

A blend used successfully in Europe for 8 years is Dynalkol, composed of 30 parts gasoline, 30 parts anhydrous ethanol, and 20 parts benzene. Another blend that gives good results is anhydrous (99 percent) ethanol 40 parts and gasoline 60 parts.

PETIT, HENRI (611)
EFFECTS OF FUEL ON POWER AND CONSUMPTION OF ENGINE. Vie Auto. 27: 579–580. 1931.

Gasoline, alcohol, and benzene are compared with regard to operating economy.

ROBERTSON, C. L. (612)
POWER ALCOHOL IN SOUTHERN RHODESIA. Rhodesia Agr. Jour. 28: 949–953. 1931.

A blend of 20 parts of alcohol and 80 parts of gasoline was used successfully without carburetor adjustment. In high-speed engines it gave greater mileage than gasoline alone.

1932

BASS, H. H. (613)
THE WORLD PROGRESS OF THE POWER ALCOHOL INDUSTRY. Internatl. Sugar Jour. 34: 26–28. 1932.

The article is an abstract of a paper presented before the Queensland Society of Sugar Cane Technologists. The author advocates the use of anhydrous instead of 96-percent ethanol for blends. An addition of 15 percent of anhydrous ethanol is the highest proportion that can be safely added without requiring engine or carburetor adjustment. Experiments have shown that water absorption of absolute alcohol is negligible when stored in large quantities where the surface-volume ratio is small. When mixed with gasoline to the extent of about 15 percent, the blend is no more hygroscopic than gasoline itself. The author's experiments have shown that under the intensely humid conditions of North Queensland, it would take a number of years for sufficient moisture to be absorbed to cause separation. Lubricating oil is not as easily dissolved in alcohol as in gasoline, hence cylinder lubrication should not be impaired. Crankcase dilution is due to heavy ends of the gasoline and not to alcohol. A mixture of alcohol and gasoline called Shellkol is being marketed in Queensland. Prejudices inevitably associated with a new product are being slowly removed. In France a 50:50 mixture is being sold and used mainly by a few large consumers, such as the Paris omnibus services. In Natal, the use of Natalite has been abandoned in favor of an anhydrous mixture. In the Federated Malay States a distillery is being built to utilize the fruit from the nipa palm. In Germany, as well as other European countries, anhydrous alcohol is being substituted for 96-percent alcohol.

BASTET, A. (614)
ALCOHOL AS A GASOLINE SUBSTITUTE IN INTERNAL COMBUSTION ENGINES. Dépéche Algérienne Mar. 15, Apr. 12, May 4 and June 21, 1932; Internatl. Rev. Agr. [Rome] 23: 343T–345T. 1932.

An engine performance test with gasoline and ethanol is briefly described. With ethanol, power is slightly less and fuel consumption higher than with gasoline. An engine designed for ethanol should show a higher efficiency.

CHARPENTIER, M. H. (615)
RECENT EXPERIENCES AND OPINIONS ON AUTOMOBILE AND AIRPLANE FUELS. Automobiltech. Ztschr. 35: 14–15. 1932.

A general discussion on the use of ethanol-gasoline-benzene mixtures in internal combustion engines.

KUNZE, K. H. (616)
ALCOHOL AS FUEL. Ztschr. f. Spiritusindus. 55: 207. 1932.

Discusses use of alcohol in racing mixtures. In connection with this paper see "Alcohol as motor fuel," Benzol-Verband G.m.b.H. Polemical with reply *by* K. H. Kunze, Ztschr. f. Spiritusindus. 55: 237. 1932.

LIZARRAGA, T., GRONKE, K., and CHURRUCA, C. DE (617)
REPORT ON ALCOHOL AND MOLASSES. Philippine Sugar Assoc., Ann. Rpts. 1931–1932: 44–52.

This is a report by the "Executive Committee Philippine Sugar Assoc." advocating the use of alcohol motor fuels and citing evidence in its support. In one of the letters published, it is stated that no corrosion or wear was noticed with alcohol, while considerable trouble had been experienced previously with kerosene distillate or gasoline.

1933

ANONYMOUS (618)
BENZOL MAKES POSSIBLE "ALKY-GAS" CITIES SERVICE SELLS ABROAD. Natl. Petrol News 25 (20): 23–24. 1933.

The Cities Service Oil Company sells a 16:9:75 ethanol-benzene-gasoline blend in England which gives greater flexibility, power, improved acceleration, miles per gallon, etc. than gasoline.

——— (619)
USE OF GRAIN ALCOHOL IN MOTOR FUEL INVOLVES MANY DIFFICULTIES. Natl. Petrol. News 25 (4): 25. 1933.

Technical objections to the use of alcohol blends are enumerated: (1) Lower mileage per gallon, (2) redesign of carburetor, (3) hard starting, (4) separation into two layers. Economic advantages to the farmer would not offset the effect of increase in cost of motor fuel to the public.

COLEMAN, W. H. (620)
MOTOR BENZENE. World Petrol. Cong. [London], Proc. 2: 753–756. 1933.

The advantages of benzene-gasoline and benzene-gasoline-ethanol blends are discussed.

COURTIER, A. (621)
FUELS WITH ALCOHOL BASE. Nature [Paris] No. 2916: 399–404. 1933.

Advantages of ethanol as fuel are discussed and test conclusions given.

FRITZWEILER, R. and DIETRICH, K. R. (622)
THE STATE OF DEVELOPMENT IN GERMANY OF THE POWER-ALCOHOL QUESTION. Chem. Indus. [New York] 33: 307–309. 1933; World Petrol. Cong. [London], Proc. 2: 784–787. 1933; Oil News 34: 117. 1934.

Ethanol alone is uneconomical because of high fuel consumption and troublesome because of its low vapor pressure. For use with pure ethanol a specially designed engine should be constructed. Blends of ethanol and ether, particularly those containing 20 to 30 percent ethanol, have none of the disadvantages but all the advantages of ethanol. Anhydrous ethanol must be used in gasoline blends; ethanol-gasoline-benzene blends (20:50:30 and 10:50:40) make good fuels.

HOPKINS, C. P., and KUHRING, M. S. (623)
THE USE OF GRAIN ALCOHOL IN MOTOR FUEL IN CANADA. ENGINE TESTS OF ALCOHOL-GASOLINE BLENDS. Canada Natl. Res. Council. Rpt. 77 pp. April 21, 1933. Revised June 19, 1933.

A review of the experience with alcohol fuels in other countries and of tests made at the authors' laboratory suggest that ethanol-gasoline blends containing from 10 to 15 percent of anhydrous ethanol are the most satisfactory. The addition of ethanol to gasoline improves the antiknock qualities and lessens carbon formation; on the whole the blends appear to be somewhat better fuels than gasoline alone. When other conditions are equal, it appears that the mileage per gallon is somewhat less with such ethanol blends although there is a diversity of opinion on this point. Ethanol mixtures are admitted to have certain other disadvantages but none of these appear to offer really serious difficulties provided reasonable precautions are taken. The large consuming areas for motor fuel, as well as most of the distilleries, are in Ontario and Quebec and the cost of transporting grain from the West would be a large item in the cost of ethanol in the eastern provinces. The increase in cost of a 10 percent blend, based on wheat at 60 cents per bushel at Fort Williams, would range from 2.1 to 3.6 cents per Imperial gallon. A saving is possible, however, because the blending would render unnecessary the importation of tetraethyl lead. Lower grades of wheat are suitable for conversion to ethanol but barley appears to be a still cheaper source. The engine tests carried on at the National Research Laboratories with blends containing 5, 10, and 15 percent ethanol show that ethanol is an excellent antiknock agent. The 15 percent blend gave somewhat more power than gasoline alone but fuel consumption was higher.

KELEMEN, J. (624)
USE OF ALCOHOL FUEL FOR GASOLINE ENGINES. An. del Inst. de Ingen. de Chile 33 (2): 48–52. 1933.

Preliminary tests indicate feasibility of using mixtures of 25 percent ether, 74.75 percent alcohol and 0.75 percent castor oil.

MCINTYRE, GORDON (625)
GASOLINE AND ALCOHOL. Canad. Chem. and Metall. 17: 184–187. 1933.

Characteristics and production methods of gasoline-alcohol blends are reviewed. A lower engine performance is obtained with blends than with gasoline if the same fuel economy is required.

MARBEAU, PIERRE (626)
ALCOHOL AS FUEL FOR INTERNAL COMBUSTION ENGINES. Chim. & Indus. [Paris] 29 Special No., pp. 534–538. June 1933.

Author summarizes practical experiences obtained in various countries and cites and gives results of road tests. The advantages of the use of binary and ternary blends are discussed.

SPAUSTA, FRANZ (627)
MIXED FUELS. Sparwirtschaft 11 (5): 157–161. 1933.

Review of experiences in various European countries shows the growing use of alcohol as admixture in gasoline and benzene.

VLUGTER, I. C. (628)
THE ADDITION OF ALCOHOL TO GASOLINE OR BENZENE. Chem. Weekbl. 30: 570–571. 1933.

At C.R. 5:1 (modern engine in 1933) no advantage can be gained through addition of ethanol.

WAWRZINIOK, OTTO (629)
INFLUENCE OF FUELS ON THE STARTING OF INTERNAL-COMBUSTION ENGINES. Automobiltech. Ztschr. 36: 464–470, 496–499. 1933.

No trouble is to be anticipated in starting with ethanol-gasoline blends containing up to 30 percent ethanol.

1934

DILLSTROM, TORBJORN (630)
A HIGH-POWER SPARK-IGNITION FUEL-INJECTION ENGINE. Soc. Automotive Engin. Jour. 35: 431. 1934.

Hesselman engines have been operated with good results on alcohol. No data are given.

INKINEN, MATTI (631)
ALCOHOL-GASOLINE BLENDS IN INTERNAL COMBUSTION ENGINES. Teknillinen Aikakauslehti. 1934 (5–6): 205–206.

Road tests have shown that 20 percent ethanol blends can be used without making any changes in engine. Fuel consumption does not exceed that of pure gasoline and cost is only slightly higher.

SPELUZI, M. (632)
CARBURETION WITH MIXTURES CONTAINING NAPHTALENE OILS. Energia Termica 2: 269–274. 1934.

Results on automotive engine tests with ethanol blends containing naphthalene oils are described.

1935

FORMÁNEK, JAROSLAV (633)
THE EFFECT OF AN ADDITION OF BENZENE TO GASOLINE-ALCOHOL MIXTURES ON THE PERFORMANCE OF THE MOTOR AND ITS FUEL CONSUMPTION. Automobiltech. Ztschr. 38: 409–413. 1935; Mech. Engin. [New York] 58: 119. 1936.

Experiments conducted with 5, 10, 20 and 30 percent benzene in alcohol-gasoline mixtures showed that addition of benzene improves engine starting, lowers fuel consumption, reduces knock, and acts as a blend stabilizer in the presence of moisture.

PIETRUSKY, KURT (634)

ALCOHOL AS BLENDING CONSTITUENT FOR MOTOR FUEL IN THE UNITED STATES. Ztschr. f. Spiritusindus. 58: 219–221, 221–231. 1935.

The performance of gasoline and gasoline-alcohol blends was studied on various cars at speeds from 10 to 60 m.p.h. on straight and inclining roads. Alcohol yield from various agricultural products and prices are quoted.

1936

DIETRICH, K. R., and LOHRENGEL, W. (635)

NECESSARY CHANGES IN FUEL COMPOSITION THROUGH INCREASED METHANOL ADMIXTURE. Oel Kohle Erdoel Teer 12: 455–457. 1936.

A 10 percent alcohol-gasoline blend containing 8 percent ethanol and 2 percent methanol is not sufficiently stable and the alcohol content should be increased to 11 percent. Water tolerance for various blends is given.

HELWICH, L. A. (636)

MOTOR ALCOHOL IN CZECHOSLOVAKIA. Indus. and Engin. Chem., News Ed. 14: 278–279. 1936.

A 20:80 ethanol-gasoline blend has given complete satisfaction and requires only a slight change in carburetor setting. No corrosion was observed. The anhydrous ethanol used contains 2 percent of methanol.

KOO, E. C. (637)

USE OF ALCOHOL AS A MOTOR FUEL IN THE PHILIPPINE ISLANDS. Indus. Res. [China] 5: 411–417. 1936.

In 1936, 41.9 million gallons of gasoline and 7.29 million of ethanol (calculated on absolute basis) were consumed as motor fuel in the Philippines. In other words, 17.4 percent of the fuel consumed was ethanol. Gasanol and Gastarla are blends containing 60 to 65 percent ethanol (96 to 98 percent), 30 to 35 percent gasoline, and smaller quantities of ether, benzene or kerosene. Blended fuels are used in cars, buses, and trucks while denatured alcohol is used in tractors and freight trucks. The fuel prices per English gallon for gasoline, Gastarla and Gasanol were $1.02, $0.68 and $0.80, respectively. Some of Teodoro's data on output and fuel consumption are given. Starting in winter on pure alcohol is difficult. Since annual average temperature in the Philippines is about 60° F., no separation occurs in blends. After 6 years no appreciable corrosion was noticed when using Gasanol; however, it is recommended to replace steel tanks by brass tanks. There is no legal compulsion to use ethanol in fuels. Gasoline and ether are permissible, denaturing agents and all denatured alcohol is tax-free; however, there is a sales tax of 1.5 percent.

NATHAN, M. R. U. (638)

POWER ALCOHOL IN QUEENSLAND. Oil News 40 (1233): 26. 1936.

When the ethanol blends were first introduced in Queensland, motorists experienced trouble with blocked carburetor jets because they failed to remove gum, scale, etc., from fuel lines. Little or no trouble is now experienced with modern cars fitted with filters and sediment bowls; however, a certain prejudice remains. The blend sells at a price ½d. below that of standard gasoline.

STEFANOWSKI, B., and SZCZENIOWSKI, B. (639)

INFLUENCE OF COMPRESSION RATIO AND PREHEATING OF MIXTURE ON BEHAVIOR OF FUELS CONTAINING ETHYL ALCOHOL, ETC. Assoc. des Chim. Bul. 53: 547–553. 1936

Tests proved that ternary mixtures containing 20 to 30 percent alcohol do not result in greater fuel consumption than gasoline alone.

STEGEMANN, W. (640)
RESULTS OF THE EXPERIMENTS WITH ENGINES USING COMPRESSED GAS AND ETHANOL BLENDS. Gas u. Wasserfach. 79: 455–459. 1936.

Compressed gas and an ethanol-gasoline-benzene blend were tested in internal combustion engines and results are given.

1937

CANESTRINI, GIOVANNI (641)
FUEL MIXTURES FOR RACING CARS. III° Cong. Internaz. del Carbonio Carburante. 2nd Session, Liquid Fuels. pp. 27–35. Rome. 1937.

Author traces the history of the use of special fuel mixtures in racing cars and gives a large number of examples. For illustration the following compositions are selected: ethanol (98 percent) 50 percent, gasoline or benzene 30 percent, acetone 20 percent; methanol 78 percent, benzene 16 percent, aviation gasoline 5 percent, castor oil 1 percent; methanol 40 percent, ethanol 40 percent, benzene 15 percent, ether 5 percent, a little castor oil.

ETAL, S. A. (642)
RESULTS OF EXPERIENCES WITH ETHERIZED ALCOHOL "CRIMA", AND ITS POSSIBILITIES IN COUNTRIES POOR IN PETROLEUM. III° Cong. Internaz. del Carbonio Carburante, 2 Session, Liquid Fuels, pp. 51–56. Rome. 1937.

Excerpts of reports of the Italian Ministries of War, Communications, and Aeronautics and others are quoted. It is stated that Crima is non-corrosive and that its use in engines results in good performance with low fuel consumption. Problems of production are discussed.

TAXNER, KAROLY (643)
ALCOHOL AS MOTOR FUEL IN HUNGARY. Szénkisérleti Közlémenyek. 3: 162–167. 1937.

A 20 percent alcohol blend, compulsory in Hungary since 1927, has shown no corrosion of Fe, Sn, Cu, Al, and their alloys, and brass.

1938

AMERICAN PETROLEUM INSTITUTE, COMMITTEE ON MOTOR FUELS (644)
TECHNICAL CHARACTERISTICS OF ALCOHOL-GASOLINE BLENDS. Motor Fuel Facts Series No. 1, 15 pp. New York. 1938.

It is concluded that alcohol-gasoline blends are in most respects somewhat inferior to straight gasoline. They would not be worth a higher price than gasoline of comparable octane rating.

AMERICAN PETROLEUM INSTITUTE, COMMITTEE ON MOTOR FUELS (645)
THE TECHNICAL CHARACTERISTICS OF ALCOHOL-GASOLINE BLENDS AS MOTOR FUELS. Brochure. 11 pp. American Petroleum Institute, New York. 1938.

A comparison is made between gasoline and ethanol blends. It is concluded that the latter are not superior fuels in technical characteristics but in many respects inferior to gasoline.

MILEWSKI, JÓZEF (646)
UTILIZATION OF ETHANOL AS FUEL. Prezegląd Chem. 2: 20–24. 1938.

Under Polish conditions the use of a 25 percent anhydrous ethanol-gasoline blend was not only economical but the unit price was actually less than that of gasoline alone. No separation of the blend was observed when suitable precautions were taken. In the presence of water, corrosion takes place. Fuel consumption was not higher than for gasoline since with gasoline richer mixtures were used.

1939

HUBENDICK, E. (647)
THE DEVELOPMENT OF ALCOHOL AS MOTOR FUEL IN SWEDEN. Kraftstoff. 15: 16. 1939.

For 10 years a 25:75 ethanol-gasoline blend (Lättbentyl) has been used successfully in Sweden. No separation troubles were encountered.

MILLER, HARRY (648)
PRODUCTION POSSIBILITIES OF ALCOHOL FOR ENGINE FUEL. Agr., Engin. 20: 265–266. 1939.

Methods are suggested for lowering the production cost. Personal experience is cited in using a 10 percent blend in a Plymouth engine fitted with an "export cylinder head" giving a C.R. 8.5:1. Fuel consumption was 28 miles per gallon compared with 17 miles per gallon when using gasoline and regular cylinder heads.

STEFANOWSKI, B., DUDZIŃSKI, S., and KARPIŃSKI, B. (649)
SYNTHETIC METHANOL AS MOTOR FUEL. Przeglad Mech. 5: 361–369. 1939.

Properties and results of road tests with synthetic methanol are given.

1940

ANONYMOUS (650)
BRITAIN FAVORS HIGH OCTANE FUELS FOR AIRCRAFT. Automotive Indus. 82: 268–271. 1940.

A table of "racing or record fuels" is given. Compositions of blends containing various proportions of gasolines, benzene, methanol, ethanol, acetone, and T.E.L. are given (see No. 456).

AUSTRALIA, QUEENSLAND, CANE GROWER'S COUNCIL (651)
POWER ALCOHOL. 2 pp. Processed 401 Q 3, Brisbane, Box 1032 N. 1940.

Best blend consists of admixture of 15 to 20 percent alcohol.
Abstract *in* Soc. Sugar Cane Technol. 512: 253. 1941.

JACKSON, R. T. (652)
FIVE HUNDRED MILE RACE RESULTS WITH AN ANALYSIS OF THE NEW DEVELOPMENTS INTRODUCED THIS YEAR FOR STAMINA AND SPEED. Automotive Indus. 82: 549–551, 590–592. 1940.

The use of methanol, ethanol, propanol, acetone, and various blends with benzene and gasoline are mentioned as fuels used in racing engines. Most familiar blend appears to be 60 to 80 percent methanol blended with 10 to 25 percent benzene and balance composed of gasoline of some sort.

MEDICI, MARIO (653)
ACETYLENE-ALCOHOL MIXTURES AS FUELS FOR INTERNAL COMBUSTION ENGINES. Autogene Metallbearbeit. 33: 294–300. 1940.

A considerable number of ethanol-acetylene mixtures were tested in Italian automobile and aircraft engines. Ethanol-acetylene blends containing 2.0 to 3.5 percent acetylene were found to be most economical.

RÖNNHOLM, C. G. (654)
PREPARATION OF MOTOR FUELS FROM TURPENTINE OILS. Finnish Paper and Timber Jour. 22: 339–342. 1940.

The high sulfur content (1.15 percent) and the presence of water make crude filtered sulfate turpentine unusuable in engines. A refined grade "motor" turpentine (0.30 percent S) is satisfactory, provided a small amount of gasoline is added to reduce resin formation. Lubricating oil must be changed more frequently.

1941

BARGER, E. L. (655)
POWER ALCOHOL IN TRACTORS AND FARM ENGINES. Agr. Engin. 22: 65–67, 78. 1941.

Tractor engine field and bench tests at C.R. ranging from 3.75 to 5.65 were conducted using a 46.5 octane number unleaded gasoline and four distillate fuels of octane numbers 31.5, 14.1, 5.8, and 4.3 each blended with 5, 10, 15, and 25 percent anhydrous ethanol. Cost of the ethanol was taken to be 25 cents per gallon, the purchasing price. In general, it was shown that at this price the use of blends would be uneconomical. Distillate-ethanol blends have high critical solution temperatures.

BARRELLIER, R. (656)
ALCOHOL-NAPHTHALENE MIXTURE AS A NEW MOTOR FUEL. Nature [Paris]. No. 3072: 272–273. 1941.

Eighty parts by volume of ethanol and 20 parts benzene with 90 to 100 grams naphthalene and small amounts of castor oil appears to be a satisfactory fuel. The engine starts well even when cold.

BRACKERS DE HUGO, J. (657)
ALCOHOL AND ITS USE IN MOTORS. Carburants Nat. 2: 241–260. 1941.

Discusses possibility of using ethanol as motor fuel in France during war. This is more adaptable to existing vehicles than other substitutes, and entails no loss of power. Since an engine will not start on ethanol at temperatures below 29° C., an auxiliary starting fuel is necessary—gasoline, ether-alcohol mixture, or benzene-alcohol mixture.

GUILLOU, M. (658)
HYDRATED ALCOHOL AND POWER FARMING. Prog. Agr. et Vitic. 116: 267–269. 1941.

The use of hydrated ethanol in tractors appears to give no trouble. In spite of a 20 percent higher fuel consumption compared with gasoline, it is still more economical. Complete combustion is essential. Expansion of ethanol production is discussed.

RAMARAO, G. (659)
METHYLATED SPIRITS AS FUEL IN PETROL ENGINES. Part I. Indian Chem. Soc. Jour., Indus. & News Ed. 4: 83–87. 1941.

Engine tests (Ford V-8 engine) using "methylated spirits" (ethanol-methanol blend) were made and results showed that this fuel might possibly be able to compete with gasoline. Small quantities of naphthalene were added to increase the heat of combustion of the fuel.

1942

DYMOND, G. C. (660)
REVIEW OF FUEL ALCOHOL PRODUCTION AND DUNDER DISPOSAL. So. African Sugar Technol. Assoc., 16th Ann. Cong. Proc. 1942: 43–44.

As long as gasoline is cheap, South Africa is not likely to adopt fuel alcohol because of loss of revenue. Molasses or cane itself may be raw materials for alcohol production and examples of their utilization are given. The experiences with fuel alcohol in Mauritius is described and the following conditions were necessary for its successful use as fuel: (1) Alcohol must be neutral and be at least 92° G. L.; all cases of corrosion were traced to nonobservance of these conditions. (2) Pyridine is an unnecessary expense, gasoline may be substituted. (3) Only engines designed for the fuel should be purchased, or if converted should (a) start and finish on gasoline, (b) have gravity feed, (c) distributor control of ignition, (d) supply tank and carburetor of suitable metal to withstand corrosion, (e) preheat device for low temperatures, and (f) correct compression ratio. Various methods of distillery slop disposal are given.

1943

UNITED STATES CONGRESS, SENATE SUBCOMMITTEE of the COMMITTEE on AGRICULTURE and FORESTRY. (661)
UTILIZATION OF FARM CROPS. INDUSTRIAL ALCOHOL AND SYNTHETIC RUBBER. S. Resolution [extending S. Res. 224–77th Cong.] U. S. Cong. 78th, 1st sess. Senate Res. 80, pp. 1629–1833. 1943.

Hearings include brief statements by the Navy, the National Bureau of Standards, Vita-Meter Corporation, and the Department of Agriculture on the use of ethyl alcohol as a motor fuel. Use of alcohols, alcohol-water solutions, or water alone for take-off have been shown to be advantages. The low heat of combustion of ethanol is one of the most serious drawbacks to its use as aviation fuel.

1944

KUTUZOV, P. K. (662)

CRACKING TURPENTINE. Lesnaya Prom. 1944 (3): 22–25.

The products obtained from cracking turpentine give fuel suitable for starting motors even in cold weather.

STEINITZ, E. W. (663)

ALCOHOL IN MOTOR-CAR OPERATION. Petroleum [London] 7: 202–203. 1944.

Conditions in France, Sweden, and Germany which led to the adoption of ethanol as motor fuel are briefly reviewed. For straight ethanol a special carburetor is required and the Esoma carburetor is described. Blends containing 13 to 18 percent of ethanol may be used with modifications in ordinary carburetors. Ethanol has good antiknock properties and leaves very little carbon deposit.

1945

MORBY, ARMAS (664)

WHAT SWEDEN DID TO OVERCOME PETROLEUM SHORTAGES. Automotive and Aviation Indus. 93 (1): 22. 1945.

Seventy thousand vehicles were driven by producer gas. Shale oil was used in Diesel fuel. Tar oils from wood may be used as substitute for kerosene in agricultural tractors. On July 1, 1942, the Swedish Board of Fuels specified the use of two alcohol blends, Motyl 50 and Motyl 85, containing 50 and 85 percent ethanol, respectively. Straight alcohol is said to cause trouble because of presence of acetic acid. The two fuels were used by the Army ground forces, fire guards, etc. A 25 percent blend caused no difficulty whatever. Lubricants are also discussed.

1946

ANONYMOUS (665)

ROCKET ENGINES POWERS XS–1. Sci. News Letter 50: 406. 1946.

Ethanol in combination with liquid oxygen was used as fuel.

JACKSON, R. T. (666)

ENGINEERING FEATURES OF INDIANAPOLIS RACE CARS. Automotive and Aviation Indus. 94 (11): 20–24, 64. 1946.

This year's list of engines not using blowers shows more alcohol users than ever before. The cars finishing first and third used alcohol. See also article by the same author, No. 652.

LINTVAREV, B. (667)

ALCOHOL FUEL FOR TACTORS AND AUTOMOBILES. Sovkhoz. Proizvod. 6 (3–4): 44–48. 1946.

VOIRET, E. G. (668)

FUEL PROBLEM. Chim. & Indus. [Paris] 55: 423–428. 1946.

The use of methanol as motor fuel is advocated.

Abstract *in* Chem. and Engin. News 25: 391. 1947.

1947

BALLINGER, CLAY (669)

WATER INJECTION OPPOSED FOR CARS. Soc. Automotive Engin. Jour. 55: 88. 1947. (Abstract of speech).

The experience of the author with water-ethanol injection in a 1946 Ford engine (C.R. increased to 8.5:1) indicates that for passenger cars the gain may not be sufficient to warrant installation of equipment. For trucks making long hauls, water injection may be practicable.

JACKSON, R. T. (670)

DESIGN HIGHLIGHTS OF NEW CARS IN THE INDIANAPOLIS RACE. Automotive and Aviation Indus. 96 (11): 24–30, 56. 1947.

It is shown in a table that 12 of the entrants used alcohol blends as fuel. No composition is given.

IV. ECONOMICS: STATISTICS, RAW MATERIALS, METHODS OF MANUFACTURE, PRODUCTION AND COST, LEGISLATION, NATIONAL POLICY

1915

ANONYMOUS (671)

FUEL BECOMES FRENCH GOVERNMENT MONOPLY IN 1917 AND WILL BE MORE WIDELY USED. Automobile 33: 486. 1915.

Since denatured alcohol will become a government monopoly in 1917, the question arises whether alcohol will be used as motor fuel. At the present price of gasoline the French Government should be able to compete successfully and still make a substantial profit.

LOEW, BARON VON (672)

DATA ON MIXED MOTOR FUELS OF INTEREST FOR AMERICAN EXPORT TRADE. Automobile. 33: 709–711. 1915.

1916

ANONYMOUS (673)

"NATALITE," A MOTOR FUEL CONSISTING OF ALCOHOL AND ETHER MADE FROM MOLASSES. Internatl. Sugar Jour. 18: 32. 1916.

For information on Natalite see other references under this subject.

LITTLE, A. D., et al. (674)

INDUSTRIAL ALCOHOL, ACETONE, ACETIC ACID. Indus. and Engin. Chem. 8: 954–958. 1916.

The ideal raw materials for the manufacture of ethanol and acetone are wood waste and sulfite liquor. If cheaply produced, ethanol would be an ideal fuel for internal combustion engines.

Abstracts *of* discussions at the 53d meeting of the Amer. Chem. Soc., New York City.

1917

ANONYMOUS (675)

ALCOHOL FOR MOTOR FUEL IN AUSTRALIA. Metall. and Chem. Engin. 17: 668–669. 1917.

In order to familiarize people with the use of alcohol as fuel, the special committee on alcohol motor fuels appointed by the Commonwealth Advisory Committee of Science and Industry in Australia intends to purchase a small stationary internal combustion engine especially for this purpose. The possible sources of alcohol and the need for a revision of the excise regulations are discussed.

1918

ASTON, B. C. (676)

MANUFACTURE OF FUEL ALCOHOL FROM SAWDUST AND TIMBER. New. Zeal. Jour. Agr. 16: 286–287. 1918.

GRIMWADE, W. R. (677)

CROPS FOR THE PRODUCTION OF POWER-ALCOHOL. Austral. Advisory Council Sci. and Indus. Bul. 7: 153–161. 1918.

The production of ethanol from various Australian crops is thoroughly discussed. Cost and yield figures are given. The same material cannot be used in all sections but should be adapted to the particular climatic conditions.

LYLE, T. R., et al. (678)

POWER ALCOHOL—PROPOSALS FOR ITS PRODUCTION AND UTILIZATION IN AUSTRALIA. Austral. Advisory Council Sci. and Indus. Bul. 6, 69 pp. 1918.

A committee which investigated the possibilities of production and use of alcohol as motor fuel reported that owing to the greater degree of compression that can be used with alcohol, a thermal efficiency of 30 percent can be obtained in a properly designed alcohol engine, as against

25 percent in a petroleum engine. The most suitable raw material which is wasted in Queensland is sugar molasses, sorghum grain being another possible source.

ORMANDY, W. R. (679)
MOTOR FUEL PROBLEM. Inst. Petrol. Technol. Jour. 5: 33–69. 1918.

Postwar requirements for motor fuel in England are estimated to be 200 million gallons a year. Various substitute fuels are discussed. In English colonies in South Africa corn can be grown to produce alcohol at a cost of 3.25 pence per gallon for the raw material only. The use of blends of alcohol with benzene or ether are considered a possibility.

1919

ANONYMOUS (680)
ALCOHOL AS MOTOR FUEL. Autocar 43: 10–11. 1919.

On the basis of information, it is concluded that a petroleum shortage is a grave possibility. Benzene, through increased recovery, and ethanol are excellent fuels and should be used in blends rather than alone, since it is not thought advisable to construct engines primarily designed for burning ethanol. "Alco" gas is mentioned as being sold as motor fuel. Raw materials for the production of ethanol such as molasses, sulfite liquor, and wood are mentioned and also the flowers of the Mahua tree (British India) are said to be a promising source (60 percent by weight of fermentable sugars).

MEIGS, J. V. (681)
ALCOHOL AS MOTOR FUEL. Chem. Age [New York]. 1: 265–268. 1919.

The use of ethanol as motor fuel is advocated in order to make the British Empire self sufficient with regard to fuel supplies. Home supplies from agricultural sources are not available and overseas supplies such as molasses, corn, and flowers of the Mahua tree may be used. Cost of denaturing should be reduced. Both experimental work and educational propaganda are needed if ethanol blends are to be used.

REDWOOD, BOVERTON, et al. (682)
THE PRODUCTION OF ALCOHOL FOR POWER. Chem. Age [New York]. 1: 66–68. 1919.

A comprehensive report of Inter-Departmental Committee on the production and use of alcohol for power and traction purposes in Great Britain. The possibility of increasing production of alcohol in tropical and semi-tropical countries from root crops, cereals, and molasses is discussed.

1920

ANONYMOUS (683)
FUEL FOR MOTOR TRANSPORT. Engineering 110: 120. 1920.

Great Britain has not the requisite raw materials for the production of power alcohol, and coal must remain the chief source of fuel.

——— (684)
POWER ALCOHOL. Times, Trade and Engin. Sup. 16: 274. 1920.

Possible sources of alcohol supply in United Kingdom are mentioned.

BAKER, T. (685)
POWER ALCOHOL: ITS POSITION AND PROSPECTS. Sci. and Indus. [Australia] 2 (2): 95–100. 1920.

Report of Power Alcohol Committee appointed by Australian Advisory Council of Science and Industry is discussed.

BARRY BARNETT, E. DE (686)
POSSIBLE SOURCES OF HOME-PRODUCED MOTOR SPIRIT. Chem. Age [London]. 3: 254–255. 1920.

After discussing various possible sources of fuels, author mentions the possibility of direct fermentation of cellulosic materials to yield acetic acid and fuel gas. Transformation of acetic acid to acetone can be readily effected and would make a good fuel. Raw materials for the production of alcohol are too scarce in Great Britain.

DIEUDONNÉ, E. (687)
COMBUSTIBLE LIQUIDS. L'Age de Fer 36: 465–467. 1920.

Author sees possibilities of increasing production of benzene and alcohol for fuel purposes.

JURITZ, C. F. (688)
A NEW MOTOR SPIRIT. So. African Jour. Indus. 3: 889–894. 1920.

PILE, W. D. (689)
PRODUCTION OF MOTOR SPIRIT FROM COAL. Gas World 72: 331. 1920.

It is estimated that from the utilization of coke byproducts used in metallugical and gas works, the possible total production of motor fuel would be 73.6 million gallons of benzene and 62.8 million gallons of alcohol.

PURGOTTI, A., and PURGOTTI, L. (690)
THE USE OF ALCOHOL IN INTERNAL COMBUSTION ENGINES. "Eterol". R. Scuola Scuola Super. Agr. in Portici, Ann. Ser. II. 16: 1–23. 1920.

The article deals with the various possibilities of ethanol manufacture in Italy for the purpose of increasing domestic fuel production, particularly in cases of war. Cost figures are given. Eterol, a special ethanol-ether blend, is said to be an excellent substitute for gasoline. It has the advantage of constant chemical composition, thus making carburetor adjustments simple. Other advantages are enumerated.

SIMMONDS, C. (691)
POSSIBLE NEW SOURCES OF POWER ALCOHOL. Nature [London] 106: 244–245. 1920.

A review, based on the report of the Fuel Research Board, Department of Scientific and Industrial Research, is given.

1921

ANONYMOUS (692)
THE ADVANTAGES, PRODUCTION AND COST OF NATALITE MOTOR FUEL. Interntl. Sugar Jour. 23: 147–153, 213–216, 266–270, 386–392. 1921.

One of the most promising substitutes for gasoline is Natalite which consists of a mixture of 55 parts of ethanol, 44.9 parts diethyl ether, and .1 part of ammonia to neutralize acids formed on combustion. It is said that Natalite can be made more cheaply than either benzene or gasoline; it has been made for 14 cents a gallon from molasses costing 2 cents a gallon. The largest Natalite plant is at Merebank, Natal, where 45 tons of molasses are mashed daily. Pure cultures of yeast are used daily in the fermentation process, and a mash containing 8 percent alcohol is obtained. The diethyl ether is manufactured under the Annaratone process, which is continuous and automatic. The apparatus consists of a superheater where the alcohol is heated under a pressure of 40 pounds of steam. Here it is volatilized and sent to an etherifier, which consists of a lead-lined cylinder filled with balls, over which sulfuric acid drops continuously. From here the diethyl ether vapors pass to a saturator or washer. The vapors are neutralized and sent to the rectifier. Only seven men are required to operate a plant mashing 45 tons of molasses per day.

——— (693)
MOTOR FUEL. So. African Engin. 32 (3): 55–56. 1921.

Report of Empire Motor Fuels Committee of Imperial Motor Transport Council on utilization of gasoline substitutes as automobile fuels is mentioned (see also No. 700).

——— (694)
NATALITE AND THE WORLD'S MOTOR FUEL POSITION. La. Planter. 66: 316–318. 1921.

Deals principally with the economics, production, and use of ethanol-ether mixtures (Natalite) as fuels for internal combustion engines and their possible use in various countries, particularly those in the tropics.

——— (695)
POWER ALCOHOL DEVELOPMENTS. Autocar 46: 977–978. 1921.

The production in England of Natalite, an ethanol-ether blend, is considered.

BEDFORD, C. H. (696)
INDUSTRIAL (INCLUDING POWER) ALCOHOL. Roy. Soc. Arts Jour. 69: 471–486. 1921.

Possible sources of alcohol within the British Empire are discussed. It is stated that a plant is being erected at Rangoon, Burma, for the manufacture of alcohol from rice straw. Various methods of denaturing alcohol for industrial use are also discussed.

BLANCHET, CHARLES (697)
INDUSTRIAL ALCOHOL. Rev. de l'Ingén. et Index Tech. 28 (4): 179–185, (5): 211–219. 1921.

Manufacture of industrial alcohol and possibility of utilizing it as automobile fuel are discussed.

BOYD, T. A. (698)
MOTOR FUEL FROM VEGETATION. Indus. and Engin. Chem., 13: 836–841. 1921.

Author believes that benzene and ethanol could solve the problem of future supplies of motor fuel since, according to the U. S. Geological survey, petroleum reserves may be exhausted in 13 years.

CLEMENTSON, N. E. (699)
ETHYL ALCOHOL AND COAL FROM SULFITE WASTE LIQUOR. Pulp and Paper Mag. Canada 19: 317–322. 1921.

Eighty-five percent ethanol can be obtained at a cost of 21.4 cents per gallon by means of a new method developed by the Ethyl Co. The residue is equal to the best coal and would sell for $5.13 a ton. The Mechanicville plant of the West Virginia Pulp and Paper Co. was erected for the production of ethanol from sulfite liquor.

GREAT BRITAIN, DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH. (700)
FUEL RESEARCH BOARD.
FUEL FOR MOTOR TRANSPORT. [Gt. Brit.] Dept. Sci. and Indus. Res. 2d Memo. 16 pp. London, H. M. Stationary Office. 1921.

The following topics are discussed: Yield of alcohol from various raw materials; experimental cultivation of Jerusalem artichokes and sugar mangels; molasses as a raw material; production of alcohol from waste cellulosic materials in the British dominions and colonies; synthesis; legislation; and denaturing. It is concluded that manufacture of any substantial quantities of alcohol from home grown (British) materials is remote but that it may be feasible in some dominions and colonies to produce enough alcohol for local consumption.
Abstract *in* Internatl. Sugar Jour. 24: 98. 1922.

HIBBERT, HAROLD (701)
THE ROLE OF THE CHEMIST IN RELATION TO THE FUTURE SUPPLY OF LIQUID FUEL. Indus. and Engin. Chem., 13: 841–844. 1921.

Production of alcohol will solve the problem of future supply of liquid fuel. From 100 kg. of grain, 33 to 44 liters of pure ethanol can be obtained by fermentation processes.

JURITZ, C. F. (702)

RAW MATERIALS FOR INDUSTRIAL ALCOHOL PRODUCTION. So. African Jour. Indus. 4: 167–175. 1921.

Alcohol yields obtained from various agricultural sources are given. Sweet potatoes are suggested as the most hopeful possibility for industrial alcohol.

——— (703)

BACTERIAL PRODUCTION OF MOTOR FUEL. So. African Jour. Indus. 4: 905–910. 1921.

In a contribution from the Department of Agriculture of the Union of South Africa, a review is given of different processes for the bacterial production of motor fuels containing alcohol and acetone. Production of alcohol from wastes such as corncobs, pineapple refuse, and other organic materials by fermentation with certain organisms is described. With *Bacillus acetoethylicum* a yield of 18.6 grams of alcohol and 5.1 grams of acetone was obtained from 100 grams of dry sweet potatoes. Acetol, a fuel consisting of alcohol and acetylene gas, increases the absorption of acetylene gas by addition of acetone to the alcohol, thus increasing the volatility and calorific value of the mixture.

SCARD, F. I. (704)

POWER ALCOHOL IN THE UNITED KINGDOM. Internatl. Sugar Jour. 23: 434–435. 1921.

The amendment to the finance bill which permits duty-free importation of colonial alcohol for denaturing and its conversion to power alcohol is discussed.

TILLERY, R. G. (705)

USE OF ALCOHOL MADE FROM FINAL MOLASSES AS A MOTOR POWER IN CUBA. La. Planter. 67: 142–143. 1921.

Because of unfavorable economic conditions the use of ethanol as motor fuel has greatly expanded and is further encouraged. Gasoline costs more than 50 cents a gallon while 95-percent ethanol is retailed at 35 cents. Slightly lower mileage is obtained with ethanol.

WALLIN, H. (706)

SWEDISH MOTOR FUEL. Svensk Papperstidning 24: 69–71. 1921.

Production of sulfite alcohol in Sweden is estimated to be 20 million kg. If all sulfite plants in the country ran alcohol departments another 20 million kg. might be produced.

1922

ANONYMOUS (707)

ALCOHOL FOR MOTOR FUEL. Soc. Automotive Engin. Jour. 10: 364–365. 1922.

The article is principally for the purpose of advising exporters of automotive equipment to study the problem of alcohol motor fuels since they are used in various tropical countries such as Cuba, the Philippines, Hawaii, South America, etc. Distribution, combustion characteristics, performance, corrosion and problems of metering are mentioned. Alcohol motor fuels are said to give good performance.

——— (708)

FRENCH NATIONAL COMPULSORY FUEL. Jour. du Pétrole 22 (12): 2–4. 1922.

This is the text of the proposed law introducing the compulsory use of denatured alcohol to the extent of 10 percent by volume of fuel blends.

——— (709)

FUEL FOR MOTOR TRANSPORT. Inst. Brewing Jour. 28: 150–153. 1922.

The article deals with the brief general survey on power alcohol contained in "Fuel for motor transport," issued by the Fuel Research Board. In Great Britain the manufacture of alcohol from home-grown materials cannot materially add to the supplies of fuel. In the dominions and colonies alcohol could be produced from molasses or vegetable substances high in starch; however, it is unlikely that it could be produced in excess of local needs.

——— (710)
THE LIQUID FUEL PROBLEM FROM THE FRENCH VIEWPOINT. Bul. Sci. des Étudiants de Paris No. 5: 2–21. 1922; Rev. de Métall. 20: 388–391. 1923. (Extraits.)

ADAM, H. R. (711)
ALCOHOL FUEL MIXTURES. Chem. Metall. and Mining Soc. So. Africa Jour. 23: 112–118. 1922.

The discussion is fundamentaly economic with reference to South African conditions and deals with the use of 95-percent ethanol alone or blended with benzene, gasoline, ethyl, or methyl ether, and acetylene. In cool weather, the engine will not start with 95-percent ethanol, and it is considered that for good starting 10 percent ether should be sufficient. This additon and that of 10 percent commercial benzene should improve the heating value as well as general performance. Methyl ether could be used but would add nothing to the heating value. Even if the price of the blend is equivalent to that of gasoline, popular prejudice must be overcome. This is important.

CAMERON, C. R. (712)
ALCOHOL AS A MOTOR FUEL IN BRAZIL. Sugar 24: 451–452. 1922.

After a great initial popularity of alcohol fuels, the use of such fuels has been abandoned temporarily in Pernambuco. In the author's opinion, this was principally due to lack of planning. There was no standardization of blends, 89-percent ethanol was frequently substituted for 95-percent ethanol and no control of any sort was exercised. For present situation see "Report on Industrial Alcohol" by Inter-American Development Commission, No. 948.

CHASE, HERBERT (713)
THE USE OF ALCOHOL AS FUEL IN EXPORTED VEHICLES. Automotive Indus. 46: 771–773. 1922.

Author recommends that automotive vehicle manufacturers should study the use of alcohol motor fuels in their engines and make necessary changes in order to create a market for their products in tropical countries, such as Cuba, Brazil, etc., where alcohol is used as fuel. The increasing use of blends e.g. 89 percent of 95-percent ethanol, 10 percent gasoline or ether, 1 percent pyridine or other denaturants) in Cuba is discussed and reference is made to C. R. Cameron's report *in* Sugar 24: 451–452. 1922 (see No. 712) regarding the situation in Pernambuco and to work of A. W. Scaratt, *in* Soc. Automotive Engin. Jour. 8: 328–330. 1921 (see No. 321) on tractors. Four minor changes in design and construction are discussed: (1) Increase in compression ratio; (2) heating of manifold; (3) slight changes in carburetor adjustment; and (4) provision for preventing or minimizing corrosion or solvent action.

COLE, H. I. (714)
MANUFACTURE OF INDUSTRIAL ALCOHOL AND ALCOHOL MOTOR FUEL IN THE PHILIPPINE ISLANDS. Philippine Jour. Sci. 21: 17–46. 1922; Chem. Age [New York] 30: 489–492. 1922.

Author discusses in a general way the use of alcohol blends as a motor fuel in the Philippines. The most abundant and cheapest raw materials for the production of alcohol are cane molasses and the juices of various palms.

GREBEL, A. (715)
STUDY OF FUEL QUESTION IN FRANCE. Génie Civil 81: 537–541, 558–563. 1922.

The French fuel supply situation is analyzed in detail and methods are suggested for increasing present production of domestic fuels.

MARILLER, CHARLES (716)
A NATIONAL (FRENCH) LIQUID FUEL. Tech. Moderne 14: 497–499. 1922.
The article summarizes material presented at the "Congress on Liquid Fuels" dealing with the "national fuel." Anhydrous ethanol blends are recommended, and it is stated that the ethanol production of France is too small at present to supply all necessary fuel requirements.

MILLET, M. (717)
USE OF ALCOHOL AS A FUEL. Cong. Prod. Colon. Marseilles 1922: 197–201.
A fuel similar to Natalite is advocated as fuel for French colonies.

OSTWALD, WALTER (718)
NEW DEVELOPMENTS IN THE FIELD OF MOTOR FUELS. Ztschr. f. Angew. Chem. 35: 278–280. 1922.
The development of internal combustion engines and fuels is discussed, and the author believes that a blend containing 50 percent benzene, 25 percent tetralin and 25 percent of 95-percent ethanol is best suited for German postwar conditions.

1923

BARBET, EMILE (719)
AGRICULTURAL DRYING PLANTS. Assoc. des Chim. de Sucr. et Distill. Bul. 40: 389–397. 1923.
A project of planting 400,000 hectares of beets to supply alcohol as motor fuel in France is discussed.

BERTHELOT, DANIEL (720)
THE SCIENTIFIC STUDY OF LIQUID FUELS. Chim. & Indus. [Paris], Special No., pp. 71–79. May 1923.
The French domestic fuel supply situation is discussed, particularly in regard to ethanol. The membership of a committee to study the use of ethanol blends is given and its proposed work plan presented.

DIOR, L., and LASTEYRIF, C. DE (721)
COMPOSITION OF ALCOHOL-GASOLINE MIXTURES KNOWN AS NATIONAL MOTOR FUEL. Soc. d'Encouragement pour Indus. Natl. Bul. 135: 451–452. 1923.
French Government specifications requiring the admixture of ethanol to benzene and gasoline are outlined.

FURNESS, REX (722)
POWER ALCOHOL FROM CALCIUM CARBIDE I, II. Chem. Age [London] 8: 280–281, 304–305. 1923.
Power alcohol could be produced economically in England with cheap electric power.

GILMORE, R. E. (723)
DENATURED ALCOHOL IN CANADA. II. RECOVERABILITY AND TOXICITY. DENATURED ALCOHOL IN GREAT BRITAIN AND UNITED STATES. INDUSTRIAL ALCOHOL FOR MOTOR FUEL. QUALITY AND PRICE. Canad. Chem. and Metall. 7: 155–158. 1923.
Denaturants used in Great Britain, Canada, and United States are discussed and compared. Power methylated spirits consist of 92 parts ethanol, 5 parts benzene, 2.5 parts wood naphtha, 0.5 parts pyridine plus yellow and red dye. Two kinds of denatured ethanol, containing 10 percent benzene and 1 percent gasoline, respectively, have been authorized for use as motor fuel in the United States. The author believes that Grade No. 2 containing pyridine would be most suitable for use as motor fuel in Canada.

GRANDMOUGIN, EUGÈNE (724)
ALCOHOL AS A MOTOR FUEL. Génie Civil 83: 5–8, 198–202, 224–228, 246–248. 1923.
Author discusses various raw materials for alcohol manufacture and concludes that beet sugar is the most economical source.

HORAINE, P. (725)
INDUSTRIAL ALCOHOL IN POLAND. Chim. & Indus. [Paris] Special No., p. 673. May 1923.

LANE, F. W., and BAUER, A. D. (726)
ECONOMIC ASPECTS OF MOTOR FUEL SUPPLY FROM PETROLEUM. Indus. and Engin. Chem. 15: 479–481. 1923.

Various possible sources of motor fuels are discussed. Rough estimates are given of the amount of ethanol obtainable from waste products, such as wood waste.

LEVI, M. G. (727)
THE ITALIAN FUEL PROBLEM. Cong. Naz. di Chim. Puro ed Appl., Atti 1923: 212–214.

A review of the fuel situation in Italy. Alcohol and nonedible vegetable oils are considered as possible future sources of fuel.

MEZZADROLI, GUISEPPE (728)
ALCOHOL AS FUEL AND ITS PRODUCTION IN ITALY. Giorn. di Chim. Indus. ed Appl. 5: 125–128. 1923.

The economic aspects of alcohol motor fuels in Italy are discussed. Raw materials considered are grape dregs, molasses, sugar beets, figs, and carob bean.

NATHAN, F. L. (729)
MOTOR FUELS, ESPECIALLY ALCOHOL. Chim. & Indus. [Paris], Special No., pp. 627–634. May 1923; Fuel in Sci. and Pract. 2: 249–254. 1923.

Discussion of the possibility of finding suitable substitutes in sufficiently large quantities for petroleum products.

SLADE, E. J. W. (730)
FUEL RESOURCES AND SUPPLIES FOR ROAD TRANSPORT. Inst. Petrol. Technol. Jour. 9: 452–468. 1923.

Benzene, alcohol, and various blends are considered as substitutes for gasoline.

SOCIÉTÉ DES INGÉNIEURS CIVILS DE FRANCE. (731)
SYMPOSIUM ON NATIONAL MOTOR FUEL IN FRANCE. Soc. des Ingén. Civils de France Procès-Verbal No. 4: 127–131, No. 5: 151–186, No. 6: 202–250. 1923; *Ibid.* Mém. et Compt. Rend. des Trav. 76 Nos. 1–3. 1923; Génie Civil 82: 239–240, 288–289, 370–373. 1923. (Information given here taken from Génie Civil.)

The folowing authors participated: Barbet, Emile; Baume, Georges; Bertholet, Daniel; Carbonado, M.; Connick, Marcel de; Ferrus; Galibourg; Grebel, A.; Guiselin; LeGrain, René: Lindet; Lizeray; Mariller, Charles; Nourry, J.; Patart, G.; Perdier, J.; Roman, L.; Verola, P.

Daniel Bertholet gives principally a historical résumé of the national fuel situation. Baume believes the best way to utilize anhydrous ethanol would be as a constituent in blends. Straight 95-percent ethanol or the use of stabilizers are considered impracticable. In the performance of ethanol blends no adverse effects have been noted. Perdier reports the experience of the Compagnie Générale des Omnibus de Paris et la Société des Transports en Commune de la Région Parisienne with a 50:50 ethanol-benzene blend. Fuel consumption was 25 percent greater than with gasoline. Up to the present, busses have run 64.5 million kilometers and it is concluded that benzene-ethanol blends are suitable fuels.

Bench tests were also reported with the following fuels: 90-percent ethanol; ethanol-benzene-ether; acetylene dissolved in ethanol-benzene; ethanol-benzene-heavy gasoline-phenol; equal proportions of ethanol. benzene, and gasoline. Further papers deal with the economics of alcohol production from raw materials such as sugar beets and potatoes and the use of naphthalene and vegetable oils as fuels, but the principal topic is the use of ethanol and ethanol blends in internal combustion engines. The fuel consumption of straight alcohol compounds with gasoline is in approximately the inverse ratio of their respective heats of combustion, assuming same conditions. Ten- to twenty-percent blends appear to give good performance without increase in fuel consumption. The price of alcohol appears to be too high, and if alcohol fuels were sold at the price of gasoline it could be done only with government aid.

Mariller states that anhydrous ethanol may be obtained at the same price as 95-percent ethanol. However, for use as a motor fuel, ethanol must become cheaper. Noury describes a dehydration method using quicklime. Galibourg completes his talk given at the previous meeting by giving additional data on the performance of 50:50 ethanol-gasoline blends. Carbonaro points out that with appropriate changes in the engine (increased compression ratio, changes in carburetor, etc.) ethanol will give performance identical with that of gasoline. The price, however, is too high. Lindet believes that while the price of gasoline will go up, that of ethanol will gradually diminish. In view of the importance of the question, two papers presented at the last session are more fully reproduced since they give the general aspect of the question.

Patart, G., "The French resources with respect to motor fuels." Various sources of carbohydrates (beets, potatoes, etc.) and their possible yields are investigated. It is concluded that the use of alcohol as motor fuel has not been retarded because of insufficiency of supply nor because of technical difficulties, but because of price. The price should at least be equal to that of gasoline. The national fuel supply could also be greatly supplemented through the manufacture of liquid fuels from coal.

Daniel Berthelot, "The technical problems in the employment of alcohol blends." With the advent of the commercial production of anhydrous ethanol there is no problem of stability. Ten-, fifteen-, or twenty-five-percent blends may be used. However, it was deemed prudent for the sake of introduction to have a sufficient quantity of ethanol in order to make separation impossible. With a 50:50 ethanol-heavy gasoline it would take an addition of 2 liters of water to 100 liters of fuel to effect separation, a quantity of water which could not be added to gasoline without impurity. Practically the same power output (or little better) can be obtained with ethanol blends at the same compression ratio. Laboratory tests indicated that for 30 and 50 percent ethanol blends fuel consumption is greater by 8 and 15 percent, respectively. However, road experiences with ethanol blends showed no or only slightly higher consumption because of elimination of knock. The law requires the purchase of ethanol equivalent to 10 percent of the imported gasoline. This does not mean, however, the requirement of a uniform blend. Ricardo's work on the effect of compression ratio on efficiency is cited.

1924

Anonymous (732)

THE MANUFACTURE OF INDUSTRIAL ALCOHOL. So. African Jour. Indus. 7: 32–35. 1924.

Raw materials, cost of production, denaturants, and coloring of motor fuel in South Africa are discussed.

——— (733)

POWER ALCOHOL FROM BEETS. Soc. Chem. Indus. Jour., Chem. and Indus. 43: 1268–1269. 1924.

British Power Alcohol Association asked the Minister of Agriculture to extend the proposed subsidy for production of sugar from beets to the production of power alcohol. The aim of the Association was to encourage the establishment of central factories on a cooperative basis with farmers participating in the profits. Ten years' subsidy would show whether power alcohol could be made in Great Britain to compete with gasoline which is rapidly diminishing.

BARBET, EMILE (734)
ALCOHOL AS AUTOMOBILE FUEL. Chaleur et Indus. Sup. to Dec. 1924 number, pp. 163–176.

After summarizing the need of France to develop her own fuels, author states that ethanol would appear to be the most desirable fuel and discusses in detail the production of alcohol from beets. The use of absolute alcohol is advocated.

BAUME, GEORGES (735)
THE PROBLEM OF NATIONAL FUEL. Ann. de Chim. Analyt. 6: 97–101, 136–144. 1924; Cong. Naz. di Chim. Indus. Atti 1924: 140.

The fuel problem and gasoline substitutes especially in France are outlined. The manufacture of power alcohol, its denaturization, and production figures are included.

BEDFORD, C. H. (736)
ALCOHOL AS A SOURCE OF POWER. 1st World Power Conf. London Trans. 3: 329–344. 1924.

The following topics are discussed: Raw materials; problems in connection with production in tropical countries; blends; heats of combustion; ignition temperature; lubrication; starting; and fuel consumption. The problem of fuel supply within the British Empire is brought into the picture in connection with the waning liquid fuel supplies throughout the world.

FOUQUE, ROBERT (737)
FRENCH COLONIAL FUELS. Génie Civil. 85: 296–298; 315–318. 1924.

Author discusses the use of ethanol, vegetable oil, and producer gas from wood as possible fuels in French colonies. An engine designed for ethanol could also be used for producer gas since both fuels can stand high compression ratios.

GALLO, GINO (738)
THE PROBLEM OF LIQUID FUELS (FOR AIRCRAFT ENGINES). [U. S.] Natl. Advisory Com. Aeronaut. Tech. Memo. No. 270, 10 pp. 1924.

Author discusses the motor-fuel situation in the light of petroleum reserves, the possibilities of synthetic fuels, and the use of alcohol and alcohol blends.

MAILHE, A. (739)
AUTOMOBILE FUEL PROBLEM FROM THE FRENCH POINT OF VIEW. Tech. Moderne 16: 773–781. 1924.

MEZZADROLI, GIUSEPPE (740)
THE PROBLEM OF ALCOHOL AS A MOTOR FUEL IN ITS RELATION TO AGRICULTURE. Cong. Naz. di Chim. Indus. Atti 1924: 171–175.

ORMANDY, W. R. (741)
POWER ALCOHOL. RESOURCES OF THE EMPIRE SERIES. Fuel in Sci. and Pract. 3: 139–199. 1924.

RAY, GEORGES (742)
SOME ASPECTS OF THE (FRENCH) NATIONAL LIQUID FUEL PROBLEM. Chim. & Indus. [Paris], Special No., pp. 283–285. May 1924.

Best methods for increasing production of alcohol in France are discussed.

RYDER, C. D. (743)
MANUFACTURE OF INDUSTRIAL ALCOHOL. Indus. Austral. and Min. Standard 72: 805, 855–856. 1924.

Author discusses raw materials available all over the world from which industrial alcohol may be produced. Some figures for alcohol yields from cereals and grains are quoted.

1925

Brame, J. S. S. (744)

motor fuels. Roy. Soc. Arts Jour. 73: 920–940, 942–954. 1925.

The first lecture deals exclusively with world production statistics, British imports of petroleum products, and the use of various types of gasolines. The second lecture entitled "Power Alcohol" makes reference to the three reports issued by the Fuel Research Board and cites the conclusion reached by it and others that under prevailing economic conditions power alcohol is not likely to be used for some time; however, it is a fuel with an "undoubted future." The question of denaturants is important; they must be completely miscible with all constituents of motor fuels, not be readily removable, have a nauseous taste but not actively poisonous, be stable and not corrosive, and be procurable in sufficient quantities at relatively low cost. The Power Methylated Spirits Regulations (1921) are quoted. The explosive limits as well as the ignition temperatures are higher for alcohol than for gasoline or benzene, thus making alcohol a safer fuel. Physical properties, viscosity, explosive range, and calorific values of the various fuels are compared and their importance discussed.

The third lecture deals with "the fuel/air mixture." Since the heat of combustion per cu. in. of mixture is the same for gasoline, benzene, and ethanol, no difference in output can be expected on that score; however, due to the higher heat of vaporization and thermal efficiency, power output will be somewhat increased. Maximum power output fuel-air ratios, exhaust gas analysis, preignition, and detonation are discussed. The work of H. R. Ricardo on the H.U.C.R. of various fuels as well as T. Midgley Jr.'s work on antiknock compounds are mentioned. Hydrocarbons only, gasoline-alcohol, and alcohol-nonhydrocarbon fuels are considered briefly. Anhydrous ethanol must be used in order to produce a stable blend. Continuity of supply is important.

Broni, Nicola (745)

the motor-fuel crisis and remedies for surmounting it. Giorn. di Bibliog. Tec. Internaz. 1925, (2) : 1–8, (3–4) : 3–13, (5) : 1–8, (6) : 1–9; 1926, (1) : 3–9.

Different types of motor fuel, including alcohol and vegetable oils, are discussed in detail. Economic, chemical, and engineering data are included.

Fouque, Robert (746)

african fuel alcohol; cost of production as compared with that of beet alcohol. Cong. Chim. Indus., Compt. Rend. 5: 362–368. 1925.

Freeland, E. C. (747)

alcohol motor fuel from molasses. i. use of cane molasses for manufacture of motor fuel. Indus. and Engin. Chem. 17: 615–621. 1925.

Author discusses the availability of molasses, method of manufacture, equipment needed, and cost data of alcohol and alcohol-ether-gasoline blends from cane molasses, with special reference to their manufacture on sugar plantations. The importance of careful investigation of problems, such as greater efficiency in manufacture, composition of fuel, denaturants, marketing, etc., is stressed.

Furness, Rex (748)

synthetic motor fuels. Indus. Chem. and Chem. Mfr. 1: 475–480. 1925.

Author discusses costs of production: of ethanol by fermentation, synthetic methanol and ethanol, synthol, benzene, etc. and concludes that gasoline will continue to dominate the liquid motor fuel market as long as its present price is maintained.

GREAT BRITAIN, DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, FUEL RESEARCH BOARD. (749)

POWER ALCOHOL FROM TUBER AND ROOT CROPS IN GREAT BRITAIN. [Gt. Brit.] Dept. Sci. and Indus. Res., Fuel Res. Bd., Fuel for Motor Transport 3rd Memo. 37 pp. 1925.

Potatoes, mangels, and Jerusalem artichokes are discussed as possible raw materials for alcohol production. The mangel is superior to the potato since it is easier to grow, harvest and store; however, it cannot be grown in the north of England and in Scotland owing to its susceptibility to frost. The Jerusalem artichoke seems to be the most suitable raw material, in that it can be grown in almost any well-drained soil and no replanting is necessary for many years once a plot is established.

Abstract *in* Nature [London] 115: 890. 1925.

LANGWELL, H. (750)

POWER ALCOHOL PROBLEM. Indus. Chem. & Chem. Mfr. 1: 14–16. 1925.

Economics of production of alcohol from cellulosic materials is discussed.

PIQUE, RENÉ (751)

THE NATIONAL MOTOR FUEL. Assoc. des Chim. de Sucr. et Distill. Bul. 42: 252–261. 1925.

On February 28, 1923, the "carburant national," an alcohol-base motor fuel, was officially introduced in France. Previous to this on Nov. 20, 1922, importers of gasoline or similar fuels were bound by law to purchase a quantity of alcohol equal to 10 percent of the amount of fuel imported. After an extended review of the history of alcohol fuels up to 1923, data of various tests made are given. Troubles encountered as, e.g. gum formation, were due either to poorly rectified alcohol or to the denaturants used. It is concluded that the carburant national has given complete satisfaction and that the price is reasonable. Alcohol produced from beets is at present more economical and practical.

PIRLOT, A. (752)

MOTOR FUELS. Féd. des Indus. Chim. Belg. Bul. 4: 387–402, 463–471. 1925.

Production of ethanol for motor fuel and its utilization in blends with benzene and tetralin are discussed.

WALKER, HERBERT (753)

DATA ON ALCOHOL MOTOR FUEL IN THE PHILIPPINE ISLANDS. Internatl. Sugar Jour. 27: 82–83. 1925.

Production of absolute alcohol in the Philippines by continuous distillation and use of alcohol as motor fuel blended with ether or gasoline are discussed.

1926

ANONYMOUS (754)

GASOLINE AND PETROL. Jamaica Agr. Soc. Jour. 30: 474–476. 1926.

Author advocates the use of power alcohol in Jamaica in order to stabilize rum production. The demand and consequently the price of rum fluctuates between wide extremes.

ANNARATONE, DUILIO (755)

THE NATIONAL [ITALIAN] MOTOR FUEL. Notiz. Chim. Indus. 1: 113–114, 147–149, 184–187, 309–310. 1926.

Author discusses mineral and vegetable sources of motor fuels in Italy and mentions advantages and disadvantages of ethanol over gasoline.

CROSS, W. E. (756)

THE UTILIZATION OF MOLASSES. Rev. Indus. y Agr. de Tucumán 17: 81–122. 1926.

Manufacture of alcohol from molasses, denaturation, and use in internal-combustion engines are discussed.

FOUQUE, ROBERT (757)

AFRICAN FUEL ALCOHOL: COST OF PRODUCTION AS COMPARED WITH THAT OF BEET ALCOHOL. Chim. et Indus. [Paris] Special No., pp. 362–368. Sept. 1926.

Cost of production of ethanol from agave in Algeria would be about half the cost of production of ethanol from beets in France.

GENTSCH, W. (758)

ALCOHOL AS MOTOR FUEL IN GERMANY. Brennstoff–u. Wärmewirt. 8: 261–264. 1926.

A discussion of the economics favoring adoption of alcohol as motor fuel.

GREAT BRITAIN. MINISTRY OF AGRICULTURE AND FISHERIES. (759)

POWER ALCOHOL PRODUCTION. REPORT OF DEPARTMENTAL COMMITTEE ON POWER ALCOHOL PRODUCTION FROM SUGAR BEET. 14 pp. London, H. M. Stationery Off. 1926.

Total cost of conversion of sugar beets to 95-percent ethanol equals 9d. per gallon. With sugar beets at £1 and £2 per ton, the cost per gallon of 95-percent ethanol is 15.9d. and 25.9d., respectively. Denaturation, selling charges, etc., are not included. One gallon of 95-percent ethanol is equivalent to less than three-fourths gallon of gasoline. A summary of processes for production of alcohol is appended. The addition of 0.5 percent of castor oil to Natalite (60:40 ethanol-ether) to prevent corrosion is mentioned. A statement implies that the "Oil Trust" has "cornered" the molasses market (price increased from £2 to£4 10s. in 5 years) and is producing up to 100 million gallons of aviation and power alcohol a year in Baltimore.

Abstract *in* Oil. Engin. and Technol. 7: 473–475. 1926.

HUMBOLDT, E. (760)

MAKING ALCOHOL-ETHER MIXTURE IN CUBA FOR MOTOR FUEL. Chem. & Metall. Engin. 33: 332–336. 1926.

A description of the process for making ethanol-ether blends containing from 20 to 35 percent of ether. These blends are very satisfactory fuels.

1927

COOK, G. A. (761)

THE POSSIBILITIES OF POWER ALCOHOL AND CERTAIN OTHER FUELS IN AUSTRALIA. Austral. Council Sci. & Indus. Res. Bul. No. 33: 7–106. 1927; Engineering 124: 706–707. 1927.

An enlarged edition of Bul. No. 20, presenting the possibilities of manufacturing ethanol in Australia from cellulosic materials such as sawdust, wood, sulfite waste liquors, and straw husks. Ethanol from ethylene and acetylene, and methanol from carbon monoxide and hydrogen are also considered.

GREAT BRITAIN. DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH. FUEL RESEARCH BOARD. (762)

POWER ALCOHOL FROM GRASSES, STRAWS AND WASTE VEGETABLE MATERIALS. [Gt. Brit.] Dept. Sci. and Indus. Res. Fuel Res. Bd. 4th Memo. 26 pp. 1927.

Conversion of hemicelluloses to manoses by acid hydrolysis and fermentation of the resulting pentoses are described. No real technical difficulties are present; however, raw materials (waste vegetable materials) must be available in sufficient quantity and at sufficiently low cost. The cost of harvesting grasses might preclude their use as raw material.

KIMPFLIN, GEORGES (763)

A FRENCH NATIONAL LIQUID FUEL POLICY. Chaleur et Indus. 8: 437–448. 1927.

Author discusses various measures by which France could become self-sustaining in regard to her supply of liquid fuels for internal-combustion engines.

MORRELL, J. C. and EGLOFF, G. (764)
MANY FUTURE SOURCES OF MOTOR FUEL. Oil and Gas Jour. 26 (18): 202, 400, 402, 404. 1927.

Sources of motor fuels and methods of production are reviewed. Methanol and ethanol are included and Ricardo's work is referred to briefly. It is stated that alcohol will make a valuable blending agent with hydrocarbons to prevent knocking of motor. Cost appears to be a limiting factor.

NATHAN, F. L. (765)
FUEL FOR INTERNAL COMBUSTION ENGINES. Soc. Chem. Indus. Jour., Trans. and Commun. 46: 211T–220T. 1927.

It is not considered possible to grow enough plant matter in Great Britain for the production of ethanol. In the Dominions and colonies, however, it is practicable and examples are cited. The acid hydrolysis of vegetable cellulose materials for conversion to fermentable sugars as well as the possibility of obtaining ethanol from ethylene and carbide are mentioned. The stability of blends containing ethanol (95 percent) is briefly discussed and the blend, Discol, composed of 50 percent ethanol (95 percent), 25 percent benzene, and 25 percent gasoline, is suitable for motorcycle operation.

PETRLIK, KAREL (766)
DEVELOPMENT OF THE USE OF DYNALKOL IN CZECHOSLOVAKIA. Chim. & Indus. [Paris] 17, Special No., pp. 246–247. 1927.

The good qualities of Dynalkol (50:50 ethanol-benzene blend) the national fuel of Czechoslovakia, are emphasized.

SCHULZ, BRUNO (767)
PROGRESS IN PRODUCTION AND UTILIZATION OF LIQUID FUELS. Brennstoff-u. Warmewirt. 9: 9–16. 1927.

Oil production statistics are given for various countries, and the lack of new discoveries is stressed. Other sources of liquid fuels such as hydrogenation and the synthol process are mentioned. Fuel requirements for various industries are discussed. Blends of 95-percent ethanol with benzene or gasoline are preferable to straight 95-percent ethanol. The latter has a tendency to form rust because of its high water content. Blends permit the use of higher compression ratios.

WAGUET, P. (768)
THE NATIONAL FUEL AND THE FRENCH AGRICULTURAL PRODUCTION. Rev. des Prod. Chim. 30: 85–90, 123–128, 327–330, 446–451, 485–488, 686–690, 727–729. 1927.

Author deals with the production of ethanol from agricultural products and discusses the economics of the use of ethanol alone or in blends with gasoline or benzene as motor fuel.

1928

ANONYMOUS (769)
ALCOHOL AND ALTERNATIVE FUELS IN ITALY. [France] Ann. de l'Off. Natl. des Combustibles Liquides 3: 143–145. 1928.

Ninety-five percent ethanol is employed in blends; however, the amount of alcohol available is relatively small.

——— (770)
CHEAP ALCOHOL FUEL. Petrol. Times 19: 868. 1928.

A brief discussion of the possible economic importance of various processes for making alcohol from wood by means of acid conversion. The Prodor and the Bergius processes are mentioned.

Burrell, G. A. (771)
status of substitute motor fuels. Oil and Gas Jour. 27 (22): 56. 1928.

Author reviews various substitue fuels used in the United States and other countries. These include Carburant National of France, a blend of 50:50 ethanol-gasoline; Natalite (54:45:1 ethanol-ether-trimetylamine) used in South Africa; Motaline, a blend of ethanol and benzene with naphthalene or tetralin used in Germany; a blend of equal parts of alcohol and benzene used to some extent in England; and a motor fuel containing 75.2 percent ethanol made from molasses, 22.6 percent of ethyl ether, and 1.5 percent of kerosene in Hawaii. The cost of making the Hawaiian fuel is 10 to 11 cents a gallon. Alcohol is possibly the only fuel which could be produced in large quantities, but its high cost prevents its competing with gasoline; however, as a byproduct from established industries it could be obtained at a price to compete with gasoline, e.g. molasses from sugar refining and sulfite liquor from wood pulp industries. Most of the alcohol made at present comes from molasses and amounts to 2 percent of the gasoline requirements of this country. On a volume basis ethanol is equivalent to ¾ its volume of gasoline. Its vapor pressure is low, making starting difficult. These difficulties could be overcome by engine changes if alcohol had to be used as a motor fuel. Other fuels such as methanol, producer gas, benzene, and synthetic fuels are also discussed.

Davies, W. (772)
artificial motor fuels. Chem. Engin. and Mining Rev. 21: 29–30. 1928.

Various methods of preparation of methanol and ethanol as well as of liquid hydrocarbons are mentioned, such as Fischer-Tropsch process, ethanol from acetylene, wood hydrolysis and the subsequent fermentation.

Kimpflin, Georges (773)
national (french) fuel. i. industrial ethyl alcohol and the synthesis of methanol. Rev. Gén. des Sci. Pures et Appl. 39: 700–703. 1928.

Author surveys the fuel situation in France and encourages the production of synthetic ethanol and methanol for motor fuel blends.

Mariller, Charles (774)
distillery and national [french] fuel. Assoc. des Chim. de Sucr. et Distill. Bul. 45: 643–658. 1928.

Alcohol and French national fuels are discussed.

Nelson, J. H. (775)
foreign trend in new motor fuels. Oil and Gas Jour. 27 (27): 148, 164. 1928.

Distillers Co. Ltd. is erecting both at Liverpool and at its Australian branch factory units for dehydrating ethanol. The output wil be used for making 15 to 20 percent ethanol blends. Nipah Distilleries of Malaya Ltd. has purchased a complete distillery and is now cooperating with Distillers Co. on technical matters in connection with ethanol fuel blends. The Royal Automobile Club of Great Britain planned to organize in Spring 1929 trials for motor vehicles using fuels other than gasoline or benzene.

Reed, J. (776)
power alcohol in australia. Nature [London] 121: 175–176. 1928.

Author briefly reviews some of the conclusions drawn from "The Possibilities of Power Alcohol and Certain Other Fuels in Australia" issued by the Council for Scientific and Industrial Research of the Commonwealth of Australia (Bulletin No. 33, by G. A. Cook, Melbourne, 1927), and from a 1925 report of the "Joint Parliamentary Committee on Public Accounts." The dependence of Australia on gasoline imports and the negative geological evidence of the presence of oil are stressed. It is recommended that alcohol should be used near the place of production. At present, molasses appears to be the best source. If all available molasses was converted to alcohol, only one-twentieth of the imported gasoline would be replaced. A million-gallon-a-year distillery is being built in Queensland.

SZILÁGYI, E. (777)
PRODUCTION AND USE OF ABSOLUTE ALCOHOL AS A MOTOR FUEL. Chem. Rundschau f. Mitteleuropa u. Balkan [Budapest] 5: 10–12, 18–20. 1928.

Modern methods of producing absolute alcohol in great quantity are described.

THAYSEN, A. C., and GALLOWAY, L. D. (778)
THE PRODUCTION OF POWER ALCOHOL FROM WASTE VEGETABLE MATERIALS, SUCH AS GRASS, STRAW AND HUSKS. Ann. Appl. Biol. 15: 393–407. 1928.

Hemicelluloses of various waste vegetable materials can be hydrolyzed by acids to yield extracts fermentable by alcohol-forming bacteria. The yield of alcohol-acetone mixture obtained from corncobs, rice husks, rice straw, and wheat straw are 22.5, 14, 19 and 16 gallons per ton of raw material, respectively. Other materials are also discussed.

UNITED STATES DEPARTMENT OF AGRICULTURE, BUREAU OF CHEMISTRY. (779)
THE UTILIZATION OF AGRICULTURAL PRODUCTS FOR THE PRODUCTION OF MOTOR FUELS. Federal Oil Conservation Board Rpt. No. II, App. IV, pp. 27–35. January 1928.

The production of ethanol from various agricultural raw materials is described briefly, and its use as motor fuel discussed. Cost figures are given.

1929

ANONYMOUS (780)
POWER ALCOHOL PRODUCTION IN AUSTRALIA. Chem. Engin. and Mining Rev. 22 (253): 11–14. 1929.

Distilling plant at Sarina, North Queensland, is described. Marketed product, Shelkol, a blend of alcohol and gasoline is said to give more power to engine, to eliminate any deposit on cylinders, and to prevent knocking.

ARNSTEIN, HENRY (781)
ALCOHOL IN INDUSTRY. Engineers and Engin. 46: 91–97, 126–130. 1929; Chemicals 31: 27–32. 1929.

Attention is called to the rapid depletion of the petroleum reserves in the United States and to the fact that ethanol is an ideal fuel which can take the place of gasoline. Extensive quotations are given of foreign experiences, all of which appear favorable.

BOYER, VICTOR (782)
AN ECONOMICAL COLONIAL FUEL: ALCOHOL FROM AGAVE PLANT. Génie Civil 95: 615–617. 1929.

After enumerating the advantages of ethanol blends as a fuel (ease of starting, greater flexibility in engine performance, better acceleration, less heating of engine, absence of corrosion of cylinder and valves, absence of fumes and odors, and cleanliness of combustion) author states that the deficiency of ethanol production in France can be made up through extensive cultivation of the agave as a raw material in French colonies.

HORI, SHINZABURO (783)
THE COMMERCIAL PRODUCTION OF A GASOLINE SUBSTITUTE. World Power Conf. Tokyo Sectional Meeting, Trans. 1: 495–559. 1929.

Experiments on the use of alcohol blends as motor fuel are described. Processes for the manufacture of alcohol and gasoline are given.

HUMBOLDT, E. (784)
MOTOR SPIRIT. Planter and Sugar Mfg. 82: 101–103. 1929.

Author, who had been superintendent of a power alcohol-ether plant built by the Lummus Co., discusses economic and agricultural conditions in Cuba, Guiana, and the tropics in general, which are favorable for the production and use of power alcohol.

LION, A. (785)
FUELS FOR MOTOR TRUCKS. Foerdertechnik u. Frachtverkehr 22: 40–42. 1929.

Author discusses briefly the use of ethanol blends in various countries and believes that their use in Germany could be greatly expanded.

NATHAN, F. L. (786)
ALCOHOL FOR POWER PURPOSES. Fuel Conf. Trans., World Power Conf., London 1928, 3: 1255–1271. 1929; Chem. Age [London] 19: 283. 1928.

It is concluded that alcohol is uneconomical to use as motor fuel except under special conditions.

SANTOS, J. M. (787)
ECONOMIC ASPECTS OF ALCOHOL AS A SUBSTITUTE FOR GASOLINE. Soc. Cubana de Ingen. Rev. 21 (4): 296–311. 1929.

The production of ethanol from sugarcane and the price of molasses are discussed. Comparative cost figures for ethanol and gasoline as fuels are given.

WHITAKER, M. C. (788)
ALCOHOL MOTOR FUELS. Engineers and Engin. 46: 147–148. 1929.

Author concludes: "There are no technical difficulties remaining, either in the making of an alcohol suitable for fuel blends or in the use of the fuels made therefrom. The problem is now solely one of suitable economic conditions, and one of public will."

Abstract *in* Mech. Engin. [New York] 51: 691. 1929.

1930

ANONYMOUS (789)
BLENDING ALCOHOL WITH GASOLINE IS COMPULSORY IN SOME COUNTRIES. Oil and Gas Jour. 29 (30): 154, 218. 1930.

American petroleum companies operating in foreign countries experience difficulties due to compulsory blendings of alcohol with gasoline, particularly in Germany and France. Reference is made to T. Kuhlein, Technische Blätter, Aug. 24, 1930, in which the blendings of Monopolin and its use in engines is discussed in great detail. Other countries with small petroleum resources are also interested in finding substitute fuels. One and a half million tons of surplus sugar in Cuba could be converted into power alcohol. In the Hawaiian Islands successful experiments have been made with the use of alcohol from cannery pineapple waste; blended with gasoline it was used in truck fleets. In Spain, where the interest is centered around lubricants, olive oil is being used to a considerable extent as an automobile lubricant.

CLAASSEN, H. (790)
PRICES AND UTILIZATION OF BEET SUGAR MOLASSES. Deut. Zuckerindus. 55: 1009–1010. 1930.

Author advocates the manufacture of power alcohol; and reviews economic and legislative measures in Germany pertaining to it.

FREISE, F. W. (791)
ALCOHOL PRODUCTION FOR MOTORS IN BRAZIL. Internatl. Sugar Jour. 32: 404. 1930.

About a million tons of inferior cane is available in the principal sugar districts, and the quantities of discarded cane and molasses which can be utilized for making power alcohol are very large. An alcohol fuel called

Azulina containing 5 percent of ether and .1 percent methylene blue as denaturant has been used satisfactorily in railway motor cars, in both suburban and main line service. A test conducted on the main line beween Rio and San Paulo (500 km.) with a motor car fitted with two 100-hp. engines gave a fuel consumption of 1.4 liters of Azulina compared with 1.0 liter of gasoline per km. However, the price of Azulina is 500 milreis per 1,000 liters while that of gasoline is 1,000 milreis for the same quantity.

KUEHLEIN, T. (792)
ALCOHOL-PETROLEUM MOTOR FUELS. Petrol. Times 24: 402–403. 1930; Tech. Blätter. 1930.

Compulsory admixture of alcohol with imported gasoline in Germany is discussed. Properties of alcohol blends are briefly mentioned.

SIEGEL, R. (793)
MOTOR FUEL IN CZECHOSLOVAKIA. Second World Power Conf., Berlin. Trans. 8: 30–32. 1930.

The economic importance of the use of benzene and ethanol as motor fuel in Czechoslovakia is reviewed.

STOEWER, H. J. (794)
MARKET POSSIBILITIES FOR ALCOHOL FUELS. Tech. u Wirtschaft 23: 295–299. 1930.

The use of alcohol as motor fuel in Germany is discussed in connection with the law requiring admixture of alcohol with gasoline.

WATSON, W. N. (795)
FACTS ABOUT INDUSTRIAL ALCOHOL. Chem. & Metall. Engin. 37: 160–161. 1930.

Statistics on production, consumption, and cost of alcohol in the United States are given.

1931

ANONYMOUS (796)
ALCOHOL LAW BURDENS FRENCH OIL INDUSTRY. Oil and Gas Jour. 29 (49): 119. 1931.

Gasoline-alcohol laws require gasoline importers to buy surplus of industrial alcohol production. Each hectoliter of "carburant national" costs the blender 190 to 195 francs and the average selling price is 95 francs. To compensate this loss the price of gasoline is increased by 5 francs a hectoliter.

——— (797)
ALCOHOL MOTOR FUEL IN BRAZIL. Petrol. Times 25: 486. 1931.

Usga and Azulina, blends of ethanol and ether with and without kerosene, replaced about 44 percent of the normal demand of gasoline in Pernambuco. The price of the blends is equivalent to 23 cents per gallon whereas that of gasoline is 38 cents.

——— (798)
FUEL ALCOHOL IN FRANCE. Engineer 151: 656. 1931.

The use of a 20 percent ethanol-gasoline blend has been recommended to the French government. This would make France partly independent of imported fuel and also give relief to agriculture.

CROSS, W. E. (799)
THE INDUSTRIAL ALCOHOL PROBLEM IN THE ARGENTINE REPUBLIC. Rev Indus. y Agr. de Tucumán 21 (5–6): 90–92. 1931.

A 20 to 25 percent ethanol-gasoline blend is a fuel superior to gasoline. With better methods of denaturing, less rigid government control, and lower cost it would be possible to replace part of 900 million liters of gasoline by ethanol. At present, the quantity of molasses thrown into the river would produce 20 million gallons of anhydrous alcohol annually.

JUMENTIER, R. (800)
ABSOLUTE ALCOHOL: ITS USE AS FUEL IN INTERNAL-COMBUSTION ENGINES AND ITS MANUFACTURE. Arts et Métiers 1931: 340–346.

Author advocates the use of ethanol-gasoline mixtures and describes the Guinot processes for the production of anhydrous ethanol.

KALTENBRUNNER, GEORG (801)
ALCOHOL MOTOR FUEL IN EUROPE. Facts About Sugar 26: 67–68, 71. 1931.

Economics of the motor-fuel situation in various European countries is discussed in detail. Agricultural products, molasses, and sulfite pulp waste liquor serve as raw materials, the last one being the cheapest source of commercial alcohol. In Sweden the retail price of alcohol is 23 to 25 cents per gallon.

MOREL, P. (802)
BANANA ALCOHOL. Arts et Métiers 1931: 303–304.

Author believes that ethanol suitable for motor fuel could be economically produced in French colonies from bananas. Experiments conducted on the Ivory Coast under unfavorable conditions gave 90 liters of ethanol per ton of fruit.

PETRLIK, KAREL (803)
NATIONAL LIQUID FUEL HAVING AN ALCOHOL BASE IN CZECHOSLOVAKIA. Chim. & Indus. [Paris] Special No., pp. 396–398. March 1931.

RANC, ALBERT (804)
ALCOHOL MOTOR FUEL. Chim. & Indus. [Paris] 26: 1479–1485. 1931.

After a résumé of the history and use of industrial alcohol, particularly as motor fuel, legislation with respect to the production of alcohol from wine and its use in blends is discussed in considerable detail.

ROUX, A. C. (805)
THE ROLE OF ALCOHOL IN THE COMPOSITION OF NATIONAL METROPOLITAN AND COLONIAL FUELS. Chaleur et Indus. 12: 634–640. 1931.

Use of alcohol in France and French colonies with particular regard to legislative developments in favor of domestic fuels is reviewed. Mixtures of alcohol with gasoline and gas oil are considered.

RUSSELL, W. (806)
COMPULSORY ADULTERATION OF MOTOR FUEL. World Petrol. 2 (5): 328–329. 1931.

Legislation making the use of ethanol compulsory in various European countries is described.

VICUNYA, G. (807)
ALCOHOL AS AUTOMOBILE FUEL. Inst. de Ingen. de Chile An. 31: 309–312. 1931.

Investigations were made in Department of Manufacturing Industries of Republic of Chile to study proposed legislation for compulsory addition of alcohol to gasoline. Results of such legislation in other countries are given.

ZANETTA, A. (808)
POSSIBILITY OF USING INDUSTRIAL ETHYL ALCOHOL FOR MOTOR FUEL. Bol. de Inform. Petrol., [Buenos Aires] 8 (78): 79–81, 87–89, 91–94. 1931.

Research and experiments carried out in various countries are reviewed.

1932

ANONYMOUS (809)
ALCOHOL AS A NATIONAL FUEL. Rev. de Agr., Com. y Trab. [Cuba] 14 (4): 3–6. 1932.

This article is based on the report of La Comision Official del Carburante Nacional de Asuncion, Paraguay. The Commission recommends the use of absolute ethanol (99° G.L. at 15° C.)-gasoline blends in proportions varying from 1 to 50 percent alcohol. Such blends have the following advantages: Absolute alcohol is miscible with gasoline in all proportions and can be used in varying amounts according to the productive capacity of a given country. Fuel consumption for various blends is given. A proposed law is outlined. It is believed that approximately 1.5 million liters can be produced annually.

——— (810)

HOW ALCOHOL AND BENZOL COMPETE AS MOTOR FUELS IN WORLD MARKETS. Chem. & Metall. Engin. 39: 443. 1932.

Data of "world consumption of motor fuels" as well as of "foreign production of alcohol and benzol for motor fuel" are presented. Author fears that if use of alcohol and benzol as motor fuel is discontinued, a large surplus would result causing collapse of world prices and possibly dumping.

——— (811)

POWER ALCOHOL. Roy. Soc. Arts Jour. 80: 1082–1083. 1932.

The use and economies of 20 percent ethanol blends in Southern Rhodesia and Queensland are briefly discussed.

AMERICAN PETROLEUM INDUSTRIES COMMITTEE. (812)

ALCOHOL-GASOLINE BLENDS; A STUDY OF THE ECONOMIC ASPECTS, TECHNICAL FACTORS, AND THE EXPERIENCE OF USERS ABROAD. Amer. Petrol. Indus. Com. Pam. 16 pp. New York. 1932.

Claims are put forward that ethanol-gasoline blends are neither economical nor practical.

CROCCOLO, ALESSANDRO (813)

MANUFACTURE OF ETHANOL. Progressi Indus. Chim. Ital. I. Decennio Regime Fascista. 1932: 417–430.

Manufacture and use of ethanol in Italy is discussed with special reference to its use as motor fuel.

DUNSTAN, A. E. (814)

FLUID FUELS TODAY AND TOMORROW. Soc. Chem. Indus. Jour., Chem. & Indus. 51: 822–831, 846–855. 1932.

The article deals with the availability, economics, and manufacture of liquid and gaseous fuels. Some of the topics discussed are: Liquid and gaseous fuels derived directly from natural gas; bottled gas; liquid hydrocarbons derived from heat treatment of gases; liquid fuels from mineral oil; oil from low temperature carbonization. The possible use of methanol and ethanol is briefly mentioned.

FULMER, E. I., HIXON, R. M., CHRISTENSEN, L. M., and COOVER, W. F. (815)

A PRELIMINARY SURVEY OF THE USE OF ALCOHOL AS MOTOR FUEL IN VARIOUS COUNTRIES. Iowa State Col. Dept. of Chem. Rpt. No. 1, 4 pp. 1932.

Nineteen countries are listed in which alcohol-gasoline blends are used, in eight of which blending is required by law. The composition of various blends used is given.

KERN, C. E. (816)

USING THIRTY PERCENT BLEND OF ALCOHOL WITH MOTOR FUELS. Oil and Gas Jour. 30 (39): 77. 1932.

A 30-percent ethanol blend is being used successfully in Argentina and is said to be superior to gasoline. A German law requires the admixture of 6 percent of ethanol to gasoline. Ethanol consumption has greatly increased.

KIMPFLIN, GEORGES (817)

THE PROBLEM OF FUELS FOR INTERNAL-COMBUSTION AUTOMOTIVE ENGINES IN THE FRENCH COLONIES. Chim. & Indus. [Paris], Special No., pp. 901–903. March 1932.

A brief discussion of the possibility of using alcohol, wood, partly carbonized wood, wood charcoal, gas, or vegetable oils as substitutes for gasoline.

MARILLER, CHARLES (818)
THE (FRENCH) NATIONAL AND COLONIAL LIQUID FUELS. Chimie & Indus. [Paris], Special No., pp. 899–900. March 1932.

A brief discussion of the possibility of replacing gasoline by alcohol in France and its colonies.

SHOEMAKER, H. I. (819)
ALCOHOL-GASOLINE MOTOR FUELS. Sugar News 13: 676–681. 1932.

The article was written as a comment on an editorial in "Sugar News." Although the author discourages any hasty legislation in the Philippines to enforce the use of ethanol blends, he takes exception to certain inaccurate and misleading statements by the editor. After quoting from a French article in which the successful use of ethanol blends in France is discussed, the writer believes that conditions in the Philippines greatly favor the use of ethanol blends, since large amounts of cheap molasses are available.

UNITED STATES DEPARTMENT OF COMMERCE (820)
MOTOR FUELS IN FOREIGN COUNTRIES. U. S. Bur. Foreign and Dom. Com. Trade Inform. Bul. 805, 35 pp. 1932.

A very complete survey, giving extensive statistical information.

WIEHE, A. (821)
THE MANUFACTURE OF ANHYDROUS ALCOHOL AND ITS USE IN INTERNAL COMBUSTION ENGINES. Rev. Agr. de l'Ile Maurice No. 63: 96–113. 1932.

Methods of and statistical data on production of absolute alcohol from molasses and various other materials are presented. The use of alcohol in internal-combustion engines is described.

1933

ANONYMOUS (822)
ALCOHOL-GASOLINE FUEL NOW ON SALE AT ILLINOIS CO-OP STATIONS. Natl. Petrol. News 25 (11): 19–20. 1933.

On March 10, a 10 percent ethanol blend was sold as premium grade gasoline (3 cents a gallon above regular grade) by stations of an Illinois Farm Bureau Oil Company in 16 counties around Peoria. Anhydrous ethanol was furnished by the American Commercial Alcohol Corp., Pekin, Ill. For blending, a mixture consisting of 10 parts of ethanol and 1 part of gasoline is prepared at the distillery and shipped to various bulk plants.

——— (823)
IOWA ALCOHOL-GASOLINE PROPOSAL TABLED TEMPORARILY AS IDEA GRIPS WEST. Natl. Petrol. News 25 (9): 11–12. 1933.

Arguments for and against the use of blended motor fuels, principally economic.

——— (824)
MAKE PART OF MOTOR FUEL FROM GRAIN IS PROPOSED AS FARM RELIEF. Natl. Petrol. News 25 (3): 15. 1933.

Proponents of farm relief claim that alcohol-gasoline blends eliminate carbon deposits, have a high octane rating, require no carburetor adjustment, and increase mileage and operating efficiency. These factors will offset the increased cost estimated to be about 2 cents a gallon.

——— (825)
POWER ALCOHOL. Nature [London], 131: 341–343. 1933.

The use of ethanol as motor fuel in Great Britain, Germany, France, Sweden, Queensland, and South Africa is discussed briefly, and it is urged that the problem of alternative fuels should be studied and a plan drawn up.

——— (826)
SALE OF ALCOHOL-GASOLINE BLEND SPREADS IN ILLINOIS. Natl. Petrol. News 25 (12): 16. 1933.

Approximately 28,000 gallons of ethanol-gasoline blends were sold in three counties near Peoria. Tests on level road indicated that blends gave slightly higher fuel consumption than gasoline.

AMERICAN AUTOMOBILE ASSOCIATION (827)
ALCOHOL-GASOLINE FUEL AND THE MOTORISTS. Pam. 11 pp. American Automobile Association, Washington. 1933.

Pamphlet cites the technical and economic disadvantages of the use of alcohol blends.

ARAUZ, JULIO (828)
ALCOHOL BLENDS PARTICULARLY THE ETHANOL-ACETONE-ACETYLENE BLEND. Univ. Central del Ecuador An. 50: 179–197. 1933.

Author discusses particularly the economic advantages of a fuel introduced in Ecuador consisting of 90 percent ethanol and 10 percent acetone saturated with acetylene.

BLACK, A. G., SHEPHERD, G. S., and DALTON, J. J. (829)
THE USE OF ALCOHOL IN MOTOR FUELS. V. SOME ASPECTS OF A PROGRAM FOR THE MANUFACTURE OF FUEL ALCOHOL FROM CORN. Iowa State Col. Div. of Agr. and Indus. Sci., Dept. of Agr. Econ. Progress Rept. No. V, 8 pp. April 1, 1933.

Report outlines briefly the major economic questions involved in a corn alcohol fuel program. The problems connected with many of these questions will require continued economic research before final conclusions can be formed. Plans for meeting certain economic difficulties should be developed before any plan is finally adopted; no difficulties, however, appear at present to be of such magnitude as to render the plan impracticable.

BROWN, G. G. (830)
MANUFACTURE AND SALE PROBLEMS OF GASOLINE-ALCOHOL MOTOR FUELS. Oil and Gas Jour. 31 (42): 27–31. 1933.

Attention is called to several factors which should be observed if ethanol blends were to be adopted as fuels. Cork floats should be replaced or coated (see No. 364). Fuel lines must be cleaned. Author believes that corrosive action may result and should be guarded against. Difficulties with phase separation may also occur. If Iowa passed legislation to compel the use of blends, cost of fuel would be higher.

CARROLL, J. F., PELZ, V. H., and WELD, L. D. H. (831)
ALCOHOL-GASOLINE MOTOR FUEL. Pam. 64 pp. General Marketing Counselors, Inc., New York. 1933.

The pamphlet was written for the American Petroleum Industries Committee in response to a report transmitted by the Secretary of Agriculture to the U. S. Senate on "The practicability and advantages to agriculture of using alcohol manufactured from corn and other farm products in motor fuel." The conclusion is that alcohol-gasoline blends are uneconomical.

COLEMAN, W. H. (832)
MOTOR BENZOL AND ITS VALUE IN FUEL BLENDS. Chem. Trade Jour. and Chem. Engin. 93: 43–44. 1933.

The composition, output, consumption in the United Kingdom, world production, knock rating, calorific value, sulfur content, carbon deposition, and freezing point of commercial benzene are discussed. Its use as a component in ethanol blends is briefly mentioned.

CONINE, R. C. (833)
MANY FALLACIES TO ARGUMENTS ADVANCED IN FAVOR OF LAWS REQUIRING GASOLINE-ALCOHOL BLENDS. Oil and Gas Jour. 31 (40): 12, 56. 1933.

A survey of legislative measures regulating admixture of alcohol and gasoline in various countries is presented. This information was taken from U. S. Department of Commerce special circular 1932. Cost of power alcohol production from corn and molasses as reported by W. N. Watson, Chief of Chemical Division, U. S. Tariff Commission (see No. 795), is discussed.

GESCHELIN, JOSEPH (834)
ALCOHOL MIXING BILLS WOULD MAKE MOTORISTS PAY FOR CORN PRICE RISE. Automotive Indus. 68: 404–406, 408. 1933.

Any legislation making mandatory the addition of alcohol in motor fuel is purely a farm-relief measure. The question also arises whether the price of corn can be stabilized. The technical problems, however, deserve serious consideration regardless of the economic situation.

HAYNES, W. (835)
1,600,000,000 GALLONS OF ALCOHOL. Chem. Markets 32 (4): 307–309. 1933.

Discusses the possible economic consequences of a law introduced by Congressman William E. Hall, Peoria, Ill., entitled "To provide that liquid fuel used in internal combustion engines shall be blended with 10 percent of alcohol, made from agricultural products grown within continental U. S." Present (1933) and future production from various sources are considered. A 10 percent ethanol blend may add approximately 5 cents a gallon to the station price of motor fuel. In a long series of experiments carried on for many years by the U. S. Industrial Alcohol Co., the practicability of ethanol blends up to 20 percent was proved by extensive road tests covering many thousands of miles. An alternate proposal for use of a 2-percent blend, requiring 120 million bushels of corn, would raise the price of fuel only an insignificant amount.

IOWA STATE COLLEGE, DIVS. OF INDUS. SCI., ENGIN. AND AGR. (836)
THE USE OF ALCOHOL IN MOTOR FUELS. III. THE USE OF AGRICULTURAL PRODUCTS IN THE MANUFACTURE OF CHEMICALS TO BE BLENDED WITH MOTOR FUELS. Progress Rpt. No. III, 13 pp. 1933; Oil and Gas Jour. 31 (43): 10–11, 29. 1933; *Ibid.* 31 (45): 16–33. 1933.

It is concluded that the conversion of substantial amounts of agricultural products, including corn, wheat, oats, barley, potatoes, and others, to alcohol to be used in motor fuel might be used as a basis for a plan which would be a permanent cure for the ills now afflicting agriculture. There are, however, many technical, economic and sociological problems to be solved. Many European nations, after a period of 10 years of research, have arrived at solutions which apparently meet their requirements. These plans cannot be transferred bodily to meet the different requirements prevailing in this country. It might be desirable, in the present emergency, to make some definite move which would be of immediate value to agriculture. It would be perfectly safe to advocate the addition of 5 percent of alcohol to motor fuel, since such a fuel certainly will not meet with any serious criticism on the basis of value. If all gasoline were so blended with alcohol prepared from corn and other cereals, approximately 350 million bushels would be removed from the food market. This probably is enough to produce a definite increase in the prices of agricultural products.

It should be possible to work out a satisfactory scheme for accomplishing this objective. Intensive research should be started on the technical, economic, and sociological problems which remain to be solved before an entirely satisfactory plan can be developed to meet future requirements.

KALTENBRUNNER, GEORG (837)
COMPULSORY USE OF ALCOHOL IN MOTOR FUEL. World Petrol. 4: 87–88, 120–121. 1933.

Recent changes and modifications in laws pertaining to mixtures of alcohol and motor fuel in all important consuming companies of the world are reviewed.

KILLEFFER, D. H. (838)
FACTS ABOUT ALCOHOL IN MOTOR FUEL. Indus. and Engin. Chem., News Ed. 11: 117–119. 1933.

There are no technical difficulties in connection with the use of alcohol in motor fuels; however, author claims it is uneconomical. Cost figures are given on the basis of 45 cents a gallon for alcohol.

MCBRIDE, R. S. (839)
ALCOHOLIZED GASOLINE FOR FARM RELIEF. Food Indus. 5 (5): 169. 1933.

Economies of the use of ethanol-gasoline blends in the U. S. are discussed.

MORRELL, J. C. (840)
CERTAIN TECHNICAL ASPECTS OF MOTOR FUELS. Agr. Engin. 14: 220–222. 1933.

After discussing briefly present and future U. S. resources of liquid fuel, writer argues against the use of ethanol-gasoline blends, on both technical and economic grounds. Cracked gasolines are treated in more detail and certain desirable motor-fuel characteristics are emphasized.

PETRLIK, KAREL (841)
THE PRESENT STATUS OF EUROPEAN NATIONAL FUELS CONTAINING ABSOLUTE ALCOHOL FOR INTERNAL COMBUSTION ENGINES. Chim. & Indus. [Paris], Special No., pp. 601–603. June 1933.

Recent progress in the use of absolute alcohol as fuel for internal combustion engines, particularly in France, Czechoslovakia, Sweden, and Poland is briefly discussed.

SAUVE, E. C. (842)
TRACTOR FUELS. Mich. Agr. Expt. Sta., Quart. Bul. 15: 287–292. 1933.

Ten to twenty percent alcohol-gasoline blends give satisfactory performance, but cost is high. The most economical fuels for tractor use, based on performance and cost are, in the order of preference: distillate, kerosene, gasoline, and alcohol-gasoline blends.

VILBRANDT, F. C. (843)
THE USE OF ALCOHOL IN MOTOR FUELS. IV. CONSTRUCTION AND OPERATION COSTS FOR CORN ALCOHOL PLANTS. Iowa State Col. Div. of Engin., Dept. of Chem. Engin. Progress Rpt. No. IV, 6 pp. March 30, 1933.

Corn prices for various alcohol values and plant productive capacities are discussed.

VILLIERS, F. J. DE (844)
INDUSTRIAL ALCOHOL: ITS PRODUCTION AND UTILIZATION. Fuel Research Board of So. Africa. Nov. 1933.

WALLACE, H. A. (845)
USE OF ALCOHOL FROM FARM PRODUTS IN MOTOR FUELS. Letter of transmittal from Secretary of Agriculture to the U. S. Senate 73d Cong., 1st sess. Doc. 57, 55 pp. 1933.

The paper was prepared in compliance with Senate Resolution No. 65 submitted by Senator Shipstead. Ethanol-gasoline blends have been successfully used and present-day engines are able to handle a 10 percent blend without adjustments. Corn would provide an abundant supply of suitable raw material. At 50 cents per bushel for corn, the use of a 10-percent blend of ethanol would add about 2⅗ cents per gallon to the cost of motor fuel. It is argued that the benefits will offset greatly this increased cost. The capacity of existing distilleries is sufficient to supply only about a 1½ percent blend on a national basis. Means are discussed for establishing a stable alcohol fuel industry and protecting the public against excessively high costs of motor fuel on account of very high prices for farm products. The possible exhaustion of our oil resources is mentioned in support of the policy.

1934

ANONYMOUS (846)
AUSTRIAN REGULATIONS CONCERNING ALCOHOL ADMIXTURES. Petrol. Ztschr. 30 (23): 3 pp. 1934; *Ibid.* 30 (29): 5 pp. 1934.

Austrian regulations governing admixture of alcohol to motor fuel and rules for enforcement of law are given.

CHRISTENSEN, L. M., HIXON, R. M. and FULMER, E. I. (847)
ALCOHOL MOTOR FUEL. Iowa Acad. Sci. Proc. 41: 168–169. 1934.

The use of 10 to 20 percent ethanol-gasoline blends is very desirable from both the fuel and the economic point of view. A 10-percent blend will cost approximately 2 cents a gallon more than gasoline.

———, HIXON, R. M. and FULMER, E. I. (848)
POWER ALCOHOL AND FARM RELIEF. "The Deserted Village" Pam. No. 3, 191 pp. The Chemical Foundation. New York. 1934.

This is a carefully written popular account of the problem and includes a large number of references. Among the chapter headings are: The properties of alcohol-gasoline blends; Alcohol-gasoline blends as fuels for present-day engines; The use of power alcohol in various countries; The preparation, storage, and handling of alcohol-gasoline blends; Cost of power alcohol and of gasoline-alcohol blends; Arguments of opponents.

AMERICAN PETROLEUM INDUSTRIES COMMITTEE (849)
A CRITIQUE OF "THE DESERTED VILLAGE NO. 3." 18 pp. Amer. Petrol. Indus. Comm. Washington. 1934.[7]

DUMANOIS, PAUL (850)
ALCOHOL AND FUELS. Indus. Chim. Belge [2] 5: 173–182. 1934.

The use of 25-percent blend of ethanol and gasoline is advocated for agricultural countries.

——— (851)
ETHANOL AS A MOTOR FUEL IN FRANCE. Assoc. Élèves de l'Inst. Sup. des Fermentations de Gand, Bul. 35: 171–192. 1934.

Author discusses properties and economics of ethanol as a fuel for internal-combustion engines, and legislative measures regarding its use.

HOPKINS, C. Y. (852)
THE USE OF ALCOHOL IN MOTOR FUEL IN FOREIGN COUNTRIES. Canad. Chem. and Metall. 18: 2–5. 1934.

The author has collected interesting material on the use of ethanol as fuel in various countries. Several, for example, Germany, France, and Italy, require compulsory purchase while others, such as Hungary, Czechoslovakia, and Latvia, require compulsory blending. It appears that the use of absolute alcohol and of low alcohol-gasoline blends is more desirable than 95-percent alcohol and consequently higher alcohol-gasoline mixtures.

PORKKA, H. H. (853)
COST OF ALCOHOL-GASOLINE BLENDS. Teknillinen Aikakauslehti 23: 168–172. 1934.

Economics of gasoline and of sulphite alcohol blends as motor fuel in Finland is discussed.

STERCK, R. (854)
ALCOHOL AS FUEL FOR INTERNAL COMBUSTION ENGINES. Ann. Zymol. [2], 1: 305–326. 1934.

An address stressing the use of alcohol-blended motor fuels in Belgium.

TALVITIE, Y. (855)
ALCOHOL AS MOTOR FUEL. Teknillinen Aikakauslehti 23: 143–151. 1934.

The high cost of manufacturing sulfite alcohol precludes its use economically as a substitute for gasoline.

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[7] An exception to alphabetical order, being an answer to the foregoing reference.

WALLIS, T. (856)
GYPSUM DEHYDRATION PROCESS FOR ALCOHOL FUEL. Petrol. Ztschr. 30 (41): 3–4. 1934; Génie Civil 106: 19–20. 1935; Interntl. Sugar Jour. 38: 217–219. 1936.

A plant having 700 hectoliter daily capacity using the gypsum process is described briefly.

1935

AMERICAN PETROLEUM INDUSTRIES COMMITTEE (857)
ECONOMIC AND TECHNICAL ASPECTS OF ALCOHOL-GASOLINE MIXTURES. Rpt. 57 pp. Amer. Petrol. Indus. Com. New York. 1935.

Arguments against the use of ethanol-blended motor fuels are presented. Blended fuels are less satisfactory than straight petroleum products. Lower horsepower, corrosion, difficulty in starting, and crankcase dilution are mentioned. The increased cost of motor fuels to all farmers would more than offset any increased return to a few from higher corn prices. The general public will have to pay for the increase in cost of motor fuel, transportation, and enforcement of blending laws.

DEARBORN CONFERENCE OF AGRICULTURE, INDUSTRY AND SCIENCE. (858)
Proc. of the Conf. 256 pp. Dearborn, Mich. May 1935. Published by The Chemical Foundation, Inc., New York. 1935.

A number of speakers were in favor of the use of ethanol in motor fuels. Among them, D. B. Gurney as one of the owners of the Fair Price Oil Company, gave a brief account of experiences with ethanol blends in the central Northwest. Fred G. Johnson discussed the raising of Jerusalem artichokes in Nebraska and their possible use as raw material for ethanol production.

Brown, G. G. Alcohol-gasoline blends as motor fuel. *Ibid.* pp. 112–123; Natl. Petrol. News 27 (20): 24A–24D. 1935. Blending of agricultural alcohol with gasoline is said to be an impractical and uneconomic means for the utilization of farm products. Results of the "Official tests of regular and alcohol blended gasoline motor fuels" sponsored by the National Bureau of Standards and the American Automobile Association are quoted in support.

Christensen, L. M. Power alcohol. *Ibid.* pp. 96–112. Ethanol alone or in blends is an excellent fuel; however, blends containing more than 25 percent of ethanol cannot be used interchangeably with gasoline and require carburetor adjustments and possibly engine changes, such as higher compression ratios for best performance. Data are quoted from various sources on physical chemical properties, power and economy tests, and relative fuel consumption of various ethanol blends.

Hale, W. J. Organic chemistry points the way. *Ibid.* pp. 124–143. Manufacture of ethanol is advocated as a "chemical" means of stabilizing all agriculture. Raw material should preferably be of the lowest grade. The cost of ethanal and the returns to the farmer per acre are calculated under assumed conditions. The arguments of G. G. Brown are refuted.

DONOVAN, W., and CALLAGHAN, F. R. (859)
POWER ALCOHOL IN NEW ZEALAND. New Zeal. Jour. Sci. and Technol. 17 (1): 398–405. 1935.

Potential sources and economics of power alcohol in New Zealand are discussed. Low raw-material prices would be unattractive to farmers.

DOYNEL, IVES (860)
NATIONAL FUEL [ARGENTINA]. Bol. de Inform. Petrol. [Buenos Aires], 12 (136): 129–153. 1935.

Ethanol-gasoline motor fuels are reviewed. A few data on power output, specific fuel consumption, and thermal efficiency of ethanol-ether blends as well as data on the cost of production of ethanol are given. The discussion is concerned principally with conditions in Argentina.

SNIDER, L. C., and BROOKS, B. T. (861)
PETROLEUM SHORTAGE AND ITS ALLEVIATION. "The Deserted Village No. 6," Pamphlet, 38 pp. The Chemical Foundation. New York. 1935.

Authors believe that even though future oil discoveries will be made, they will not be of sufficient magnitude to prevent a shortage of domestic production in the near future. Importation may keep prices down for a while; however, substitute fuels such as those from oil shale or coal will and can be used to alleviate any shortage.

AMERICAN PETROLEUM INDUSTRIES COMMITTEE (862)
MEMORANDUM IN REPLY TO "THE DESERTED VILLAGE NO. 6." 5 pp. Amer. Petrol. Indus. Comm. New York. 1935.[8]

The article refutes the idea of an impending petroleum shortage stated in "The Deserted Village No. 6," and argues against the use of alcohol as motor fuel.

1936

ANONYMOUS (863)
ALCOHOL AS MOTOR FUEL. Indus. and Engin. Chem., News Ed. 14: 277–278. 1936.

The use of alcohol motor fuels in various parts of the world is reviewed briefly.

——— (864)
ALCOHOL MOTOR FUEL—THE CASE PRO AND CON. World Petrol. 7: 306–308. 1936; Kishline, F. F., Motor fuels of the future. *Ibid.* p. 308; Tokayer, Oskar, Europe's huge bill for alcohol fuel. *Ibid.* pp. 309–318.

In the first paper it is argued that ethanol blends are, in general, inferior and would be uneconomical in the United States. In the second paper, Kishline thought ethanol blends are as good as gasoline and the only question appears to be the relative cost. The last paper attempts to evaluate the economics of the use of ethanol blends in various European countries. Tokayer concludes that those countries are sustaining a loss.

CHARLTON, J. (865)
POWER AND INDUSTRIAL ALCOHOL, POSSIBILITIES OF MANUFACTURE IN BURMA. Burma Dept. Agr., Agr. Survey No. 24: 12. 1936.

A 70 percent yield of ethanol, calculated on the sugar content of the molasses, was obtained in large-scale fermentation tests in Burma.

DIETRICH, K. R. (866)
USE OF ETHYL ALCOHOL AS A MOTOR FUEL. Allg. Oel u. Fett. Ztg. 33: 76–77. 1936; Chem. Ztg. 59: 693–695. 1935.

About 60 percent of the alcohol produced in Germany is used for motor fuel. The various ratios of alcohols, gasoline, and (or) benzene in the mixtures marketed in Germany are discussed.

——— and LOHRENGEL, W. (867)
NEW (GOVERNMENT) ORDINANCES REGARDING THE COMPOSITION OF FUELS. Oel Kohle Erdoel Teer 12: 637–641. 1936.

A detailed description of the various blends (ethanol, methanol, benzene, gasoline) which may be used in Germany. Water tolerances are given.

FLOHR, H. (868)
REGULATIONS FOR ALCOHOL ADMIXTURES IN GERMANY. Petrol. Ztschr. 32 (34): 1–4. 1936.

Regulations for compulsory use of alcohol admixtures in motor fuels in Germany are given.

[8] An exception to alphabetical order, being an answer to the foregoing reference.

FRITZWEILER, R. (869)
ETHYL ALCOHOL AS MOTOR SPIRIT. Ztschr. f. Spiritusindus. 59: 172, 174–175, 179–180, 182–183. 1936.

The history of the use of ethanol motor fuels in Germany is reviewed, the composition of various blends given, and the economic background discussed. An apparatus for blending fuels is shown. Various methods for dehydrating ethanol are described, in particular the use of trichlorethylene in the Drawinol process of the German alcohol monopoly administration. Patent and other references relating to the dehydration of ethanol for motor fuels are given.

HULL, H. G. (870)
COMMERCIAL DEMONSTRATION TO TEST POWER ALCOHOL FEASIBILITY. Chem. & Metall. Engin. 43: 352–354. 1936.

The Atchison, Kan., power alcohol plant, having a rated capacity of 10,000 gallons a day, is described in detail.

MARILLER, CHARLES (871)
NATIONAL FUELS (FRENCH) AND MOTOR ALCOHOL. Assoc. des Chim. Bul. 53: 662–678. 1936.

The use of alcohol as motor fuel is rapidly spreading in France. Statistical and technical data are given on the various mixtures authorized by law. The possible use in Diesel engines of hydrated alcohol or mixtures of gas oil with 90° G.L. alcohol is discussed.

MOSELEY, J. W. (872)
USE OF ALCOHOL FUEL OUTSIDE OF UNITED STATES. Mines Mag. 26 (10): 12–14. 1936.

Advantages and disadvantages of the use of ethanol as motor fuel are discussed. Equipment and cost of production for a 5,500 gallons-per-day plant are estimated. Bibliography is appended.

SANSONE, RAFFAELE (873)
ALCOHOL-BASE MOTOR FUEL IN ITALY. Indus. and Engin. Chem., News Ed. 14: 279–280. 1936.

A 20-percent blend was found to give the best results. Production figures are quoted.

SECOND DEARBORN CONFERENCE OF AGRICULTURE INDUSTRY AND SCIENCE (874)
Proc. of the Conf. 409 pp. Farm Chemurgic Council, Dearborn, Mich., May 1936.

Chapter IV, "Power alcohol," includes the following papers: Brooks, B. T., "Our domestic petroleum supply." pp. 125–138. Reference is made to the paper by L. E. Snider and B. T. Brooks on "Probable Petroleum Shortage in the U. S. and Method for its Alleviation." (See No. 875.) This is a very comprehensive survey of petroleum resources of this country and methods are proposed to alleviate probable future shortage.

Buffum, W. W., "America's first power alcohol plant." pp. 108–111. Author states that the power alcohol plant at Atchison, Kan., will be capable of producing 10,000 gallons of anhydrous ethanol per day, and gives a few general remarks concerning development of the plant.

Burlison, W. L., "Growing artichokes in America." pp. 111–120. The Jerusalem artichoke is considered a possible raw material for the production of alcohol in the United States. Production costs are given.

Garvan, F. P., "Scientific method of thought in our national problem." pp. 85–95. Author considers the use of alcohol as fuel from economic point of view and cites a few successful experiences in the Philippines. General economic situation in the United States is outlined.

Kishline, F. F., "Coming motor fuels." pp. 121–125; World Petrol. 7 (6): 308. 1936. High compression ratios are essential for good economy, and power alcohol blends have possibilities. Experience quoted shows that power alcohol blends remove accumulated carbon deposits.

Snider, L. C., and Brooks, B. T. (875)
probable petroleum shortage in the united states and methods for its alleviation. Amer. Assoc. Petrol. Geol. Bul. 20: 15–50. 1936. See No. 874.

Ziegenhain, W. T. (876)
agrol gasolines—will they succeed? Oil and Gas Jour. 35 (18): 38–39. 1936.

It is planned to produce 10,000 gallons a day of anhydrous ethanol for motor fuel blends at Atchison, Kan. A 50:50 ethanol-gasoline blend will be marketed. Mixing procedure and estimated cost are given.

1937

Bandat, Guenther (877)
use of domestic fuels in austria. III° Cong. Internaz. del Carbonio Carburante, 5 Session Economics, Statistics, Legislation pp. 57–76. Rome. 1937.

Wood, charcoal, producer gas from wood, liquefaction of coal, city gas, petroleum, ethanol from potatoes, and sulfite liquor are discussed as possible sources of domestic fuels. Statistical information is given on the availability of raw materials and on consumption.

Barbet, Emile (878)
corn as an economical source of fuel alcohol. Mém. Soc. Ingén. Civils de France 90: 807–813. 1937.

Corn as a source of cellulose and of ethanol is discussed. Cost of planting and agricultural statistics with reference to corn for some French colonies are given.

Capitani, Serafino, de (879)
possibilities of production and use of substitute fuels in italian africa. III° Cong. Internaz. del Carbonio Carburante, 4 Session, Colonial Substitute Fuels, pp. 4–16. Rome. 1937.

In addition to other fuels, the possible production of methanol and ethanol, as well as thermal cracking of vegetable oils, is considered.

Fabris, Pietro (880)
a future fuel with ethanol or denatured ethanol as base and other substitute fuels manufactured in italy from italian raw materials exclusive of petroleum and its derivatives, benzol, fuel made by cracking process, etc. III° Cong. Internaz. del Carbonio Carburante, 2 Session, Liquid Fuels, pp. 169–172. Rome. September 1937.

A brief discussion of the economics of using ethanol as a base for fuels in Italy.

Larguier, Louis (881)
french legislative measures for the encouragement of the production and use of replacement fuels. III° Cong. Internaz. del Carbonio Carburante, 5 Session, Economics, Statistics, Legislation, pp. 77–80. Rome. 1937.

Cost figures are given for the various ethanol blends in use. The cost of gas-generator fuels (wood and charcoal) is compared with that of gasoline.

Loskot, Karel (Charles) (882)
agricultural raw material as basis for domestic fuels in czechoslovakia. III° Cong. Internaz. del Carbonio Carburante, 5 Session, Economics, Statistics, Legislation, pp. 3–12. Rome. 1937.

After brief mention of benzene production and the use of gas generators, author discusses the production of ethanol and the use of ethanol blends in Czechoslovakia. Statistics of consumption of Dynalkol, benzene, and gasoline are given. The consumption of ethanol in 1936

was 22 percent of the total fuel consumed. Octane numbers (Cooperative Fuel Research Motor Method) are given for various gasolines and blends containing gasoline, ethanol (99.7 percent), benzene, and T.E.L.

MILLER, HARRY (883)
INDUSTRIAL ALCOHOL. Oklahoma Farm Chemurgic Conf. Proc. 1, 4 pp. 1937.

A discussion with special reference to power alcohol and its production from farm products at the Atchison, Kan., plant of the Chemical Foundation of Kansas Company.

PANDOLFELLI, MICHELE (884)
ITALIAN LEGISLATION IN REGARD TO SUBSTITUTE FUELS. III° Cong. Internaz. del Carbonio Carburante, 5 Session, Economics, Statistics, Legislation, pp. 29–34. Rome. 1937.

Legislation regarding the use of methane gas, gas generators, ethanol, and methanol is briefly discussed.

SULLAM, ANGELO (885)
USE AND PRODUCTION OF FUELS AND LUBRICANTS IN ITALY. III° Cong. Internaz. del Carbonio Carburante, 5 Session, Economics, Statistics, Legislation, pp. 35–50. Rome. 1937.

A thorough study of the possibilities of methane, peat, and wood for the production of domestic fuels is advocated. Grain sorghums is a cheaper raw material for the production of ethanol than beets. Helianthus and castor oils, particularly the latter, make good lubricants.

VOSSINIOTIS, C. J. (886)
THE PRODUCTION OF VOLATILE FUEL FROM DOMESTIC (GREEK) RAW MATERIALS. Praktika Akad. Athenon 12: 334–344. 1937.

Possibilities of producing motor fuels in Greece from domestic raw materials are discussed.

WEBSTER, HENRY (887)
POWER ALCOHOL POLICY THROUGHOUT THE WORLD. Petrol. Times 37: 35–42. 1937.

Economic considerations and national policies of various nations on required use of alcohol in motor fuels is reviewed.

1938

ANONYMOUS (888)
SUGAR AND ALCOHOL PRODUCTION IN BRAZIL. Internatl. Sugar Jour. 40: 140. 1938.

Alcohol motor fuel statistics are given. In 1936 approximately 62 million liters of alcohol was produced, of which 24.3 million was used in blends. A total of approximately 139 million liters of mixed fuel was consumed. A 10 to 15 percent blend is most suitable for automotive engines.

BARRINGER, E. L. (889)
AGROL MOVEMENT COLLAPSES. Natl. Petrol. News 30: 25–33. Sep. 28 1938.

The "collapse" of the agrol movement in Sioux City, Iowa, is ascribed to the fact that a proposed $500,000 alcohol plant was never built. Three blends containing approximately 5, 10 and 15 percent ethanol, were marked at the price of regular gasoline. Price differentials between regular and agrol blends are discussed.

BRUNSCHWIG, R. (890)
THE PROBLEM OF SUBSTITUTE FUELS IN FRANCE. Rev. de Indus. Minérale No. 421: 313–328. 1938.

This is a discussion of the French fuel situation from the point of view of national defense. Various processes for making liquid fuels, such as hydrogenation, shale distillation, Fischer-Tropsch process, low temperature carbonization, and others are mentioned. In addition, the use of compressed gases and of gas producers is also considered. In case of war all the ethanol will be used in the manufacture of explosives and will not be available as fuel.

DELLEY, E. (891)
SUBSTITUTE AND SYNTHETIC MOTOR FUELS Schweiz. Tech. Ztschr. 1938: 59–66, 75–80.

A detailed report is given on methods of production, production figures, and possible use of various fuels, including ethanol, methanol, benzene, and vegetable oils.

FRITZWEILER, R. (892)
METHODS FOR THE PRODUCTION OF ANHYDROUS ALCOHOL. Ver. Deut. Ingen. Ztschr. 82: 1373–1378. 1938.

Costs of dehydration processes are compared in tables.

GRAF, ERNST (893)
ALCOHOL AS A GENERAL FUEL AND AS MOTOR FUEL. Bau u. Werk 1938: 275, 286.

Summary of the methods of alcohol production and of plant operations are given, including the properties and use of alcohol motor fuel blends.

JACOBS, P. B. (894)
ALCOHOL MOTOR FUEL IN THE UNITED STATES. U.S. Bur. Agr. Econ., Agr. Situation 22 (12): 20–23. 1938.

——— and NEWTON, H. P. (895)
MOTOR FUELS FROM FARM PRODUCTS. U. S. Dept. Agr. Misc. Pub. No. 327, 129 pp. December 1938.

Statistics are presented on the annual production and geographic distribution of various farm crops suitable as raw material for producing alcohol or similar compounds for use in motor-fuel blends. The average fermentable content and anticipated alcohol yields, farm return, relative values, and utilization problems of the crops are discussed. The occurrence of crop surpluses, low or sample grades, and culls is considered. The present alcohol industry is described. Locations and requirements of alcohol production plants, process and equipment problems, and the economic principles involved are discussed. The relative cost and efficiency of various motor fuels are compared. The possibility of producing fuels from materials other than agricultural products is pointed out, and data are given on the national supply of such materials. The manufacture and use of replacement fuels, abroad, as well as in the United States, are discussed. Estimates are presented on motor registration, fuel requirements, and percentage of farm-owned vehicles. The agricultural situation now existing is discussed in relation to the general background established.

KURONO, KANROKU (896)
FUEL ALCOHOL. Fuel Soc. [Japan] Jour. 17: 743–753 (in English 70–72). 1938.

Legislative measures in Japan for compulsory mixing of 5 percent alcohol with gasoline are described. This is expected to be increased gradually to 20 percent. Amylo process of producing alcohol from starch is less expensive than the rice malt process or the acid saccharification process.

MILEWSKI, JÓZEF (897)
MOTOR FUEL BLENDS USED IN GERMANY. Przeglad Chem. 2: 19–20. 1938.

Author discusses in a general way various blends used in internal combustion motors in Germany. Large amounts of methanol are produced as a byproduct in the manufacture of synthetic gasoline. As a result of political economy it was necessary to find an outlet for the methanol by mixing it with ethanol in the alcohol-gasoline blends. The ratio of ethanol to methanol was at first 9:1, later it was reduced to 4:1 and finally in 1937 to 2:1.

NAUS, H. B. (898)
MOLASSES AS FUEL. Cong. Internatl. Tech. et Chim. des Indus. Agr. Compt. Rend. V[e] Cong. 1: 779–801. 1937; Internatl. Sugar Jour. 40: 141–145. 1938.

For the past 5 years, 200,000 tons of molasses has been used at the Sucreries d'Egypte as furnace fuel in place of oil. Flow sheet of plant and details of burners are shown, and thermal efficiency calculations are given.

SCHLÄPFER, P. (899)
THE MANUFACTURE OF REPLACEMENT FUELS IN SWITZERLAND. Schweiz. Ver. Gas — u. Wasserfach., Monats-Bul. 18: 49–60. 1938.

A review discussing possibilities of liquid fuel production by synthesis, fermentation, etc.

SKINNER, W. W. (Revised by P. B. Jacobs, Jan. 1938.) (900)
INFORMATION ON INDUSTRIAL ALCOHOL. U. S. Bur. Chem. and Soils Cir. MC–22, 18 pp. 1922.

See No. 962.

VAN VOORHIS, M. G. (901)
HIGH-PRESSURING FOR AGROL PLANTS. Natl. Petrol. News 30 (19): 25–29. 1938.

The article deals with the sale of Agrol, an alcohol-gasoline blend containing from 5 to 20 percent alcohol (Agrol 10 is equivalent to a 10-percent blend). A table gives the schedule of prices paid farmers by the Atchison Agrol Plant for grain. Under this schedule the farmer has a choice of receiving all cash; part cash and cattle feed; part cash and a gallon of Agrol or other combinations. The results of the M.I.T. work are cited . . . . "when properly adjusted to the percentage of alcohol in the blend, then the fuel is very satisfactory, indeed." A 1938 Plymouth engine changed to 8.6:1 compression ratio and using a 17½-percent blend gave excellent performance. Service station price for Agrol 10 was 1 cent above regular and 1 cent below premium grade gasoline.

WHALLEY, W. C. (902)
ROAD TRANSPORT FUELS FROM OPERATOR'S POINT OF VIEW. Inst. Fuel London Jour. 11: 459–465. 1938; Gas and Oil Power, Ann. Tech. Rev. No. 1938: 15–16.

Economics of the use of various fuels such as Diesel fuel, ethanol, compressed gas, steam, etc., are reviewed.

1939

ACHARYA, C. N. (903)
POWER ALCOHOL IN OTHER COUNTRIES. Madras Agr. Jour. 27 (1): 3–9. 1939.

Author believes that blends of gasoline with anhydrous ethanol are good fuels, and discusses the use of alcohol motor fuels in various countries.

BACQUEYRISSE, L. (904)
FRENCH FUELS: THEIR CONSERVATION AND REPLACEMENT. Mém. Soc. Ingén. Civils de France 92: 241–286. 1939.

Review of possible sources of gasoline substitutes in France is given. Production of alcohol from beets, molasses, wine, and corn is considered.

BERTHELOT, CHARLES (905)
PRODUCTION AND USE OF KETONES AS LIQUID FUELS OF HIGH OCTANE NUMBER. Chim. & Indus. [Paris] 42: 779–786. 1939.

General review dealing with manufacture of ketones, catalytic production of ketones from alcohol, and the use of ketones as fuel for internal-combustion engines.

CHATTERJI, N. G. (906)
POWER ALCOHOL IN INDIA. Facts about Sugar 34 (4): 49–50. 1939.

The economics of the use of power alcohol are discussed. The recommendations of the Power Alcohol Engineering Committee are, briefly: Establishment of an advisory board; government control over manufacture, distribution, and price of blends; all fuels to be blended; existing gasoline distributors to take over sale of blends.

DYMOND, G. C. (907)
A GENERAL SURVEY OF FUEL ALCOHOL PRODUCTION WITH SPECIAL REFERENCE TO BRAZIL. So. African Sugar Technol Assoc. 13th Ann. Cong. Proc. 1939: 45–53.

After discussing the use of Agrol in the U. S., the author (South African) is interested chiefly in the production of power alcohol in the sugar-producing countries, particularly Brazil. In that country oil companies must purchase anhydrous ethanol to the extent of 5 percent of their imports of gasoline, and must market a blend containing from 10 to 15 percent anhydrous ethanol. In addition, there are a large number of blends on the market running as high as 95 percent ethanol. A list of Brazilian alcohol distilleries and their daily plant capacities is given. In the extended discussion the possibility of establishing an alcohol-sugar industry in Natal similar to that in Brazil is discussed.

EGLOFF, GUSTAV (908)
MOTOR FUELS OVER THE WORLD. Ill. State Acad. Sci. Trans. 32 (2): 103–113. 1939.

The use of alcohol as a substitute for gasoline is uneconomical and mechanically troublesome.

FRITZWEILER, R. (909)
THE FUTURE OF ALCOHOL AS A MOTOR FUEL. Kraftstoff 15: 48–49. 1939.

Consumption figures for the period 1926-1938 are given.

HÄGGLUND, ERIK (910)
NATIVE (SWEDISH) LIQUID MOTOR FUELS. Svensk Papperstidning 42: 488–490. 1939.

The preparation and use of gasoline-alcohol (from waste sulfite liquor) blends are discussed and a comparison with gasoline made.

HOPKINS, C. Y. (911)
AGRICULTURAL ALCOHOL FOR MOTOR FUEL. Canada Natl. Res. Council, Rpt. No. 886, 9 pp. 1939. Reprinted February 1941.

The obstacles to the use of ethanol blends in Canada are largely economic, since experience in other countries has shown that few technical difficulties are involved. If a 10-percent blend were used in Canada, the average increase in cost of motor fuel at bulk depots would be 3 cents per imperial gallon. The blend would, however, have a higher octane number than the base gasoline. Fuel consumption in Canada in 1939 was about 800 million imperial gallons, and if all were blended the use of about 40 million bushels of wheat would be necessary. Author discusses possible raw materials such as potatoes, sugar beets, barley, and wheat and gives approximate prices allowable for these raw materials when the value of alcohol per imperial gallon is 40 cents. Experience in foreign countries is discussed briefly.

JACOBS, P. B. (912)
MOTOR FUELS FROM FARM PRODUCTS. Paper presented at the Fifth National Farm Cemurgic Conference, 7 pp. Jackson, Miss., March 31, 1939. (U. S. Dept. Agr. Northern Regional Res. Lab., Peoria, Ill.)

After briefly reviewing U. S. Dept. of Agr. Misc. Publ. 327, (see No. 895) the three main sources of replacement fuels other than agricultural materials are discussed. These sources are natural gas, shale oil, and coal. It is probable that the cost of producing alcohol will be less than the cost of producing liquid fuels from shale and coal.

——— (913)
MOTOR FUELS FROM FARM PRODUCTS. Agr. Engin. 20 (11): 433–436. 1939.

Author gives estimated cost of a power alcohol program during the years 1930 to 1937 and advises thorough study of economics before embarking on a power-alcohol program.

——— (914)
MOTOR FUELS FROM AGRICULTURAL PRODUCTS. U. S. Dept. Agr. Natl. Resources Com. Rpt. of the Energy Resources Com., Sec. Energy Resources and Natl. Policy, pp. 332–337. Washington. 1939.

A nationwide, 10 percent alcohol blend is not considered practical because neither the occasional surpluses of crops nor the amounts of alcohol obtainable from culls or waste products would provide sufficient raw materials. The present manufacturing facilities are totally inadequate. Tables are given for quantities of alcohol obtainable from various crops now produced in the United States, farm materials used by the distilling industry, and yields of alcohol in gallons per ton and per acre of several principal crops. Before the use of ethanol blends is introduced, careful consideration must be paid to the technical and economic problems involved.

LOUIS, MARCEL (915)
ALCOHOLS AND GASOLINE. Sci. et Indus. Tech. des Indus. du, Pétrole No. 284 (bis.): 41–43. 1939.

The use of ethanol motor fuels in Europe is briefly reviewed. In 1937 the amount of alcohol used as motor fuel was 5.4 percent in France, 8 percent in Germany, and an average of 4.4 percent in Europe. The properties of methanol, ethanol, and isopropanol as fuels are briefly reviewed. It is concluded that the use of ethanol as fuel exerts a stabilizing influflence on agriculture in times of peace, since in war it will be used in the manufacture of explosives.

REYNOLDS, CONGER (916)
THE ALCOHOL-GASOLINE PROPOSAL. Paper presented at annual meeting of American Petroleum Institute, 5 pp., Chicago, Ill., November 14, 1939.

Author argues against possible legislation in favor of alcohol-gasoline blends.

UNITED STATES CONGRESS, SENATE SUBCOMMITTEE OF THE COMMITTEE ON FINANCE. (917)
USE OF ALCOHOL FROM FARM PRODUCTS IN MOTOR FUEL. Hearings . . . 76th Cong., 1st sess. on S.552, 207 pp. 1939.

Extensive arguments against and in favor of legislation concerning the use of alcohol-motor fuels.

1940

ANONYMOUS (919)
AUSTRALIA'S GROWING NEED FOR POWER ALCOHOL. Internatl. Sugar Jour. 42: 338–339. 1940.

Gasoline costs 15.8d. per gallon. If blended in the proportion of 1 to 5 with ethanol, the price of the "supergrade admixture" amounts to 1s. 9.75d. which is 0.75d. higher than the price of the imported supergrade fuel. At the estimated consumption of 336 million gallons of supergrade fuel, the extra charge to be borne by the consumer would be £1,050,000. However, a possible reduction of £1 per ton would bring the price below that of the imported fuel.

BERTHELOT, CHARLES (919)
SYNTHETIC AND SUBSTITUTE FRENCH FUELS. Chim. & Indus. [Paris] 43: 957–959. 1940.

Use of producer gas and alcohol fuels in France is discussed.

DYMOND, G. C. (920)
A HARDY ANNUAL WITH VARIATIONS, FUEL ALCOHOL PRODUCTION. So. African Sugar Jour. 24: 595–599. 1940.

Author discusses briefly the fuel alcohol situation principally in the Philippines, Brazil, Australia, and South Africa. In the Philippines, of the total consumption of 38 million gallons of motor fuel, 9 million was 95- to 96-percent ethanol. The three adjustments required were: (1) Shimming connecting rod bearings to give increased compression, (2) installing metal floats in carburetors and increasing size of jets, (3) using a pump diaphragm resistant to alcohol and adequate screens in fuel lines. However, 95-percent ethanol has been used in modern cars without any modifications. The advantages of decentralization of alcohol production as in Brazil are (1) a single management, laboratory, etc., (2) steam economy, (3) no freight charges on molasses, (4) simplification of sugar production under the quota system, and (5) production of relatively larger quantities of power alcohol from surplus cane, raw juice, mill juice, etc. The problems of harvesting and of slop disposal are discussed. Finally, a comparison is made between the cost of producing alcohol in Natal and in Queensland. It is concluded that conditions for an extended power alcohol program are more favorable in South Africa than in Australia.

ESTAPÉ, A. C. (921)
ALCOHOL-GASOLINE MIXTURES FOR INTERNAL-COMBUSTION ENGINES. Soc. Cubana de Ingen. Rev. 34: 236–264. 1940.

Alcohol-gasoline blends should be used in Cuba because of reduction of sugar exports and increase in gasoline price. Blends with more than 75 percent alcohol can be used; however, gasoline engines should have their compression ratios increased. Fifty percent of 96-percent alcohol in a blend will cause no liquid separation at Cuban temperatures.

SHEPHERD, G. S., MCPHERSON, W. K., BROWN, L. T., and HIXON, R. M. (922)
POWER ALCOHOL FROM FARM PRODUCTS; ITS CHEMISTRY, ENGINEERING AND ECONOMICS. Iowa Corn Res. Inst. Contrib. 1 (3): 283–375. 1940.

Ethanol-gasoline blends containing up to 20 percent alcohol will have slightly greater mileage at low speeds, slightly better acceleration, and a materially higher antiknock rating than the original gasoline. Ethanol should be considered a supplement to gasoline as well as a direct competitor with other antiknock agents, cracking and polymerization processes on the basis of their cost. Ethanol can be made at a profit for 25 cents per gallon from corn at 50 cents per bushel. The net cost of making alcohol rises about one-fifth cent for every cent rise in the price of corn. With alcohol at 25 cents per gallon, 5 to 12 percent blends will cost the distributor (1940), on the open market, about 0.7 to 1.2 cents per gallon more than gasoline of equal antiknock value. Present and future problems are outlined and it is stated that a well-planned power alcohol program would not conflict with soil conservation, ever-normal granary storage and surplus removal, nor would it replace them.

1941

ANONYMOUS (923)
ALCOHOL IN BRAZIL. Intern. Sugar Jour. 43: 292. 1941.

Statistical data on the production of alcohol for motor fuel in Brazil.

——— (924)
NATIONAL FUEL (ARGENTINA). Bol. de Inform. Petrol. [Buenos Aires] 18 (203): 3–27. 1941.

Report of a special commision on the economics of the production and sale of ethanol as motor fuel in Argentina.

ARAUJO NABUCO DE, C. E., JR., and SA'FREIRE, A. P. DE (925)
FUEL PROBLEMS IN BRAZIL. Soc. Quím. del Peru Bol. 7 (1): 7. 1941.

Production of ethanol from cane sugar amounts to about 10 percent of imported gasoline.

AUSTRALIA. COMMONWEALTH GOVERNMENT. POWER ALCOHOL COMMITTEE OF INQUIRY. (926)

POWER ALCOHOL PRODUCTION IN AUSTRALIA. Rpt. Commonwealth Government Printer, Canberra, Australia. May 17, 1941; Internatl. Sugar Jour. 43: 365–367. 1941.

The Committee of Inquiry included representatives of the Government Departments and two representatives of the sugar industry. The Committee considers a 15 percent ethanol-gasoline blend to be equal in engine performance to standard gasoline. The blend should be marketed through established distribution channels under names indicating the presence of alcohol. On the basis of annual total requirements of 350 million gallons of motor fuel, the alcohol required would amount to 52.5 million gallons. The three existing power alcohol distilleries in Australia could produce up to 7 million gallons and the rest—45.5 million gallons—could be produced from wheat and sugar in new distilleries which Committee recommends should be erected. The wholesale price should be 2s. per gallon. Although the cost is higher than that of imported gasoline, the expansion program is justified for reasons of national defense and stabilization of agriculture. The distilleries should be owned by the Government which should also control the blending and sale of alcohol. A period of 5 years is recommended for experiment in operation of distilleries.

CANESSA, J. V. (927)

GRAIN ALCOHOL AS A MOTOR FUEL. Bol. Inform. Petrol. [Buenos Aires] 18 (206): 14–20. 1941.

A discussion of technical and economic aspects of the alcohol problem in Argentina.

DIETRICH, K. R. (928)

THE OUTLOOK FOR FUEL PRODUCTION BY BIOCHEMICAL MEANS. Kraftstoff 17: 349–351. 1941.

The possibilities of production of ethanol, isopropyl alcohol, isopropyl ether, and butyric acid suitable for motor fuels are discussed.

DUPONT, GEORGES (929)

SUBSTITUTE MOTOR FUELS. Carburants Nat. 2: 121–130. 1941.

Substitute fuels such as alcohols and compressed or liquefied gases are discussed. War shortages of gasoline in France can be replaced by ethanol, methanol, and acetone.

——— (930)

SUBSTITUTE COMBUSTIBLES. Soc. Chim. de France Bul. 8: 629–643. 1941.

Author discusses briefly methods of manufacture and properties of substitute fuels and concludes that, as far as liquid fuels are concerned, ethanol is most readily available.

DYMOND, G. C. (931)

FUEL ALCOHOL PRODUCTION. Internatl. Sugar Jour. 43: 55–56. 1941.

This is a slight abridgment of "A hardy annual with variations." So. African Sugar, Jour. 24: 595–599. 1940. (See No. 920.)

GARFIAS, V. R., and WHETSEL, R. V. (932)

WORLD PRODUCTION OF PETROLEUM SUBSTITUTES. Amer. Inst. Mining and Metall. Engin. Trans. 142: 246–250. 1941; Petrol. Times 45: 142–143, 148. 1941.

A preliminary statistical survey.

HARMAN, R. W., JR. (933)

SUBSTITUTE MOTOR FUEL IN AUSTRALIA. Austral. Chem. Inst. Proc. 8: 270. 1941.

Shale oil, benzene, and power alcohol from molasses and sugar can supply one-third of consumption at present. Extension of power alcohol would necessitate use of wheat as raw material. Greater possibilities are seen from coal by use of the Fischer-Tropsch (process) synthesis which, however, is not yet in operation.

HUTCHINSON, R. C. (934)
A REPORT ON THE POSSIBILITY OF PRODUCING POWER ALCOHOL IN NEW GUINEA. New Guinea Agr. Gaz. 7: 141–165. 1941.

Data on possible yields of ethanol per ton and per acre are given for cassava, sago palm, and nipa palm. Comparison is made with crops grown in temperate climates.

LEMOIGNE, M., LEFERVRE, J., and BLANC, A. (935)
REAL AGRICULTURAL POSSIBILITIES FOR THE PRODUCTION OF ETHANOL. Acad. d'Agr. de France, Compt. Rend 26: 366–381. 1941.

The need for gylcerine, ketones, and particularly ethanol is emphasized and the following sources are mentioned: Sugar beets, grapes, cider, wood, potatoes, corn, sorghum, and Jerusalem athichokes.

OWEN, W. L. (936)
NOW, A REAL MOTOR FUEL FROM MOLASSES. Sugar 36 (11): 21–23. 1941.

Jeanite, made by passing ethanol and butanol over a catalyst, has a composition similar to gasoline and an octane rating of over 80 before redistillation. It can be produced at a cost of 14.2 cents a gallon if the ethanol is made from surplus cane. The economic significance for Cuba in particular is discussed.

ROSTEN, M. M. (937)
POWER ALCOHOL IN CANADA. Pam. by author. November 1941. (50 East 78th St., New York 21, N. Y.)

The use of alcohol-gasoline blends in Canada is advocated, and a plan for its accomplishment is presented.

——— (938)
ALCOHOL FROM WASTE SULPHITE LIQUOR. Pulp and Paper Mag. Canada 42: 558–562. 1941.

Author emphasizes the advantages gained through use of Melle process in connection with the fermentation of sulfite liquor. Although the alcohol content amounts to only from 0.7 to 1.5 percent, steam consumption is only about 3 cents higher than for the usual 7 to 10 percent concentration. Cost of sulfite liquor alcohol is estimated to be 20 cents a gallon and it is shown that even at a price of 35 cents, a 10 percent alcohol-gasoline blend can be sold economically. It is estimated that 250,000 tons of fermentable sugar from sulfite liquor is available annually.

1942

ANONYMOUS (939)
ALCOHOL FUEL FROM SUGAR IN BRAZIL. Foreign Com. Weekly 8 (11): 14. 1942.

——— (940)
PETROL SUBSTITUTES IN SOUTH AFRICA. Engineer 174: 79–80. 1942.

Cost of power alcohol from molasses is 7d. per gallon.

——— (941)
POWER ALCOHOL. Canad. Automotive Trade 24 (9): 17–18, 50, 52. 1942.

Production of industrial alcohol in United States, South America, Germany, Great Britain, and other countries is discussed.

ARGENTINA. SPECIAL COMMISSION FOR MOTOR FUEL STUDY IN BUENOS AIRES PROVINCE. (942)
ETHYL ALCOHOL AS A MOTOR FUEL. Rpt.. *in* Indus. y Quim. 4 (5): 119–122. 1942.

The article contains information presented by a special commission assigned to investigate the possibility of using alcohol-gasoline blends. The possible construction and location of distilleries, and availability of raw materials are discussed. The use of blends containing 10 percent or more of anhydrous ethanol is recommended. Cost figures are given.

BENNASAR, J. A. (943)
CORN AS FUEL. Bol. Inform. Petrol. [Buenos Aires] 19 (218): 32–46. 1942.

The use of corn as fuel for automobiles and locomotives is discussed. Under present conditions the manufacture of alcohol from corn is uneconomical.

BROWNLIE, DAVID (944)
POWER ALCOHOL. AN IMPORTANT NEW DEVELOPMENT. Indian Engin. III: 79–80. 1942.

Author discusses production of power alcohol by fermentation and chemical synthesis, giving sources of raw materials and capital requirements.

DEVAUD, C. (945)
LIQUID SUBSTITUTE FUELS. Bul. Tech. de la Suisse Romande 68 (13): 148–150. 1942.

Production and possible use of methanol and ethanol in Switzerland are discussed.

DEVON, J. (946)
PROSPECTS AND PROBLEMS OF POWER ALCOHOL. Petroleum 5: 57. 1942.

The use of alcohol as fuel for internal combustion engines in England is discussed. Some of the disadvantages of alcohol are: Lack of raw materials in England, lack of satisfactory method of using alcohol by itself, lower calorific value, and higher initial boiling temperature. The octane number of alcohol is 100 compared with 65 to 68 for gasoline.

EGLOFF, G., and VAN ARSDELL, P. M. (947)
SUBSTITUTE FUELS AS A WAR ECONOMY. Chem. and Engin. News 20: 649–658. 1942; Inst. Petrol. Jour. 28: 115–132. 1942.

Compressed gas as fuel, hydrogenation of coal, Fischer-Tropsch process, gas producer development, and power alcohol in various European countries and Japan are discussed. Production of power alcohol (ethanol and methanol) in the axis countries amounted to 6,170,000 barrels in 1939; the production in Sweden was 290,000 barrels in 1941. In Japan oil companies were required to maintain emergency reserves of alcohol equivalent to at least 20 percent of the gasoline on hand for 6 months' sales.

INTER-AMERICAN DEVELOPMENT COMMISSION (948)
REPORT ON INDUSTRIAL ALCOHOL. 71 pp. Inter-American Development Commission, Economic Research Unit, Rio de Janeiro, Mar. 20, 1942.

This is a detailed account of the Institute Do Açucar e Do Alcool (Sugar and Alcohol Institute), an organization for the control of sugar and ethanol production. The membership consists of four delegates, one each from the Bank of Brazil and the Ministries of Finance, Agriculture, and Labor. Four representatives of the Sugar Mill owners, 3 and 1 representatives respectively of the sugarcane growers and of the owners of small animal-powered mills. The Institute's prime concern is the financial well-being of the sugar industry, and it is really guaranteeing the mill owner a profitable outlet for his molasses. The proportion of ethanol in blends is very flexible. A 40-percent blend (often 95-percent ethanol) is used in Pernambuco. In the Federal District, States of Rio, Baia, Espirilo Santo and parts of Minas Gerais and São Paulo the proportion is only 10 percent.

MARILLER, CHARLES (949)
THE PRODUCTION OF ALCOHOL FOR USE AS MOTOR FUEL. Carburants Nat. 3: 185–190. 1942.

After reviewing the various possible sources from which ethanol may be made, author believes that power alcohol is essential for France's national economy.

OWEN, W. L. (950)
JEANITE: MOTOR FUEL FROM MOLASSES. Sugar 37 (4): 20–23; (7): 26–29. 1942.

Author discusses the possible application of Jean's process for making motor fuels in Cuba, South Africa, Australia, and British India.

RIVERS-ANDERSON, C. (951)
THE PRODUCTION OF POWER ALCOHOL IN AUSTRALIA. Fuel in Sci. and Pract. 21: 17–18. 1942.

Raw materials for production of power alcohol in Australia are sugar and wheat. In Tasmania, wood can be used for the same purpose. It is more practical to transport raw materials to where fuel is to be used, because of the danger of contamination of alcohol by water in shipping.

SOBRERO, L. R. (952)
SURPLUS CORN TO BE EXPORTED IN FORM OF ALCOHOL. Bolsa de Com. Bol. Ofic. [Rosario, Argentina] 30 (728): 7–10. 1942.

Author outlines the plan to convert the Argentine corn surplus into alcohol which is to be sold to the United States. Production capacity of Argentine factories; dry ice as a byproduct of alcohol manufacture, and mechanical harvesting as a factor in reducing costs are discussed.

WEGELIUS, T. (953)
MANUFACTURE OF LIQUID FUELS AND LUBRICANTS FROM WOOD CONVERSION PRODUCTS. Finnish Paper and Timber Jour. 24 (7A): 62–68. 1942; Inst. Paper Chem. Bul. 13: 144. 1942.

Methyl alcohol used as a fuel is obtained from wood carbonization and as a byproduct in the manufacture of pulp. Mixtures of aliphatic alcohols, ethers, and ketones from the distillation of black liquor or from wood or pulp by catalysis are satisfactory airplane fuels.

1943

ANONYMOUS (954)
KETONE MOTOR FUELS. Oel u. Kohle 39: 138–139. 1943; Chem. & Metall. Engin. 51 (3): 191. 1944.

Various manufacturing processes for making ketones, particularly acetone, for fuel purposes are discussed briefly.

BRAZIL. SECRETARIA DA AGRICULTURA (955)
PRODUCTION OF INDUSTRIAL ALCOHOL. Brazil. Secretaria da Agricultura. Comunicado da Diretoria de Publicidade Agricola. Quím. e Indus. 11 (131): 22–23. 1943.

In spite of the fact that 220 liters of ethanol may be produced from a ton of manioc and only 60 liters from a ton of sugarcane, there are sufficient other advantages in favor of the latter to make the use of sugarcane more profitable. These advantages are stated briefly.

CANESSA, J. V. (956)
ALCOHOL FROM CORN AS FUEL. Bol. de Inform. Petrol. [Buenos Aires] 20 (221): 41–48. 1943.

Data show that in Argentina it is more economical to burn corn as a substitute for fuel oil than to use a 10 percent ethanol blend in automotive engines.

CHAVANNE, G. (957)
A METHOD OF POSSIBLE UTILIZATION OF PALM OIL FOR THE MANUFACTURE OF A HEAVY FUEL. Soc. Chim. de France Bul. 10: 52–58. 1943.

Author discusses the production of ethyl esters of palm oil which, when mixed with hydrocarbons, can be used as motor fuel. Economic factors involved in ethanol production are given.

LEFOL, J. (958)
LIQUID FUELS BY SYNTHESIS. Carburants Nat. 4: 137–141. 1943.

A lecture briefly reviewing the possibility of manufacturing liquid fuels by carbonization, synthesis, hydrogenation, and fermentation of sugar from the hydrolysis of wood.

MENENDEZ LEES, PEDRO (959)
ABSOLUTE ALCOHOL. Assoc. de Ingen Agron. Rev. 15 (4): 9–32. 1943.

Author believes that the use of ethanol-gasoline blends depends on the particular economic conditions prevailing in any one country. Their use should not depend on whether it harms or benefits any particular industry or group, but whether it is beneficial to the country as a whole. Many countries are using gasoline blends containing anhydrous ethanol without experiencing difficulties. A description of various methods of dehydrating ethanol is given.

OWEN, W. L. (960)
MOTOR FUEL FROM MOLASSES. Sugar 38 (3): 22–26. 1943; *Ibid.* 38 (5): 22–26, 27. 1943.

Author discusses possibility of using surplus sugarcane for production of motor fuel, synthetic rubber, feeding, etc.

SINGLY, R. DE (961)
A COLONIAL (FRENCH) INDUSTRY OF THE FUTURE: WOOD HYDROLYSIS. Carburants Nat. 4: 161–169. 1943.

Historical review of processes for wood hydrolysis is given. The possibilities of producing alcohol in French colonies from hydrolyzed wood is emphasized.

SKINNER, W. W. (revised by P. B. Jacobs, March, 1943) (962)
INDUSTRIAL ALCOHOL. U. S. Dept. Agr., Bur. Agr. and Indus. Chem. AIC–3, NM–235, 25 pp., Peoria, Illinois. Northern Regional Research Laboratory. 1943.

The article, designed for general information, covers briefly the various manufacturing methods, cost of production, and use of alcohol as motor fuel. The cost of alcohol per gallon from blackstrap molasses at 5 cents a gallon and from corn at 40 cents a bushel is estimated to be 20 and 23.5 cents a gallon, respectively. References are given, including Government publications.

VALLETTE (963)
SYNTHETIC ETHYL AND METHYL ALCOHOLS. Soc. des Ingén. de l'Auto. Jour. 16: 280–282. 1943.

The synthesis of methanol is described in some detail and it is concluded that practically unlimited amounts could be manufactured because of the availability of suitable raw materials. The same situation does not prevail in regard to the other alcohols. Methanol, therefore, should be considered along with ethanol as a fuel in spite of its low heat of combustion. It can be produced by synthesis or by fermentation.

1944

ANONYMOUS (964)
ALCOHOL PRODUCTION MAKES PROGRESS IN AUSTRALIA. Chem. & Metall. Engin. 51 (2): 168. 1944.

Alcohol for power purposes is produced in Australia in newly erected plants by Amylo process. Yield from this method is 2.5 gallons per bushel of wheat compared with 2.3 gallons by the malt process.

——— (965)
POSITION OF FRENCH ALCOHOL INDUSTRY. Indus. Chem. and Chem. Mfr. 20: 113–116. 1944.

Cost, production, legislative measures, and economics of ethanol and gasoline are discussed.

BERTOLINI, L. H. (966)
DRINKING ALCOHOL AND NATIONAL (ARGENTINA) FUEL—THE PROBLEM WHICH CONCERNS THE CUYO PROVINCE. Vinos, Viñas y Frutas 39: 371–373. 1944.

Author advocates the manufacture of power alcohol from grapes in order to take care of overproduction.

JORDAN, W. A. (967)

POWER ALCOHOL LEGISLATION LOOMS AGAIN IN POSTWAR DISCUSSIONS. Chem. Indus. [New York] 54: 721. 1944.

In Canada there are two sources for alcohol production, wheat and sulfite liquor; the former, however, is not available at present. Alcohol distillery capacity is now greater than normal peacetime requirements. If, at a later date, surplus wheat should again become a factor, it is stated that any sound proposal for the utilization of alcohol as fuel might receive a favorable hearing in Ottawa. Such a step would eliminate any surplus of wheat and provide, aside from the alcohol, a million tons of high protein feed.

MARILLER, CHARLES (968)

INDUSTRIAL BALANCE SHEET OF THE PRODUCTION OF ALCOHOL AND ITS POSSIBILITIES FOR IMPROVEMENT. France Énergétique 3 (3–4): 3–12. 1944.

Sugar beets are at present the best source of ethanol. Production is stable and the cost of ethanol from beets is a function of approximately three-fourths their price. Great progress has been realized in the technology of conversion of sugar to ethanol and more can be envisaged, particularly in connection with its use as fuel and in the storage of beets. Production of Jerusalem artichokes has barely started, and the cost of ethanol production from them will be higher than from beets. Progress must come from selection of plants for higher sugar yields. Alcohol from wood should be important in times of peace. Corn is not of interest; however, sorghums may be of interest in certain regions of North Africa. A judicious program of intensive agricultural alcohol production must be realized in as short a time as possible, within a period of 10 years, parallel to a program of electrification and work on the development of lignite in order to insure a maximum production of domestic fuels.

OWEN, W. L. (969)

MOTOR FUEL PRODUCTION FROM MOLASSES. Sugar 39 (1): 22–24. 1944; *Ibid.* 39 (2): 24–27. 1944; *Ibid.* 39 (4): 26–29. 1944; Internatl. Sugar Jour. 46: 218, 247. 1944; *Ibid.* 47: 78. 1945.

Author discusses utilization of over-quota cane for production of a variety of commodities and factors affecting cost of production. He outlines a scheme for converting a sugar factory having a cane-grinding capacity of 2,000 tons a day into a distillery having a capacity equivalent to 300,000 gallons of mash i.e., 5,400 gallons of 95-percent ethanol per day.

SEAGRAM, J. E. & SONS, INC. (970)

POWER ALCOHOL CONFERENCE. Report of the meeting. 32 pp. Joseph E. Seagram & Sons, Inc., Louisville, Ky. Dec. 27, 1944; See also H. W. Stenerson, "Technologists discuss power alcohol developments." Indus. and Engin. Chem., News Ed. 23: 168–170. 1945.

The conference was attended by representatives of agriculture, industry, and various government agencies. Seagram's continuous processes of making ethanol and the development of a "distillery on wheels" were presented in detail. A report of representatives of the Vimalert Corp. on a modified Chrysler engine for use with alcohol indicated that various difficulties must be overcome before satisfactory operation can be expected.

SILVEIRA, A. H. DA (971)

MOTOR ALCOHOL. Ceres [Brazil] 5: 172–177. 1944.

A review of the use of ethanol blends in Europe, South Africa, and particularly in Brazil. The organization and work of the I.A.A. (Sugar and Alcohol Institute) are described.

UNITED STATES CONGRESS (972)

FARMERS' FUTURE, AMERICA'S FUTURE. (Address of Senator G. M. Gillette). Congressional Record 90: A4850–A4852. December 19, 1944.

Various means of disposing of possible farm surpluses are discussed, such as conversion of crops to ethanol for the production of synthetic rubber and for use in motor fuels. An ever-normal granary of at least 1 billion bushels, and a stock pile of at least 300,000 tons of synthetic rubber and at least 50 million gallons of ethanol are suggested.

UNITED STATES TARIFF COMMISSION (973)

INDUSTRIAL ALCOHOL. U. S. Tariff Comm. War Changes in Indus. Ser. Rpt. No. 2, 57 pp. 1944.

The prewar, wartime, postwar status and potential foreign competition of the industrial-alcohol industry are discussed. It is concluded that increased costs of petroleum, because of depletion at some future date, might make alcohol an attractive source of both synthetic rubber and motor fuel.

VICIEDO PERDOMO, EUSEBIO (974)

CUBAN ALCOHOL INDUSTRY. Sugar 39 (5): 36. 1944.

Because of shortage of gasoline, a national fuel consisting of 65 percent of 95-percent alcohol and 35 percent of gasoline was developed. Present production of alcohol (92 to 95 percent) is 216 million liters, future production probably 360 million liters. Many distilleries are not very efficient.

WILSON, R. E. (975)

LIQUID FUEL FROM NON-PETROLEUM SOURCES. Indus. and Engin. Chem., News Ed. 22: 1244–1250. 1944; Natl. Petrol. News 36 (36): R596–R602. 1944.

The author believes that ethanol can be produced economically i.e., in competition with gasoline, from agricultural sources only where it might be made as a byproduct.

1945

ANONYMOUS (976)

SYNTHETIC FUELS CONSIDERED. Indus. and Engin. Chem., News Ed. 23: 2254. 1945.

The main ingredient of four blends used in South Africa which meet the requirements of the Customs and Excise Act is absolute alcohol. These blends are 72.5 percent ethanol, 22.5 percent benzol, 5 percent acetone; 95 percent ethanol, 2.5 percent acetone, 2.25 percent benzol, 0.25 percent pyridine; 60 percent ethanol, 35 percent benzol, 5 percent gasoline; and 95 percent ethanol, 5 percent benzol. Since the supply situation has changed it is not certain that these fuels will be produced.

ALLCUT, E. A. (977)

A FUEL POLICY FOR CANADA. Univ. of Toronto. School of Engin. Res., Tech. Memo. No. 3, 34 pp. 1945. [Reprinted *from* Canad. Jour. Econ. and Polit. Sci. 11: 26–34. 1945].

The economic possibilities of conserving Canada's waning fuel resources are summarized under three headings: (1) Conservation, (2) reproduction, and (3) substitution. Under conservation, the author mentions the absurdity of providing 85 to 100 hp. to carry one person around and America should follow Europe in providing lighter engines. Under reproduction, the use of alcohol is cited. Blends up to 20 percent of alcohol in gasoline will not affect appreciably either power or economy in existing engines. Under the third heading, increased use of electricity, colloidal fuel and hydrogenation are discussed.

JACOBS, P. B. (978)

ALCOHOL FROM AGRICULTURAL COMMODITIES. Mimeograph Rpt. AIC–95, 77 pp. 1945. U. S. Dept. Agr. Bur. Agr. Indus. Chem. Northern Regional Res. Lab., Peoria, Ill.

An extensive and complete discussion, principally on production and cost of alcohol. The scope of the paper is indicated by some of the chapter headings, such as: Production and consumption of industrial alcohol, Organization of the distillatin industries, Alcohol production capacities, Foreign alcohol situation, Alcohol from agricultural products, Sources of alcohol, Financial aspects, Present status of methods for producing alcohol from agricultural products, and Alcohol for synthetic rubber production. There is also a chapter on the use of alcohol in motor fuel. Discussing the "postwar aspects of alcohol motor fuel," it is stated that the expected use of higher compression ratios and the relatively high cost of high-octane fuels may make alcohol an accepable blending agent.

MARTRAIRE, MAURICE (979)
HYDROUS BEET-SUGAR ALCOHOL AN ECONOMIC MOTOR FUEL. Assoc. des Chim. Bul. 62: 204–214. 1945.

Author presents a detailed economic picture of beet-sugar alcohol production and believes that the latter is economically sound. The use of 95-percent ethanol without further dehydration in suitably designed engines is advocated.

MEHTA, T. N. (980)
POWER ALCOHOL FOR INDIA. Univ. of Bombay, Dept. Chem. Technol. Pub. 24 pp. 1945.

The aims of the power alcohol program for India are (1) to provide a motor fuel for India's industrialization and (2) to utilize the waste of blackstrap molasses and thus help stabilize the country's sugar industry. It is concluded that molasses is at present the only source and that the manufacturing cost per gallon (imperial?) would be at most 18 cents and at filling stations 36 cents, the additional cost being mainly tax.

TAUB, A., SHIRE, A. C., LAMIE, R. D., BONILLA, C. F., and SANDO, C. E. (981)
SUBSTITUTE FUELS. Engin. Rpt. E.N.G.–27. 35 pp. 1945. U. S. Foreign Econ. Admin. Bur. of Supplies, Service. September 1945.

The activities of the Foreign Economic Administration in connection with substitute motor fuels are explained.

TOUSLEY, R. D. (982)
ALCOHOL ECONOMICS WILL DETERMINE FUTURE PRODUCTION PROCESSES. Wash. State Col., Bur. of Econ. and Business Res. Bul. 3, 69 pp. 1945; Chem. & Metall. Engin. 52 (10): 120–133. 1945.

The cost of alcohol made by various methods is estimated: From ethylene at 3 cents a pound, the cost is 13 to 14 cents a gallon; from molasses at 5 cents a gallon, about 16 cents a gallon; from corn at 45 cents a bushel, 20.5 to 23.5 cents a gallon; from sulfite liquor, 15 to 19 cents a gallon (postwar estimate 2 cents lower); from hydrolysis of wood at $2 per ton dry basis, 20.5 to 22 cents a gallon.

1946

ANONYMOUS (983)
ALCOHOL ON THE HOOF. SEAGRAM'S DESIGNS MOBILE CONTINUOUS PROCESS ALCOHOL UNIT. Chem. Indus. [New York] 59: 650–651. 1946.

A small-scale demonstration model of the continuous fermentation process of making 95-percent ethanol from agricultural products was shown at the National Chemical Exposition in Chicago in September 1946. The proposed industrial alcohol unit could be moved about the country on a five-car railroad train. It is based on a throughput of 500 bushels of grain per day yielding 2.5 wine gallons of ethanol per bushel. (See also No. 970.)

LYLE, OLIVER (984)
[FUEL] INEFFICIENCY. Inst. Fuel, Bul., Oct. 1946, pp. 1–26.

In connection with an extensive survey of the present inefficient utilization of coal, it is proposed also to study the possibilities of fuel crops.

PERAIRE, MARCEL (985)

250,000 TRACTORS? YES, BUT HOW TO POWER THEM? Terre D'Oc 28: 699–702. 1946. Published also as: "Will alcohol fuel solve the problem of mechanical traction?" France Agr. 2 (66) 1, 3. 1946.

Commenting on the intention of the French Government to build and deliver 50,000 tractors and 10,000 units of mechanized farm machinery each year for the next 5 years, author states that such a plan must include the problem of fuel. Four horses are aproximately equivalent to a 10/20 hp. tractor; the former need 4½ hectares for feed while the latter needs the equivalent of 3 hectares of beets for production of alcohol (byproducts to be used for cattle feed). This would leave the difference for production of food. Farmers prefer Diesel engines and, of course, in the colonies extensive use is made of locally produced vegetable oils for Diesel fuel. However, because of recent catalytic methods, Diesel fuel is becoming scarce in the United States and in any case both this fuel and gasoline must be imported. It is concluded that the problem of alcohol motor fuel should be seriously considered in connection with the problem of motorization of French agriculture.

TATE, E. A. (986)

GASOLINE AND ALCOHOL AS FUELS FOR AUTOMOBILES. Assoc. de Téc. Azucareros Cuba, Bol. 5: 242–244. 1946.

Author advocates the use of 25 percent ethanol-gasoline blends in Cuba. No carburetor adjustments are necessary and engine performance is as good with gasoline in automobiles with C.R. 6:1 to 6.7:1. In Brazil petroleum companies are obligated to prepare and sell alcohol-gasoline blends in proportions regulated by the government, 10 percent in Rio de Janeiro region and 20 percent in Pernambuco. In the future it is expected that the proportion of ethanol in blends will increase to 95 percent. In Cuba it is necessary to import more than a half million tons of petroleum fuels anually. This presents a possibility of growing corn on a large scale, and using for motor fuel the 30 percent of sugarcane which at present is wasted.

TOUSLEY, R. D. (987)

PROSPECTIVE POSTWAR COSTS OF PRODUCING ALCOHOL. Pulp and Paper Mag. Canada 47, (1): 48–55. 1946.

See reference by the same author in Chem. and Metall. Engin. 52 (10): 120–123. 1945. (No. 982.)

UNITED STATES TARIFF COMMISSION (988)

PETROLEUM. War Changes in Indus. Ser. Rpt. No. 17, 152 pp. Washington. 1946.

All mineral products are exhaustible; however, it is possible to produce ethanol or related liquid fuels from currently growing vegetation. As shown in the "War Changes in Industry Report No. 2, 1944" present prices of alcohol are much higher than those of petroleum products.

1947

ANONYMOUS (989)

USES OF SPECIALLY DENATURED ALCOHOL. Chem. and Engin. News 25: 858. 1947.

In the fiscal year ending June 1946, 381,480 wine gallons of ethanol were used as fuel in this country.

ARIES, R. S. (990)

THE CHANGING INDUSTRIAL ALCOHOL PICTURE. Chem. and Engin. News 25: 1792–1796. 1947.

The past, present and future economic picture of ethanol production is discussed (see previous similar discussion by P. B. Jacobs, Alcohol from Agricultural Commodities AIC–95. May 1945. No. 978). It is argued that power alcohol is not economical and should not "be counted upon in the foreseeable future."

EGLOFF, GUSTAV (991)
FUELS USED IN SWEDEN. Petrol. Times 51: 64, 66, 71. 1947; Chem. and Engin. News 25: 71. 1947. Paper presented before Amer. Chem. Soc., "Technical Conference of Chicago Section," Evanston, Ill. Jan. 24, 1947.

Incidental to a discussion of the general fuel situation in Sweden, the following information on alcohol motor fuels is given: The normal prewar production of 26,000 metric tons, of which 18,000 tons was used as motor fuel, was tripled in 1945. Two standardized fuels were used, a 50:50 and an 85:15 alcohol-gasoline blend. At present (August 1946), a 15 percent alcohol blend is compulsory.

MCCLURE, H. B., and BATEMAN, R. L. (992)
THE SYNTHETIC ALIPHATIC INDUSTRY I & II. Chem. and Engin. News 25: 3208–3214, 3286–3289. 1947.

Discussion of the changing source of supply of alcohols.

OWEN, W. L. (993)
THE CUBAN DISTILLING INDUSTRY AT CROSS ROADS. Assoc. de Téc. Azucareros Cuba, Proc. 18th meeting, pp. 215–221; Internatl. Sugar Jour. 49: 217. 1947.

Unless steps are taken to find improved processes in the utilization of blackstrap molasses, Cuba will be faced either with a surplus or with unprofitable utilization of its molasses for the local motor fuel industry.

STENERSON, HARRY (994)
BEHIND THE MARKETS. Chem. and Engin. News 25: 3180. 1947.

It is stated if only one-fifth of the country's motor fuel is made by the Fischer-Tropsch process, byproduct ethanol would amount to 200 million gallons a year.

V. MISCELLANEOUS INFORMATION ON AGRICULTURAL MOTOR FUELS

1907

THOMAS, E. (995)
ALCOHOL ENGINES AS A FUTURE POWER. Elect. World 49: 20–22. 1907.

1915

ANONYMOUS (996)
NEW ALCOHOL FUEL. Engineer 119: 584. 1915.

1916

ANONYMOUS (997)
ALCOHOL-BENZOL FUEL. Automobile 35: 282. 1916.

GLICK, B. N. (998)
ALCOHOL—THE FUEL OF THE FUTURE. Automobile 35: 932. 1916.
Large potential supplies are available from utilization of wood waste.

PIKE, S. (999)
DENATURED ALCOHOL AS A SUBSTITUTE FOR GASOLINE. Sci. Amer. 114: 449. 1916.

1917

ROWE, W. T. (1000)
ALCOHOL AS A SOURCE OF POWER. Engineer 124: 471. 1917.

1918

GJERDE, G. K. (1001)
MOTOR FUEL. Papir-Jour. 1918 (6): 42.

Comparison of acetylene, sulfite alcohol, and other gasoline substitutes is made. It is stated that sulfite alcohol is the best substitute for gasoline. Twenty percent of benzene should be added to alcohol to facilitate starting the motor.

1919

ANONYMOUS (1002)
ALCOHOL MOTOR FUEL. Engineer 128: 17–18. 1919.

FINDLEY, H. A. (1003)
NATALITE FUEL. Automotive Indus. 40: 59. 1919.

HERITAGE, J. P. (1004)
IS ALCOHOL DEAD? Sci. Amer. Sup. 88: 242. 1919.

1920

ANONYMOUS (1005)
ALCOHOL AS A POSSIBLE REMEDY FOR FUEL SHORTAGE. Automotive Mfr. 62 (7): 18–20; (8): 28–30. 1920.

——— (1006)
ALCOHOL AS FUEL. Auto. Engin. 10: 157–160. 1920.
A review

——— (1007)
ALCOHOL FUEL PATENTS. Motor Traction 31: 310–311. 1920.
Legal considerations affecting the validity of patents are discussed.

EASTWOOD, J. (1008)
ALCOHOL FOR FUEL. Calif. Cult. 54: 700. 1920.
Author advocates the manufacture of ethanol for use as fuel.

HAMOR, W. A. (1009)
THE PROBLEM OF THE PETROLEUM INDUSTRY. Chem. & Metall. Engin. 23 (10): 425–434. 1920.
A discussion of possible future fuel supplies and their better utilization, with brief mention of sources and use of ethanol as a motor fuel.

MEIGS, J. V. (1010)
ALCOHOL MAY PERMIT USE AS MOTOR FUEL OF HEAVY HYDROCARBONS. Natl. Petrol. News 12: 49. Feb. 4, 1920.

ORMANDY, W. R. (1011)
ALCOHOL AS A FUEL. Motor Traction 31: 481–483. 1920.

——— (1012)
RECENT PATENTS ON MIXED FUELS. Inst. Petrol. Technol. Jour. 6: 229–248. 1920; Internatl. Sugar 22: 402–405. 1920.
Author severely criticizes the issuance of the many patents on blends, and concludes that this is a distinct danger to the motor user, to the motor manufacturer, and to the general public that such patents should be allowed.

PISAR, C. J. (1013)
NEW MOTOR FUEL IN SOUTH AFRICA. U. S. Bur. Foreign and Dom. Com. Rpt. No. 252: 411. 1920.
Acetol is a mixture of alcohol, ether, and other components which are not mentioned.

POGUE, J. E. (1014)
POSSIBILITIES OF ALCOHOL AS FUEL. Power 51: 177. 1920.

PURGOTTI, A. (1015)
EMPLOYMENT OF ALCOHOL IN INTERNAL COMBUSTION ENGINES. "ETHENOL." Gior. di Chim. Indus. ed Appl. 2: 191. 1920.
Ethenol, a mixture of ethanol and ether, is a satisfactory fuel for internal-combustion engines.

RANC, A., and BOISSEAU, J. (1016)
ALCOHOL AND AUTOMOTIVE POWER. Nature [Paris] No. 2429: 260–263. 1920.
Survey of studies to determine the applicability of alcohols as motor fuel.

SKERRETT, R. G. (1017)
SHALL THE CORN FIELDS RUN OUR CARS? Sci. Amer. 123: 274, 284. 1920.

TUNISON, B. R. (1018)
THE FUTURE OF INDUSTRIAL ALCOHOL. Indus. and Engin. Chem. 12: 370–376. 1920. Published *also* as: Molasses best source of industrial fuel. Sugar 22: 397–399. 1920.

A general discussion of the possible future of ethanol in motor fuels.

1921

GILBERT, A. H. (1019)
POSSIBILITIES OF ALCOHOL FOR FUEL. Agr. Engin. 2: 5–6. 1921.

Report of committee, summarizing results of research conducted by technical institutions and government agencies, presented at the meeting of American Society of Agricultural Engineers.

HIND, R. R. (1020)
FOSTER PROCESS ALCOHOL FUEL FOR INTERNAL COMBUSTION ENGINES MADE FROM WASTE MOLASSES. Facts About Sugar 12: 91. 1921.

SCARD, F. I. (1021)
ALCOHOL MOTOR FUEL IN THE TROPICS. Mundo Azucarero 9: 88. 1921.

SCHERRARD, E. C. (1022)
FOREST PRODUCTS AS MOTOR FUELS. Sci. Lubrication 1 (2): 8–13, 25. 1921.

Ethanol alone or in blends is considered as a substitute for gasoline.

WOOD, C. W. (1023)
POWER ALCOHOL AS A FUEL FOR EGYPT. Cairo Sci. Jour. 10: 9–24. 1921.

A general discussion on the power alcohol industry in Egypt.

1922

JONES, C. L. (1024)
ALCOHOL IN CUBA. Sugar 24: 300. 1922.

MALLET, P. (1025)
OUR (FRENCH) RESOURCES IN LIQUID FUELS. Jour. des Usines à Gas. 46: 305–308. 1922.

MIDGLEY, T., JR., and BOYD, T. A. (1026)
THE APPLICATION OF CHEMISTRY TO THE CONSERVATION OF MOTOR FUELS. Indus. and Engin. Chem. 14: 849–851, 894–898. 1922.

Potential sources of gasoline are discussed and ethanol is mentioned as one of them. Ethanol and benzene are good knock suppressors; however, compared to tetraethyl lead their "potency" is small.

SCHRAUTH, WALTHER (1027)
HYDRATED NAPHTHALENE AS FUEL FOR AUTOMOBILES. Auto. Tech. 11 (9): 6–7. 1922.

Author defends the use of tetralin in the German national fuel (benzene 50, tetralin 25, 95-percent ethanol 25) and claims that difficulties were encountered because directions given were not observed. For cold starting in winter, addition of 5 percent of gasoline or ether is advised.

1923

ARNSTEIN, HENRY (1028)
ABSTRACTS AND QUOTATIONS FROM RECENT SCIENTIFIC LITERATURE ON SUBJECTS OF ALCOHOL AS A MOTOR FUEL. La. Planter 70: 568–569, 590–591, 608–610; *Ibid.* 71: 32–33. 1923.

BERTHELOT, CHARLES (1029)
CONGRESS AND THE EXPOSITION OF LIQUID FUELS (OCTOBER 4–15 1922). Rev. de Métall. 20: 112–129, 175. 1923.

Author discusses, among other fuels, alcohol and vegetable oils.

CAREY, H. (1030)
MOTOR FUELS AND ENGINES OF THE FUTURE. Oil and Gas Jour. 22 (36): 94. 1923.

Shale oil and alcohol are considered to be the future substitutes for gasoline.

1924

ANONYMOUS (1031)
THE NEW BENZENE-ALCOHOL FUEL 20 + 80. Allg. Auto. Ztg. 25 (46): 13. 1924.

CHIARIA, PIETRO (1032)
THE PROBLEM OF A NATIONAL (ITALIAN) MOTOR FUEL. Gior. di Farm. di Chim. et di Sci. Affini 73: 105–107. 1924.

The mixture of ethanol and benzene which the French advocate as a national motor fuel was described in 1917 by Luigi Solari.

GARELLI, FELICE (1033)
THE USE OF ALCOHOL AND ITS MIXTURES FOR INTERNAL-COMBUSTION MOTORS. Cong. Naz. di Chim. Indus. Atti 1924: 154–164.

A general discussion on alcohol as motor fuel.

GUINOT, H. (1034)
THE INDUSTRIAL DEHYDRATION OF ALCOHOL FOR THE PREPARATION OF FUELS. La. Planter 72: 512. 1924.

For successful utilization as motor fuel, alcohol must be anhydrous. Dehydration with benzene is recommended.

1925

ANONYMOUS (1035)
ALCOHOL AS MOTOR FUEL. Sugar 27: 52. 1925.

The article contains a number of recommendations of the "Congress of Agriculture" held at Rio de Janeiro to investigate and stimulate the use of alcohol motor fuels.

——— (1036)
ALCOHOL STILL UNABLE TO REPLACE PETROL. Natl. Petrol. News 17: 58. July 29, 1925.

BAETSLÉ, R. (1037)
THE NATIONAL LIQUID FUEL PROBLEM IN BELGIUM. Assoc. des Elèves de l'Inst. Sup. des Fermentations de Gand Bul. 26; Soc. des Brasseurs Ann. 34: 191–209. 1925.

The possible use of ethanol, benzene, and synthetic petroleum is considered.

HARDY, F. (1038)
THE POWER ALCOHOL PROBLEM. Trop. Agr. [Trinidad] 2: 192–194. 1925.

A review.

KILLEFFER, D. H. (1039)
WHAT CHEMISTS ARE WORKING ON FOR FUTURE FUELS. Automotive Mfr. 67 (4): 23–25. 1925.

Benefits of alcohol and other substitute fuels for gasoline are considered.

WHITAKER, M. C. (1040)
ALCOHOL MOTOR FUELS. Oil, Paint and Drug Rptr. 108 XI, Pt. 2, Oct. 5, 1925; Chemicals 24: 8. Oct. 5, 1925.

If compression ratio is increased and carburetor is properly adjusted, alcohol blends easily excel gasoline on every point, and the future of alcohol is largely an economic and a sociological problem.

WINKLER, H., and JACQUÉ, L. (1041)
SYNTHETIC PETROLEUM AND THE NATIONAL FUEL. Nature [Paris] 53: 325–327, 346–347. 1925.

Ethanol and methanol are considered as possible motor fuels.

1926

ALBERTI (1042)
MONOPOLIN IN THE FIELD OF FUELS. Ztschr. f. Spiritusindus. 49: 100. 1926.

PLUENTSCH, F. M. (1043)
MONOPOLIN AS A FUEL FOR TRUCKS. Ztschr. f. Spiritusindus. 49: 109. 1926.

RAY, GEORGES (1044)
UNRECOGNIZED ADVANTAGES OF FERMENTATION ALCOHOL AS FUEL. Chim. & Indus. [Paris], Special No., pp. 354–356. Sept. 1926.

SCHWARTZ (1045)
ALCOHOL AS MOTOR FUEL. Ztschr. f. Spiritusindus. 48: 327, 393–395. 1925; *Ibid.* 49: 33, 101–102, 110–111. 1926.

The German patent literature on alcohol motor fuels is reviewed.

1927

DEAN, S. W., JR. (1046)
AFTER PETROLEUM—WHAT? Chemicals 27: 17. 1927.

DENNETT, J. H. (1047)
ALCOHOL FUEL AND THE NIPAH PALM—A POPULAR OUTLINE. Malayan Agr. Jour. 15: 420–432, 433–445. 1927.

Author summarizes previous information on cost and production of ethanol and ether from nipa palm in a plant having capacity of 200 imperial gallons per day (see Malayan Agr. Jour. 13: 64-76. 1925).

FRITZWEILER, R. (1048)
IS THE PRODUCTION OF WATER-FREE MOTOR ALCOHOL A LUXURY OR A NECESSITY? Ztschr. f. Spiritusindus. 50: 260–270. 1927.

A discussion on the necessity of producing absolute alcohol for use as motor fuel.

KANSAS CITY TESTING LABORATORY (1049)
MOTOR FUEL. Kansas City Testing Laboratory, Kansas City, Mo., Bul. No. 22, 22 pp. 1927.

The possibilities of the production of methanol and ethanol for fuel purposes are reviewed briefly.

NEUMANN, H. (1050)
MONOPOLIN IN SAXONY. Ztschr. f. Spiritusindus. 50: 260. 1927.

SORNAY, P. DE (1051)
INDUSTRIAL AND BEVERAGE ALCOHOL. Rev. Agr. de l'Ile Maurice 4: 313–320. 1927.

1928

ANONYMOUS (1052)
FRANCO-BELGIAN MEETING OF USERS OF NATIONAL FUELS. Chaleur et Indus. 9: 550–555. 1928.

The use of alcohol as a national fuel is discussed.

GUIFFORT, M. (1053)
FUELS FOR TRUCKS. Indus. des Voies Ferrées et des Transports Auto. 22: 199. July 1928.

1929

SINGER, LEOPOLD (1054)
LATEST LITERATURE ON MOTOR FUELS. Petrol. Ztschr. 25: 513–524. 1929.

Recent literature and patents of alcohol motor fuels, substitute fuels, carbon removers, antifreeze compounds, and in general all literature referring to combustion in the engine is reviewed.

1930

DIETRICH, K. R. (1055)
ALCOHOL AS MOTOR FUEL AND COMPULSORY ADMIXTURES OF ALCOHOL IN FUEL BLENDS. Chem. Ztg. 54: 796. 1930.
Editorial.

——— (1056)
MANUFACTURE OF ALCOHOLIC MOTOR FUEL. Ztschr. f. Spiritusindus. 53: 349. 1930.
The article was written to help inexperienced motor-fuel manufacturers in the preparation of ethanol blends. A 20-percent blend was specified.

HERZFELD, A. A. (1057)
MOTOR FUELS AND THEIR PROPERTIES. Österr. Chem. Ztg. 33: 134–138. 1930.
A review.

——— (1058)
STANDARDIZATION AND CHARACTERIZATION OF MOTOR FUELS. Automobiltech. Ztschr 33: 428–430. 1930.
Author emphasizes the importance of standardization of testing procedures for the large number of fuels used in Europe which include alcohol blends. Several suggestions are made.

HUBENDICK, E. (1059)
THE USE OF ALCOHOL MOTOR FUELS IN SWEDEN. Ztschr. f. Spiritusindus. 53: 231–232. 1930.

OSTWALD, WALTER (1060)
ALCOHOL FUEL AND ADMIXTURE ORDINANCE. Chem. Ztg. 54: 645–646. 1930.

PINEAU, L. (1061)
THE FUNCTION OF THE OFFICE NATIONAL DES COMBUSTIBLES LIQUIDES IN EXPERIMENTAL PREPARATION OF FUELS. Chem. Listy 24: 129–134. 1930.
An address.

PYHÄLÄ, E. (1062)
THE ADDITION OF ALCOHOL AND OTHER SUBSTITUENTS TO MOTOR FUELS. Acta Chem. Fenn. 3: 123–129. 1930.
A review.

STEINITZ, E. W. (1063)
ALCOHOL FUELS. Automobiltech. Ztschr. 33: 707–708. 1930.
A general discussion of alcohol-gasoline mixtures.

1931

ANONYMOUS (1064)
ALCOHOL AND ACETYLENE AS ENGINE FUELS. Power Plant Engin. 35: 173. 1931.

——— (1065)
DEVELOPMENT OF ABSOLUTE ALCOHOL PRODUCTION IN FRANCE AND IN OTHER COUNTRIES AND ITS USE AS MOTOR FUEL. Ztschr. f. Spiritusindus. 54: 30–31, 36–37. 1931.

——— (1066)
USING ALCOHOL IN MOTOR FUEL IN GERMANY, FRANCE AND ITALY. Chemicals 35: 8. Jan. 1931.

ARMATRIAIN, R. (1067)
GASOLINE SUBSTITUTES. Rev. de Ingen. Indus. [Madrid] 2 (15): 235–238, 2 (17): 316–322. 1931.
Research and use of alcohol-gasoline blends in France, Germany, Hungary, Poland, Australia, Brazil, and Sweden are reviewed.

BOSMAN, F. (1068)
ALCOHOL—ITS THREE IMPORTANT USES. Chem., Metall. and Mining Soc. So. Africa Jour. 32: 83–91. 1931.

Alcohol as fuel is mentioned as one of its important uses.

DIETRICH, K. R. (1069)
ALCOHOL AS MOTOR FUEL. Automobiltech. Ztschr. 34: 209–210, 234–235. 1931.

Includes a historical review of the development in the application of alcohol-gasoline, alcohol-benzene, and alcohol-gasoline-benzene mixtures as motor fuel.

FRANK, FRITZ (1070)
THE CHEMICAL AND ECONOMIC IMPORTANCE OF LIQUID FUELS. Wärme 54: 438–441. 1931.

Ethanol is mentioned in connection with other fuels for motor and industrial use.

PAN AMERICAN UNION (1071)
POWER ALCOHOL IN BRAZIL. Pan. Amer. Union Bul. 65: 545. 1931.

PARRAVANO, NICOLA (1072)
ALCOHOL AS AN AUTOMOBILE FUEL. Giorn. di Chim. Indus. ed. Appl. 13: 193–199. 1930.

Author recommends a blend of gasoline and 20 to 25 percent anhydrous ethanol in place of present blend consisting of gasoline, benzene, and 95-percent ethanol.

RATHBUN, J. B. (1073)
DID YOU EVER HEAR OF USGA OR AZULINA? Petrol. Age 25: 32–33. Mar. 1931.

1932

ANONYMOUS (1074)
ALCOHOL FUEL IN JUGOSLAVIA. Facts About Sugar 27: 510. 1932.

——— (1075)
MOTOR FUELS IN SOUTH AMERICA. Petrol. Times 23: 655–657. 1932.

Statistics published in Information Bul. No. 805, U. S. Bur. Foreign and Domestic Commerce, illustrate increasing use of ethanol-benzene blends.

VALERIO, MANLIO (1076)
POWER ALCOHOL. Indus. Sac. Ital. 25: 218–229. 1932.

A review.

——— (1077)
THE USE OF POWER ALCOHOL IN GERMANY. Indus. Sac. Ital. 25: 256–269. 1932.

A review.

ZARZECKI, S. (1078)
THE PROBLEM OF ALCOHOL FUEL BLENDS IN POLAND. Przemysł. Naftowy 7: 376–379, 400–402, 430–433. 1932.

1933

ANONYMOUS (1079)
ALCOHOL FUELS IN U. S. Oil, Paint and Drug. Rpt. 123: 14, 26. Jan. 30, 1933.

——— (1080)
ALCOHOL-GASOLINE BLEND BILLS INTRODUCED IN CONGRESS. Natl. Petrol. News 25 (7): 14–15. 1933.

Difficulties of legislative action are cited. It is claimed that the manufacture of anhydrous alcohol would greatly increase cost of motor fuel and that in any event the blends are not stable.

——— (1081)
ALCOHOL-GASOLINE MIXTURES AS MOTOR FUELS. Mech. Engin. [New York] 55: 285–286. 1933; Auto. Engin. 23: 238. 1933.

——— (1082)
ALCOHOL IN INTERNAL COMBUSTION FUELS. Oil, Paint, and Drug Rptr. 123: 15, 20. Mar. 6, 1933.

This is principally a reprint of an article which appeared in "The Lamp," published by the Standard Oil Co. of New Jersey, arguing against the use of ethanol blends, and of a letter by Prof. Charles E. Finley of Iowa State College giving octane rating data of three ethanol blends.

——— (1083)
PLAN TO BLEND ALCOHOL AND GASOLINE IN UNITED STATES IS HELD NOT FEASIBLE. Oil and Gas Jour. 31 (36): 28, 32. 1933.

The use of alcohol-gasoline blends in the United States is considered undesirable from economic and technical standpoint.

AMERICAN MOTORISTS ASSOCIATION (1084)
WHAT FRENCH MOTORISTS SAY ABOUT ALCOHOL-GASOLINE MOTOR FUEL BLENDS. Pam. 23 pp. 1933. Amer. Motor. Assoc. Washington.

The pamphlet contains a number of letters written by French motorists on the use of alcohol-gasoline blends, none favorable.

CORBETT, ADRIAN (1085)
THE USE OF ALCOHOL AS MOTOR FUEL. Petrol. Times 30: 459. 1933.

The economic and political aspects of the use of alcohol as motor fuel in France, Germany, the United States, and other countries are discussed.

DEULLIN, R. (1086)
OCTANE NUMBER AND ANTI-DETONATING FUELS. Nature [Paris] No. 2909: 52–57. 1933.

A general discussion of octane numbers and their determination. The French 25 percent ethanol blend has excellent antiknock properties.

EGLOFF, GUSTAV (1087)
ALCOHOL-GASOLINE BLENDS WOULD CAUSE ENORMOUS ECONOMIC LOSSES. Natl. Petrol. News 25 (17): 30–32. 1933.

Ethanol blends are inferior in every respect and would cause endless trouble.

FULMER, E. I., HIXON, R. M., CHRISTENSEN, L. M., and COOVER, W. F. (1088)
THE USE OF ALCOHOL IN MOTOR FUELS. VI. ABSTRACTS OF THE MORE IMPORTANT TECHNICAL PUBLICATIONS CONCERNING THE USE OF ABSOLUTE ALCOHOL IN GASOLINE AS A MOTOR FUEL. Iowa State Col. Div. of Indus. Sci., Dep. of Chem. Progress Rpt. No. VI, 40 pp. May 1, 1933.

Papers discussed in this report are abstracted in this bibliography.

GESCHELIN, JOSEPH (1089)
ALCOHOLIZED FUELS WOULD COST OUR CUSTOMERS HALF BILLION. Automotive Indus. 68: 644–647. 1933.

JONES, W. B. (1090)
MOTOR FUEL FROM THE FARM. Agr. Engin. 14: 112. 1933.

A brief note in which the author calls attention to various problems in connection with the use of alcohol-gasoline blends. Similarly to the precedent of the "infant industry" doctrine of protective tariff, certain tax reduction may be allowed but ultimately the industry should hold its own by sheer merit.

KEYSTONE STEEL and WIRE CO. (1091)
HERE'S THE BEST WAY TO BRING BACK BETTER TIMES THAT WE HAVE SEEN YET. Cir. 6 pp. 1933. Also *in* "Alcohol from grain." Booklet 16 pp. 1933.

Keystone Steel and Wire Co., Res. Div. Peoria, Illinois. 1933.

OSTWALD, C. O. (1092)
GERMAN VIEWS ON ALCOHOLIC GASOLINES. Automotive Indus. 68: 549. 1933.

OSTWALD, WALTER (1093)
NEWER DEVELOPMENT OF MOTOR FUEL AND THE VEHICLE MOTOR. Brennstoff-Chem. 14: 349–353. 1933.

PLATT, W. C. (1094)
SANER GASOLINE PRICE STRUCTURE IS IMPERATIVE. SUBSIDY BY MOTORISTS FOR RELIEF OF FARMERS. AN EDITORIAL. Natl. Petrol. News 25 (8): 13–14. 1933.

Editor believes ethanol-gasoline blends require mechanical changes in carburetors to give efficient and satisfactory performance. No economic advantages are to be expected.

RATHBUN, J. B. (1095)
WILL GASOLINE-ALCOHOL MIX? Petrol. Age 27: 22–23. Jan. 1933.

SMITH, E. N. (1096)
ALCOHOL-GASOLINE BLEND UNSATISFACTORY AS MOTOR FUEL. Radio address reprinted as Pam. 5 pp. 1933. American Automobile Association. Washington.

On the basis of various tests conducted by the American Automobile Association in cooperation with the National Bureau of Standards, the speaker claims that a compulsory 10-percent blend would mean a huge increase in the Nation's motor fuel bill.

1934

ANONYMOUS (1097)
POWER ALCOHOL AND ALCOHOL MOTORS. Indian Engin. 96 (11): 209–210. 1934.

A discussion of the possible use of power alcohol in India.

BEOBIDE, J. G. (1098)
ALCOHOL IN NON-DETONATING FUELS. Sugar News 15: 262–264. 1934.

The use of ethanol-gasoline blends in the Philippines is advocated.

DIETRICH, K. R. (1099)
ETHYL ALCOHOL AS FUEL. Chem. Ztg. 58: 519–521. 1934.

Description of dehydrating processes are given.

EVANS, E. B. (1100)
MOTOR SPIRIT AND LIGHT DISTILLATES. Inst. Petrol. Technol. Jour. 20: 392–405. 1934.

A review of the literature on automotive fuels published in 1933. Alcohol fuels are included in the numerous references given.

PUGNANI, A. (1101)
USE OF ALCOHOL IN INTERNAL COMBUSTION ENGINES. Energia Termica 2: 183–184. 1934.

Alcohol fuel in internal combustion engines from a military viewpoint is noted briefly.

WILLIAMS, A. E. (1102)
INDUSTRIAL ALCOHOL FOR MOTOR FUEL. Chem. Age [London] 30: 403. 1934.

1935

ANONYMOUS (1103)
ALCOHOL IN EUROPEAN FUELS. Petrol. Ztschr. 31 (26): 5–6. 1935; Natl. Petrol. News 27 (34): 21–22. 1935.

WILLIAMS, A. E. (1104)
INDUSTRIAL ALCOHOL. Engineering 140: 27–29, 40, 53–54. 1935.

European use of fuel alcohol is reviewed.

EGLOFF, G., and MORRELL, J. C. (1105)
ALCOHOL-GASOLINE AS MOTOR FUEL. Indus. and Engin. Chem., Indus. Ed. 28: 1080–1088. 1936.

The technical, economic, and political aspects of the problem are discussed. The authors conclude that on all three counts alcohol-gasoline blends are inferior to gasoline (47 references).

BROOKS, B. T. (1106)
ALCOHOL-GASOLINE AS MOTOR FUEL. Indus. and Engin. Chem., Indus. Ed. 28: 1477–1478. 1936.[9]

A criticism of the article "Alcohol-gasoline as motor fuel." It is claimed that estimates made by G. Egloff and J. C. Morrell are too optimistic. In *their* reply (*Ibid.* 28: 1478. 1936) Egloff and Morrell maintained their previous stand.

FLINNER, A. O. (1107)
ALCOHOL GASOLINE MIXTURES AS MOTOR FUEL. Kansas Engin. Soc., Year Book 1936, pp. 87–97.

Distillation and performance data are given.

FRIEDWALD, MARIO (1108)
THE DEVELOPMENT OF FUEL SUBSTITUTES IN GERMANY. Rev. Pétrol. 1936: 397–398.

MAULIK (1109)
THE PRESENT-DAY SITUATION CONCERNING MOTOR-FUEL SUBSTITUTES. Automobiltech. Ztschr. 39: 37–38. 1936.

A general discussion on the use of Diesel oil, heavy crude oils, alcohols, solid fuels, and gaseous fuels in automobile engines.

SINGER, E. (1110)
REPORT ON THE INVESTIGATION OF FUELS (1936). I. G. Farbenindustrie A. G. Ludwigshafen-Oppau Rpt. 326, Jan. 26, 1937; A. D. I. (K) Microfilm, Reel 106, 48C–C67, Part I; Sum. of C.I.O.S. Docs., Ref. No. I. 70.

New 1936 blends containing benzene, ethanol, and methanol have properties practically identical with the blends of 1935.

TUPHOLME, C. H. S. (1111)
BRITISH RESEARCHES FOR A NEW ALCOHOL MOTOR FUEL BLEND. Chem. Indus. [New York] 38: 469–470. 1936.

It is suggested that ethylene, ethane, propane, and butane be dissolved in methanol for motor-fuel use, and a manufacturing process is outlined.

1937

ANONYMOUS (1112)
UTILIZATION OF FODDER CORN FOR PRODUCTION OF ALCOHOL FUEL. Génie Civil 111: 556–557. 1937.

——— (1113)
BENZOL, METHANOL, AND OTHER FUELS IN ITALY. Riv. Ital. del Petrol. 5: 1. 1937.

MÜLLER, F. (1114)
BENZENE-LIKE MOTOR FUEL FROM PLANT JUICE. Allg. Oel. u. Fett. Ztg. 34: 327–328. 1937.

The preparation of fuel from plant juice according to the method of Agnoletto (Fr. Pat. 804,630) is described. This fuel can be mixed with methyl or ethyl alcohol to serve as motor fuel.

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[9] An exception to alphabetical order, being an answer to the foregoing reference.

PFEIFFER, J. P. (1115)
THE TECHNICAL AND ECONOMICAL ADVANTAGES AND DISADVANTAGES OF THE ADDITION OF ALCOHOL TO GASOLINE AS A FUEL FOR ENGINES. Cong. Internatl. Tech. et Chim. des Indus. Agr., Compt. Rend. V^e Cong. 2: 615–631. 1937.

Ethanol-gasoline blends are neither technically nor economically justified.

RITTER, M. H., VON (1116)
SOURCES OF ENERGY AND FUELS FOR MOTOR VEHICLES CONSIDERED FROM THE POINT OF VIEW OF DEFENSE. III° Cong. Internaz. del Carbonio Carburante, 5 Session, Economics, Statistics, Legislation, pp. 51–56. Rome 1937.

A very general discussion of the necessity of having sufficient domestic fuel supplies available because of the increased mechanization of the army.

1938

BIHOREAU, M. (1117)
CONSIDERATIONS REGARDING NATIONAL FUELS IN FRANCE. Soc. des Ingén. de l'Auto. Jour. 11: 235–246. 1938.

The French domestic fuel situation is reviewed.

CHRISTENSEN, L. M. (1118)
THE COMPOSITION OF AND SPECIFICATION FOR AGROL MOTOR FUELS. Memo. 7 pp. The Chemical Foundation of Kansas Co., August, 1938.

EGLOFF, GUSTAV (1119)
SUBTITUTE MOTOR FUEL ECONOMY OF EUROPE. HYDROGENATED MOTOR FUELS, BENZENE AND COMPRESSED GAS. Petrol. Times 40: 371–374, 377–378, 395–398, 435–437. 1938.

Alcohol as motor fuel is briefly discussed.

——— (1120)
MOTOR FUEL ECONOMY OF EUROPE. Indus. and Engin. Chem., Indus. Ed. 30: 1091–1104. 1938.

Processes for making fuels from coal by hydrogenation or the Fischer-Tropsch process are described. The use of compressed gas, such as methane and acetylene, is mentioned. Producer gas and alcohol blends are cited. Reasons for and statistics on the use of nonpetroleum fuels are given. Author believes their use is uneconomical.

GIZIŃSKI, BRONISŁAW (1121)
UTILIZATION OF HYDROCARBONS AND OTHER LIQUID FUELS IN INTERNAL COMBUSTION MOTORS. Przegląd Chem. 2: 17–19. 1938.

A comparative review.

KOWALCZYK, L. (1122)
PRODUCTION OF MOTOR FUEL. Przegląd Mech. 4: 245–250, 280–283. 1938.

Production of anhydrous alcohol and its application as motor fuel is reviewed.

REID, G. (1123)
ALCOHOL BLEND POOR SUBSTITUTE FOR MOTOR FUEL. Oil Weekly 91 (2): 18–20. 1938.

Editorial comment on the operation of the Atchison Agrol Co. owned by the National Farm Chemurgic Council. Blends are said to be inferior in most respects to straight gasoline.

1939

MENEGHINI, DOMENICO (1124)
ETHYL ALCOHOL MOTOR FUEL FROM VEGETABLE PRODUCTS. Ricerche Sez. Sper. Zuccheri, R. Univ. Studi Padova, Inst. di Chim. Indus. 3: 179–189. 1939.

MILEWSKI, JÓZEF (1125)
ROLE OF ALCOHOL AS FUEL. Przegląd Chem. 3: 214–216. 1939.

A review.

1940

AMERICAN PETROLEUM INSTITUTE. COMMITTEE ON MOTOR FUELS (1126)
POWER ALCOHOL. HISTORY AND ANALYSIS. Survey Rept., 58 pp. 1940. Amer. Petrol. Inst. Chicago, Ill.

Arguments are presented against the use of alcohol blends. The important references given are discussed elsewhere.

BURSTALL, A. F. (1127)
ALTERNATIVE FUELS FOR ROAD VEHICLES. Chem. Engin. and Mining Rev. 32: 306–307. 1940.

Author discusses synthetic gasoline, benzene, and alcohol briefly.

DODGE, B. F. (1128)
SOURCES OF ENERGY—PAST, PRESENT AND FUTURE. Armour Engin., 6 (2) 14–17, 45–49. 1940.

There is no question but that alcohol in blends with gasoline or even alone is a satisfactory motor fuel. Its use is merely a matter of economics.

EGLOFF, GUSTAV (1129)
MOTOR FUELS OF PRESENT AND FUTURE. Inst. Fuel London Jour. 13: 175–188. 1940; West. Soc. Engin. Jour. 45 (2): 79–92. 1940.

In discussing the use of alcohol motor fuels in Europe, author believes that the real reason for the introduction of alcohol blends is to maintain a vital wartime industry during peacetime. Some alcohol fuel statistics are given.

PENTHER, H. (1130)
RACING [MOTOR] FUELS. Kraftstoff 16: 120–121. 1940.

Historical sketch of the use of alcohol fuels in automobile racing from 1890 on. Formulas are given.

WINDFELD-HANSEN, I. (1131)
PRODUCTION OF MOTOR ALCOHOL FROM COAL, MORE PARTICULARLY FROM THE STANDPOINT OF THE POSSIBILITY OF CREATING A SYNTHETIC MOTOR ALCOHOL INDUSTRY IN DENMARK. Ingeniøren 49 (6): A 17–25. 1940; Chim. & Indus. [Paris] 43: 645. 1940.

1941

ANONYMOUS (1132)
ALTERNATIVE FUELS. Auto. Engin. 31: 65–68, 238–242, 276–278. 1941.

BLOOM, M. T. (1133)
THE CASE FOR ALKY-GAS. Coronet Mag. 5 pp. November 1941.

DICKINSON, H. C. (1134)
ALCOHOL AS MOTOR FUEL. U. S. Bur. Foreign and Dom. Com., Dom. Com. Ser. 28 (16): 15. 1941.

THORBJÖRNSON, B. (1135)
DOMESTIC FLUID FUELS. Tek. Tid. 71 (12), Uppl. A.: 93–100. 1941.

Methanol from wood is advocated as motor fuel.

1942

DEVON, J. (1136)
ROAD-TRANSPORT FUELS. Petroleum [London] 5: 3–8. 1942.

Alternate motor fuels, such as creosote, alcohol, methane, and natural gas are reviewed.

LOGAN, L. J. (1137)
WAR EMPHASIZES THE INFERIORITY OF PETROLEUM SUBSTITUTES. Oil Weekly 107 (6): 13–16. 1942.

Brief review of substitute fuels used during the war in Europe. Fuels discussed are methanol, ethanol, coal, wood, charcoal, natural gas, city gas, refinery gas, and sewage gas.

NARASHIMA, G. (1138)
POWER ALCOHOL. Sugar Tech. Assoc. of India, Proc. 10th Ann. Conv. Pt. 2, 121–128. 1942.

A review.

VAILLAUD, M. and RONDEAU, A. (1139)
THE USE OF SUBSTITUTE FUELS IN P.T.T.[10] Jour. des Télécommunications 9 (10): 163–166. 1942; *Ibid* 10 (1): 22–25; 10 (2): 35–39. 1943.

The use of producer gas and alcohol in trucks is described.

ZEDET, E. (1140)
COMPARISON OF SUBSTITUTE FUELS. Chim. & Indus. [Paris] 48: 192–195, 250–254. 1942.

The properties of various fuels derived from animal and vegetable matter are discussed in a general way, coal and petroleum included. Oxygen-containing fuels derived from living matter are considered to be of special importance.

1943

ANONYMOUS (1141)
LIST OF DEVELOPMENT WORK CARRIED OUT BY THE TECHNICAL STATION IN THE FIELD OF AVIATION. I. G. Farbenindustrie A. G. Ludwigshafen-Oppau Rpt. 704, Mar. 30, 1943; A.D.I. (K) Microfilm, Reel 112, Special Reel B; Sum. of C.I.O.S. Docs., Ref. No. X. 9.

Among the research problems listed was methanol and water injection.

GILLAN, P. O. (1142)
INDUSTRIAL AND POWER ALCOHOL. Soc. Chem. Indus. [Victoria] Proc. 43: 475–482. 1943.

A review.

LANG, W. A. (1143)
ALTERNATE FUELS FOR MOTOR VEHICLES. Engin. Jour. 26: 449–455. 1943.

Alcohols, benzene, gaseous fuels, liquefied bottled gas, and fuels from hydrogenation processes are discussed.

1944

RIDLEY, C. (1144)
ALCOHOL: ETERNAL FUEL. Passenger Transport Jour. 90 (2271): 38–40. 1944.

Use of ethanol as a substitute for coal and oil is discussed.

SINGLETON, P. A. (1145)
POSTWAR OUTLOOK FOR ETHYL ALCOHOL. Chem. Indus. [New York] 54: 676–679. 1944.

Use of alcohol for motor fuel and synthetic rubber is mentioned.

1945

MOYNOT (1146)
THE FUEL OF TOMORROW. Ann. des Mines et Carburants, Mém. 134: 128–149. 1945.

A general discussion of the fuel requirements of automobiles, stressing particularly the beneficial effects of higher compression ratios on specific fuel consumption. Methanol and ethanol are included.

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[10] French telephone and telegraph technical service.

1946

ANONYMOUS (1147)

MOTOR FUEL FROM ALLIGATORS. Indus. and Engin. Chem., News Ed. 24: 2974. 1946.

A brief notice in which the use of castor oil-alcohol blends in Brazil is reported.

1947

ANONYMOUS (1148)

GASOLINE ECONOMY DEVICE WILL GET FIRST MASS TRYOUT FROM A GASOLINE PRODUCER. Wall Street Jour. 79 (137): 1. June 12, 1947.

Installation of Vita-meters in 150 trucks is announced by Atlantic Refining Co. for the purpose of testing the efficiency of water-alcohol injection.

——— (1149)

A PHILIPS ENGINE. Gas and Oil Power 42: 192. 1947.

Under "The Month's News," a report from Eindhoven, Holland, says that a 15 hp. experimental engine has been built at the laboratories of the Philips Electrical Co., which can run on petrol oil, methanol, or gas, and makes no more noise than a sewing machine. It is said to have external combustion, and to have been called by the makers a "hot air motor." For complete description of the engine see H. de Brey and F. L. Weenen, "Philips air engine," Automotive Indus. 97 (12): 24-28, 58, 60. 1947.

CASS, W. G. (1150)

SPAIN (WORLD WIDE CHEMISTRY). Chem. and Engin. News 25: 2037. 1947.

Scarcity and rising prices of gasoline has stimulated production of methanol. The latter may be substituted for ethanol in many instances. However, demand for alcohol is heavy and the use of alcohol to eke out gasoline supplies appears to be a little precarious.

EGLOFF, GUSTAV (1151)

THE PETROLEUM AND AGRICULTURAL INDUSTRIES. Paper presented before the Midwest regional meeting of the Amer. Chem. Soc. 17 pp. Kansas City, Mo., June 23–25, 1947.

After a thorough discussion of the interrelation between agriculture and the petroleum industry, brief mention is made of a roundabout Japanese method of making isooctane during the war by dehydration of butanol to butylenes and subsequent isomerization, polymerization, and hydrogenation.

KLEIN, E. L. (1152)

FUELS FOR ROCKET AND JET POWER-PLANTS. Paper presented at the summer meeting of the Soc. Automotive Engin. June 4, 1947.

In discussing new aircraft fuels, E. L. Klein, Bureau of Aeronautics, Navy Dept., stated at SAE summer meeting that aside from petroleum fuels other available fuels would include "liquid oxygen, various alcohols, hydrogen peroxide, and organic amines."

Abstract *in* Natl. Petrol. News 39 (24): 48. 1947.

THORNTON, D. P. (1153)

DESPERATE JAPS TRIED TO MAKE "AVGAS" EVEN FROM PINE TREE ROOTS, NEEDLES. Petrol Processing 2: 815–820. 1947.

Use of methanol and ethanol as fuel for training planes is mentioned.

WYLD, J. H. (1154)

THE LIQUID-PROPELLANT ROCKET MOTOR. Mech. Engin. [New York] 69: 457. 1947.

After a historical review, the article deals with trends in rocket-motor research, rocket-motor structural problems, research required in fuel injection, and other problems. The use of hydrogen peroxide in combination with alcohol and hydrazine hydrate is mentioned.

VI. VEGETABLE OILS: PREPARATION OF FUELS AND PERFORMANCE DATA

1920

MAYNÉ, R. (1155)

PALM OIL MOTORS. Ann. de Gembloux 26: 509–515. 1920; Bul. des Matières Grasses de l'Inst. Colon. de Marseille No. 1: 15–16. 1921.

The price of gas oil in the Belgian Congo is approximately four times that of palm oil. Since the heat of combustion of the latter is about 20 to 25 percent less than that of gas oil, the s.f.c. will be proprotionately higher. One disadvantage of palm oil is its high liquefaction point (37° C.).

1921

ANONYMOUS (1156)

PALM OIL AS MOTOR FUEL. [Gt. Brit.] Imp. Inst. Bul. 19: 515. 1921; Gas and Oil Power 16 (185): 85–86. 1921.

A 6-hour test with a slow speed semi-Diesel engine with palm oil as fuel indicated satisfactory performance. No carbon deposits were noted. Fuel consumption was 0.671 lbs. per b.hp. hr.

GOFFIN (1157)

TESTS OF AN INTERNAL COMBUSTION MOTOR USING PALM OIL FUEL. Bul. des Matières Grasses de l'Inst. Colon. de Marseille : 19–24. 1921.

Operation of a two-stroke Diesel with palm oil gave satisfactory performance. Water injection was at a rate of 100 grams per b.hp. hr. while s.f.c. was 340 grams per b.hp. hr.

KOBAYASHI, KIUHEI (1158)

FORMATION OF PETROLEUM FROM FISH OILS. Chem. Indus. [Japan] Jour. 24: 1–26. 1921. (*Ibid.* pp. 107–110 in English.)

The yield of petroleum products depends on the type of fish oil, on the apparatus used, the time of distillation, and the contact materials such as Fuller's earth). Data are presented on shark, sardine, arctic sperm oil, and "pressed fish" oils.

——— and YAMAGUCHI, E. (1159)

ARTIFICIAL PETROLEUM FROM FISH OILS. Chem. Indus. [Japan] Jour. 24: 1399–1400. 1921.

The production of petroleumlike products from fish oils is a function of type of retort, time of contact, kind of catalyst, and of the particular fish oil. The specific gravities, saponification values, and crude distillate yields of various fish oils are given in parenthesis after each oil: Shark oil (0.9192, 163.6, 74 percent); sardine oil (0.9272, 173.6, 61 percent); and arctic sperm oil (0.8775, 114.2, 64 percent). The specfiic gravities of the crude distillates varied from 0.8080 to 0.8502 and the saponification values from 12.2 to 47.6. Fractional distillation resulted in 38 percent of gasoline of end point below 100° C., 8 percent of naptha (boiling range 100°-150°) and 39 percent of lubricating oil boiling above 250°.

——— (1160)

ARTIFICIAL PETROLEUM FROM SOYBEAN, COCONUT, AND CHRYSALIS OILS AND STEARIN. Chem. Indus. [Japan] Jour. 24: 1421–1424. 1921. (*Ibid.* pp. 110–111 in English.)[11]

Distillation of soybean oil at atmospheric pressure and at temperatures up to 700° C. yielded 55 percent of a distillate. Further fractionation of the latter gave 10 percent of light oil, 17.3 percent of kerosene, and 27.7 percent of heavy oils.

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[11] Sequence of annotations 1159 and 1160 is according to journal reference.

LAZENNEC, I. (1161)

PALM OIL AS MOTOR FUEL. Indus. Chim. [Paris] 8: 262. 1921; Chem. Age [London] 4: 606–607. 1921; Com. Rpts. 1: 10–11. 1921.

The use of palm oil as Diesel fuel is described. Specific fuel consumption is 20 percent greater because of the correspondingly lower heat of combustion. Gas oil should be used for starting as well as for finishing the run. Palm oil solidifies on cooling.

MATHOT, R. E. (1162)

UTILIZATION OF VEGETABLE OILS AS MOTOR FUEL. Bul. des Matières Grasses de l'Inst. Colon. de Marseille No. 1: 5–9. 1921; *Ibid.* No. 7 & 8: 116–128. 1921.

Experiments showed that vegetable and gas oil had the same thermal efficiency in the three engines tested. If a good grade of lubricating oil is used and if the engine is run near normal output, overhaul periods need not be frequent. The use of palm, peanut, cottonseed, and sesame oil as fuel for semi-Diesel engines is also discussed. Physical properties are given. Design changes are recommended.

1922

ANONYMOUS (1163)

THE UTILIZATION OF PALM OIL AS A MOTOR FUEL IN THE GOLD COAST. [Gt. Brit.] Imp. Inst. Bul. 20: 499–501. 1922.

Palm oil containing from 5 to 6 percent free fatty acids was used as fuel in a Tangye semi-Diesel engine. The engine started from cold. Water injection was not required. After a 24-hour run slight deposits were noted on the injection nozzle and exhaust valve.

MAILHE, A. (1164)

PREPARATION OF MOTOR FUELS FROM VEGETABLE OILS. Jour. des Usines à Gaz. 46: 289–292. 1922.

Catalytic transformation of vegetable oils to petroleumlike products is described. Considerable portion of aromatics is present in the final product.

SATO, MASANORI (1165)

PREPARATION OF A LIQUID FUEL RESEMBLING PETROLEUM BY THE DISTILLATION OF THE CALCIUM SALTS OF SOYBEAN-OIL FATTY ACIDS. Chem. Indus. [Japan] Jour. 25: 13–24. 1922.

1923

CHARLES, L. A. (1166)

THE USE OF VEGETABLE OILS IN DIESEL ENGINES. Chaleur et Indus. 4: 125–128. 1923.

Because of high ignition temperatures, complete vaporization of vegetable oils (palm, cottonseed, groundnut oils) is necessary, when injected, in order to insure rapid and complete combustion. Incomplete combustion produces organic acids which will corrode the piston. Results obtained with a 20 hp. "Charles" slow speed semi-Diesel engine are given.

MAILHE, A. (1167)

PREPARATION OF PETROLEUM FROM VEGETABLE OILS. [Paris] Acad. des Sci. Compt. Rend. 177; 202–204. 1923.

Distillates obtained from cracked vegetable oils form lubricating oils when treated with zinc chloride. Further treatment yields waxy solids.

SATO, MASANORI (1168)

PREPARATION OF LIQUID FUEL RESEMBLING PETROLEUM BY DISTILLING THE CALCIUM SOAP OF SOYBEAN OIL. Chem. Indus. [Japan] Jour. 26: 297–304. 1923.

1924

LUMET, GEORGES (1169)
UTILIZATION OF VEGETABLE OILS. Chaleur et Indus. Special No. 5: pp. 190–195. Dec. 1924.
Vegetable oils may be used as fuels for Diesel engines under the same conditions as gas oil.

MELIS, BENIAMINO (1170)
EXPERIMENTS ON THE TRANSFORMATION OF VEGETABLE OILS AND ANIMAL FATS TO LIGHT FUELS. Cong. Naz. di Chim. Indus. Atti 1924: 238–240.
Saponification and decomposition of vegetable oils by means of potassium hydroxide and calcium oxide results in products miscible with absolute ethanol. These blends are suitable fuels. A table gives the amount of oil obtainable from 51 varieties of plants.

1926

HOFF, F. A. (1171)
BLENDING A GOOD DIESEL OIL. Oil Trade 17 (11) : 18. 1926.
Blend of 6 percent castor oil is said to make a perfect Diesel engine oil for all purposes.

SATO, M. and TSENG, K. F. (1172)
ON THE PREPARATION OF FUEL OIL BY THE DISTILLATION OF THE LIME SOAP OF SOYBEAN OIL. THIRD REPORT EXPERIMENT IN WHICH OXIDE AND CARBONATE OF ALKALI METALS HAVE BEEN USED AS SAPONIFYING AGENT. Soc. Chem. Indus. [Japan] Jour. 29: 109–115. 1926. (*Ibid.* pp. 23B–24B in English.)
Experiments on the direct distillation of soybean oil or its fatty acid in the presence of oxides or carbonates of alkali metals indicate that fuel oil is more easily obtained than by the direct distillation of the soaps. No significant differences in properties, yield, or composition of the product were found.

1927

LUMET, G. and MARCELET, H. (1173)
UTILIZATION OF MARINE ANIMAL AND FISH OILS (AS FUELS) IN MOTORS. [Paris] Acad. des Sci. Compt. Rend. 185: 418–420. 1927.
The following conclusions were drawn from engine tests relative to the performance of gas oil with four marine animal and four fish oils: Outputs are practically identical; fuel consumption is somewhat greater; smoother running was experienced with marine and fish oils than with gas oil; because of the higher viscosities, preheating is necessary; exhaust was colorless and practically odorless.

MARCELET, HENRI (1174)
HEAT OF COMBUSTION OF SOME OILS FROM MARINE ANIMALS. [Paris] Acad. des Sci. Compt. Rend. 184: 604–605. 1927.
Because of the possibility of using fish oils in semi-Diesel engines, the heats of combustion, flash points, and burning temperatures of 10 different oils were determined. Values varied from 8,700 to 10,790 calories per gram, 195° to 310° C., and from 230° to 345°, respectively.

——— (1175)
DETERMINATION OF SOME PHYSICAL CONSTANTS OF OILS FROM MARINE ANIMALS. [Paris] Acad. des Sci. Compt. Rend. 185: 455–457. 1927. Chim. & Indus. [Paris] Special No., p. 531. Apr. 1928.
The heats of combustion, flash points, burning temperatures, and specific gravities were determined for 29 marine oils. In addition, fluidities and viscosities of these oils were measured at 25°, 56°, and 100° C. The lower the specific gravity, the higher the heat of combustion indicating high hydrocarbon content. At the same temperatures the marine oils are more viscous than vegetable oil. Heats of combustion varied from 8,593 to 10,790 calories per gram, flash points from 175° to 317° C., and specific gravities from 0.8658 to 0.9654. Previous data included. (See No. 1174.)

SATO, MASANORI (1176)
PREPARATION OF FUEL OIL BY THE DRY DISTILLATION OF CALCIUM SOAP OF SOYBEAN OIL. IV. COMPARISON WITH MAGNESIUM SOAP. Soc. Chem. Indus. [Japan] Jour. 30: 242–245. 1927.

Distillation time for magnesium soap was slightly less and yields were somewhat greater than the corresponding values for calcium soap.

——— and MATSUMOTO, H. (1177)
PREPARATION OF FUEL OIL BY THE DRY DISTILLATION OF CALCIUM SOAP OF SOYBEAN OIL. V. HYDROGENATION OF THE DISTILLED OIL. Soc. Chem. Indus. [Japan] Jour. 30: 245–252. 1927.

Hydrogenation of the light oil (100° to 175° C.) proceeded rapidly at 80°. Vapor phase reaction took place readily at 140°, forming a colorless liquid with no disagreeable odor. Liquid phase hydrogenation of the middle fraction (175° to 300°) at 140° with 2 percent nickel decreased the iodine number to 60. Vapor phase reaction gave similar results.

1931

GAUTIER, MARCEL (1178)
UTILIZATION OF VEGETABLE OIL AS FUEL IN DIESEL ENGINES. Tech. Moderne 23: 251–256. 1931.

Peanut, palm, and castor oils and karite butter can be used as fuels in Diesel engines; however, their cost is prohibitive. Tables give results in detail.

1932

EGLOFF, G. and MORRELL, J. C. (1179)
THE CRACKING OF COTTONSEED OIL. Indus. and Engin. Chem., Indus. Ed. 24: 1426–1427. 1932.

Detailed data are given of the products obtained from the pressure distillation of cottonseed oil.

FARAGHER, W. F., EGLOFF, G., and MORRELL, J. C. (1180)
THE CRACKING OF FISH OIL. Indus. and Engin. Chem., Indus. Ed. 24: 440–441. 1932.

Detailed data on cracking of menhaden fish oil are presented.

GONZAGA, LUIS (1181)
THE ROLE OF COMBINED OXYGEN IN THE EFFICIENCY OF VEGETABLE OILS AS MOTOR FUEL. Philippine Univ. Nat. and Appl. Sci. Bul. 2: 119–124. 1932.

Because of the presence of oxygen in the molecular structure of vegetable oils, the heat of combustion is lower than that of hydrocrabon oils. However, aside from the heat of combustion, the change of volume during combustion is also a factor in increasing the power output per unit of fuel. It is suggested that the latter combination would make vegetable oils a suitable gas-turbine fuel.

MORRELL, J. C., EGLOFF, E., and FARAGHER, W. F. (1182)
CRACKING OF PALM OIL. Soc. Chem. Indus. Jour., Chem. and Indus. 51: 133T–134T. 1932.

Cracking of Sumatra and niger palm oil produced motor fuel yields of 62 and 71 percent, and Diesel oil yields of 11.6 and 9.5 percent, respectively. After refining, these fuels are suitable for use in internal-combustion engines.

SCHMIDT, A. W. (1183)
VEGETABLE OILS AS FUELS FOR INTERNAL COMBUSTION ENGINES. Tropenpflanzer 35: 386–389. 1932; Chim. & Indus. [Paris] 29: 74. 1933.

Physical properties and results of Diesel engine tests are given for groundnut oil, soybean oil, sunflower oil, and palm oil. Output was less and fuel consumption was greater than with gas oil.

1933

FACHINI, S. (1184)
THE PROBLEM OF OLIVE OILS AS FUELS AND LUBRICANTS. Chim. & Indus. [Paris] Special No., pp. 1078–1079. June 1933.

1934

SCHMIDT, A. W. and GAUPP, K. (1185)
VEGETABLE OILS AS DIESEL ENGINE FUELS. Tropenpflanzer 37: 51–59. 1934; Chim. & Indus. [Paris] 32: 322. 1934.

The specific fuel consumption of vegetable oils is higher and thermal efficiencies are said to be lower than when using gas oil.

SERMOISE, CARLES DE (1186)
THE USE OF CERTAIN FUELS IN DIESEL MOTORS. Rev. des Combustibles Liquides 12: 100–104. 1934.

Fuels obtained from the dry distillation of peanuts, for instance, may be used either alone or blended as fuel in Diesel engines.

1935

GAUTIER, MARCEL (1187)
VEGETABLE OILS AND THE DIESEL ENGINES. Rev. des Combustibles Liquides 13: 129–136. 1935.

Peanut, palm, and linseed oils were tested in a Diesel engine. Results were encouraging.

KOO, E. C., and CHENG, S. M. (1188)
FIRST REPORT ON THE MANUFACTURE OF GASOLINE FROM RAPESEED OIL. Indus. Research [China] 4: 64. 1935.

A 52 percent by volume of crude (based on the original oil) petroleum-like product was obtained in the vapor phase cracking of rapeseed oil. Fractionation of this crude oil resulted in 53 percent of unrefined gasoline and 47 percent of crude fuel oil.

——— and CHENG, S. M. (1189)
THE MANUFACTURE OF LIQUID FUEL FROM VEGETABLE OILS. Chinese Indus. 1: 2021–2039. 1935.

The vapor phase and catalytic cracking of rapeseed, soybean, cottonseed, and tung oil give similar results. Rates of decomposition are important. Cracking temperatures and yields are given.

———, CHENG, S. M. and MA, H. M. (1190)
A STUDY ON THE MANUFACTURE OF LIQUID FUEL FROM VEGETABLE OIL. Indus. Research [China] 4: 466–479. 1935.

Vapor phase or catalytic cracking of rapeseed oil yields good quality gasoline and kerosene fractions. A 50:50 gas oil-cottonseed oil mixture is suitable for Diesel engines. The crude distillate from cottonseed oil may also be used for the same purpose.

MANZELLA, GIUSEPPE (1191)
PEANUT OIL AS DIESEL-ENGINE FUEL. Energia Termica 3: 153–160. 1935; Chim. & Indus. [Paris] 35: 69. 1936.

Satisfactory performance was obtained with the use of peanut oil in Diesel engines. Fuel consumption was higher at normal loads but lower at part load. Its heat is lower than that of gas oil.

PING, K. (1192)
CATALYTIC CONVERSION OF PEANUT OIL INTO LIGHT SPIRITS. Chinese Chem. Soc. Jour. 3: 95–102. 1935; Chem. Engin. [China] Jour. 3: 201–210. 1936.

Liquid phase cracking of peanut oil in the presence of aluminum chloride (1 percent) at atmospheric pressure and at temperatures between 250° and 400° C. produced 27 percent of refined gasoline (end point 200°) and 31 percent of refined kerosene (boiling point range 200° to 300°). The remainder consisted of gas, coke, and liquid residue, all of which can be used as fuel. The gasoline had a low octane rating.

——— (1193)
FURTHER STUDIES ON THE LIQUID PHASE CRACKING OF VEGETABLE OILS. Chinese Chem. Soc. Jour. 3: 281–287. 1935; (in English.)

Cracking of cottonseed, castor, perilla, soybean, tung, sesame, linseed, and hempseed oils with aluminum chloride gave approximately the same yields (about 30 percent by volume). Further investigation is required to determine the percentage of catalyst required for any one oil.

SHINOZAKI, Y. and KUBO, H. (1194)
HIGH PRESSURE HYDROGENATION OF SOYBEAN OIL. IV. THE FORMATION OF HYDROCARBONS. Soc. Chem. Indus. [Japan] Jour., Sup. Binding 38: 21B. 1935.

This investigation deals with the products obtained in the decomposition of ester wax with a Cu-Cr catalyst at temperatures above 390° C. At about 450° the yield of gasolinelike oil was 70 percent.

1936

KOO, E. C. and CHENG, S. M. (1195)
INTERMITTENT CRACKING OF RAPESEED OIL. Chem. Engin. [China] Jour. 3: 348–353. 1936.

Intermittent heating improves the yield as well as the product obtained in the liquid phase cracking of rapeseed oil. Calcium oxide and magnesium oxide are the most economical catalysts.

LO, T. S., and TSAI, L. S. (1196)
THE EFFECT OF TIME OF HEATING AND TEMPERATURE ON CRACKING OF COTTONSEED OIL. Chinese Chem. Soc. Jour. 4: 157–171. 1936. (in English).

Maximum yield of gasoline was only 43.4 percent in contrast to Egloff and Morrell's yield of 51 percent. This is explained on the basis of the lower temperature of cracking used in this work.

MANZELLA, GIUSEPPE (1197)
RAISIN SEED OIL AS A PETROLEUM SUBSTITUTE. Energia Termica 4: 92–94. 1936.

Distillation of raisin seed yields approximately 10 to 15 percent of an oil which is similar to gas oil. Diesel engine performance was practically identical with that obtainable with gas oil, except that cold starting was more difficult. Engine deposits were noted.

SHINOZAKI, Y., KAGARA, S., and SATO, M. (1198)
STUDIES ON THE HIGH PRESSURE HYDROGENATION OF SOYBEAN OIL. V. THE PREPARATION OF LIGHT HYDROCARBON OIL. Soc. Chem. Indus. [Japan] Jour., Sup. Binding 39: 22B. 1936.

The influence of pressure, time, and temperature as well as the kind of catalyst on the high pressure hydrogenation of soybean oil was studied.

TU, C. M., and KU, T. T. (1199)
COTTONSEED OIL AS A DIESEL OIL. Chem. Engin. [China] Jour. 3: 211–221. 1936.

Seventy to thirty cottonseed oil-Diesel oil, 80:20 cottonseed oil-kerosene, or 90:10 cottonseed oil-gasoline blends fulfill the requirements of Diesel oil specifications, indicating the possibility of direct use of cottonseed oil in Diesel engines.

——— and PAN, F. Y. (1200)
DRY DISTILLATION OF COTTONSEED OIL FOOT. Chem. Engin. [China] Jour. 3: 231–239. 1936.

Dry distillation of cottonseed oil foot yielded 11 percent by weight of light oil, 17 percent of middle oil, and 10 percent of heavy oil. Insertion of a vaporphase cracking unit increased slightly the yield of light and middle oils at the expense of the heavy fraction.

——— and WANG, C. (1201)
VAPOR-PHASE CRACKING OF CRUDE COTTONSEED OIL. Chem. Engin. [China] Jour. 3: 222–230. 1936.

Vapor phase cracking of cottonseed oil at about 706° C. (approximate optimum temperature) yielded 80 percent by weight of a crude oil which on fractionation gave 22 percent light oil and 46 percent of middle oil. Temperature control is important since at low temperatures a large amount of fatty acids are formed and at high temperatures an excess amount of gas is produced.

1937

FRIEDWALD, MARIO (1202)
NEW METHODS FOR THE CONVERSION OF VEGETABLE OILS TO MOTOR FUEL. Rev. Pétrol. No. 734: 597–599. 1937.

The Legé process is described. Vegetable oils are heated in a specially designed furnace and the oil obtained is redistilled in the presence of catalysts. Forty-two to fifty percent of crude oil and 15 to 20 percent of coke is obtained. Fractionation of crude yields 35 percent gasoline, 20 percent kerosene, 30 percent gas oil, and 15 percent fats and paraffin.

GAUPP, KURT (1203)
VEGETABLE OIL FUELS FOR C. I. ENGINE. Automobiltech. Ztschr. 40: 203–207. 1937.

The following vegetable oils were tested in a two-cylinder Diesel engine: Sesame, groundnut, palm, and sunflower oils. Fuel consumption was 12 to 15 percent higher than for commercial Diesel fuel. Palm and groundnut oils were slightly superior to soybean and sesame oils. The proper selection of lubricating oils is important. Soybean and sesame oils showed no corrosive tendencies; however, palm and groundnut oils attacked brass, copper, and galvanized iron. A slight attack on steel by groundnut oil was also noted. The following instructions are given: Engine should be started with gas oil; good filters must be provided; oils must be preheated; injector trips should be inspected more frequently; and the use of gas oil just before stopping engine is recommended.

MICHOT-DUPONT, F. (1204)
FUELS OBTAINED BY THE DESTRUCTIVE DISTILLATION OF CRUDE OIL SEEDS. Assoc. des Chim. Bul. 54: 438–448. 1937.

Dry distillation of peanuts produced, after fractionation, fuels similar to those obtained from petroleum.

SIRTORI, A. (1205)
FUELS FOR DIESEL ENGINES. III° Cong. Internaz. del Carbonio Carburante, 2nd Session, Liquid Fuels, pp. 123–136. Rome. 1937.

Possible use of vegetable oils for high-speed Diesel engines is discussed.

TATTI, E., and SIRTORI, A. (1206)
USE OF PEANUT OIL IN INJECTION, HIGH COMPRESSION, HIGH SPEED AUTOMOBILE MOTORS. Energia Termica 5 (7): 59–64. 1937; Chim. & Indus. [Paris] 38: 883. 1937.

Preheating of peanut oil, when used in Diesel engines, appears desirable and becomes necessary if the temperature is below 10° C. Peanut oil injected into a cold engine is deposited on the walls and, because of incomplete oxidation, may form incrustations. Copper is attacked slightly and its use must be avoided. For continuous use it is recommended to increase injection pressure as well as the size of injector openings. Exhaust odor is bad.

THIRD CHEMICAL CONGRESS OF SOUTH AMERICA. Secção de Chimica. (1207)
RICINUS OIL AS LUBRICANT. Inst. de Pesquisas Technol. [Sao Paulo, Brasil] Bol. No. 17: 143–162. July 1937.

The viscosity of ricinus oil in Saybold seconds is 1174, 263, and 111 at 40°, 70°, and 95° C., respectively, and its variation with pressure at 40° is quite similar to that of lard and colza oils. Ricinus oil ordinarily contains 1.08 percent free acid expressed as oleic; this amount increases to 1.5 percent after heating for 100 hours at 140°. Addition of 10 percent mineral oil reduces these figures to 0.69 and 1.22 percent, respectively. Tests with three cars showed that a ricinus oil containing 10 percent mineral oil compares favorably with mineral oils commonly used. Large quantities of ricinus oil are available in Brazil.

1938

CERCHEZ, V. T. (1208)
CONVERSION OF VEGETABLE OILS INTO FUELS. Monit du Pétrole Roumain 39: 699–702. 1938.

A process is described for the conversion of oilseeds to gasoline.

KOO, E. C. (1209)
BLOWN OIL FROM VEGETABLE OILS AS SUBSTITUTE FOR LUBRICANT. Chem. Engin. [China] Jour. 5: 53–61. 1938.

Cottonseed and rapeseed oils when treated by air-blowing at 150° or 200° C. can replace mineral lubricating oils. The density of vegetable oils is increased when subjected to air-blowing; however, their acidity and possible corrosive action are decreased.

LO, T. S., and TSAI, L. S. (1210)
FURTHER STUDY OF PRESSURE DISTILLATE FROM THE CRACKING OF COTTONSEED OIL. Chinese Chem. Soc. Jour. 6: 1–7. 1938. (in English).

Data of the fractionation of the total pressure distillate are presented. Specific gravity, acid, and iodine values were determined. Acid values decrease the longer the time of heating or the higher the temperature. As distillation proceeds, the iodine values diminish.

WALTON, JOHN (1211)
THE FUEL POSSIBILITIES OF VEGETABLE OILS. Gas and Oil Power 33: 167–168. 1938.

The most promising vegetable oils as fuels are palm oil, soybean oil, cottonseed oil, and groundnut oil. Output was about 90 percent of gas oil power, and fuel consumption higher. Exhaust was clean. Road tests showed that starting from cold could be accomplished with one injection of gas oil. Preheating by means of exhaust heat is necessary; however, no particular difficulties are encountered in the use of vegetable oils.

1939

ANONYMOUS (1212)
LUBRICANTS FROM FISH OIL (JAPAN). Indus. and Engin. Chem., News Ed. 17: 710. 1939.

The Japan Oil and Fat Company announced the plan for the erection of a plant to produce aircraft lubricants from whale, sardine, and herring oils. Process is not disclosed.

DALAL, N. M., and MEHTA, T. N. (1213)
CRACKING OF VEGETABLE OILS. Indian Chem. Soc. Jour., Indus. and News Ed. 2: 213–245. 1939.

Cracking of cocoanut, groundnut, sesame, and mowrah oils is described. The percentage of motor fuel in the pressure distillate increases with increase of pressure while that of Diesel oil falls. The acid value decreases with increase in pressure.

DINTILHAC, J. (1214)
RESEARCH ON LUBRICATING OILS. Soc. des Ingén. de l'Auto Jour. 12: 212–214. 1939.

Castor oil is not suitable for modern aircraft engines since it forms a rubberlike subtance at about 200° C.

Abstract *in* Automotive Indus. 80 (5): 23-24. 1939; Jour. Aeronaut. Sci. 6: 182. 1939.

HAMABE, G., and NAGAO, H. (1215)
PERFORMANCE OF DIESEL ENGINES USING SOYBEAN OIL AS FUEL. Soc. Mech. Engin. [Japan] Trans. 5 (20, II): 5–9. 1939; Jap. Jour. Engin. Abs. 19: 40. 1940.

A comparison of the performance of soybean oil and commercial Diesel fuel in a single-cylinder engine showed nearly equal output and thermal efficiency. Fuel consumption of soybean oil was higher because of its lower heat of combustion. The engine ran more smoothly with soybean oil and starting was also easier. The fuel was kept at approximately 70° C. by means of the cooling water.

D'OLLIVIER, A. B. (1216)
FRENCH PRODUCTION OF SOYBEAN OIL. Rev. des Combustibles Liquides 17: 225–235. 1939.

Soybean oil has a higher viscosity than gas oils; recommendations are made to overcome this difficulty.

1940

AGGARWAI, J. S., and VERMAN, L. C. (1217)
VEGETABLE OILS AS LUBRICANTS. Indian Indus. Res. Bur. Bul. No. 18, Pt. I: 5–25. 1940.

Castor oil is more susceptible to oxidation after heat treatment, particularly in presence of iron. The latter has only a slight effect on mineral oil. The effect of a large number of antioxidants on the stability of raw castor oil, refined groundnut, and cottonseed oils was investigated by means of a modified "Air Ministry Oxidation Test." It was shown that tin compounds, organo-metallic compounds, and colloidal graphite, which are pronounced antioxidants for mineral oils, are, in the case of vegetable oils, either ineffective or may act, in some instances, as prooxidants. Groundnut oil and cottonseed oil behaved widely different towards the same antioxidant. The most effective stabilizers were phenols and aromatic amino compounds. Castor oil is the most satisfactory lubricant; however, it cannot be used in aircraft engines, where it produces heavy shellaclike deposits because of the prevailing higher temperatures.

LO, T. S. (1218)
SOME EXPERIMENTS ON THE CRACKING OF COTTONSEED OIL. Science [China] 24: 127–138. 1940.

Conversion of cottonseed oil into various petroleum fractions is described.

OKAMURA, KENZI (1219)
SUBSTITUTE FUELS FOR HIGH SPEED DIESEL ENGINES. Fuel Soc. [Japan] Jour. 19: 691–705. 1940.

Tests with soybean and fish oils in specially equipped high-speed Diesel engines gave an increase in s.f.c. of 8 and 12 percent, respectively. A 2 percent reduction in thermal efficiency was also noted.

TUPHOLME, C.H.S. (1220)
SOYBEAN OIL (DIESEL FUEL). Indus. and Engin. Chem., News Ed. 18: 861. 1940.

Preheating of tank and supply line is applied when soybean oil is used as Diesel fuel.

1941

BLITZ, K., and SIMON, W. (1221)
STUDIES OF HIGHLY OXIDIZABLE OIL TREATED TO RETARD IGNITION. Monatschr. f. Textil Indus. 56: 195–198. 1941.

The action of α- and β-naphthol and of pyrocatechol on the spontaneous ignition of linseed oil, sunflower oil, tung oil, sunflower oil fatty acids, and tall oil fatty acids was studied. Pyrocatechol is the most effective and β-naphthol has the least effect. Tung oil is not sufficiently protected, however, even by pyrocatechol.

CHANG, C. H., SHIAH, C. D., and CHAN, C. W. (1222)
EFFECT OF THE ADDITION OF LIME ON THE CRACKING OF VEGETABLE OILS. Chinese Chem. Soc. Jour. 8: 100-107. 1941.

MARTINOT-LAGARDE (1223)
VEGETABLE OILS AS FUELS FOR DIESEL ENGINES—CASTOR OIL. Soc. des Ingén. de l'Auto. Jour. 14: 237–246. 1941.

SUEN, T. J., and WANG, K. C. (1224)
CLAY TREATMENT OF VEGETABLE GASOLINE. Chinese Chem. Soc. Jour. 8: 93–99. 1941.

Treatment of vegetable gasoline with clay was successful in reducing the gum content but gave very little improvement in color.

SUN, Y. C. (1225)
PRESSURE CRACKING OF DISTILLATION BOTTOMS FROM PYROLYSIS OF MUSTARD SEED. Chinese Chem. Soc. Jour. 8: 108–111. 1941.

A gasoline of 51 octane number was obtained.

1942

ABEELE, M. VAN DEN (1226)
PALM OIL AS RAW MATERIAL FOR THE PRODUCTION OF A HEAVY MOTOR FUEL. Bul. Agr. du Congo Belge 33: 3–90. 1942.

Esterification of palm oil with anhydrous ethanol is described in detail. The product consists of a mixture of ethyl esters of palmitic, oleic, linoleic, and stearic acids, and is miscible with gasoline and with palm oil. No appreciable corrosion was observed in spite of its slight acidity.

AUBERVILLE, M. A. (1227)
SUBSTITUTE MOTOR FUELS IN DARK AFRICA. Carburants Nat. 3: 281–287. 1942.

The review includes a discussion of vegetable oils used in Diesels and as lubricating oils.

BARAVE, R. V., and AMRUTE, P. V. (1228)
GROUNDNUT OIL FOR DIESEL ENGINES. Current Sic. [India] 11: 403–404. 1942.

Groundnut oil showed a performance superior to Diesel "B"-grade fuel.

BURG, M. (1229)
THE OPERATION OF TWO-STROKE C.I. ENGINES ON DIFFERENT FUELS. Motortech. Ztschr. 4: 339. 1942.

Single- and three-cylinder Diesel engine tests using a variety of fuels including vegetable and animal oils are described. Satisfactory performance was obtained.

Abstract *in* Inst. Engin. Jour. 13 (1): XXVI. 1944.

CHOWHURY, D. H., MUKERJI, S. N., AGGARWAI, J. S., and VERMAN, L. C. (1230)
INDIAN VEGETABLE OILS AS FUELS FOR DIESEL ENGINES. Dept. Sci. Indus. Res. Bur. [India] Bul. No. 19; Gas and Oil Power 37: 80–85. 1942.

Detailed results are given which were obtained in single-cylinder Diesel engine tests with groundnut, castor, kapok, cottonseed, rape, and other vegetable oils.

FURIA, ANTONIO (1231)
PYRODISTILLATION OF VEGETABLE OILS. Rev. Brasil. de Quím. (Sci. & Indus.) 14: 328. 1942.

Pyrodistillation of sunflower seeds (average oil content 20 percent) at 600° C. (maximum) in presence of 5 percent of lime gave 29.7 percent distilled oil, 17.4 percent acid liquors, 30.7 percent carbon residue, and 22.2 percent gases. After it was washed with sodium carbonate, the oil was fractionated, yielding a product distilling between 70° and 300°. Castor oil gave similar results.

Abstract *in* Chem. & Metall. Engin. 50 (8): 191. 1943.

JALBERT, JEAN (1232)
COLONIAL MOTOR FUELS AND LUBRICANTS FROM PLANTS. Carburants Nat. 3: 49–56. 1942.

Possibilities of obtaining Diesel fuel and lubricating oils from vegetable oils in French Africa are outlined.

SEDDON, R. H. (1233)
VEGETABLE OILS IN COMMERCIAL VEHICLES. Gas and Oil Power 37: 136–141, 146. 1942.

Vegetable oils contain normally much abrasive materials. Because of their high viscosity these oils must be preheated, e.g., by means of exhaust gas. Starting with vegetable oils is more difficult and fuel consumption is higher. In general, performance is not as good as with gas oil.

1943

ANONYMOUS (1234)
BRAZIL USES VEGETABLE OIL FOR DIESEL FUEL. Chem. & Metall. Engin. 50 (5): 225. 1943.

A brief notice reports that the Brazilian Government has prohibited the export of cottonseed oil because of shortage of imported Diesel oil. Performance of cottonseed oil in Diesel engines was satisfactory and the only objection was the higher price. The Government will take 30,000 to 40,000 tons of next season's crop.

BONNEFOI, JACQUES (1235)
NATURE OF THE SOLID, LIQUID, AND GASEOUS FUELS WHICH CAN BE OBTAINED FROM THE OIL-PALM FRUIT. Bul. des Matières Grasses de l'Inst. Colon. de Marseille 27: 127–134. 1943.

Results of laboratory experiments in the dry distillation and cracking of shells, palm fruit, and palm oil are given. Dry distillation processes which can be carried out on a commercial scale are outlined. It is believed that fuel prepared from oil palm fruit shows possibilities and may present a practical solution of the problem of colonial motor transportation.

CHAVANNE, G. (1236)
A METHOD OF POSSIBLE UTILIZATION OF PALM OIL FOR THE MANUFACTURE OF A HEAVY FUEL. Soc. Chim. de France Bul. 10: 52–58. 1943.

The reaction of ethanol with palm oil produces esters which may be blended with hydrocarbons for use as motor fuel. Economic factors and possibilities of production are discussed.

LAPORTE, J. (1237)
THE USE OF VEGETABLE OILS IN INTERNAL COMBUSTION ENGINES. Asoc. Quím. Argentina An. 31: 86–87. 1943.

Fifty to fifty and 80:20 linseed oil-gas oil mixtures in Diesel engines gave normal power output. Fuel consumption was inversely proportional to the heat of combustion. Precombustion chamber engines are better adapted and preheating of charge is necessary for smooth operation. The 50:50 blend gave a clean exhaust; linseed oil alone causes a very disagreeable exhaust odor. With vegetable oils the tendency to foul engines is greater.

PANUNZI, U. (1238)
ON THE UTILIZATION OF VEGETABLE OILS AS MOTOR FUELS. Olivicoltore 20 (20): 1–6. 1943.

TORRE, FLORENTINO DE LA (1239)
CATALYTIC CONVERSION OF CORN OIL FOR THE PRODUCTION OF NAPHTHA AND KEROSENE TYPE HYDROCARBONS. Asoc. Quím. Argentina An. 31: 85–86. 1943.

Cracking of corn oil at 550° to 630° C. yields a petroleumlike product. By distilling the crude product, a gasoline fraction (40° to 150°) and a kerosene fraction (150° to 230°) can be obtained.

1944

BERL, E. (1240)
PRODUCTION OF OIL FROM PLANT MATERIAL. Science 99: 309–312. 1944.

The production of petroleumlike products from agricultural plant materials is described.

BOISSELET, L., and LOUIS, M. (1241)
DRY DISTILLATION OF GRAPE SEEDS AND MARC. Ann. des Mines et Carburants Mém. [14], 4: 232–235. 1944.

The dry distillation of grape seeds and residues will yield a considerable percentage of tar which on further cracking and refining would yield motor fuels.

BORGES, G. P. (1242)
USE OF BRAZILIAN VEGETABLE OILS AS FUEL. Assoc. Quím. do Brasil An. 3: 206–209. 1944.

The heats of combustion of various Brazilian vegetable oils vary from 9,080 to 11,232 cal. per gm. The value for Diesel oil lies between 10,000 to 12,000 cal. per gm. The sulfur content of vegetable oils ranges from 0.011 to 0.164 percent.

LUGARO, M. E., and MEDINA, F. DE (1243)
THE POSSIBILITY OF THE USE OF ANIMAL OIL AND GRASSES IN DIESEL MOTORS. Inst. del Sudamericano del Petróleo, Sec. Uruguaya, Mem. Primera Conf. Nacl. Aprovisionamiento y Racionalización en el Empleo de los Combustibles 2: 159–175. 1944.

Preliminary tests indicate that tallow may be used as Diesel fuel. Preheating is necessary. Heat of combustion of the tallow used was 9,460 cal. per gm.

1945

CHENG, F. W. (1244)
CHINA PRODUCES FUELS FROM VEGETABLE OILS. Chem. & Metall. Engin. 52(1): 99. 1945.

Thermal or catalytic cracking of vegeable oils will produce a crude distillate which, after refining, will yield gasoline and Diesel oil fractions. High pressure cracking operations at pressures from 50 to 150 p.s.i. and at temperatures between 400° to 500° C. may yield as much as 75 percent of motor fuels of which 50 percent is "gasoline." In atmospheric cracking of vegetable oils, usually in form of lime soaps, lower yields (50 percent) are obtained. Data are given.

OTTO, R. B. (1245)
GASOLINE DERIVED FROM VEGETABLE OILS. Bol. de Divulgação do Inst. de Óleos 1945, No. 3: 91–99.

A review.

1946

DUPORT, R. (1246)
AUTO-IGNITION TEMPERATURES OF DIESEL MOTOR FUELS. Oléagineux 1: 149–153. 1946.

Oleic acid, alkyl esters of palm oil fatty acids, and distillation products of palm oil and certain oleaginous fruits (palm, arachis, etc.) have ignition temperatures between 240° to 265° C. and are suitable as Diesel fuels for normal running and starting from cold. Vegetable oils having higher ignition temperatures (400°) are not suitable for cold starting. Dopes have little effect on ignition temperature. Ethanol, glycerol, or in general, compounds containing the OH group are not suitable for Diesel use.

MANDLEKAR, M. R., MEHTA, T. N., PEREKH, V. M., and THOSAR, V. B. (1247)
CRACKING OF VEGETABLE OILS. Sci. and Indus. Res. [India] Jour. 513: 45–47. 1946.

Complete gasification of vegetable oils for fuel is described.

NEELY, G. L., ET AL. (1248)
JAPANESE FUELS AND LUBRICANTS—ARTICLE 4: PINE ROOT OIL PROGRAM. U. S. Naval Tech. Mission to Japan Rpt. X–38(N)–4, 214 pp. Feb. 1946; Published as Rpt. PB L 53047 U. S. Dept. Com. Off. of the Pub. Bd.

The production and refining of a pine root gasoline is described in detail. Work on the combustion of pine oil in turbine rockets is mentioned.
Abstract *in* Bibliog. Sci. and Indus. Rpts. 4 (11): 955. 1947.

SUEN, T. J., KING, T. S., and HSIA, D. Y. (1249)
SYNTHETIC LUBRICANTS FROM VEGETABLE OILS. Chinese Inst. Engin. Jour. 4 (1): 15–28. 1946.

A brief description is given of the pyrolysis process of vegetable oils and soaps for the production of lubricants as practiced at the Tung Li Oil Works at Chungking. Experimental data on pyrolysis and polymerization with use of various materials are presented.

UNITED STATES NAVAL TECHNICAL MISSION TO JAPAN (1250)
JAPANESE FUELS AND LUBRICANTS—ARTICLE 6: RESEARCH ON DIESEL AND BOILER FUEL AT THE FIRST NAVAL FUEL DEPOT. OFUNA. Rpt. X–38 (N)–6, 129 pp. Feb. 1946. Published as Rpt. PB L 48374. U.S. Dept. Com. Off. of the Pub. Bd.

It is mentioned that battleship Yamato used edible refined soybean oil as bunker fuel.
Abstract *in* Bibliog. Sci. and Indus. Rpts. 5 (1): 12. 1947.

1947

AMRUTE, P. V. (1251)
GROUNDNUT OIL FOR DIESEL ENGINES. Australasian Engin. 47: 60–61. Mar. 1947.

Tests at the Burhanpur power station with two 165 b.hp. Deutz engines using groundnut oil indicated satisfactory performance. The use of the oil as fuel was uneconomical and had to be discontinued.
Abstract *in* Gas and Oil Power 42: 183. 1947.

CHANG, C. C., and WAN, S. W. (1252)
CHINA'S MOTOR FUELS FROM TUNG OIL. Indus. and Engin. Chem., Indus. Ed. 39: 1543–1548. 1947.

For the preparation of crude vegetable oil distillate three methods may be used: (1) Destructive distillation of the oil with simultaneous or subsequent cracking of its vapors, (2) liquid-phase cracking with or without catalysts, and (3) pyrolysis of vegetable soaps. Data are given for all three methods and plant operation is described. Mechanism of cracking is explained. A ton of crude distillate may yield 60 gallons of regular gasoline, 40 gallons of regular kerosene, 0.6 tons of regular Diesel oil, and 0.06 tons of tar. Vegetable gasoline may be blended with ethanol (see No. 260). In order to stabilize the gasoline, treatment with concentrated sulfuric acid is recommended. This treatment also eliminates any disagreeable odor, however at the cost of octane number reduction and output. Improvements for the cracking process are outlined.

FRANÇOIS, ROGER (1253)
MANUFACTURE OF MOTOR FUELS BY PYROLYSIS OF OLEAGINOUS SEEDS. Tech. et Appl. du Pétrole 2: 325–327. 1947.

A process for making gasoline and other petroleum products from oil-bearing vegetable seeds or residues is described. Data are given for peanuts, cottonseed, the fruit of palmetto, castor-oil plant, and other plants.

VII. PATENTS

1914

GOLDSTEIN, H. (1254)

MOTOR SPIRIT. Brit. 21,316. Oct. 21, 1914.

A fuel blend consisting of 86 volumes of 95-percent ethanol, and 10 volumes of ether, with or without a denaturing agent such as 1 volume of wood spirit and 3 volumes of benzene is claimed.

JENKINS, B. O. (1255)

IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF OILS OR SPIRITS FOR USE IN INTERNAL COMBUSTION ENGINES. Brit. 3,899. Aug. 10, 1914.

A process is described for preparing a blend consisting of ethanol (74 to 49 percent), benzene (25 to 50 percent), and camphor (1 percent). Methylated alcohol (82 percent ethanol, 10 percent methanol, 8 percent water) and a mixture of benzene and toluene or naphtha can also be used. The constituents are distilled from an ordinary still at about 100° C. The blend thus prepared has a high flash point, high thermal efficiency, and high explosive pressure.

1915

BUNDY, L. (1256)

SOLUTION FOR REMOVING CARBON DEPOSITS FROM INTERNAL-COMBUSTION ENGINES. U. S. 1,125,003. Jan. 12, 1915.

A blend composed of 66.6 percent water, 11.2 percent potassium nitrate, and 22.2 percent denatured alcohol is claimed to remove carbon deposits from engines.

1916

AXTELL, F. C. (1257)

LIQUID FUEL. U. S. 1,204,638. Nov. 14, 1916.

A fuel for internal-combustion engines consists of an alcohol (95-percent), kerosene, and a light paraffin distillate boiling at about 60° to 80° C., mixed in equal amounts. A blending agent such as anhydrous fusel oil is added.

DÉSMARAIS, P. A. M. (1258)

UTILIZING ALCOHOL AS MOTOR FUEL. Fr. 481,037. Oct. 24, 1916.

Studies based on boiling point and volatility, density of the vapors, air requirement for combustion, and inflammability of ethanol make it a valuable fuel when blended with benzene.

1917

FOSTER, J. P. (1259)

LIQUID FUEL FOR INTERNAL COMBUSTION ENGINES. U. S. 1,248,302. Nov. 27, 1917.

A blend is described consisting of ether, alcohol, and pyridine, the last serving as a neutralizer of combustion products and at the same time as a denaturing agent. Example given: Methanol 2 gallons, ethanol 100 gallons, ether 15 gallons, pyridine 2 quarts.

SOLARI, LUIGI (1260)

ALCOHOL FUEL FOR INTERNAL COMBUSTION ENGINES. Fr. 484,324. Sept. 25, 1917.

Benzaline is a fuel composed of equal parts of anhydrous ethanol and gasoline.

1918

BACKHAUS, A. A. (TO U. S. INDUSTRIAL ALCOHOL CO.) (1261)

LIQUID FUEL. U. S. 1,271,114. July 2, 1918.

To a fuel consisting mainly of ethanol, gasoline, and kerosene any or all of the following components may be added: methanol, nitrobenzene, benzene, cresol, and toluene.

STEVENS, E. W. (1262)
MOTOR FUEL. U. S. 1,259,053. Mar. 12, 1918.

A blend of 52 parts kerosene, 25 parts ethyl alcohol, 5 parts fusel oil, 10 parts ether, and 8 parts toluene may be used as motor fuel.

WADE, H. (1263)
MOTOR SPIRIT. Brit. 141,091. Nov. 4, 1918.

A blend of alcohol and ether is mixed with a small proportion of aliphatic amines and esters of formic acid.

1919

BACKHAUS, A. A. (TO U. S. INDUSTRIAL ALCOHOL CO.) (1264)
LIQUID FUEL. U. S. 1,324,765. Dec. 9, 1919.

A homogeneous motor fuel is claimed consisting of ethanol 25 parts by volume, gasoline 25 parts, and carbon disulfide (as blending agent) 8 parts.

UNITED STATES INDUSTRIAL ALCOHOL CO. (1265)
IMPROVEMENT IN LIQUID FUEL. Brit. 134,766. Nov. 13, 1919.

Gasoline or other petroleum distillate is mixed with ethanol or other alcohol and small amounts of ricinoleic acid or castor oil.

1920

BLACK, JOSEPH (1266)
LIQUID FUEL. U. S. 1,360,872. Nov. 30, 1920.

A process for blending 100 gallons of aliphatic hydrocarbon not exceeding 50° Bé with 5 gallons of gasoline and 10 percent benzene is described. To this blend 16 ounces of ether, 100 ounces of acetone, and 14 ounces of alcohol, preferably methanol, are added in order to lower the ignition point, prevent carbon formation, improve starting, and decrease knocking.

DINSMORE, G. F. (1267)
MOTOR FUEL FOR INTERNAL-COMBUSTION ENGINES. U. S. 1,331,054. Feb. 17, 1920.

Kerosene or the like is mixed with crude wood spirit from destructive distillation of wood in the proportion of 5 parts to 1. Methyl acetate and ketones present in wood spirit are absorbed by kerosene, which forms a suitable motor fuel. Methyl alcohol and water separate out and give a valuable byproduct.

HAYES, ALBERT (TO ARTHUR F. RAY) (1268)
COMPOSITE MOTOR FUEL. U. S. 1,338,982. May 4, 1920.

A motor fuel consisting of 75 parts of alcohol (95 percent or less), 10 parts of ether, and 15 parts of water can be used in ordinary gasoline engine.

——— (TO U. S. INDUSTRIAL ALCOHOL CO.) (1269)
MOTOR FUEL. U. S. 1,361,153. Dec. 7, 1920.

A blend of petroleum distillate (gasoline or kerosene), benzene, methanol or ethanol, and dimethyl or diethyl ether is adapted for use in internal combustion engines.

KNIGHT, LEWIS (1270)
IMPROVEMENTS RELATING TO PETROL AND OTHER LIQUID FUELS. Brit. 170,-075. July 8, 1920.

The use of coloring matter which is insoluble in water but soluble in gasoline or other liquid fuels such as alcohols is claimed. Aniline or nonsulfonated members of azo-group dyes are suitable. A good proportion is 1 to 500,000 of gasoline.

UNITED STATES INDUSTRIAL ALCOHOL CO. (1271)
LIQUID FUEL. Brit. 140,796 and 140,797. Mar. 25, 1920.

A blend is described which consists of petroleum distillate (gasoline, kerosene), methanol or ethanol, and an aromatic nitro compound (nitrobenzene or nitrotoluene) which serves as a blending agent.

——— (1272)

IMPROVEMENTS IN LIQUID FUEL. Brit. 143,017. May 20, 1920.

A mixture of gasoline, ethanol or other alcohol, and a chlorohydrocarbon such as chloroform, carbontetrachloride, etc., can be used as a motor fuel.

——— (1273)

IMPROVEMENT IN LIQUID FUEL. Brit. 144,052. June 10, 1920.

A fuel suitable for motors consists of petroleum distillate, an alcohol, an aromatic hydrocarbon, and a phenol. Nitrobenzene or other aromatic nitro compounds may be added.

——— (1274)

IMPROVEMENTS IN PROCESS OF PRODUCING LIQUID FUEL AND PRODUCT THEREOF. Brit. 149,398. Aug. 9, 1920.

A process for the production of a fuel comprising dehydrated ethanol, light hydrocarbon, and acetylene is described.

——— (1275)

IMPROVEMENTS IN NON-FREEZING FUEL. Brit. 153,925. Nov. 8, 1920.

A motor fuel is claimed which has a freezing point below —60° F. It consists of a major portion of ethanol (20 to 40 volume) blended with gasoline, benzene, ether and toluene or methyl ethyl ketone.

1921

FOSTER, J. P. (1276)

COMPOSITE MOTOR FUEL. U. S. 1,384,946. July 19, 1921.

A composition of motor fuel suitable for tropical and subtropical countries is: ethanol 63 percent by volume, ether 34 percent, kerosene 2 percent, and aniline 1 percent. In colder climates the percentage of ether may be increased to 45 percent or more.

HAYES, ALBERT (TO U. S. INDUSTRIAL ALCOHOL CO.) (1277)

METHOD OF MAKING MOTOR FUEL. U. S. 1,378,858. May 24, 1921.

A stable motor fuel is prepared by adding ether to kerosene and then successively adding benzene and alcohol vapors until about 27 parts of alcohol have been absorbed.

HOFFMAN, W. J. (TO U. S. MOTOR FUEL CORPORATION) (1278)

PROCESS FOR THE TREATMENT OF HYDROCARBON DISTILLATES. U. S. 1,367,-968. Feb. 8, 1921.

A motor fuel consisting of hydrocarbon distillate, mixed with a solution of picric acid and methanol and saturated with acetylene is claimed.

KOBAYASHI, KIUHEI (1279)

HYDROCARBON OILS. Brit. 170,264. Apr. 22, 1921.

Distillation of herring oil, sardine oil, shark oil, and salmon oil at 500° C. in the presence of Japanese acid clay produces a distillate resembling petroleum. The product may be fractionated and refined by the usual acid or alkali treatment.

LE PETIT, CHARLES (TO POWER ALCOHOL LIMITED OF LONDON, ENGLAND) (1280)

FUEL. U. S. 1,377,992. May 10, 1921.

A fuel for internal-combustion engine which prevents formation of acidic compounds and is free from objectionable odor from the exhaust is claimed. It consists of 38 to 70 percent ethanol by weight, 60 to 30 percent ether, 0.5 to 3 percent methylamine and 0.5 to 2 percent ethyl formate.

RICARDO, H. R. (1281)

MOTOR FUEL FOR AIRCRAFT. Brit. 185,449. Apr. 7, 1921.

A fuel is described which at low altitudes has a high latent heat in relation to its heat value; at high altitudes this fuel is cut off and normal hydrocarbon fuel is used. Pure methanol; a blend of ethanol, methanol, and water; or a blend of ethanol, acetone, benzene, and water can be used as the special fuel.

ROHRS, F. W. (1282)
MOTOR FUEL. U. S. 1,399,227. Dec. 6, 1921.

A blend claimed to be superior to gasoline consists of 1 to 3 percent acetone, 8 to 15 percent kerosene, and 80 to 90 percent gasoline. Such fuel does not produce excessive carbon deposits, does not cause the engine to overheat, and does not attack metal parts of the carburetor and fuel system.

SCHREIBER, W. T. (TO U. S. INDUSTRIAL ALCOHOL CO.) (1283)
MOTOR FUEL FOR AIRPLANES. U. S. 1,398,947. Nov. 29, 1921.

A blend comprising from 35 to 50 percent of ethanol (95 percent), 25 to 35 percent benzol, and 20 to 40 percent diethyl ether is claimed for use in airplanes. Instead of ethanol, methanol or butanol may be used, toluene may be substituted for benzol, and butyl ether for ethyl ether.

——— (TO U. S. INDUSTRIAL ALCOHOL CO.) (1284)
INTERNAL-COMBUSTION-MOTOR FUEL. U. S. 1,398,948. Nov. 29, 1921.

Ninety to ninety-two percent of heavy hydrocarbons (density 30°-50° Bé) are mixed with 8 to 10 percent of very volatile combustible constituent such as diethyl ether.

SESTI, C. G. (1285)
A NEW MOTOR SPIRIT. Brit. 147,803. Oct. 10, 1921.

A motor fuel which can be used instead of gasoline is obtained by mixing any kind of ethyl alcohol (any source and concentration) with carbon disulfide previously treated with calcium oxide. A blend of 100 parts of ethanol (90 percent) with 30 to 35 parts of carbon disulfide is claimed to be suitable for ordinary engines.

STEVENS, E. W. (1286)
DISTILLING ALCOHOL FOR USE IN MOTOR. U. S. 1,372,465. Mar. 22, 1921; Brit. 159,880. May 25, 1922.

Blends containing anhydrous ethanol, gasoline, benzene, and fusel oil are prepared for use as motor fuels by redistilling the aqueous alcohol with benzene, gasoline or kerosene, and fusel oil.

——— (TO CHEMICAL FUEL COMPANY OF AMERICA, INC.) (1287)
MOTOR FUEL. U. S. 1,388,531. Aug. 23, 1921; Can. 222,289. Aug. 15, 1922.

Motor fuel for internal-combustion engines is claimed, comprising petroleum oil, ethanol, methyl ethyl ether, and an oily blending agent. Examples given: Kerosene 50 parts by volume, ethanol 30 parts, methyl ethyl ether 5 to 10 parts, and toluene 8 to 10 parts.

WILFORD, A. T., and DURANT, A. A. M. (1288)
IMPROVEMENTS IN OR RELATING TO MOTOR FUEL. Brit. 167,831. Aug. 12, 1921.

A fuel to be used in internal-combustion engines with normal compression consists of absolute, aqueous, or denatured ethanol containing 1 to 2 percent of ammonium nitrate. This fuel yields exclusively gaseous products of decomposition in the engine. Instead of ethanol, mixtures of ethanol with ether, acetone, or benzol can be used.

1922

BACKHAUS, A. A. (TO U. S. INDUSTRIAL ALCOHOL CO.) (1289)
LIQUID FUEL. U. S. 1,419,910. June 20, 1922.

A fuel is described consisting principally of a blend of kerosene, gasoline, and ethanol. Other additional blending constituents are benzene, toluene, nitrobenzene, cresol, and methanol.

BLAKE, S. W. (1290)
IMPROVEMENTS IN OR RELATING TO ALCOHOL FUELS. Brit. 187,335. Oct. 19, 1922.

Alcohol fuels in which the volatility and calorific value are increased by the presence of dissolved acetylene are described. A mixture of mono-hydric alcohol (from ethanol to amylol) and acetone is treated in a pressure resisting vessel with calcium carbide under agitation until the liberated acetylene is absorbed, the lime being removed by chemical means.

——— (1291)

IMPROVEMENTS IN ALCOHOL FUELS. Brit. 178,498. Apr. 18, 1922.

A method for producing a motor fuel is described. Three to five pounds of calcium carbide are agitated with 9 gallons of commercial alcohol and 1 gallon of acetone until the acetylene is absorbed. The liquid is cleared by carbon or other flocculating agent. The resulting fuel contains over 12.5 times its volume of acetylene.

CHARBONNEAUX, E. A. (1292)

GASEOUS FUEL. U. S. 1,420,622. June 27, 1922.

A suitable motor fuel may consist of turpentine, ether, and alcohol. Oils such as eucalyptus or oil of cedar may be substituted for turpentine.

DUNSTAN, A. E., and THOLE, F. B. (1293)

MOTOR SPIRIT. Brit. 205,367. Nov. 16, 1922.

A homogeneous and stable mixture of alcohol and a liquid hydrocarbon is prepared by cooling the mixture to from 0° to —20° C. and removing the shallow denser layer of aqueous alcohol and hydrocarbon which separates out. For example, 900 parts of gasoline and 100 parts of alcohol are cooled to —10°.

ELLIS, CARLETON (TO SETH B. HUNT, TRUSTEE OF MOUNT KISCO, NEW YORK) (1294)

FUEL AND PROCESS OF MAKING SAME. U. S. 1,412,233. Apr. 11, 1922.

A process is described of obtaining a mixture of alcohols (with predominant amount of isopropyl alcohol) by treating olefines present in cracked gasoline with sulfuric acid. Such a mixture of alcohols may be used for fuel as such, or blended with benzene and gasoline. Ketones may be utilized in a similar manner. They can be obtained from secondary alcohols or by direct oxidation of olefines.

HAWES, JOHN (1295)

AN IMPROVED ALCOHOL FUEL. Brit. 184,607. Aug. 24, 1922.

An alcohol fuel containing nitrobenzene as denaturing agent is claimed to have increased volatility and to be suitable for use in internal combustion engines. Not more than 5 percent by volume is added to ethanol alone or to the mixture of ethanol, coal tar naphtha, petroleum naphtha, and amyl alcohol.

HAYES, ALBERT (TO U. S. INDUSTRIAL ALCOHOL CO.) (1296)

METHOD OF FORMING A LIQUID FUEL. U. S. 1,428,885. Sept. 12, 1922.

An apparatus and a process are described for making a liquid fuel which will not separate into phases, by subjecting a vaporized mixture of a heavy hydrocarbon oil and alcohol (containing small proportion of light hydrocarbon and ether) to the action of zinc or nickel catalyst at a temperature a little below 300° C.

HINO, KUMAZO (1297)

MOTOR SPIRIT. Jap. 41,887. Feb. 28, 1922.

A mixture of 50 parts of alcohol, 50 parts of benzene, 10 parts of nitrotoluene, and 0.5 to 1 part of ammonium nitrate is claimed. Gasoline can be used in place of benzene and nitrobenzene in place of nitrotoluene.

——— (1298)

MOTOR SPIRIT. Jap. 41,888. Feb. 28, 1922.

Five parts of naphthalene are dissolved into 60 parts of solvent naphtha, 5 parts by weight of acetylene are passed in, and then 30 parts of benzene and 90 parts of alcohol are added.

LENNOX, P., and CALDER, J. C. (1299)
IMPROVEMENTS IN OR RELATING TO INFLAMMABLE VAPORISABLE LIQUID FUELS. Brit. 205,582. Nov. 27, 1922.

A fuel for internal-combustion engines consists of ethanol, hydrocarbon, and water in such proportions as to form a homogeneous solution (46:50:4). Pyridine is used to denature the alcohol; picric acid or a barium peroxide and hydrochloric acid are added to generate oxygen to improve combustion.

LICHTENTHAELER, F. E. (1300)
IMPROVED MANUFACTURE OF ALCOHOL ETHER MIXTURES. Brit. 187,051. Oct. 19, 1922.

Object of invention is to eliminate the necessity for employing refrigerating apparatus and to provide safe storage. These are accomplished by condensing the ether in ethanol, since ether-ethanol blends containing up to 45 percent ether have been found to be suitable motor fuels.

MORGAN, B. H. (1301)
IMPROVED FUEL FOR INTERNAL COMBUSTION ENGINES. Brit. 189,715. Dec. 7, 1922.

A fuel for internal-combustion engines comprises a mixture of alcohol and ether to which is added from 0.2 to 5 percent of castor oil.

PENHALE, JOHN (1302)
IMPROVEMENTS IN ALCOHOL FUEL. Brit. 178,373. Apr. 20, 1922.

Ethanol saturated with acetylene is improved by the addition of ethyl or methyl nitrate not exceeding 1 percent by volume of the total.

RIBOISIÈRE, J. F. P. DE LA (1303)
IMPROVEMENTS IN AND RELATING TO FUELS FOR INTERNAL COMBUSTION ENGINES. Brit. 213,948. Dec. 11, 1922.

A suitable fuel consists of a large proportion of constituents boiling above 160° C. (brown coal-tar oil), a liquid hydrocarbon boiling below 150°, a small proportion of an ether, and a phenolic compound to retain the ether in mixture with other ingredients.

RICARDO, H. R. (1304)
IMPROVEMENTS IN OR RELATING TO FUEL FOR USE IN INTERNAL COMBUSTION ENGINES. Brit. 183,577. July 26, 1922.

A fuel which increases the volumetric efficiency of the engine and lowers the mean temperature of the cycle performed by the engine has the following composition: 60 percent of ethanol, 20 percent of acetone, 10 percent of benzene, and 10 percent of water.

ROHRS, F. W. (1305)
MOTOR FUEL. U. S. 1,425,136. Aug. 8, 1922.

A motor fuel comprising 3 percent of acetone, 3 percent of kerosene, 9 percent of benzol, and 85 percent of gasoline is claimed to increase the mileage per gallon, to improve efficiency of the motor, and to be free from corrosive effects.

SCHREIBER, W. T. (TO U. S. INDUSTRIAL ALCOHOL CO.) (1306)
PROCESS OF PRODUCING LIQUID FUELS. U. S. 1,405,805. Feb. 7, 1922; Can. 221,090. July 18, 1922.

A process of manufacturing homogeneous fuel for use in motors is described. It consists of dehydrating 95-percent ethanol with a carbide, passing acetylene generated into a light hydrocarbon oil, and mixing the latter with the ethanol.

——— (TO U. S. INDUSTRIAL ALCOHOL CO.) (1307)
AIRPLANE MOTOR FUEL. Can. 216,287. Feb. 28, 1922.

A suitable fuel homogeneous at low temperatures contains 40 to 60 parts of ethanol, 30 to 50 parts gasoline, 25 parts benzene, and 5 parts ethyl ether.

——— (TO U. S. INDUSTRIAL ALCOHOL CO.) (1308)
NON-FREEZING FUEL. Can. 216,290. Feb. 28, 1922; U. S. 1,474,982. Nov. 20, 1923.

A blend consisting of 40 parts alcohol, 30 parts gasoline, 17 parts benzene, 7 to 15 parts ether, and 8 parts toluene is claimed to have a freezing point below —50° F. Other examples are given. Kerosene and methyl ethyl ketone are also used as components.

——— (1309)
AEROPLANE MOTOR FUEL. U. S. 1,428,913. Sept. 12, 1922.

Methanol, ethanol, or butanol may be used as components of aviation fuels. Blends may consist of 40 to 60 parts ethanol, 30 to 50 parts gasoline, about 25 parts benzene, and from 5 to 20 parts ethyl ether.

STEVENS, E. W. (TO CHEMICAL FUEL CO. OF AMERICA, INC.) (1310)
MOTOR FUEL. U. S. 1,414,759. May 2, 1922.

A petroleum distillate such as kerosene or gas oil is mixed with alcohol, toluene, and methyl or ethyl formate in the proportion 75:15:5:5 parts, respectively.

TERRISSE, HENRI (1311)
PROCESS FOR THE PREPARATION OF A CARBURETTING FUEL MIXTURE FOR INTERNAL COMBUSTION ENGINES. Brit. Specification 202,264. Dec. 28, 1922. (Patent not accepted.)

A process is described for the preparation of an automobile fuel consisting in that acetal or paraldehyde or a mixture of these two substances is added to hydrocarbons or to alcohol.

TUNISON, B. R. (TO U. S. INDUSTRIAL ALCOHOL CO.) (1312)
FUEL OF LIQUID TYPE. U. S. 1,423,048 and 1,423,049. July 18, 1922.

A blend suitable, among other uses, for internal-combustion engines consists of heavy oil, i.e., petroleum distillates heavier than 40° Bé and admixture of one or more volatile combustible constituents, such as alcohols, ethers, esters, and ketones. An example is a blend of: Heavy oil 70 parts by volume, ethanol (95 percent) 20 parts, ether 4 parts, ethyl acetate 3 parts, and acetone 3 parts.

——— (TO U. S. INDUSTRIAL ALCOHOL CO.) (1313)
LIQUID FUEL. U. S. 1,423,050. July 18, 1922.

WHITAKER, M. C. (TO U. S. INDUSTRIAL ALCOHOL CO.) (1314)
LIQUID FUEL. U. S. 1,405,809. Feb. 7, 1922.

A blend adapted for motor fuels contains light hydrocarbon and alcohol with terpene as blending agent. For example: 25 cc. gasoline, 25 cc. kerosene, 25 cc. ethanol, and 14 cc. pine oil.

——— (TO U. S. INDUSTRIAL ALCOHOL CO.) (1315)
INTERNAL COMBUSTION ENGINE FUEL. U. S. 1,420,006. June 20, 1922.

Fuels especially adapted for use in aeroplanes contain a large proportion of ketones preferably other than acetone. An example of such fuel is: diethyl ketone 35 percent, alcohol 25 percent, petroleum distillate 35 percent, and ethyl acetate 5 percent.

——— (TO U. S. INDUSTRIAL ALCOHOL CO.) (1316)
FUEL FOR INTERNAL-COMBUSTION ENGINES. U. S. 1,420,007. June 20, 1922.

A fuel especially suitable for airplane motors consists of alcohol, aromatic hydrocarbon, and ethyl acetate. Best results were obtained with the following composition: Ethanol (95 percent) 40 parts by volume, benzene 30 parts, and ethyl acetate 30 parts.

——— (TO U. S. INDUSTRIAL ALCOHOL CO.) (1317)
ENGINE FUEL. U. S. 1,421,879. July 4, 1922.

A blend consisting of heavy hydrocarbon (50° Bé) and a volatile ester can be used as fuel in internal-combustion engines. For example: fuel comprised of kerosene 90 to 92 parts by volume and ethyl acetate 8 to 10 parts is satisfactory.

——— (TO U. S. INDUSTRIAL ALCOHOL CO.) (1318)
FUEL ADAPTED FOR USE IN INTERNAL-COMBUSTION ENGINES. U. S. 1,423,-058. July 18, 1922.

A blend adapted for use in internal-combustion engines, especially in airplane motors, consists mainly of alcohol, gasoline, and an ester. It can be varied by addition of benzol or toluene or substituting kerosene for part of gasoline, as for example: ethanol 40 parts by volume, gasoline 28 parts, benzol 17 parts, ethyl acetate 7.5 to 10 parts, and toluol 8 parts. It is claimed that blends of this type will not freeze at —50° F. Alcohol commonly used is 95-percent ethanol but other alcohols, such as methanol, butanol, etc., can be used as well.

1923

BACKHAUS, A. A. (TO U. S. INDUSTRIAL ALCOHOL CO.) (1319)
LIQUID FUEL FOR MOTORS. U. S. 1,474,135. Nov. 13, 1923.

A fuel to be used in airplanes and other internal-combustion engines, in general, consists of anhydrous butyl alcohol and gasoline in about equal proportions.

BUC, H. E. (TO STANDARD DEVELOPMENT CO.) (1320)
DEHYDRATION OF ALCOHOL. U. S. 1,455,072. May 15, 1923.

A mixture of alcohol with 20 to 50 percent of kerosene is distilled with lime. Dehydrated alcohol may be either condensed alone or with some hydrocarbons into the blend to be used as fuel.

CHEVALIER, J. M. A., BOURCET, P., and REGNAULT, H. (1321)
IMPROVEMENTS IN OR RELATING TO CARBURETTING OR ENRICHING ALCOHOL. Brit. 168,308. Feb. 5, 1923.

A fuel blend that has a calorific power similar to that of gasoline is claimed. It consists of 1,000 gm. of alcohol, 200 to 500 gm. of resin spirit (pine or spruce) of 0.890 sp. gr., and 125 gm. of acetone.

DIAMOND, ISAAC (1322)
MOTOR SPIRIT. Brit. 207,883. Dec. 7, 1923.

A fuel with a reduced tendency to corrode the metal of the piston and cylinder is claimed. It consists of ethanol or methylated spirit 60 to 100 gallons, ether 40 to 80 gallons, benzene 25 to 60 gallons, and nicotine (98 percent) 2 to 4 ounces.

GARLOCK, L. R. (1323)
FUEL. U. S. 1,444,341. Feb. 6, 1923.

A blend comprising a gasoline substitute has the following composition: kerosene 47.9 percent, gasoline (benzene) 48 percent, ether 3.5 percent, and nitre 0.6 percent.

HENNEBERG, G., and CHARPENTIER, M. H. (1324)
IMPROVEMENTS IN THE MANUFACTURE OF FUEL ALCOHOL AND IN APPARATUS THEREFOR. Brit. Specification 213,526. Sept. 21, 1923. (Patent not accepted).

A fuel for lighting, heating, or power purposes comprises acetylene dissolved in acetone and dehydrated alcohol, with or without ether and ammonia.

HOSTETTLER, FRITZ (TO JACOB DOLFEN) (1325)
IMPROVED PROCESS FOR THE MANUFACTURE OF LIQUID FUELS FOR USE IN INTERNAL COMBUSTION ENGINES AND OTHER PURPOSES. Brit. 174,360. Apr. 20, 1923.

A process for the manufacture of liquid fuel consisting of tar distillate, petroleum oil distillate, and methanol is described.

——— (TO JACOB DOLFEN) (1326)
IMPROVED PROCESS FOR THE MANUFACTURE OF LIQUID FUELS FOR USE IN INTERNAL COMBUSTION ENGINES AND OTHER PURPOSES. Brit. 176,329. Apr. 20, 1923.

A process for the manufacture of liquid fuel consisting of using aliphatic or aromatic ketones, aldehydes, and ethers or esters blended with raw petroleum distillate is claimed.

LLOMPART Y VALDÉS, MIGUEL, and BACALLAO Y VILLAR, VICENTE (1327)
LIQUID FUEL. U. S. 1,448,245. Mar. 13, 1923.

Liquid fuel for internal-combustion engines consists of 99 percent ethanol blended with 0.75 percent nitrobenzene and 0.25 percent nitrous ether.

LORIETTE, PIERRE (1328)
PROCESS FOR THE PRODUCTION OF LIQUID FUEL MIXTURES CONTAINING ALCOHOL. Brit. 188,336. Nov. 29, 1923.

A homogeneous mixture of alcohol and benzene, gasoline or other hydrocarbon fuel is obtained by dehydrating alcohol with calcium or calcium carbide.

MOURA, ACCIOLY, F. DE (1329)
PROCESS AND APPARATUS FOR THE MANUFACTURE OF NONPOTABLE ALCOHOLIC LIQUID. U. S. 1,453,374. May 1, 1923; Brit. 187,640. Apr. 20, 1921.

A process for the preparation of a nonpotable alcoholic liquid from the juices of sugarcane, oranges, manioc, etc. is described. Turpentine, ether, naphtha, etc. may be added.

MURPHY, J. J. (1330)
MOTOR FUEL. U. S. 1,471,566. Oct. 23, 1923.

Heavy petroleum derivative such as coal oil or kerosene is mixed with alcohol (95 percent), benzene, and ether. For example: coal oil 40 parts, benzene 40 parts, ether 5 parts, and ethanol 20 parts. Other specific mixtures are described.

RIEDEL, J. D. AKT-GES. (1331)
FUEL FOR INTERNAL COMBUSTION ENGINES. Brit. 184,785. May 17, 1923.

A blend to be used in internal-combustion engines consists of hydronaphthalene, aliphatic hydrocarbon boiling below 100° C., and ethanol with the admixture of small amounts of ether or amyl alcohol as blending agents. This mixture remains homogeneous at —10°. An example is: tetrahydronaphthalene 30 parts, light petroleum 35 parts, ethanol 30 parts, and amyl alcohol 5 parts.

ROHRS, F. W. (1332)
MOTOR FUEL MIXTURE. U. S. 1,460,767. July 3, 1923.

A fuel containing 1 to 3 parts of acetone, 25 to 35 parts of a mixture of gasoline and kerosene, and 50 to 80 parts of benzene is described.

SCHREIBER, W. T. (TO U. S. INDUSTRIAL ALCOHOL CO.) (1333)
MOTOR FUEL. U. S. 1,469,053. Sept. 25, 1923.

A fuel for airplanes, consisting of various proportions of the following components: alcohol, ketone, ether, kerosene, and gasoline is claimed. For example: acetone or higher ketone 35 parts by volume, ethanol 25 parts, ether 5 parts, kerosene 17½ parts, and gasoline 17½ parts.

——— (TO U. S. INDUSTRIAL ALCOHOL CO.) (1334)
MOTOR FUEL. U. S. 1,474,983. Nov. 20, 1923.

A fuel adapted for use in airplanes contains various proportions of petroleum distillate, an alcohol, benzene, and a higher ketone. The following is an example: 25 parts of ethanol, 35 parts of benzene, 5 parts of diethyl ketone, 17½ parts of kerosene, and 17½ parts of gasoline.

SOCIÉTÉ RICARD, ALLENET ET CIE. (1335)
DEHYDRATION OF ALCOHOL. Ger. 489,919. Feb. 22, 1923.

Alcohol for propelling fuel is dehydrated by treating it with salts such as anhydrous K_2CO_3 in the presence of hydrocarbons. Homogenizing agents, such as butanol or cyclohexanol, may be present in small quantities.

——— DISTILLERIES DES DEUX-SÈVRES (1336)
PROCESS FOR RENDERING SOLUBLE LIQUID FUEL MIXTURE OF PETROL AND ALCOHOL. Brit. 191,000. June 14, 1923.

Normal butanol is used as a blending agent for gasoline and ethanol (95° Gay-Lussac). The quantity used varies according to the composition of the mixture and the temperature at which it is to be used. At 0° C. a homogeneous mixture is produced by blending 4.75 volumes of *n*-butanol with 100 volumes of gasoline and adding this mixture to equal volumes of ethanol (95 percent).

1924

ANNARATONE, DUILIO (1337)
A PROCESS OF PREPARING LIQUID FUELS FOR INTERNAL COMBUSTION ENGINES. Brit. 217,873. Oct. 16, 1924.

Fuel ingredients are mixed to obtain a graded boiling-point range. A fuel for automobiles comprises ether 20 parts, alcohol or benzene 25 parts, heptane 14 parts, toluene 8 parts, and small proportions of fusel oil, xylol, hydrogenated cresol, and decahydro naphthalene.

BACKHAUS, A. A. (TO U. S. INDUSTRIAL ALCOHOL CO.) (1338)
FUEL FOR MOTORS. U. S. 1,516,907. Nov. 25, 1924.

Equal parts by volume of anhydrous methanol and gasoline (or naphtha) make a suitable fuel for airplanes and other internal combustion engines. The percentage of alcohol may vary from 40 to 70, as desired.

——— (TO U. S. INDUSTRIAL ALCOHOL CO.) (1339)
AIRPLANE MOTOR FUEL. Can. 239,779. Apr. 29, 1924.

A fuel is claimed containing gasoline, absolute ethanol, and benzene.

BLACK, JOSEPH (1340)
PROCESS OF MANUFACTURING LIQUID FUEL. U. S. 1,480,368. Jan. 8, 1924.

A process is described for manufacturing motor fuel by dry steam distillation of approximately equal volumes of crude petroleum and raw coal oil and containing 5 percent of a mixture of acetone, benzene, ethanol, and the water obtained from the dry steam.

CHARBONNEAUX, E. A. (1341)
FUEL AND PROCESS OF PRODUCTION. U. S. 1,480,372. Jan. 8, 1924.

Crude petroleum oil is nitrated and the product mixed with 100 parts its volume of alcohol. Ether also may be added.

HENNEBERG, G. and CHARPENTIER, M. H. (1342)
IMPROVEMENTS IN THE MANUFACTURE OF FUEL ALCOHOL AND IN APPARATUS THEREFOR. Brit. Specification 217,882. Mar. 20, 1924. (Patent not accepted).

This is a modification of the invention described in Specification 213,526, Sept. 21, 1923 (see No. 1324) for dehydrating ethanol. The operation is carried out in a series of small dehydrators provided with new means for separating the lime.

——— and CHARPENTIER, M. H. (1343)
IMPROVEMENTS IN THE MANUFACTURE OF FUEL ALCOHOL AND IN APPARATUS THEREFOR. Brit. Specification 226,143. Mar. 20, 1924. (Patent not accepted).

Dehydrated alcohol which may contain up to 3 percent water is mixed with 7 percent acetone and 7 percent of ether. Combustible gases such as acetylene, ethylene, etc. may be dissolved in the fuel.

KEYES, D. B. (TO U. S. INDUSTRIAL ALCOHOL CO.) (1344)
FUEL COMPOSITION. U. S. 1,496,810. June 10, 1924.

A fuel adapted for use in internal-combustion engines is formed by mixing, for example, 50 parts ethanol, 40 parts light petroleum distillate and 10 parts normal butylene or similar hydrocarbon. These proportions may vary and other alcohols, such as methanol, propanol, butanol, and pentanol can be used.

LICHTENTHAELER, F. E. (1345)
MOTOR FUEL. U. S. 1,488,605. Apr. 1, 1924.

An apparatus and method for preparing a blend of alcohol and ether are described. Ether is continuously generated from alcohol and the condensed vapors are mixed with additional alcohol vapors to produce the desired mixture. This method eliminates the necessity of handling and storing liquid ether as such.

LORIETTE, PIERRE (1346)
PROCESS OF DEHYDRATING ALCOHOL. Brit. 189,453. Feb. 7, 1924.

Calcium carbide may be used in the dehydration of alcohol, especially if the dehydrated alcohol is intended for use in the preparation of fuel mixtures. The resultant mixture of alcohol and acetylene is suitable for blending with gasoline, etc.

MORGAN, B. H. (1347)
A FUEL FOR INTERNAL COMBUSTION ENGINES. Brit. 219,903. Aug. 7, 1924.

A blend of denatured alcohol 60-70 parts, ether 40-30 parts, and a small amount of castor oil is mixed with a petroleum fraction heavier than kerosene.

——— (1348)
FUEL FOR INTERNAL COMBUSTION ENGINES. Brit. 225,685. Dec. 11, 1924.

Fifty parts of gasoline is blended with 50 parts of a mixture of alcohol and ether. Up to 5 percent castor oil may be added as a lubricant and corrosion preventive.

RECORDS, E. H. (1349)
LIQUID FUEL. U. S. 1,491,275. Apr. 22, 1924.

An alcoholic fuel for internal-combustion engine consists of 81.5 percent alcohol, 10 percent benzene, 5 percent ethyl ether, and 3.5 percent naphthalene.

SCARAVELLI, GUISEPPE (1350)
IMPROVED MOTOR SPIRIT. Brit. 206,147. Aug. 28, 1924.

Ether or amyl acetate or acetone is mixed with methylated spirit and kerosene, or a mixture of methylated spirit and kerosene is treated with lime and sulfuric acid. Five to 10 percent of castor oil may be added to lubricate the engine.

SOCIÉTÉ RICARD, ALLENET ET CIE. (1351)
LIQUID FUEL. Brit. 206,516. Oct. 9, 1924.

Mixtures of alcohol and a liquid hydrocarbon are dehydrated and made stable by treating them with a dehydrating agent practically insoluble in either liquid. A stabilizer such as ether, benzene, or higher alcohol can be added.

WHITE, D. O. (1352)
MOTOR FUEL. U. S. 1,501,383. July 15, 1924.

A motor fuel adapted for use in gasoline engines consists of ethanol 98 percent, ether 1.75 percent, ammonium chloride 0.125 percent, and phenol 0.125 percent.

1925

BACKHAUS, A. A. (TO U. S. INDUSTRIAL ALCOHOL CO.) (1353)
AEROPLANE MOTOR FUEL. U. S. 1,527,594. Feb. 24, 1925.

Blends of ethanol 40 to 60 percent, benzene 25 to 35 percent, and gasoline or naphtha 30 to 50 percent by volume are claimed to be especially adapted for use in airplanes. Alcohol should be 98-percent or absolute alcohol and gasoline and naphtha should have a specific gravity of from 52° to 60° Bé.

BADISCHE ANILIN SODA-FABRIK (1354)
LIQUID FUEL FOR INTERNAL-COMBUSTION ENGINES. Brit. 215,776. May 28, 1925.

Methanol or a liquid consisting principally of methanol obtained through the reduction of oxides of carbon by means of hydrogen or hydrocarbons is an excellent motor fuel. Methanol prepared in this way always contains traces of iron carbonyl which however is neither beneficial nor harmful.

——— (1355)
IMPROVEMENTS IN THE MANUFACTURE AND PRODUCTION OF LIQUID FUELS. Brit. 226,731. Jan. 1, 1925.

Iron carbonyl 0.1 to 1.0 percent is used with alcohol, gasoline, or their blends to prevent knocking.

COSMO, JOSEPH DE (1356)
IMPROVEMENTS IN FUELS FOR EXPLOSION MOTORS OF ALL KINDS. Brit. 205,070. Mar. 27, 1925.

A liquid for internal-combustion engines consists of ethanol 500, naphthalene 335, nitronaphthalene 15, "crystallizable gasoline" 100, ether 10, and cresol 40 pounds.

HUTCHINSON, H. B., and DISTILLERS, CO. LTD. (1357)
IMPROVED PROCESS FOR THE PRODUCTION OF LIQUID FUEL SUITABLE FOR INTERNAL COMBUSTION ENGINES. Brit. 232,276. Apr. 17, 1925.

A stable mixture of alcohol and gasoline is obtained by distilling the mixture until the greater portion of water has passed over, allowing the distillate to stand and mixing the layer consisting mainly of alcohol and hydrocarbon with the mixture of alcohol and hydrocarbon remaining in the still.

LEONORI, OVIDIO (1358)
IMPROVEMENTS IN OR RELATING TO FUELS FOR INTERNAL COMBUSTION ENGINES AND PROCESSES FOR MANUFACTURING SAME. Brit. 245,460. Dec. 31, 1925.

A process is described for preparing anhydrous alcohol by the addition of calcium chloride and for purifying alcohol by addition of ammonia to neutralize all the acid substances present. Alcohol (methanol, ethanol, etc.) thus dried and purified can be blended with gasoline, benzene, and naphthalene to be used in internal-combustion engines. The amount of constituents may vary: alcohol from 50 to 95 percent, benzene 0 to 30 percent by weight, gasoline 0 to 40 percent, and naphthalene 0 to 10 percent.

McKEE, R. H. (1359)
MOTOR FUEL. Can. 246,362. Jan. 27, 1925; U. S. 1,494,613. May 20, 1924.

The gasolinelike fraction of shale oil containing nitrogen bases is used as a motor fuel ingredient with benzene, toluene, alcohol, and ether.

MEYER, E. G. E. (1360)
IMPROVEMENTS IN AND RELATING TO FUELS FOR USE IN INTERNAL COMBUSTION ENGINES AND FOR OTHER PURPOSES. Brit. 262,363. June 12, 1925.

Complex fuel mixtures are described which may contain mineral oil or high-boiling coal-tar distillates, diethyl ether, ammonia, naphthalene, sulfur, and methanol.

ROBOISIÈRE, J. F. P. DE LA (1361)
MOTOR FUEL. U. S. 1,557,257. Oct. 13, 1925.

A blend of a hydrocarbon (gasoline, benzene, hydrogenated naphthols, and naphthenes), aniline, and ether is claimed to possess antiknock characteristics comparable to a 50 percent benzene-50 percent gasoline mixture.

SARIGNY, RENÉ, DE (1362)
AN IMPROVED ALCOHOL FUEL. Brit. 238,818. Aug. 27, 1925.

Alcohol, preferably 68° to 74° "overproof," is mixed with 1 percent tetrahydo- or decahydro naphthalene to form a fuel suitable for heating, lighting, or power purposes.

TERRISSE, HENRI (TO PRODOR FABRIQUE DE PRODUITS ORGANIQUES S. A.) (1363)
FUEL FOR INTERNAL-COMBUSTION ENGINES. U. S. 1,556,047. Oct. 6, 1925.

Kerosene or other hydrocarbon heavier than ordinary gasoline is mixed with ethanol and acetaldehyde. For example, a blend of 20 percent kerosene, 60 percent heavy petrol, and 20 percent of a mixture of 2 parts ethanol and 1 part acetaldehyde gives a satisfactory motor fuel.

1926

CANADIAN ELECTRO PRODUCTS CO. (1364)
A NEW OR IMPROVED COMPOSITION OF MATTER FOR USE AS A FUEL. Brit. 249,348. Mar. 25, 1926.

A motor fuel consists of gasoline or other hydrocarbon fuel mixed with acetaldehyde or paraldehyde and an unsaturated hydrocarbon such as acetylene.

CARROLL, R. A., and ELLIOTT, H. L. (TO JAMES V. ELLIOTT) (1365)
MOTOR FUEL. U. S. 1,587,899. June 8, 1926.

The preparation of blended motor fuel consisting of relatively large amounts of aromatic hydrocarbons free from sulfur, petroleum distillates, a lower monohydric alcohol, a readily volatile terpene compound, naphthalene, and water is described.

DIETZ, F. L. (1366)
FUEL OIL. U. S. 1,573,307. Feb. 16, 1926.

A fuel for internal-combustion engines consists of low-temperature tar and a mixture of ethanol and benzene or gasoline.

ESSELEN, G. J., JR. (TO UNITED FRUIT CO.) (1367)
LIQUID FUEL. U. S. 1,591,665. July 6, 1926.

A fuel for internal-combustion engines comprises large amounts of ethanol and ether mixed with lubricating oil and with small amounts of a higher fatty acid or its salt. For example: 60 to 80 parts by volume of ethanol, 40 to 20 parts of ether, 2½ parts of lubricating oil, and 1/12 to ¼ part of ammonium stearate is claimed to be a good fuel.

FIRMA BENZOL-VERBRAND IN BOCHUM (1368)
APPARATUS FOR THE REGULATION OF COMBUSTION IN CARBURETOR ENGINES BY MEANS OF THROTTLE DEVICE THROUGH THE ADDITION OF FLUIDS. Ger. 426,006. Mar. 5, 1926.

A small pump is described which will inject water, alcohol, or similar fluids either into the venturi or direct into the cylinder, when the engine is operating under full or nearly full load. A regulating device is suggested and sketch for the complete injector is shown.

FLORES, E. M. (1369)
LIQUID FUELS AND PROCESS OF MANUFACTURING THE SAME. Brit. 249,577. Mar. 29, 1926.

A mixture of fermented musts, 100 parts by volume, containing 10 parts of alcohol, 1 part of benzene, and 0.5 parts of methanol and acetone is allowed to stand for 24 hours in a closed vessel and then is distilled to obtain the fuel. This fuel can be enriched by treatment with carbureting substances such as acetylene or crude petroleum fractions distilling from 150° to 220° C.

HAMMOND, GRANT (1370)
FUEL FOR INTERNAL COMBUSTION ENGINES. U. S. 1,570,059 and 1,570,060. Jan. 19, 1926.

A fuel is claimed consisting of kerosene and gasoline or other hydrocarbon to which small quantities of acetone, glycerol, and butanol are added. A specified mixture comprises kerosene 40 to 50 parts, gasoline 50 to 60 parts, butanol 1 to 4 parts, and benzene 3 to 12 parts.

HUDSON, C. M. (1371)
COMPOSITE MOTOR FUEL. U. S. 1,607,891. Nov. 23, 1926.

A mixture for internal-combustion engines, consisting of ethanol, acetone, a small quantity of kerosene, and aniline is claimed. Aniline is used to neutralize acidic products of combustion. The relative proportions of constituents vary according to conditions of climate. In the tropics 60 percent ethanol, 37 percent acetone, 2 perent kerosene and 1 percent aniline are used. In colder climates a higher percentage of acetone may be used.

JOHANSEN, ERNEST (TO NEW ENGLAND OIL REFINING CO.) (1372)
MOTOR FUEL AND ITS MANUFACTURE. U. S. 1,601,215. Sept. 28, 1926.

A motor fuel is described consisting of a product formed by the reaction of lead oxide and "sour distillates" obtained in the distillation of crude petroleum (method of preparation specified in U. S. Pat. 1,601,216). The new motor fuel can be used either pure or blended with gasoline, benzene, alcohol, or ether.

JOHNS, C. O. (TO STANDARD DEVELOPMENT CO.) (1373)
LIQUID FUEL. Can. 262,023. June 22, 1926.

A motor fuel consists of a mixture of 90 to 97 percent gasoline and 3 to 10 percent alcohol. Lead tetraethyl (½ cc. per gallon) is added to the mixture.

MCKEE, R. H. (1374)
MOTOR FUEL. U. S. 1,570,161. Jan. 19, 1926.

A stable blend is formed from the gasolinelike fraction of shale oil, benzene, alcohol, and 2 to 8 percent ethylene.

MACKILLIGIN, A. P., and GARLAND, F. (1375)
IMPROVEMENTS IN OR RELATING TO LIQUID FUELS. Brit. 251,157. Apr. 29, 1926.

Ethanol-ether type of fuel used in ordinary gasoline engines is described. Ethanol is obtained from Nipah palm and is denatured by caoutchoucine (a distillate from crude plantation rubber). A small amount of pyridine is used to neutralize acidic products of combustion. A suitable blend consists of: ethanol 55 parts by volume, ether 43 parts, pyridine 0.5 part, caoutchoucine 0.5 part, and kerosene 1 part.

MIDGLEY, THOMAS, JR. (TO GENERAL MOTORS CORPORATION) (1376)
FUEL. U. S. 1,578,201. Mar. 23, 1926.

Fifty percent of commercial ethanol (95 percent) is mixed with an equal quantity of cracked gasoline. Such fuel contains substantially 42 percent of saturated paraffin compounds, 8 percent of olefines, and 50 percent of 95-percent ethanol. It produces homogeneous fuel for internal-combustion engines without employing blending agents.

RIEDEL, J. D. AKT.-GES. (1377)
MANUFACTURE OF A FUEL FOR INTERNAL COMBUSTION ENGINES. Brit. 246,182. Oct. 7, 1926.

Tetrahydronaphthalene with or without hydrogen is heated to above 400° C. in the presence of aluminum oxide and the product is distilled to obtain the fraction boiling below 200°. Alcohol, gasoline, or other fuel may be added.

SARIGNY, RENÉ, DE (1378)
IMPROVEMENTS RELATING TO ALCOHOL FUELS. Brit. 250,019. Apr. 8, 1926.

A suitable fuel for internal-combustion engines consists of: 50 percent ethanol, 34 percent gasoline, 12 percent benzene, 3 percent ether, and 1 percent denaturant (a mixture of pyridine and mineral oil).

SOCIÉTÉ DES BREVETS ÉTRANGERS LEFRANC ET CIE. (1379)
LIQUID FUELS FOR INTERNAL COMBUSTION ENGINES. Brit. Specification 268,735. Apr. 3, 1926. (Patent not accepted).

Complex ketones or ketone mixtures known commercially as "ketol" and obtained by the dry distillation of calcium butyrate are blended with 95-percent ethanol or gasoline. A stable blend is obtained with 50 percent ethanol (95 to 96 percent) and 50 percent gasoline (d = 0.75) mixed with 5 percent of complex ketones distilling between 100° and 120° C.

1927

BENZOL-VERBAND GESELLSCHAFT (1380)
IMPROVEMENTS IN AND RELATING TO ALCOHOL AND ITS HOMOLOGUES AND MIXTURES CONTAINING THE SAME. Brit. 257,881. Jan. 27, 1927.

To prevent corrosion of the metal of carburetors, storage tanks, etc., 0.2 to 0.3 percent of sodium benzoate is added to ethanol-benzene blends or other alcohol-hydrocarbon fuels.

CHANDLER, E. F. (1381)
FUEL FOR AUTOMOTORS. U. S. 1,622,572. Mar. 29, 1927.

The patent covers the use of blends consisting of gasoline, kerosene, ketones, alcohols, and water as fuels for internal-combustion engines.

DIETZ, F. L. (1382)
FUEL OIL. U. S. 1,620,635. Mar. 15, 1927.

A fuel suitable for internal-combustion engines consists of a mixture of low-temperature tar 35 parts, ethanol 35 parts, and naphthalene-tetrahydride 30 parts.

HERZOG-IN ALBON, H., and HÜSSY-BÜHLER, W. (1383)
PROCESS OF PREPARING MOTOR FUEL FOR INTERNAL COMBUSTION ENGINES. Swiss 127,535. Mar. 8, 1927.

Motor fuel consists of petroleum and alcohol in the proportion 9:1 which is passed over a catalyzer such as fused lead or unslaked lime.

I. G. FARBENINDUSTRIE A.-G. (1384)
IMPROVEMENTS IN THE MANUFACTURE AND PRODUCTION OF MOTOR FUEL. Brit. 251,969. Mar. 3, 1927.

A fuel which reduces knocking properties of gasoline and has a high calorific value consists of gasoline with a small admixture of methanol, preferably anhydrous. For example, 96 percent gasoline is mixed with 4 percent methanol.

OSTWALD, WALTER (1385)
COUNTERACTING CORROSIVE EFFECTS OF ALCOHOL AND ITS MIXTURES ON METALS. Can. 268,556. Feb. 22, 1927; U. S. 1,644,267. Oct. 4, 1927.

A small proportion of sodium benzoate or other suitable benzoate is added to prevent corrosion of metals such as zinc, iron, and copper with which alcohol or mixtures containing alcohol may come into contact.

RIBOISIÈRE, J. F. P. DE LA (1386)
IMPROVEMENTS IN AND RELATING TO MOTOR FUELS. Brit. 257,613. May 19, 1927.

A blend is claimed which has antiknock characteristics comparable to a 50 percent benzene and 50 percent gasoline mixture. It is obtained by adding to a hydrocarbon a small proportion of aromatic amine, such as aniline, and a small proportion of ether, such as diethyl ether, or ketone.

SCHREIBER, W. T. (TO U. S. INDUSTRIAL ALCOHOL CO.) (1387)
A METHOD OF RETARDING OR PREVENTING THE CORROSION OF METHAL CONTAINERS CONTAINING ALCOHOL. U. S. 1,613,808. Jan. 11, 1927; Brit. 269,135. Feb. 9, 1928.

Soaps such as sodium or potassium salts of palmitic, steeric, or oleic acids or of rosin will retard or prevent the corrosion of tin plate, terne plate, or iron containers by ethanol containing impurities or denaturants. The soaps are added in amounts of 0.01 to 0.25 gm. per 100 cc. of liquid, This method may also be used with other alcohols.

1928

DUMANOIS, PAUL (1388)

METHOD FOR CARBURATION OF METHANOL. Fr. 633,443. Jan. 28, 1928.

Methanol is blended with higher alcohols and aromatic and other hydrocarbons to produce a fuel for internal-combustion engines which has high calorific value and low detonation. A satisfactory blend is composed of 70 percent methanol, 15 percent ethanol, and 15 percent benzene by volume.

FLORES, E. M. (1389)

LIQUID FUEL. U. S. 1,657,961. Jan. 31, 1928.

A method is described for the preparation of fuel for internal-combustion engines from a mash (plant waste) containing about 10 percent of fermented distillate products. This is mixed with formaldehyde and mineral oil, which serve as carbureting materials, and to this mixture methanol containing 25 percent acetone is added in such quantity as to produce a distillate having a density of 0.7801 and viscosity of 1.08 Eugler.

——— (1390)

METHOD OF PREPARATION OF COMBUSTIBLE LIQUID. Fr. 646,775. Nov. 15, 1928.

The preparation of a liquid fuel by means of distillation of products of alcoholic fermentation (regardless of source) along with fuels as crude gasoline, tetralin, synthol, ketol, etc., is described.

I. G. FARBENINDUSTRIE, A. G. (1391)

IMPROVEMENTS IN THE MANUFACTURE AND PRODUCTION OF MOTOR FUELS. Brit. 278,341. Apr. 2, 1928.

This is an improvement of the invention claimed in Brit. Pat. 259,944, Oct. 1925. Low aliphatic alcohol is blended with products of destructive hydrogenation of coals, tars, mineral oils, etc. The blend can be used with or without gasoline.

KIRSCHNER, JOHANN (1392)

PROCESS OF AND APPARATUS FOR THE PRODUCTION OF HOMOGENEOUS MIXTURES OF ALIPHATIC MINERAL OILS OR DISTILLATES AND ALIPHATIC ALCOHOLS. Brit. 277,357. Dec. 10, 1928.

A method and apparatus are described for blending methanol or ethanol containing water with gasoline by means of nascent hydrogen at raised temperature. Homogeneous mixtures obtained in this way can be used as motor fuels and in textile and leather industries.

LEONORI, OVIDIO (1393)

A PROCESS OF DEHYDRATING ALCOHOL TO BE USED IN PREPARATION OF FUELS. Fr. 636,551. Apr. 12, 1928.

Alcohol for use as a fuel is dehydrated by treating it with a mixture of carbides of calcium, barium, manganese, etc., which are decomposed by water. Hydride of calcium or aluminum may also be added and the water may be first saturated with ammonia.

MELAMID, MICHAEL (1394)

METHOD TO INCREASE THE SOLUBILITY OF ALCOHOL IN HYDROCARBONS. Fr. 648,142. Dec. 5, 1928.

Esters of naphthenic acid such as amyl, cresylic, or cyclohexanolic esters will increase the solubility of alcohol in hydrocarbons for motor fuel. These esters can serve also as emulsifying agents for oils, fats, soaps, etc., and can be applied in many industries.

RECORDS, E. H. (1395)

LIQUID FUEL. U. S. 1,684,685 and 1,684,686. Sept. 18, 1928.

A fuel for use in internal-combustion engines is described which consists of alcohol 72 percent, benzene 18 percent, ether 5 percent, naphthol 2.5 percent, ozone or hydrogen peroxide 1.5 percent, and sodium hydroxide 1 percent.

RICARD, E. and GUINOT, H. (1396)
DEHYDRATING ALCOHOL FOR MOTOR FUELS. U. S. 1,659,958. Feb. 21, 1928.

Alcohol is mixed with liquid hydrocarbon material such as gasoline and the mixture is subjected to action of a dehydrating agent, such as K_2CO_3, $CuSO_4$, or $MgCl_2$.

SOCIÉTÉ DES BREVETS ÉTRANGERS LEFRANC ET CIE. (1397)
FUELS HAVING KETONE BASE. Fr. 637,993. May 12, 1928.

Complex ketones obtained from the dry distillation of calcium butyrate are mixed in equal proportions with methanol or benzene. The ketones are preferably those which distill between 60° and 140° C.

STEIGER, WALTER (1398)
MOTOR FUEL. Ger. 505,929. Apr. 8, 1928.

Vegetable oil (olive or castor oil) is saturated with acetylene and sprayed into alcohol. Crude petroleum may be added.

1929

BURGART, R. and DISERENS, L. (1399)
LIQUID FUEL. Fr. 700,802. Nov. 4, 1929.

Use of alcohols, ketones, and esters in petroleum fuels and stabilizers to prevent separation are described.

FACCIONI, GUERRINO (1400)
ALCOHOL FUEL FOR INTERNAL COMBUSTION ENGINES. Swiss 134,952. Aug. 31, 1929.

An alcohol blend intended to be used in internal-combustion engines without special carburetor adjustments has the following composition: ethanol (94° to 95°) 100 liters, castor oil 5 liters, ether 5 liters, turpentine 2 liters, and phenol 200 gm.

HAMMOND, GRANT (TO FUEL DEVELOPMENT CORP.) (1401)
FUEL AND PROCESS OF MAKING THE SAME. U. S. 1,699,355. Jan. 15, 1929.

Fuel suitable for automobiles is prepared by mixing gasoline with about 5 percent of commercial ethanol (185-195° proof) and heating the mixture in a closed retort to produce a pressure of about 25 p.s.i., then cooling to normal temperature and pressure, and decanting the mixture of alcohol and gasoline.

JAMES, J. H. (1402)
COMPOSITION OF MATTER AND METHOD OF MAKING THE SAME. U. S. 1,716,272. June 4, 1929.

A catalytically prepared fuel called oxidized kerosene is blended with ethanol, benzene, and the like.

STEIGER, WALTER (1403)
FUEL. Swiss 135,751 and 135,752. Dec. 16, 1929.

Turpentine or benzene is saturated with acetylene and added to three to four times as much alcohol containing up to 20 percent water.

TERASHI, HEIICHI (1404)
METHOD FOR PREPARING ALCOHOL FUEL. Fr. 672,259. Dec. 26, 1929.

A method of preparing alcohol fuel for internal-combustion engines containing acetylene is described. To this fuel benzene, toluene, turpentine, etc., may be added. It is claimed that a blend of this kind has a high calorific value, is easily ignitable, and is free of corrosive effects.

1930

BOURIE, IGNACE (1405)
INTERNAL-COMBUSTION-ENGINE FUEL. U. S. 1,752,724. Apr. 1, 1930.

A small amount of alcohol (1 oz.) added to 10 to 15 gallons of gasoline is said to give marked increase in engine power.

Compagnia Italiana Sviluppo Invenzioni Societá Anon. and Gallarati, V. (1406)
motor fuel. Brit. 358,484. July 5, 1930.

An explosive such as nitroglycerine, nitroguanidine, nitrocellulose, etc., is emulsified in a vegetable oil and the emulsion is dissolved in alcohol or other solvent or mixture of solvents.

Gaus, Wilhelm (to I. G. Farbenindustrie A. G.) (1407)
motor fuel. U. S. 1,775,674. Sept. 16, 1930.

To reduce knocking produced by gasoline, a blended fuel is prepared consisting of gasoline and not more than 12 percent of crude methanol containing isobutyl alcohol or other higher alcohols which serve as blending agents.

Gerlach, R. M. (1408)
method for producing homogeneous motor fuels. Ger. 491,514. Feb. 10, 1930.

One hundred parts gasoline by volume, 1.5 parts naphthenic acid and 100 parts 95-percent alcohol give a homogeneous mixture.

Gutehoffnungshütte Oberhausen A.-G. (1409)
a process for treating vegetable oils. Fr. 682,850. June 3, 1930.

A process for the catalytic hydrogenation of soybean or other vegetable oils is described. The product is suitable for motor fuel.

Hudson, C. M. (1410)
motr fuel mixture. U. S. 1,775,461. Sept. 9, 1930.

Alcohol, castor oil, ether, kerosene, and aniline oil are used in various proportions.

Johns, C. O. (to Standard Oil Development Co.) (1411)
motor fuel U. S. 1,757,837 and U. S. 1,757,838. May 6, 1930.

A motor fuel is claimed which comprises petroleum hydrocarbons, aromatics of the type of benzene, alcohol, and a metallo-alkyl antiknock agent.

Mann, M. D., Jr. (1412)
stable mixture of petroleum hydrocarbons and alcohols. U. S. 1,774,180. Aug. 26, 1930.

Use of a secondary alcohol such as secondary butanol is recommended as a blending agent for fuels consisting of gasoline and primary alcohols (such as 95-percent ethanol).

Papprill, R. S. (1413)
motor fuel. Australian 29,444. Oct. 7, 1930.

Equal parts of alcohol, benzene, and spirit distilled from shale oil are mixed with toluene.

Société H/H Oil Co. Akts. (1414)
method of improving hydrocarbons as fuels for internal combustion engines. Fr. 691,430. Oct. 21, 1930.

Aromatic hydrocarbons are treated first with nitric acid and then with sulfuric acid. The excess of acid is removed and the resulting products are mixed with petroleum hydrocarbons; the whole mixture is distilled and saturated with oxygen. Part of the petroleum hydrocarbons can be replaced by alcohol. The water contained in the alcohol is emulsified with salts favorable to combustion, such as ammonium nitrate and a fatty acid.

1931

Dominik, W., and Przedpełski, B. (1415)
liquid fuel for internal combustion engines composed of gasoline and alcohol. Polish 14,696. Nov. 28, 1931.

The fuel does not contain more than 0.2 percent of water and has a vapor pressure of from 80 to 160 mm. Hg at 0° C. This is accomplished through addition of gasoline or ether. Separation is prevented through addition of benzene or butanol.

FLORES, E. M. (1416)

PROCESS FOR MANUFACTURING LIQUID FUEL FOR MOTORS, ETC. Ger. 539,355. Nov. 27, 1931.

To fermented mash or must is added light hydrocarbon (gasoline, benzene, etc.) to the extent of 5 to 10 percent of the alcohol content. On simple distillation a homogeneous mixture of hydrocarbon and alcohol containing 5 to 8 percent water comes over first. This may be dehydrated by means of chemical agents.

I. G. FARBENINDUSTRIE A. G. (1417)

LIQUID FUEL. Fr. 729,190. Jan. 4, 1931.

The fuel is composed of a mixture of a product obtained by hydrogenation under pressure having a relatively high content of fractions boiling above 200° C., benzene or products having a high content of aromatic hydrocarbons, and one or more alcohols such that at least 90 percent of the mixture boils below 190°. An example contains hydrogenation product 70 parts, methanol 10 parts, benzene 10 parts, and ethanol 10 parts.

MEYER, E. G. E. (1418)

MOTOR SPIRIT. Brit. 369,731. Mar. 3, 1931.

A blend is described which comprises liquid fuel hydrocarbon mixed with an aldehyde and volatile base such as ammonia, ether, ethanol, etc.

SINZABURO, H., and HAYASI, S. (1419)

ALCOHOL LIQUID FUEL. Jap. 90,945. Apr. 7, 1931.

Methanol or ethanol (100 parts by volume) is blended with formaldehyde (30 to 40 parts) and benzene (100 parts). The water content of the mixture is kept at about 16 percent.

SOCIÉTÉ POUR L'EXPLOITATION DES BREVETS D'INVENTION (S.E.B.I.) (1420)

LIQUID FUEL. Fr. 719,708. July 7, 1931.

Nitro, azo, and hydrazo derivatives and hydrogenated derivatives of naphthalene are added to methanol or ethanol. This blend can be used with or without benzene.

WHITEMAN, J. L. (1421)

IMPROVEMENTS IN OR RELATING TO LIQUID FUEL. Brit. 357,453. June 1, 1931.

A liquid fuel for internal-combustion engines is prepared by mixing crude petroleum oil, shale oil, and oils produced from the distillation of coal (tar oil, etc.) with methanol or ethanol in such proportions that tar and other normally insoluble constituents of the crude oil are dissolved. Example: Crude peroleum oil 75 parts by volume and power alcohol (90 percent) 25 parts by volume. Fuel of this type is cheap, has high calorific value, and may be safely stored.

1932

BONA, G. A. (1422)

MOTOR FUEL. Fr. 733,497. Oct. 6, 1932.

Barium carbide is used to dehydrate ethanol-gasoline blends. The barium hydroxide is filtered out.

LOVELL, W. G., and BOYD, T. A. (TO GENERAL MOTORS RESEARCH CORP.) (1423)

REMOVING CARBON DEPOSITS FROM INTERNAL-COMBUSTION ENGINE CYLINDERS. U. S. 1,825,358. Sept. 29, 1932.

A mixture consisting of 40 percent nitromethane, 30 percent benzene, and 30 percent alcohol is used to remove carbon deposits from engine cylinders.

RICHMAN, C. T. (TO WILLIAM C. KUHN and PETER J. SMITH) (1424)

MOTOR FUEL. U. S. 1,891,181. Dec. 13, 1932.

Small amount of pyroligneous acid added to ethanol reduces the specific gravity of the alcohol and makes it possible to use alcohol of 130 proof. In preparing a gallon of the fuel, approximately 2 ounces of pyroligneous acid is added to 126 ounces of ethanol and 2 ounces of camphor. A small amount of vegetable or fish oil or glycerin can be added.

RUTZEBECK, A. V. (1425)
LIQUID FUEL. Brit. 375,525. June 30, 1932.

Fuel for internal-combustion engines consists of medium-heavy hydrocarbon oils mixed with 2 to 10 percent ethanol.

STANDARD OIL COMPANY OF CALIFORNIA (1426)
MOTOR FUELS. Fr. 738,536. Dec. 27, 1932.

In order to avoid separation, strongly basic amines, particularly aliphatic, are added (dissociation constants $> 2.4 \times 10^{-5}$). Suitable substances are triethyl amine, benzyl-amine, and piperidine.

1933

APPLEBEY, M. P., and IMPERIAL CHEMICAL INDUSTRIES, LTD. (1427)
MOTOR FUELS. Brit. 403,406. Dec. 13, 1933.

A mixture of ethanol and isopropanol is prepared by catalytic hydration of ethylene and propylene. The product is added to hydrocarbon motor fuel which may be blended with methanol or other lower aliphatic alcohols.

CHAFFETTE, MAURICE (1428)
STABLE FUEL BLENDS. Fr. 755,445. Nov. 24, 1933.

Aliphatic or aromatic hydrocarbon fuels blended with methanol or ethanol are stable in the presence of small amounts of water at —10° C. if oleic acid or a pyridine base is added. The following blend was found to be stable in the presence of 0.5 percent water: gasoline 54 parts by volume, benzene 18 parts, methanol 18 parts, and "pyridine oleate" 0.9 parts.

LAUER, GERALD (1429)
MOTOR FUEL. Fr. 740,322. Jan. 24, 1933.

Thirty volumes of tar oil and 70 volumes of ethanol (92 to 96 percent is claimed to be a suitable fuel.

LIVRAGHI, ERMINIO (1430)
APPARATUS FOR MANUFACTURING MOTOR FUELS. Ger. 640,805. Feb. 5, 1933.

Apparatus for flash distillation of mixtures of hydrocarbon fractions with methanol or ethanol at 250° to 700° C. is described. Stability (with regard to phase separation) is improved by removal of heavier fractions and by cracking.

MCDERMOTT, F. A. (TO E. I. DU PONT DE NEMOURS & CO.) (1431)
PREVENTING CORRISON OF METAL BY COMMERCIAL ALCOHOL. U. S. 1,927,842. Sept. 26, 1933.

A small proportion (about 0.3 percent) of sodium or potassium carbonate, lactate, acetate, or borate is added to the alcohol.

MASSARDIER, L. G. A. (1432)
LIQUID FUELS. Fr. 745,723. May 15, 1933.

Benzene, gasoline, or alcohol can be improved as fuels by addition of naphthalene impregnated with a solution of camphor in oil of mirbane.

RIBOISIÈRE, J. F. P. DE LA (1433)
FUEL FOR INTERNAL-COMBUSTION ENGINES. Swiss 159,412. Mar. 16, 1933.

Aniline in methanol or ethanol may be added in small amounts to gasoline as an antidetonant. Other amines such as methyl pyridine and other pyridines are also suitable.

VAN SCHAACK BROS. CHEMICAL WORKS, INC. (1434)
MOTOR FUEL. U. S. 1,907,309. Feb. 5, 1933.

Fuel consists of 75 volumes of gasoline and 25 volumes of tertiary butanol.

1934

KAISLER, P., and STOCKERT, E. (1435)
LIQUID FUELS. Fr. 765,333. June 8, 1934.

A mixture of ethanol and benzene is introduced in either vapor or liquid form into a gaseous fuel such as acetylene, ethylene, or oil gas under pressure and in the presence of a catalyst (zinc or iron oxide).

MEYER, E. G. E., and BRITTOL SYNDICATE LTD. (1436)
MOTOR FUEL. Brit. 411,904. June 15, 1934.

Liquid hydrocarbon or a mixture of hydrocarbon and alcohol is blended with a small amount (0.25 to 5 percent) of ether, ketone, and ammonia.

PIER, M., and RINGER, F. (TO STANDARD-I. G. CO.) (1437)
NON-KNOCKING MOTOR FUEL. U. S. 1,979,841. Nov. 6, 1934.

An apparatus is described for producing hydrocarbon fuel similar to gasolines by catalytic reduction with hydrogen of branched aldehydes and alcohols.

RADELET, F. (1438)
FUEL FOR INTERNAL COMBUSTION ENGINES. Belg. 403,773. July 31, 1934.

Distillation product of vegetable origin containing 25 percent of cyclic hydrocarbons is mixed with ethanol and gasoline.

SOCIÉTÉ ANONYME DES CARBURANTS SPÉCIAUX (1439)
MOTOR FUELS. Fr. 761,473. Mar. 20, 1934.

Gasoline or a mixture of gasoline and alcohol containing aromatic amines is stabilized against darkening by the addition of amino alcohols.

1935

BERLINER, J. F. T. (TO E. I. DU PONT DE NEMOURS & CO.) (1440)
MOTOR FUEL. U. S. 2,010,005. Aug. 6, 1935.

A fuel suitable for racing motor boats consists of methanol 60 to 75 parts by volume mixed with higher boiling liquids, principally alcohols obtained from methanol synthesis, and with volatile hydrocarbons such as gasoline, kerosene, benzol, toluene, etc. To this blend a suitable vegetable oil, preferably castor oil, is added (15 percent of the total composition) to make the fuel self-lubricating. The following blend gave over 7 percent more power than high-test gasoline: methanol 71 percent, higher boiling byproducts of methanol synthesis 15 percent, benzol 5 percent, castor oil 9 percent.

——— and PLUMMER, R. W. (TO E. I. DU PONT DE NEMOURS & CO.) (1441)
MOTOR-FUEL BLEND. U. S. 2,012,945. Sept. 3, 1935.

A major proportion of liquid paraffin hydrocarbons, such as gasoline, is used with a minor proportion of methanol, and with borneol or isoboreol as a blending agent.

BUTI, PIERO (1442)
MOTOR FUEL. Fr. 786,336. Aug. 31, 1935.

A blend of 22 to 42 parts of hydrocarbon distillate (b.p. 70° to 100° C.) and 50 to 70 parts of ethanol is stabilized by the addition of benzene up to 8 parts. Ethanol can be replaced by methanol alone or with admixture to it of isopropanol or isobutanol.

CLASSEN, J. M. H. K. (1443)
MOTOR FUEL. Ger. 622,087. Nov. 19, 1935.

Fuels particularly suitable for Diesel engines consist of furfural blended with bunker C oil, Diesel oil, and other similar oils. Gasoline, benzene, or alcohol may also be added.

COUSTAL, R. A., and SPINDLER, H. (1444)
FUEL. Fr. 775,851. Jan. 11, 1935.

A fuel is claimed which gives better thermodynamic cycle in the internal-combustion engine than gasoline. It consists of adding diethyl peroxide or its homologues to methanol or ethanol or to the blends of these alcohols with gasoline or benzene. A suitable blend comprises: Ethanol (95°) or methanol 80 percent, and diethyl peroxide 20 percent; or ethanol (95°) 60 percent, benzene 35 percent, and diethyl peroxide 5 percent.

DARBOIS FRÈRES SOC. (1445)
METHOD OF DETERMINING ALCOHOL CONTENT IN HYDROCARBONS. Fr. 781,-095. May 8, 1935.

A method is devised to determine the alcohol content in hydrocarbon fuels by introducing a determined amount of liquid (water can be used) which is a better solvent for alcohol than for hydrocarbon. A dye is introduced which is soluble either in alcohol, in the hydrocarbon, or in the added liquid. In this way a colored and a clear layer can be easily seen and measured.

GIUNTA, A., and LETOURNEUR, P. (1446)
MOTOR FUEL. Fr. 787,590. Sept. 25, 1935.

The temperature at which phase separation of gasoline-ethanol blends, owing to the presence of water, takes place can be lowered by the addition of a substance which is soluble in all three components, such as isopropanol, ethyl ether, acetone, amines, etc.

L'ETAT FRANÇAIS REPRÉSENTÉ PAR LE MINISTERE DE LA MARINE (1447)
PROTECTING METALS AGAINST CORROSION BY ALCOHOL. Fr. 785,117. Aug. 2, 1935.

The addition of at least 0.03 percent of ethyl- or diethylamine or aqueous ethanol will inhibit corrosion of steel. This solution will not attack copper as would be the case if ammonia was added as inhibitor.

MCELROY, K. P. (TO GULF REFINING CO.) (1448)
MAKING BLENDED FUELS. U. S. 2,012,199. Aug. 20, 1935.

A method is described of making blended fuels of ethanol and gasoline with simultaneous dehydration of ethanol. A mixture of gasoline and commercial ethanol is submitted to a heating operation and distillation in such a way that the greater proportion of mixture remains undistilled. Water escapes with a small part of the gasoline, while the liquid in the still become a homogeneous mixture of ethanol and gasoline. In this way complete miscibility is obtained between ethanol and gasoline in any desired proportions.

1936

GACHET, J. R. (1449)
MOTOR FUEL. Fr. 802,914. Sept. 18, 1936.

Fuels suitable for engines are prepared when vegetable fats and oils or hydrocarbon oils are mixed with either hydrogen, acetylene, gasoline vapors, or ether.

HALE, W. J., and CHRISTENSEN, L. M. (TO CHEMICAL FOUNDATION, INC.) (1450)
METHOD OF DEHYDRATING ALCOHOL. U. S. 2,038,357. Apr. 21, 1936.

A method of preparing anhydrous alcohols (ethanol, propanol, butanol) used as constituents in gasoline blends for motor fuels is described. It consists first of dehydrating alcohol by means of alumina, thoria, clay, or other dehydrating agents at temperatures from 200° to 300° C. to form the corresponding ether which is then added to aqueous alcohol and is caused to react with the water to produce additional alcohol and render it anhydrous. It is claimed that by several successive treatments of alcohol with ether it is possible to reduce water content to less than 0.1 percent. A blend of 90 percent gasoline and 10 percent ethanol is prepared according to this invention.

1937

BERGWERKSGESELLSCHAFT, HIBERNIA A. G. (GROSS, OTTO, INVENTOR) (1451)
MOTOR FUELS. Ger. 654,470. Dec. 20, 1937.

Fuel is described consisting of dimethyl ether mixed with 5 to 45 percent methanol to suppress knocking. The heat of combustion of ether is nearly twice as great as that of methanol.

CHAVANNE, G. (1452)
FUELS FROM VEGETABLE OILS. Belg. 422,877. Aug. 31, 1937.

The catalytic formation from fatty acids and lower alcohols is described.

I. G. FARBENINDUSTRIE A. G. (1453)
IMPROVEMENTS IN OR RELATING TO MOTOR FUELS. Brit. 463,218. Mar. 24, 1937.

Corrosion of magnesium and its alloys by fuel blends containing anhydrous alcohols can be prevented by the addition of fluorides of the alkali metals or ammonium. Fluorides contained in a liquid-permeable bag must be present in excess of their solubility in the fuel.

HOWARD, F. A. (TO STANDARD OIL DEVELOPMENT CO.) (1454)
MOTOR-FUEL BLEND AND PROCESS OF MAKING THE SAME. U. S. 2,068,857. Jan. 26, 1937.

Five to thirty-five percent of ethanol or isopropanol is added to gasoline containing gum-forming constituents to improve its knock rating. A sufficient amount (about 1.5 to 10 percent is suitable) of pine oil is added to prevent separation. The addition of approximately 0.2 to 2.0 parts by volume of a viscous hydrocarbon oil will overcome the tendency of gasoline-alcohol blends to deposit gum.

LEGÉ, E. G. M. R. (1455)
FUEL OILS. Fr. 812,006. Apr. 28, 1937.

Animal or vegetable materials containing oils or fats are distilled at 250° to 600° C., preferably in the presence of a hydrocarbon oil and a catalyst, e.g., clay. The distillate is then heated to 250° to 600° with a caustic alkali or alkaline earth, whereby carboxylic acids or their esters are decarboxylated and oily products, free from saponifiable constituents and useful as motor fuel, are obtained.

PORTES, J. G., and GORGON, G. M. M. (1456)
FUEL FOR INTERNAL COMBUSTION ENGINE. Fr. 821,132. Nov. 27, 1937.

Patent covers the use of gasoline blended with benzene, acetone, ethanol, or methanol and with or without tetraethyl lead. For example, a mixture may consist of: Gasoline 34 liters, alcohol 33 liters, and acetone 33 liters.

SAVAGE, W. R. (1457)
MOTOR FUEL COMPOSITION. U.S. 2,088,000. July 27, 1937.

A motor fuel consisting of gasoline or a light volatile petroleum distillate to which is added less than 1 percent of a mixture of alcohol, acetone, and naphthalene is described.

WEBER, E. M. (1458)
METHOD FOR PREPARING FUELS. Fr. 812,649. May 13, 1937.

A preparation of fuel which will improve the combustion of hydrocarbon fuels by addition of a mixture of alcohol, aldehyde, and ether is described. If methanol is used, it should be mixed with formaldehyde, methyl ether, and nitromethane; if ethanol is used, corresponding ethyl compounds should be added.

1938

BLUDWORTH, J. E. (TO CELANESE CORP. OF AMERICA) (1459)
COMBUSTION POWER LIQUID. U. S. 2,128,910. Sept. 6, 1938.

The patent covers the use of stabilizers which will prevent separation of gasoline blended with either methanol or ethanol into two layers. Such an agent may consist of, for example, 2 to 4 parts propanol, 2 to 4 parts butanol, and 5 parts of a mixture of oxygenated hydrocarbons of non-acidic nature. Additions of 0.1 to 1 percent based on the volume of the base gasoline, are recommended.

——— (TO CAMILLE DREYFUS) (1460)
ANTI-KNOCK MOTOR FUEL. Can. 377,463. Nov. 1, 1938.

To a gasoline is added the product formed by oxygenation of lower liquid saturated hydrocarbon, e.g., butane, together with methanol in amount equal to 3 to 20 percent by volume.

CALLIS, C. C. (1461)
FUEL. U. S. 2,104,021. Jan. 4, 1938.

A specific object of the invention is to provide a fuel for aviation motors containing an aviation naphtha, ethanol, and a stabilizing agent. The water tolerance of the blend is up to 12 percent. The mixture remains homogeneous at sub-zero temperatures (—20° F.). When gasoline is used in place of naphtha, the blend can be used in other internal-combustion engines. Examples of the blends are: aviation naphtha 84 percent by volume, ethanol (95 percent) 10 percent, butyl ether or ethylene glycol 2 percent, and butanol 4 percent; gasoline 80 percent by volume, ethanol (95 percent) 9 percent, saturated aliphatic ether 2 percent, and higher aliphatic alcohol 9 percent.

CHRISTENSEN, L. M. (TO CHEMICAL FOUNDATION, INC.) (1462)
ALCOHOLIC MOTOR FUEL. U. S. 2,128,987. Sept. 6, 1938.

Ethanol or ethanol-gasoline blends are denatured by the mixture of alkyl isonitriles (from methyl to amyl isonitrile) in the amount ranging from 0.05 percent to 0.001 percent by volume. A 10 to 20 percent ethanol-gasoline blend requires only 0.0005 percent of isonitrile mixture. The boiling points of the isonitriles lie very close to that of ethanol, thus makng separation of denaturants practically impossible.

CRIMA SOCIÉTÉ ANONYME (1463)
METHOD FOR PREPARING A VOLATILE LIQUID FUEL CONTAINING ETHER FROM ETHANOL. Fr. 825,983. Mar. 18, 1938.

A fuel for internal-combustion engines is prepared by catalytic etherification at 200° C. and atmospheric pressure, of ethanol vapors containing up to 15 percent water. Part of the ethanol that remains unchanged is mixed wih ether and is used as fuel. Specific gravity is 0.718 to 0.780, b.p. 40° to 80° C. depending on the amount of ether formed. Catalysts employed are either double salts (alum) or a mixture of single salts (sulphates) mixed with small quantities of activating agent (silver ethyl sulfate). Fuel made by this process is free from acids and sulfur compounds.

JEAN, J. W. (1464)
MOTOR FUEL. U. S. 2,117,609 and 2,117,610. May 17, 1938.

The products obtained by fermenting and distilling plant-waste material and containing butanol 53, dimethyl ketone 50, diethyl ether 10, and corn oil 7 percent can be used as motor fuel. Another blend composition contains butanol 35 percent, dimethyl ketone 30 percent, diethyl ether 10 percent, ethanol 20 percent, and corn oil 5 percent.

JOHNSON, J. W., VAN ROOSEN, H., USHAKOFF, A. E., and BROPHY, J. J. (1465)
LIQUID FUEL MIXTURES SUITABLE FOR INTERNAL COMBUSTION ENGINES. U. S. 2,125,448. Aug. 2, 1938.

A stable mixture which has antiknocking properties is composed of 58 parts of oleic acid, 20 parts of butyl Cellosolve, 25 parts of sec-hexyl alcohol, 18 parts of triethanolamine, 75 parts of water, and 750 parts of gasoline.

KOKATNUR, V. R. (TO AUTOXYGEN INC.) (1466)
MOTOR FUEL. U. S. 2,111,100. Mar. 15, 1938.

A fuel is described consisting of 50 percent of gasoline, together with at least 5 percent of water and 5 percent or more of a monohydric alcohol of a b.p. not exceeding 200° C. Ammonium soap is added as a blending agent to produce clear fuel.

STANDARD OIL DEVELOPMENT CO. (1467)
MOTOR FUEL. Fr. 825,559. Mar. 7, 1938.

The formation of ice crystals in gasoline-blended fuels is prevented by adding an alcohol such as methanol in amount of about 0.5 percent.

——— (1468)
MOTOR FUELS. Fr. 828,020. May 9, 1938.

Stability of blends containing hydrocarbon oils and lower aliphatic alcohols is improved in respect to water by adding ether of the type ROR^1 in which R and R^1 are hydrocarbon radicals, one of which is a branched aliphatic radical. The proportion of ether is about 10 to 25 percent and of alcohol 5 to 50 percent.

1939

BOUFFORT, M. M. J. (1469)
CONVERTING FATTY COMPOUNDS INTO PETROLEUM OILS. Fr. 844,105. July 19, 1939.

The process consists in transforming animal or vegetable oils into gasoline or petroleum through the action of heat, formaldehyde, and soda lime. (Sodium may be replaced by potassium.)

ELLIS, CARLETON (TO STANDARD OIL DEVELOPMENT CO.) (1470)
POLYFURCOUS FUEL. U. S. 2,143,870. Jan. 17, 1939.

A motor fuel is claimed consisting of a mixture of light hydrocarbons with an "acetal" which possesses at least one bifurcous terminal, such as diisopropyl acetal which serves as an "antiknock-igniter."

JEAN, J. W. (1471)
MOTOR FUEL. U. S. 2,179,151. Nov. 7, 1939.

The patentee claims a fuel mixture which consists of butanol 38 parts, ethanol 10 parts, acetone 30 parts, turpentine 4 parts, and benzene 18 parts.

LES USINES DE MELLE, and GUINOT, H. (1472)
ANTI-DETONATING FUELS. Fr. 837,965. Feb. 23, 1939.

Various esters, such as ethyl acetate and particularly those with branched chain molecules (e.g., isoproyl and isobutyl acetate), are excellent fuels having high antiknock properties and may be blended either alone or in mixtures with ethanol. The action of the esters is independent of that of organo-metallic antidetonants.

LOVENS, IVAN (1473)
MOTOR FUELS. Brit. 506,230. May 24, 1939.

A mixure of gasoline, alcohol, benzene, or heavy oils is improved by adding a product obtained from dissolving nondrying oil (castor, olive) in a solvent (e.g., benzene, toluene, white spirit, gasoline, or methanol) which is brought in contact with oxygen and hydrogen alternately, with excess of hydrogen.

MUSKAT, I. E. (TO PITTSBURGH PLATE GLASS CO.) (1474)
MOTOR FUEL. U. S. 2,178,403. Oct. 31, 1939.

Antiknock properties of straight-run or cracked gasoline or their mixtures, are increased by addition of, e.g., 5 to 50 percent of a volatile oxygenated organic compound, such as an unsaturated aliphatic alcohol or ether.

NAKAMURA, SIZUKA (1475)
GASOLINE-LIKE FUEL FROM ETHYL ALCOHOL. Jap. 132,401. Oct. 3, 1939.

Ethyl alcohol is polymerized by heat at atmospheric pressure with the aid of a catalyst.

NALDI, PHILIPPE (1476)
CONVERTING PLANT MATERIAL SUBSTANCES INTO FUELS. Fr. 847,075. Oct. 3, 1939.

Use of ketones, aldehydes, and alcohols in motor fuels is described.

OCON, E. A. (1477)
PRODUCTION AND RECOVERY OF BRANCHED CHAIN ALIPHATICS (MOTOR FUELS). U. S. 2,175,359. Oct. 10, 1939.

Oxygen derivatives of straight-chain aliphatic compounds such as alcohols, fatty acids, etc., are treated with alkali and the products are heated with hydrogen and carbon monoxide in the presence of a catalyst at 320° to 480° C. Product obtained when fractionated gives a high antiknock motor fuel.

SCHNEIDER, H. G., and SMYERS, W. H. (TO STANDARD OIL DEVELOPMENT CO.) (1478)
MOTOR FUEL AND METHOD OF PREPARING SAME. U. S. 2,176,747. Oct. 17, 1939.

The object of this invention is to prepare a motor fuel of especially high octane number such as those suitable for aviation engines. A light hydrocarbon liquid is blended with ketones and a small amount of metalo-organic antiknock agent as, for example: Petroleum naphtha 75 percent, methyl propyl ketone 25 percent, and 1 cc. of lead tetraethyl per gallon of mixture.

SOCIÉTÉ INTERNATIONALE DES CARBURANTS ET DES INDUSTRIES CHIMIQUES "BREVETS CONSALVO." HOLDING, S. A. (1479)
FUEL FOR INTERNAL COMBUSTION ENGINES. Belg. 437,458. Dec. 22, 1939.

A mixture of ethanol and petroleum distillates is subjected to catalytic dehydration, scission, and polymerization at 150 to 350° C.

1940

CHRISTENSEN, L. M. (TO CHEMICAL FOUNDATION, INC.) (1480)
MOTOR FUEL. U. S. 2,194,495. Mar. 26, 1940.

A fuel containing a preponderant amount of gasoline and a minor amount of ethanol is blended with a smaller amount of dehydrated "light oil" (from hard wood). The latter acts as both denaturant and inhibitor.

——— (TO CHEMICAL FOUNDATION, INC.) (1481)
POWER ALCOHOL. U. S. 2,194,496. Mar. 26, 1940.

This patent covers the use of an addition to ethanol to be used in alcohol-gasoline blends. It acts as a denaturant, top-cylinder lubricant, and gum inhibitor. The blending alcohol contains approximately 5 percent of this addition which comprises a blend of crude wood methanol, the higher boiling alcohols from crude synthetic methanol, and light wood tar distillate. Other similar combinations are also mentioned.

GAULT, HENRY (1482)
COMBUSTIBLE GAS FROM LIQUID FUELS SUCH AS FUEL OIL, GASOLINE, OR AN ALCOHOL. U. S. 2,185,549. Jan. 2, 1940.

Apparatus and continuous method of generating a combustible gas mixture are described.

SCHNEIDER, H. C., and SMYERS, W. H. (TO STANDARD OIL DEVELOPMENT CO.) (1483)
MOTOR FUEL AND METHOD OF PREPARING THE SAME. U. S. 2,225,942. Dec. 24, 1940.

As antiknock agent the use of branched aliphatic ketones in the amount of 5 to 50 percent is claimed.

1941

ARCHER, H. R. W., and GILBERT-TOMLISON, A. (1484)
COCONUT PRODUCTS. Australian 113,672. Aug. 13, 1941.

Coconut is treated at 150° to 800° C. and distilled at the temperature necessary to produce the results sought. The oily fraction containing acetone, methanol, and benzene and their homologues are blended to make a motor fuel with heavier fraction similar to kerosene but completely soluble in alcohol.

ELLIS, CARLETON (TO STANDARD OIL DEVELOPMENT CO.) (1485)
POLYFURCOUS FUEL. U. S. 2,237,660. Apr. 8, 1941.

An antiknock motor fuel for high-compression spark-ignition engines is claimed. It consists of a major proportion of gasoline hydrocarbons blended with an aliphatic mono-ester having two branched alkyl terminals, such as esters prepared from isovaleric acid and isopropyl alcohol or trimethyl acetic acid and tertiary butyl alcohol.

ROSEN, RAPHAEL (TO STANARD OIL DEVELOPMENT CO.) (1486)
MOTOR FUEL. U. S. 2,256,627. Sept. 23, 1941.

The addition of 5 to 50 percent of unsaturated ethers such as divinyl or dimethallyl ether to gasoline reduces its knocking tendencies. Unsaturated ethers may be also blended with other antiknock blending agents such as alcohols, isopropyl ether, and aromatic amines.

1943

MOTTLAU, A. Y., and MILLER, P. (1487)
MOTOR FUEL. U. S. 2,321,311. June 8, 1943.

Octane number of gasoline (b.p. 40° to 230° C.) for spark-ignition engines can be raised from 78.5 to 79.5 by addition of 1 percent of furan or its derivatives.

1944

BACKOFF, W. J., WILLIAMS, N. D., O'LOUGHLIN, J. F., MOIR, H. L., and YULE, J. S. (TO THE PURE OIL CO.) (1488)
MOTOR FUEL COMPOSITION. U. S. 2,341,892. Feb. 15, 1944.

A gum solvent is described containing about 5 percent of a cyclic ketone (benzophenone) boiling above 350° F. and 5 percent by volume of materials boiling below 350° having gum solvent properties at normal temperatures, such as esters of aliphatic acids (ethyl acetate), aliphatic ketones, and aliphatic alcohols.

ROBERTSON, A. E. (TO STANDARD OIL DEVELOPMENT CO.) (1489)
MOTOR FUELS. U. S. 2,365,009. Dec. 12, 1944.

The present invention claims to overcome certain disadvantages of alcohol-gasoline blends, such as the formation of two liquid phases and vapor lock, by blending from at least 5 to 10 percent (as the upper practical limit) by volume of selected low-molecular-weight hydrocarbon component having from three to five carbon atoms per molecule with a major portion of an alcohol likewise having from three to five carbon atoms per molecule. Small amounts of ethane or hexane do not destroy the value of the fuel for the intended purpose. Ethanol and methanol are useful and isopropanol and secondary butanols are outstanding. The preferred alcohols have normal boiling points below 150° C. The preferred blends are obtained by selecting a relatively higher molecular weight hydrocarbon for blending with a lower molecular weight alcohol, e.g., a C_4 to C_5 hydrocarbon with a C_1 to C_2 alcohol and vice versa. Blends formulated have unusual distillation and vapor pressure characteristics which enable them to form a vapor charge which undergoes quick ignition in cold motors at subzero temperatures.

WORSLEY, R. R. L. (TO ARTHUR ABBEY) (1490)
MOTOR SPIRITS AND LUBRICANTS. Brit. 565,975. Dec. 7, 1944.

Motor fuels are prepared from oil-bearing seeds, vegetable oils or fatty acids by means of distillation and subsequent cracking at 500° to 650° C. The resultant product is fractionated.

1945

CARMODY, D. R. (TO STANDARD OIL CO. OF INDIANA) (1491)
KNOCK-RESISTANT MOTOR FUEL. U. S. 2,391,084. Dec. 18, 1945.

Production of aviation fuel through combination of methanol and natural gas (fuel contains methyl-tertiary ether) is described.

WOLFNER, A. S. (1492)
PREPARATION OF STABLE BINARY MOTOR FUEL. U. S. 2,371,010. Mar. 6, 1945.

A stable anhydrous alcohol-gasoline mixture is produced from 95 percent alcohol-gasoline by means of distillation.

1946

EVANS, T. W., and CATTANEO, A. G. (1493)
MOTOR FUELS. U. S. 2,409,746. Oct. 22, 1946.

A motor fuel which reduces knocking in supercharged spark ignition gasoline engine consists of a mixture of gasoline hydrocarbons and methyl tertiary butyl ether. Gasoline hydrocarbons contain a substantial amount of isooctane, neohexane, triptane, and mixture thereof. The addition of the ether increases the allowable boosting of the intake pressure without causing knocking.

MARSCHNER, R. F., and CARMODY, D. R. (TO STANDARD OIL CO.) (1494)
AVIATION SUPERFUEL. U. S. 2,407,718. Sept. 17, 1946.

A fuel adapted for aviation purposes consists of isooctane as a main component blended with hydrocarbon-ketone azeotrope, such as mixtures of methyl ethyl ketone with benzene, cyclohexane or triptane, or methylisobutyl ketone may be employed forming an azeotrope with isooctane itself. The following blend exemplifies new aviation superfuel: 85 to 60 percent isooctane and 15 to 40 percent by volume of an azeotrope of 40 to 60 percent diisopropyl ketone and 60 to 40 percent of acetone.

ROBERTSON, A. E. (TO STANDARD OIL DEVELOPMENT CO.) (1495)
MOTOR FUELS. U. S. 2,404,094. July 16, 1946.

Motor fuels are claimed consisting of from 80 to 98 percent methanol and 20 to 2 percent of a hydrocarbon with three to five carbon atoms, selected from a group of aliphatic and cycloaliphatic hydrocarbons, the latter of sufficient amount to raise the Reid vapor pressure of the blend 5 to 13 p.s.i. at 100° F. Fuel may contain 1 to 4 cc. T.E.L. per gallon. Ethanol and isopropanol and secondary butanols are also excellent components for the blend. Water up to a certain limit improves the blend, and it may replace a certain amount of the alcohols without changing substantially the proportion of hydrocarbons.

——— (TO STANDARD OIL DEVELOPMENT CO.) (1496)
MOTOR FUELS. U. S. 2,408,999. Oct. 8, 1946.

Properly selected alcohols when blended with low-molecular-weight hydrocarbons having from three to five carbon atoms per molecule give quick-starting fuels for high-compression spark-ignition engines. These fuels are free from vapor lock. Alcohol used should be preferably monohydric aliphatic alcohols of one to five carbon atoms blended in the proportion: 90 to 95 percent alcohol and 10 to 5 percent hydrocarbon by volume.

STANLY, A. L. (1497)
KETONES IN AVIATION GASOLINE. U. S. 2,398,197. Apr. 9, 1946.

An aviation motor fuel is claimed consisting of gasoline to which are added 0.25 to 1 percent aniline or other aromatic amines and 3 to 5 percent of an asymmetric ketone having five or six carbon atoms.

WEIZMANN, CHARLES (1498)
MOTOR FUELS. Brit. 575,637. Feb. 27, 1946.

Aviation fuels containing 10 to 25 percent aliphatic mono-ketones are described.

VIII. BOOKS

1919

SIMMONDS, C. (1499)
ALCOHOL AS A SOURCE OF LIGHT, HEAT AND MOTION POWER. 558 pp. Chap. IX, pp. 372–389. London, MacMillan and Co., Ltd. 1919.

The use of alcohols as a fuel is described very briefly. Includes an abstract of U. S. Geological Survey Bul. No. 392 by R. M. Strong. Heats of combustion are explained and a few values given.

1920

MOORE, HAROLD (1500)
LIQUID FUELS FOR INTERNAL COMBUSTION ENGINES [A PRACTICAL TREATISE FOR ENGINEERS AND CHEMISTS]. 206 pp. New York, Van Nostrand Co., Inc. 1920.

1921

FARMER, R. C. (1501)
INDUSTRIAL AND POWER ALCOHOL. 110 pp. New York, Pitman and Sons, Ltd. 1921.

1922

MONIER-WILLIAMS, G. W. (1502)
POWER ALCOHOL, ITS PRODUCTION AND UTILIZATION. 323 pp. London, Henry Frowde, Hodder, and Stoughton, Oxford Tech. Pub. 1922.

Author discusses extensively the various manufacturing processes and also includes a section on denaturation and hydrometry (212 pp.). After principles of the internal-combustion engine have been given, engine-performance data are presented. Conclusions are similar to those given by H. Ricardo. A review of physical data and an account of experiences with various blends are also given. Work on corrosion, by G. Heinzelmann (Ztschr. f. Spiritusindus. 27: 399. 1904; *Ibid.* 28: 368–369. 1905) and by R. P. Duchemin (Assoc. des Chim. de Sucr. et Distill. Bul. 26: 1076–1078. 1909; 7th Internatl. Cong. Appl. Chem. London 1909) by ethanol, solutions of ethanol with acetaldehyde, ethylacetate, and amyl acetate; and of methanol, solutions of methanol with acetone, and methylacetate is mentioned.

SIMMONDS, C. (1503)
ALCOHOL IN COMMERCE AND INDUSTRY. 119 pp. London, Sir Isaac Pitman & Sons, Ltd. 1922. (Reviewed *in* Nature [London] 111: 181. 1923.)

1923

LESLIE, EUGENE (1504)
MOTOR FUELS: THEIR PRODUCTION AND TECHNOLOGY. 681 pp. New York, Chemical Catalog. Co., 1923. (Reviewed *in* Iron Age 113: 1693. 1924.)

1924

AUBERT, MARIUS (1505)
LES COMBUSTIBLES LIQUIDES ET LE PROBLÈME DU CARBURANT NATIONAL. 368 pp. Paris, Gauthier-Villards et Cie. 1924. (Reviewed *in* Mech. Engin. 46: 441. 1924.)

LUMMUS COMPANY, THE WALTER E. (1506)
MOTOR FUEL FROM MOLASSES. Booklet 62 pp. Boston, Mass., The Walter E. Lummus Co. 1924.

Alcohol-ether blends are superior to alcohol alone and a mixture called Natalite consisting of approximately 55:45:0.25 denatured ethanol-ether-ammonia or trimethyl amine has been used successfully in South Africa. The mileage per gallon varies from 93 to 100 percent of the mileage per gallon of good gasoline. A Hawaiian blend used in 1920 and later comprises 63.3 percent ethanol, 34.8 percent ether, 1.3 percent kerosene, and 0.6 percent pyridine. A quite similar mixture is known in British Guiana as Alcolene. The following performance advantages are enumerated: Easier starting, no carbon deposits, better acceleration, no knock, cooler engine, no corrosion, the fact that power and mileage with properly adjusted carburetor are practically equal to those of gasoline, that lower consumption of lubricating oil, and that fires can be extinguished with water. Cost will be lower when molasses is cheaper. Corrosion has been traced to denaturants (methanol), particularly in presence of excess of water. Cost figures and description of process are given.

1925

HELDT, P. M. (1507)
FUELS AND CARBURETORS. 378 pp. Alcohol pp. 287–316. Nyack, N. Y. 1925.

1927

RICHARD, A. (1508)
LES AUTOMOBILES SANS PÉTROLE; L'ALCOOL D'INDUSTRIE. 222 pp. Paris, Masson et Cie. 1927. (Reviewed *in* Rev. des Prod. Chim. 30: 569. 1927.)

1928

AVALLE, EDOUARDO (1509)
I COMBUSTIBILI LIQUIDI PER I MOTORI ENDOTERMICI. PROCESSO DELLA COMBUSTIONE—COMBUSTIBILI LIQUIDI DERIVATI DALLE SOSTANZE VEGETALI —GLI ALCOOLI COME CARBURANTI—COMBUSTIBILI LIQUIDI DAI CARBONI FOSSILI, DALLE LIGNITE, TORBE, ASFALTI BITUMI E SCHISTI—IL PROCESSO BERGIUS—PROCESSO DI CRACKING. 407 pp. Milan, C. Tamburini fu Camillo. 1928.

1930

FACCIONI, GUERRINO (1510)
STUDI E RICERCHE PER UN CARBURANTE NAZIONALE A BASE DI ALCOOL PER MOTORI A SCOPPIO. 62 pp. Vicenza, Off. Tip. Vicentina. 1930.

MATTHIS, A. R. (1511)
POLITQUE NATIONALE ET TECHNOLOGIE, RESUMÉE DE LA QUESTION DES CARBURANTS. 200 pp. Paris, H. Dunod. 1930.

1931

LEVI, M. G. (1512)
STUDI E RICERCHE SUI COMBUSTIBILI T. II. 418 pp. Rome, Tipografia Editrice Italia. 1931. (Reviewed *in* Chim. & Indus. [Paris] 25: 1044. 1931.

HUBENDICK, E. L. (1513)
SPIRITUSMOTOREN. STUDIEN ÜBER DIE VERWENDUNG VON SPIRITUS UND SPIRITUS-KOHLENWASSERSTOFF-GEMISCHEN FÜR DEN BETRIEB VON VERGASERMOTOREN. 139 pp. (Translated from Swedish to German by Gerhard Gerson). Berlin, Klasing & Co., 1931.

Under the heading "Motor Fuels" the author discusses the following topics: Physical properties (vapor pressures, densities, etc.) of ethanol, benzene, toluene, paraffin hydrocarbons (hexane and heptane), critical-solution temperatures of fuel blends such as ethanol-benzene-water, ethanol-heptane-water, ethanol-gasoline-water, ethanol-ether-water and others, and stabilizers. No trouble was experienced in Sweden in using a 25:75 alcohol-gasoline blend. Part II deals with the operation of alcohol engines. Some of the topics covered are: Carburetor action, engine performance with alcohol and gasoline, mixture formation, volumetic efficiency, fuel and oil consumption, preheating, jacket temperature, ignition velocity, spark advance. Reported difficulties (during World War I) with alcohol fuels were due principally to poor quality of lubricating oil and poor adjustments of carburetors. Part III deals with alcohol engines and discusses C.R., influence of fuel-air ratio on thermal efficiency, ignition temperatures, knock. Part IV gives practical advice to the driver.

RE, U., and VARETON, E. (1514)
CARBURANTI E CARBURAZIONE. 516 pp. Milan, Ulrico Hoepli. 1931. (Reviewed *in* Indus. and Engin. Chem. 23: 597. 1931.)

Deals with the physical and chemical characteristics of materials which are or may be used as motor fuels. Mechanism and operation of motors, carburation, and compressors and superfuelizers are discussed.

1934

HALE, W. J. (1515)
THE FARM CHEMURGIC. 201 pp. New York, Chem. Foundation, Inc. 1934. (Reviewed *in* Textile Colorist 56: 775. 1934.)

ÖSTERREICHISCHES PETROLEUM-INSTITUT (1516)
ALKOHOL-GEMISH-KRAFTSTOFFE. Booklet 30 pp. Vienna, Verlag für Fachliteratur Ges. M.B.H. 1934.

A brief discussion of various aspects of ethanol-gasoline blends. Includes a list of 139 references. Stability, blending and handling, carburetion, combustion, fuel consumption, and performance are considered.

1935

NASH, A. W., and HOWES, D. A. (1517)
ALCOHOL FUELS. THE PRINCIPLES OF MOTOR FUEL, PREPARATION AND APPLICATION. 538 pp. Alcohol fuels, V. 1, Chap. IX, pp. 349–451. New York, John Wiley & Sons, Inc. 1935.

The authors give an extended review on alcohol motor fuels (100 pp.). This includes discussion of manufacturing processes, solubility relations with hydrocarbons, blending agents, and engine performance. An economic review and bibliography are also included.

1937

KLAR, M. (1518)
FABRIKATION VON ABSOLUTEM ALKOHOL ZWECKS VERWENDUNG ALS ZUSATZMITTEL ZU MOTOR-TREIBSTOFFEN. 2nd Ed., 91 pp. Halle a Salle, W. Knapp. 1937. (Reviewed *in* Chem. Trade Jour. 101: 592. 1937).

The author gives a description of all principal dehydration methods.

SABINO DE OLIVEIRA, EDUARDO (1519)
ALCOOL MOTOR E MOTORES A EXPLOSÃO. 356 pp. Brazil, São Paulo. Ministerio do Trabalho Industria e Commercio, Instituto de Technologia. 1937.

The following table of contents indicates the scope of the book: Heat and work, pp. 27–37; Molecular dissociation, pp. 38–48; Carburetor, pp. 49–139; Detonation, pp. 140–182; Solubility of alcohol-gasoline mixtures, pp. 198–201; Performance of liquid fuels in internal combustion engines, pp. 202–229; Engine adjustments for use with alcohol, pp. 230–270; Alcohol engine, pp. 271–299; 10 Percent alcohol-gasoline mixture, pp. 300–322; Advice concerning the solution of the problem of alcohol motor fuel in S. Paulo, pp. 323–346; and Bibliography pp. 347–356.

1938

DUNSTAN, A. E., NASH, A. W., BROOKS, B. T., and TIZARD, H. (1520)
THE SCIENCE OF PETROLEUM. 4 v., 3192 pp., v. 4, pp. 2391–3192. London, Oxford University Press. 1938.

Information regarding methanol and ethanol will be found under the following headings: Special Engine Fuels, D. A. Howes, p. 2444 (physical properties, antiknock values, racing fuels, use in automobile engines); The Solubility Relationships of Mixtures of Gasolines, Benzoles, Alcohols and Water, D. A. Howes, p. 2823; Combustion Phenomena of Hydrocarbons, D. M. Newitt and D.T.A. Townend, p. 2860 (ignition temperature, slow combustion at high pressures, peroxide theory); Combustion Phenomena at High Pressures, D. M. Newitt and D.T.A. Townend, p. 2884.

MAYER-SIDD, E. (1521)
DER KRAFTFAHRZENGBETRIEB MIT HEIMISCHEN TREIBSTOFFEN. 126 pp. Hall, Karl Marhold. 1938.

TAYLOR, C. F., and TAYLOR, E. S. (1522)
THE INTERNAL COMBUSTION ENGINE. 322 pp. Scranton, Pa., International Textbook Co., 1938.

1939

BERTHELOT, CHARLES (1523)
DE LA CARBONIZATION AUX CARBURANTS D'AVIATION. T. I. LE PÉTROLE ET SES SUCCÉDANÉS. 327 pp. Paris, H. Dunod. 1939. (Reviewed *in* Inst. Petrol. Jour. 25: 284A. 1939.)

SPAUSTA, FRANZ (1524)
TREIBSTOFFE FÜR VERBRENNUNGSMOTOREN. 346 pp. Vienna, J. Springer. 1939.

The use of alcohol and alcohol blends is briefly discussed.

1941

BERTHELOT, C., LÉCHÈRES, P., and HOT, A. (1525)
CARBURANTS ET LUBRIFIANTS NATIONAUX. 571 pp. Paris, Dunod. 1941.

The book emphasizes the importance of production of fuels within French territory. Vehicle-gas producers, compressed gas (hydrogen, methane, acetylene, ammonia, propane, and butane), methanol, ethanol, ketones, vegetable oil, shale oil, hydrogenation, lubricants, etc. are discussed.

JUDGE, A. W. (1526)
AIRCRAFT ENGINES. v. I, 380 pp. New York, Van Nostrand Co., Inc. 1941.

RICARDO, H. R. (REVISED BY H. S. GLYDE) (1527)
THE HIGH-SPEED INTERNAL COMBUSTION ENGINE. 434 pp. New York, Interscience Publishers, Inc. 1941.

Introduction—the use of alcohol is advocated since it involves no drain on the limited supply of oil. Chapter I—the volumetric efficiency of an engine using alcohol is considerably greater than when it is using gasoline; this results in higher thermal efficiency. Tables showing heats of vaporization, air-fuel ratios, fall of temperature due to heat of vaporization, heats of combustion, etc. Chapter II—graph showing the continued rise of i.m.e.p. of ethanol with mixture strength beyond 20 percent excess fuel. In case of gasoline the i.m.e.p. shows a drop at this point. However, in all cases there is a decided decrease in thermal efficiency. In practice only a relatively small percentage of the alcohol is evaporated during the suction stroke, and efficient atomization of alcohol should be provided to take advantage of the total heat. Because of its higher volumetric efficiency, alcohol will show a higher i.m.e.p. compared with gasoline.

VUILLEUMIER, HENRI (1528)
LES CARBURANTS DE REMPLACEMENTS. 245 pp. Bern. Hallwag S. A. 1941.

Among the possible substitute fuels which might be used in Switzerland is ethanol. Blends containing up to 30 percent are very satisfactory; however, sufficient raw material is not available for the production of ethanol. Mention is made of the establishment of a factory making an ethanol-ether mixture according to the Italian Crima process at Bale (Basel). A 35-percent blend of this mixture with gasoline is said to give good performance.

1942

SOARES PEREIRA, MOACYR (1529)
O PROBLEMA DO ÁLCOOL-MOTOR. 195 pp. Rio de Janeiro, J. Olympic. 1942.

Deals with the economics of alcohol motor fuels in Brazil.

WILLKIE, H. F., and KOLACHOV, P. J. (1530)
FOOD FOR THOUGHT [PRODUCTION AND UTILIZATION OF POWER ALCOHOL]. 209 pp. Indianapolis, Indiana Farm Bureau, Inc. 1942. (Reviewed *in* Chem. and Engin. News 20: 1678. 1943.)

1943

BARBOSA LIMA SOBRINHO, A. J. (1531)
ALCOOL-MOTOR, A AÇÃO DO INSTITUTO DO AÇUCAR E DO ALCOOL NO DEFESA DO CARBURANTE NACIONAL. 82 pp. Rio de Janeiro, Americ-edit. 1943.

Economic aspects of alcohol as motor fuel in Brazil are emphasized. Production figures for 1935-1942 are given. More than 200 million liters of anhydrous ethanol were used in gasoline blends in Brazil during 1934 to 1941. The experiments performed at the Institute of Technology under the direction of E. Sabino de Oliveira showed that a 10-percent blend of anhydrous alcohol was very satisfactory. It did not require major carburetor adjustments and, in general, engine performance was equal to that of gasoline.

LEFRANC, J., BERTHELOT, C., and JUIN, G. (1532)
COMBUSTIBLES ET LUBRIFIANTS DE REMPLACEMENT. 78 pp. Chap. I. J. Lefranc. Les cétones carburant a grand pouvoir indétonant, pp. 3–27. Conservatoir National des Arts et Métiers. Paris, Hermann & Cie. 1943.

Ketone motor fuel, such as acetone, methyl ethyl ketone, dipropyl ketone, the higher ketones, and a mixture of various ketones produced through a combination of aerobic and anaerobic fermentation and subsequent distillation of the calcium salts, have proper boiling range (52° to 200° C.), very high antiknock ratings, are readily blended with gasoline or ethanol, and have heats of combustion higher than that of ethanol though lower than that of the hydrocarbon. Physical properties, octane number of blends, and lead susceptibilities are given. Results of two single-cylinder engine tests indicate that this fuel can be supercharged to higher boost pressures than 100-octane number gasoline with consequent higher output and only slighly higher s.f.c. Similar results were also obtained with a 12-cylinder-type Y.C.R. Hispano-Suiza engine.

PESCE, J. C., and MENEGAZZI, J. (1533)
URUGUAY. ADMINISTRACION NACIONAL DE COMBUSTIBLES, ALCOHOL Y PORTLAND. 12 pp. Montevideo, Casa A. Barreiro y Ramos. 1943.

1944

CHRISTILLE, M. (1534)
LES CARBURANTS DE REMPLACEMENT ET LEUR TECHNIQUE; GAZ PAUVRE AU GAZ DE CARBONE, BENZOL, ALCOOL, NAPHTALINE, MÉTHANE, ACÉTYLÈNE, ACÉTONE ET ALCOOL MÉTHYLIQUE, L'AUTOMOBILE À ACÉTYLÈNE. 73 pp. Paris, E. Chiron. 1944.

JALBERT, JEAN (1535)
LE MOTEUR À ALCOOL. 88 pp. Paris, H. Dunod. 1944.

A detailed theoretical analysis is made of the use of gasoline, methanol, and ethanol in carburetor and direct-injection engines. It is concluded that the latter type of engine is definitely superior in performance. In discussing an existing type of gasoline carburetor engine modified for use with straight ethanol the following points are mentioned: Increasing weight of float and of size of jets; preheating of mixture; starting with gasoline or using electric heater; avoiding use of zinc; preventing cylinder dryness either through addition of colloidal graphite to lubricant or by means of a needle valve to the fuel; using hotter spark plug; increasing C.R. to 8. Without changing the C.R. but with the changes indicated, the power output and s.f.c. of a six-cylinder engine run on gasoline and ethanol were 34.5 and 34 hp., respectively, for power output and 263 and 426 gm., respectively, for s.f.c. An interesting development is the combination of high compression (11.65:1) with automatic manifold-pressure control (Bonnier-Viel arrangement). A comparison with results obtained at C.R. 5.65:1 and at approximately the same peak pressures, show the same power output but increased efficiency with consequently lower s.f.c. An arrangement like this necessitates, therefore, only a change in piston or in cylinder head. Direct injection is the best solution. Ethanol is injected at the beginning of the compression stroke in order to obtain uniformity of the charge.

Spark advance of 30° at 2,000 r. p. m. is recommended. Pump pressures may be approximately 30 kg. Since alcohols have poor lubricating properties, special precautions must be taken for pump lubrication.

Injection pumps fall generally into two classes. The first class is illustrated by the JUMO 211, as well as by the pump used with the Brandt 4-cylinder, four-cycle direct-injection alcohol engine (displacement per cylinder 4,950 cm^3). Lubrication of the piston plunger is assured by oil introduced at a pressure higher than injection pressure. Results given indicated thermal efficiencies of more than 40 percent for both methanol and ethanol (95.8 percent and 80 percent.)

The other class of direct-injection method is illustrated by its adaptation to alcohols by Coatalen and Retel. Retel's device, when substituted for a carburetor and without making any other change, resulted in a 24-percent gain in power and a 13.8-percent increase in thermal efficiency with ethanol as fuel. A comparison of an Ateliers et Chantiers de la Loire Diesel engine (pneumatic-injection system of Jalbert) with one which was slightly modified for use with methanol (C.R. 13:1, spark ignition installed) showed that the alcohol engine gave superior performance.

The difference of mixture formation and control between a Diesel and alcohol engine is emphasized. In the former, injection takes place near top dead center while in the latter it is near bottom dead center at the beginning of compression. The amount of fuel injected is regulated through synchronization with air intake. Nitrated steel for cylinder walls is recommended.

Use of alcohols as combustion-turbine fuel is briefly discussed and data are given which show that the use of ethanol in an aviation engine gave greater power and higher ceiling at approximately the same s.f.c. In reviewing the use of alcohol fuels to date, it is concluded that the fuel possibilities of ethanol, for instance, are not utilized when blended with gasoline. A multifuel, high-compresson direct-injection engine is visualized for France, in which straight methanol or ethanol will be used under the most favorable conditions.

VAN WINKLE, MATTHEW (1536)

SPECIAL AVIATION FUELS AND AVIATION FUEL COMPONENTS. Aviation Gasoline Manufacture. 275 pp., Chap. VIII, pp. 212–233. New York, McGraw Hill Book Co., Inc. 1944.

The blending octane numbers and the lead susceptibility of acetone and methyl ethyl ketone blended with gasolines are approximately of the same order as those of isooctane. A table of the lead susceptibilities of gasoline blended with various alcohols shows that tertiary butyl alcohol has approximately the same lead response in blends as isooctane. The performance data of aviation gasoline-alcohol blends show marked freedom from carburetor icing, toleration of richer mixtures, lower cylinder temperatures, a tendency to preignite at high cylinder temperatures, a power loss in cruising, and a higher s.f.c.

SERRUYS, MAX (1537)

ELEMENTS DE THERMODYNAMIQUE ET PHYSICO-CHIMIQUE DE LA COMBUSTION DANS LES MOTEURS. 106 pp. Paris, H. Dunod. 1945.

Deals first in detail with the principles involved in the various combustion cycles and their application to actual problems. In connection with a discussion on the efficiency of combustion, a diagram gives i.m.e.p. and s.f.c. against fuel-air ratio for 20:70:10 gasoline-ethanol-diethyl acetal, ethanol, and gasoline. Both the blend and ethanol show higher i.m.e.p. values than gasoline, but their s.f.c. is also higher and roughly in inverse ratio to the respective heats of combustion. The beneficial effect of improved distribution on the s.f.c. of ethanol by means of a combination atomizer and preheater (pulverisateur-rechauffeur Defrance) is illustrated in another diagram for speeds above 1,000 r.p.m. It appears that the s.f.c. was slightly better at 17° C. air temperature than at 55°. Direct cylinder injection at high C.R. with spark ignition favors the use of methanol and ethanol. Under these conditions and with i.m.e.p. shown, the following results are given:

	i. m. e. p., kg.	*s. f. c., gm./hp.-hr.*	*Indicated thermal efficiency*
Gasoline	9.9	194.5	0.3
Ethanol	12.6	244.0	.4
Methanol	14.6	276.0	.44

The Brandt four-cylinder direct-injection spark-ignition alcohol engine is described.

IX. ADDENDUM

1934

HOFFERT, W. H., and CLAXTON, G. (1538)
RECENT PROGRESS IN THE FIELD OF GUM INHIBITORS FOR MOTOR FUELS. XIV^{me} Cong. de Chim. Indus. 8 pp. 1934.

Treatment of benzene and impurities present in motor fuels must be considered when gum inhibitors are used. The variable behavior of inhibited benzene and gasoline blended with methanol or ethanol must be attributed to the poor quality of alcohol or of hydrocarbon. Twenty-percent ethanol blends containing inhibited benzene used in Great Britain were completely stable and the trouble encountered was solely a problem of alcohol quality.

1935

DRYER, C. G., LOWRY, C. D., JR., EGLOFF, G., and MORRELL, J. C. (1539)
A PURE HYDROCARBON STANDARD FOR EVALUATING INHIBITORS. Indus. and Engin., Chem. Indus. Ed. 27: 315–317. 1935.

It has been found that some solvents reduce the induction period of certain inhibitors. Methanol, ethanol, *n*-propanol, isopropanol, and acetone will reduce the action of a wood-tar inhibitor (Lowry and Dryer, U. S. 1,889,835 and 1,889,836). The reduction is greatest with methanol and smallest with acetone. Ether and methyl ethyl ketone had either no effect or only a small one.

1944

CARBONARO, M. (1540)
ALCOHOL AND THE SUPPLYING OF FRANCE WITH MOTOR FUEL. Énergie 28: 154–155. 1944.

According to the author's calculations, France is capable of producing 15,550,000 hectoliters of alcohol from beets, Jerusalem artichokes, wood, and molasses. This amount of alcohol is equivalent to 970,000 metric tons of gasoline.

COLIN (1541)
PROJECT OF AN ALCOHOL ENGINE HAVING A HIGH COMPRESSION RATIO AND A LOW FEED RATE. Soc. des Ingén. de l'Auto Jour. 17: 201–204. 1944.

HARRIES, M. L., NELSON, R. L., and BERGUSON, H. E. (1542)
EFFECT OF WATER INJECTION ON THE KNOCK-LIMITED PERFORMANCE OF AN ALLISON V-1710-99 ENGINE. [U. S.] Natl. Advisory Com. Aeronaut. Memo. Rpt. 17 pp., 40 figs. Sept. 9, 1944 (Unclassified).

The maximum knock-limited b.hp. attained through water injection with an Allison V-1710-99 engine was 1965 at a fuel-air ratio of 0.08, a carburetor temperature of 50° F., and a water-fuel ratio of 0.6. This was 615 b.hp. above that for gasoline alone under the same engine conditions.

1945

DUNNING, J. W. and LATHROP, E. C. (1543)
THE SACCHARIFICATION OF AGRICULTURAL RESIDUES—A CONTINUOUS PROCESS. Indus. and Engin. Chem., Indus. Ed. 37: 24–29. 1945.

Authors describe the saccharification process used at the Northern Regional Research Laboratory. The possibilities of using this process for the production of liquid fuels and other compounds is discussed.

NELSON, R. L., HARRIES, M. L. and BRUN, R. J. (1544)
EFFECT OF INTERNAL COOLANTS ON THE KNOCK-LIMITED PERFORMANCE OF AN ALLISON V-1710-99 ENGINE WITH A COMPRESSION RATIO OF 6.0. [U. S.] Natl. Advisory Com. Aeronaut. Memo. Rpt. No. E5F30 13 pp., 9 figs. 1945.

A maximum knock-limited b.hp. of 2,310 was attained at a fuel-air ratio of 0.079 and a carburetor-air temperature of 60° F. when ethanol-water mixture was introduced through the fuel-spray nozzle with an Allison V-1710-99 engine with compression ratio of 6:1. Water alone was more effective at low internal-coolant flows, whereas at high rate of flow ethanol-water gave greater knock-limited output.

1946

JALBERT, JEAN (1545)
COMPARATIVE BEHAVIOR OF AIR-GASOLINE AND AIR-METHANOL MIXTURES IN THE ENGINE CYLINDER. Soc. des Ingén. de l'Auto. Jour. 19: 105–108. 1946.

MAZURKIEWICZ, A. G. and OBERHOLZER, V. G. (1546)
REVIEW OF THE CHEMICAL STRUCTURE OF FUELS AND THEIR DETONATION IN ENGINE. Inst. Petrol. Jour. 32: 685–702. 1946.

The major portion of the article deals with hydrocarbon fuels. Ratings of five heptanols are given in terms of aniline number. The values range from —6 for *n*-heptanol to 21 for 2,2,3,3,-tetramethyl propanol, indicating that branching improves the rating noticeably, which is the general case for all types of compounds.

NEELY, G. L., ET AL (1547)
JAPANESE FUELS AND LUBRICANTS III. NAVAL RESEARCH ON ALCOHOL FUEL. Naval Tech. Mission to Japan Rpt. X-38 (N)-3, 172 pp. Feb. 1946. Published as Rpt. PBL 53046 U. S. Dept. Com. Off. of the Pub. Bd.

The report deals mainly with improvements in fermentation techniques, the synthesis of alcohols, and the practical testing of alcohol-aviation gasoline blends. In view of the service-performance characteristics of the blend investigated, the use of alcohol blends was confined to training planes.

Abstract *in* Bibliog. Sci. and Indus. Rpts. 6 (9): 759. 1947.

SERRUYS, MAX (1548)
THE POSSIBILITY OF ADAPTING INTERNAL-COMBUSTION ENGINES TO VARIATIONS OF OCTANE NUMBER. Soc. des Ingén. de l'Auto. Jour. 19: 69–79. 1946.

1947

BAXTER, A. D. (1549)
AIRCRAFT ROCKET MOTORS. Aircraft Engin. 19: 249–257. 1947.
Methanol is mentioned as a possible constituent of rocket fuel.

EGLOFF, GUSTAV (1550)
CHEMICALS FROM PETROLEUM AND NATURAL GAS. Chem. and Engin. News 25: 3634-3637. 1947.

No mention is made of alcohol motor fuel; it is important, however, to point out that large amounts of alcohols and ketones will become available as byproducts of new synthetic processes.

GESCHELIN, JOSEPH (1551)
OBSERVATIONS. Automotive Indus. 97 (10): 41. 1947.

Author comments on the claims of a large number of installations for water-alcohol injection principally to improve performance of engines with fuels having a moderate octane number. Further investigation appears desirable.

LI, N. C. C. and TERRY, T. D. (1552)
DIELECTRIC STUDIES WITH GASOLINE. Paper presented at the 112th meeting of the Amer. Chem. Soc., New York City. Sept. 15–19, 1947.

Authors mention the use of dielectric constant measurements for the analysis of ethanol in blends with gasoline.

SEIFERT, H. S., MILLS, M. M. and SUMMERFIELD, M. (1553)
PHYSICS OF ROCKETS: LIQUID-PROPELLANT ROCKETS. Amer. Jour. Phys. 15: 121–140. 1947.

The use of blends of liquid oxygen—ethanol, of nitric acid—furfuryl alcohol—hydrogen peroxide—nitromethane, and of hydrazine hydrate—methanol—water as rocket fuels is described.

STANLEY, R. M. and SANDSTROM, R. J. (1554)
DEVELOPMENT OF THE XS-1 SUPERSONIC RESEARCH AIRPLANE. Aeroaut. Engin. Rev. 6 (8): 22–26, 72. 1947.

A combination of liquid oxygen and ethanol as propellant for the power plant of a 6,000-pound rocket motor was considered preferable to a number of other possible constituents, principally because the combination is relatively safe and convenient and also because of its good specific impulse.

VERNON, W. H. J. (1555)
CHEMICAL RESEARCH AND CORROSION CONTROL: SOME RECENT CONTRIBUTIONS OF A CORROSION RESEARCH GROUP. Soc. Chem. Indus. Jour., Chem. and Indus. 66: 137–142. 1947.

On page 138 under "Corrosion in de-icing systems" appears the statement that the solution consisting of ethylene glycol and industrial methylated spirit with 10 percent water used for wing de-icing would corrode solder. Some 200 substances were investigated for possible inhibitive properties and from these the following six inhibitors are given in order of their effectiveness (percentage given is in terms of gm. per 100 ml. of de-icing fluid): Sodium selenate 0.2 percent; sodium arsenate 0.5 percent; sodium salt of fluorescein 0.5 percent; potassium chromate 1.0 percent; sodium cinnamate 1.0 percent; and sodium selenite 1.0 percent.

VICTOR, MAURICE (1556)
ROCKETS. Rev. de Aluminium 24: 69–74. 1947.

A combination of alcohol and liquid oxygen is mentioned as one type of rocket-propulsion agent.

WEIZMANN, C., BERGMAN, E. and SULZBACHER, M. (1557)
CARBOHYDRATES AS AN ALTERNATIVE SOURCE TO PETROLEUM FOR ORGANIC CHEMICALS. Chem. and Indus. 50: 769–771. 1947.

Since isobutylene may be produced as a byproduct in the manufacture of acetic acid from the aldolization product of acetone (diacetone-alcohol), substances such as neohexane, triptane, and isooctane become potential produts of a fermentation industry. The same is true for ethylbenzene and mesitylene. Blending octane numbers of light ketones are given. Specifications are given for a fuel of composition: Isopentane 20, isooctane 25, benzene 5, ethylbenzene 35, methyl isobuty ketone 15 percent. The Motor and Research Method octane numbers for the unleaded, for that with 2 ml. T.E.L. per gallon, and for that with 4 ml. T.E.L. per gallon are, respectively, 190.5/102, 102/107, and 107/109. Extraction methods by means of selective solvents or selective absorption which may supplant fractionation are outlined briefly.

1948

ANONYMOUS (1558)

ALCOHOL-WATER INJECTION TO RECEIVE FURTHER STUDY. Petrol. Processing 3 (1): 12. 1948.

The new research program on water-alcohol injection at the Northern Regional Research Laboratory is discussed briefly.

——— (1559)

OUT OF GAS. Time 51 (6): 36. Feb. 9, 1948.

To relieve the gasoline shortage, the Cuban Government has set aside 40 million gallons of blackstrap molasses for the making of power alcohol for blending.

——— (1560)

POWER ALCOHOL. Chem. and Engin. News 26: 342. 1948.

A panel has been set up by the Government of India for the purpose of making recommendations regarding the development of the sugar, alcohol, and food-yeast industries during the postwar period. This panel has recommended the compulsory admixture of gasoline with power alcohol in the proportion of 80:20. There are 250,000 tons of molasses available for the production of power alcohol.

HELDT, P. M. (1561)

KNOCK-FREE ENGINE OPERATION ON LOW-OCTANE GASOLINE. Automotive Indus. 98 (2): 32–33, 68, 70, 72. 1948.

After discussing briefly the principle of the Vita-meter (see No. 525), the use of the antidetonating fluid Vitol is recommended. It has the following tentative composition: 85 percent alcohol (of which at least 50 percent should be methanol), 15 percent water and 3 ml. T.E.L. per gallon. Improvements in road octane numbers with Vitol injection are given for Dodge, Chevrolet, GMC truck, Pontiac, and Ford engines. Best results would be obtained if a straight-run instead of a cracked, reformed, or blended fuel was used. Economics of operation is discussed.

OBERT, E. F. (1562)

DETONATION AND INTERNAL COOLANTS. Soc. Automotive Engin. Quarterly Trans. 2: 52–58. 1948.

The effect of coolant water is to suppress detonation by slowing down combustion time and by lowering the temperature of the end portion of the charge. Ethanol behaves similarly when added to rich mixtures. For lean mixtures, however, the antiknock qualties of ethanol are important.

INDEX OF AUTHORS

[Refers to item numbers]

SUBJECT INDEX

[Index refers to item numbers. Comparatively fuller information will be found in items indicated by bold face type.]

LIST OF TECHNICAL PUBLICATIONS

A.D.I.	American Documentation Institute. Washington.
Acad. d'Agr. de France. Compt. Rend.	Académie d'Agriculture de France. Comptes Rendus Hebdomadaires des Séances. Paris.
Acad. des Sci. U.R.S.S. Compt. Rend. (Dok.)	Académie des Sciences de l'U.R.S.S. Comptes Rendus (Doklady). Moscow.
Acta Chem. Fenn.	Acta Chemica Fennica (on the cover Suomen Kemistilehti). Helsinki.
Aero Digest	Aero Digest. New York.
Aeronaut. Engin. Rev.	Aeronautical Engineering Review. New York.
Aeronaut. Res. Inst., Tokyo Imp. Univ. Rpt.	Aeronautical Research Institute, Tokyo Imperial University. Reports. Tokyo.
Agr. Engin.	Agricultural Engineering. St. Joseph, Michigan.
Agr. Mexicano	El Agricultor Mexicano. Juárez.
Aircraft Engin.	Aircraft Engineering. London.
Allg. Auto. Ztg.	Allgemeine Automobile Zeitung. Berlin.
Allg. Oel u. Fett-Ztg.	Allgemeine Oel- und Fett-Zeitung. Berlin-Lichterfelde.
Aluminium	Aluminium. Berlin.
Amer. Assoc. Petrol. Geol. Bul.	American Association of Petroleum Geologists. Bulletin. Tulsa, Oklahoma.
Amer. Chem. Soc. Jour.	American Chemical Society Journal. Washington.
Amer. Inst. Mining and Metall. Engin. Trans.	American Institute of Mining and Metallurgical Engineers. Transactions. New York.
Amer. Jour. Phys.	American Journal of Physics. New York.
Amer. Petrol. Inst., Proc.	American Petroleum Institute. Proceedings. New York.
An. de la Soc. Cient. [Argentina]	Anales de la Sociedad Cientifica Argentina. Buenos Aires.
Analyst	Analyst. London.
Angew. Chem.	Angewandte Chemie. Berlin.
Ann. Appl. Biol.	Annales of Applied Biology. London.
Ann. de Chim.	Annales de Chimie. Paris.
Ann. de Chim. Analyt.	Annales de Chimie Analytique et de Chimie Appliquée et Revue de Chimie Analytique Réunies. Paris.
Ann. de Gembloux	Annales de Gembloux. Anderghem, Belgium.
Ann. de l'Univ. de Sofia	Annuaire de l'Université de Sofia. Sofia, Bulgaria.
Ann. des Falsif.	Annales des Falsifications et des Frauds. Paris.
Ann. des Mines et Carburants Mém.	Annales des Mines et Carburants Mémoirs (France, Ministère des Travaux Publics, des Postes et des Télégraphes). Paris.
Ann. di Chim. Appl. [Rome]	Annali di Chimica Applicata. Rome.
Ann. Zymol.	Annales de Zymologie. Brussels, Belgium.
Armour Engin.	Armour Engineer and Alumnus. Chicago.
Arts et Métiers	Arts et Métiers. Paris.
Asoc. de Téc. Azucareros Cuba, Bol.	Asociación de Técnicos Azucareros de Cuba. Boletin. Havana.
Asoc. Quím. Argentina An.	Asociación Química Argentina. Anales. Buenos Aires.
Assoc. de Ingen. Agrón. Rev.	Associación de Ingenieros Agrónomos. Revista. Montevideo, Uruguay.
Assoc. des Chim. Bul.	Association des Chimistes. Bulletin. Paris.
Assoc. des Chim. de Sucr. et Distill. Bul.	Association de Chimistes de Sucrerie et de Distillerie de France et des Colonies. Bulletin. Paris.
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Assoc. Franc. des Tech. du Pétrole	L'Association Française des Techniciens du Pétrole. Paris.
Assoc. Quím do Brasil An.	Associacão Química do Brasil. Anais. Rio de Janerio.
Astronautics	Astronautics (American Rocket Society). New York.
Atti di Guidonia	Atti di Guidonia. Rome.
Austral. Advisory Council Sci. and Indus. Bul.	Commonwealth of Australia. Institute of Science and Industry Bulletin. Melbourne.
Austral. Chem. Inst. Jour. and Proc.	Australian Chemical Institute. Journal and Proceedings. Melbourne.
Austral. Council Sci. & Indus. Bul.	Australia. Council for Scientific and Industrial Research. Bulletin. Melbourne.
Australasian Engin.	The Australasian Engineer. Sydney.
Auto. Engin.	Automobile Engineer. London.
Auto.-Rundschau	Automobile-Rundschau, Zeitschrift des Mitteleuropäischen Motorwagen-Vereins. Berlin.

Auto-Tech.	Auto-Technik. Berlin.
Autocar	Autocar. London.
Autogene Metallbearbeit.	Autogene Metallbearbeitung. Zentralblatt für Azetylen und für autogene Schweiss- und Schneidtechnik. Halle.
Automobile	Automobile. New York.
Automobiltech. Ztschr.	Automobiltechnische Zeitschrift. Berlin.
Automotive and Aviation Indus.	Automotive and Aviation Industries. Philadelphia.
Automotive Indus.	Automotive Industries. Philadelphia.
Automotive Mfr.	Automotive Manufacturer. New York.
Aviation Maintenance	Aviation Maintenance. New York.
Bau u. Werk	Bau und Werk (Österreichischer Ingenieur und Architektenverein). Vienna.
Bibliog. of Sci. and Indus. Rpts.	Bibliography of Scientific and Industrial Reports. U. S. Department of Commerce. Washington.
Bol. de Divulgação do Inst. de Óleos	Boletin de Divulgação do Instituto de Óleos. Rio de Janeiro.
Bol. de Inform. Petrol. [Buenos Aires]	Boletin de Informaciones Petroleras. Buenos Aires.
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Brennstoff-u. Wärmewirt.	Brennstoff-und Wärmewirtschaft. Halle.
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Bur. of Supplies, Engin. Service, Foreign Econ. Admin.	Bureau of Supplies, Engineering Service, Foreign Economic Administration. Washington.
Burma Dept. Agr., Agr. Survey	Burma Department of Agriculture. Agricultural Survey. Rangoon.
Cairo Sci. Jour.	The Cairo Scientific Journal. Cairo, Egypt.
Calif. Cult.	California Cultivator. Los Angeles.
Canad. Automotive Trade	Canadian Automotive Trade. New York.
Canad. Chem. and Metall.	Canadian Chemistry and Metallurgy. Toronto.
Canad. Jour. Econ. and Polit. Sci.	The Canadian Journal of Economics and Political Science. Toronto.
Canad. Jour. Res. Sect. A, Phys. Sci., Sect. B, Chem. Sci.	Canadian Journal of Research. Section A. Physical Sciences, Section B, Chemical Sciences. Ottawa.
Canada Natl. Res. Council Rpt.	National Research Council of Canada. Report. Ottawa.
Carburants Nat.	Les Carburants Nationaux. Paris.
Ceres	Ceres. Escola Superior de Agricultura do Estado de Minas Gerais. Brazil.
Chaleur et Indus.	Chaleur et Industrie. Revue Mensuelle des Industries du Fue. Paris.
Chem. Age [London]	Chemical Age. London.
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Chem. and Engin. News	Chemical and Engineering News. Washington.
Chem. & Metall. Engin.	Chemical & Metallurgical Engineering. New York.
Chem. Engin. and Mining Rev.	Chemical Engineering and Mining Review. Melbourne, Australia.
Chem. Engin. [China] Jour.	Journal of Chemical Engineering. Tientsin. China.
Chem. Indus. [Japan] Jour.	Chemical Industry, Japan. Journal. Tokyo.
Chem. Indus. [New York]	Chemical Industries. New York.
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Chem. Markets	Chemical Markets. New York.
Chem. Metall. and Mining Soc. So. Africa. Jour.	Chemical, Metallurgical and Mining Society of South Africa. Journal. Johannesburg.
Chem. Obzor	Chemický Obzor. Prague.
Chem. Rev.	Chemical Reviews. Baltimore.
Chem. Rundschau f. Mitteleuropa u. Balkan [Budapest]	Chemische Rundschau für Mitteleuropa und den Balkan. Budapest.
Chem.-Tech. Rundschau	Chemische-Technische Rundschau und Anzeiger der Chemische Industrie. Berlin.
Chem. Trade Jour. and Chem. Engin.	Chemical Trade Journal and Chemical Engineer. London.
Chem. Weekbl.	Chemische Weekblad. Amsterdam.
Chem. Ztg.	Chemiker-Zeitung. Cöthen, Germany.
Chemicals	Chemicals. New York.
Chemie	Die Chemie. Berlin.
Chim. & Indus. [Paris]	Chimie et Industrie. Paris.
Chim. e l'Indus.	La Chimica e l'Industria. Milan.
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Chinese Indus.	Chinese Industry.

Chinese Inst. Engin. Jour.	Chinese Institute of Engineers. Journal. American Section, New York. Chinese Section, Shanghai.
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Cong. Internaz. del Carbonio Carburante III°. Rome	Congresso Internazionale del Carbonio Carburante III°. Rome.
Cong. Internaz. di Chim., Atti X°	Atti del Congresso Internazionale di Chimica X°. Rome.
Cong. Mondial du Pétrole II^{me}, Paris	Congrès Mondial du Pétrole II^{me}. Paris.
Cong. Naz. di Chim. Indus. Atti	Congresso Nazionale di Chimica Industriale. Atti. Milan.
Cong. Naz. di Chim. Pura ed Appl. Atti	Congressi Nazionale di Chimica Pura ed Applicata. Atti. Rome.
Cong. Prod. Colon. Marseilles	Congrès Production Coloniale. Marseilles.
Coronet Mag.	Coronet Magazine. Chicago.
Current Sci. [India]	Current Science. Indian Institute of Science. Bangalore.
Dépéche Algérienne	Dépéche Algérienne. Alger, North Africa.
Deut. Kraftfahrtforsch.	Deutsche Kraftfahrtforschung im Auftrag des Reichs-Verkehrsministeriums. Berlin.
Deut. Zuckerindus.	Deutsche Zuckerindustrie. Berlin.
Dinglers Polytech. Jour.	Dinglers Polytechnisches Journal. Berlin.
Elec. World	Electrical World. New York.
Enregia Termica	L'Energia Termica. Milan.
Engin. Digest	The Engineers' Digest. New York.
Engineer	The Engineer. London.
Engineering	Engineering; an Illustrated Weekly Journal. London.
Engineers and Engin.	Engineers and Engineering. Philadelphia.
Erdöl u. Teer	Erdöl und Teer. Berlin.
Facts About Sugar	Facts About Sugar, including Sugar and The Planter and Sugar Manufacturer. New York.
Féd. des Indus. Chim. Belg. Bul.	Fédération des Industries Chimiques de Belgique. Bulletin. Brussels.
Fette u. Seifen	Fette und Seifen. Berlin.
Finnish Paper and Timber Jour.	Finnish Paper and Timber Journal. Helsinki.
Flight	Flight (Royal Aero Club of the United Kingdom). London.
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Food Indus.	Food Industries. New York.
Foreign Com. Weekly	Foreign Commerce Weekly. Washington.
France Agr.	La France Agricole. Paris.
[France] Ann. de l'Off. Natl. des Combustibles Liquides	Annales de l'Office National des Combustibles Liquides. Paris.
France Énergètique	La France Énergètique. Paris.
Fuel Conf. Trans., World Power Conf. London. 1928	Transactions of the Fuel Conference, a Sectional Meeting of the World Power Conference. London. 1928.
Fuel in Sci. and Pract.	Fuel in Science and Practice. London.
Fuel Soc. [Japan] Jour.	Fuel Society of Japan. Journal. Kawaguchi Saitama.
Gas and Oil Power, Ann. Tech. Rev. No.	Gas and Oil Power, Annual Technical Review Number (Incorporating "The Internal Combustion Engineer"). Dumfriesshire, England.
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Gas World	The Gas World. London.
Génie Civil	Le Génie Civil. Paris.
Gior. di Bibliog. Tec. Internaz.	Giornale di Bibliografia Tecnica Internazionale. Bologne.
Gior. di Chim. Indus. ed Appl.	Giornale di Chimica Industriale ed Applicata. Milan.
Gior. di Farm. di Chim. e di Sci. Affini	Giornale di Farmacia, di Chimica e di Scienze Affini. Turin.
Grazhdanskaya Aviatsiya (U.S.S.R.)	Grazhdanskaya Aviatsiya U.S.S.R. Moscow.
[Gt. Brit.] Dept. Sci. and Indus. Res. Fuel Res. Bd.	Great Britain. Department of Scientific and Industrial Research. Fuel Research Board. London.
[Gt. Brit.] Imp. Inst. Bul.	Imperial Institute Bulletin. London.
Idaho Agr. Expt. Sta. Bul.	Idaho University Agricultural Experiment Station. Bulletin. Moscow.
Ill. State Acad. Sci. Trans.	Illinois State Academy of Science. Transactions. Springfield.
Illus. Motorztg.	Illustrierte Motorzeitung. Berlin.
Imp. Acad. Japan. Proc.	Imperial Academy of Japan. Proceedings. Tokyo.

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New Zeal. Jour. Agr.	New Zealand Journal of Agriculture. Wellington.
New Zeal. Jour. Sci. and Technol.	New Zealand Journal of Science and Technology. Wellington.
Notiz. Chim. Indus.	Il Notiziario Chimico-Industriale. Milan.
Novosti Tekhniki	Novosti Tekhniki. Moscow.
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Oel und Kohle ver. Petrol.	Oel und Kohle vereinigt mit Petroleum und Bohrtechniker-Zeitung mit den Mineralöl-Berichten. Berlin.
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Oil and Gas Jour.	Oil and Gas Journal. Tulsa, Okla.
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Oil Engin. and Technol.	Oil Engineering and Technology. London.
Oil News	Oil News. London.
Oil, Paint, and Drug Rptr.	Oil, Paint, and Drug Reporter. New York.
Oil Weekly	Oil Weekly. Houston, Texas.
Oil Trade	The Oil Trade. New York.
Oklahoma Farm Chemurgic Conf. Proc.	Oklahoma Farm Chemurgic Conference. Proceedings.
Oléagineux	Oléagineux (Revue Mensuelle des Matiéres Grasses). Paris.
Olii Minerali, Olii e Grassi, Colori e Vernici	Olii Minerali, Olii e Grassi, Colori e Vernici. Milan.
Olivicoltore	L'Olivicoltore. Rome.
Österr. Chem. Ztg.	Österreichische Chemiker-Zeitung. Vienna.
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Papir-Jour.	Papir-Journalen. Fachorgan for Traemasse-Cellulose & Papirindustri. Oslo, Norway.
[Paris] Acad. des Sci. Compt. Rend.	Institut de France. Académie des Sciences. Comptes Rendus Hebdomadaires des Séances. Paris.
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Petrol. Age	Petroleum Age and Service Station Merchandising. Chicago.
Petrol. Processing	Petroleum Processing. Cleveland, Ohio.
Petrol. Refiner. Proc.	Petroleum Refiner Proceedings. Houston, Texas.
Petrol. Times	Petroleum Times. London.
Petrol. World [London]	Petroleum World. London.
Petrol. Ztschr.	Petroleum Zeitschrift. Vienna.
Petroleum [London]	Petroleum. London.
Pharm. Weekbl.	Pharmaceutisch Weekblad. Amsterdam.
Phil. Mag. and Jour. Sci.	Philosophical Magazine and Journal of Science. London, Edinburgh, and Dublin.
Philippine Agr.	Philippine Agriculturist. Los Bãnos.
Philippine Jour. Sci.	Philippine Journal of Science. Manila.
Philippine Sugar Assoc., Ann. Repts.	Philippine Sugar Association. Annual Reports. Manila.
Philippine Univ. Nat. and Appl. Sci. Bul.	Philippine Islands University. Natural and Applied Science Bulletin. Manila.
Planter and Sugar Mfr.	Planter and Sugar Manufacturer. New York.
Politecnico [Italy]	Il Politecnico (Rivista di Ingegneria, Tecnologia, Industria, Economia, Arte). Milan.
Praktika Akad. Athenon	Praktika tes Akademias Athenon. Athens, Greece.
Power	Power. New York.
Power Plant Engin.	Power Plant Engineering. Chicago.
Power Wagon	Power Wagon. Chicago.
Prog. Agr. et Vitic.	Progrès Agricole et Viticole. Montpellier, France.
Przegląd Chem.	Przegląd Chemczny. Lwów, Poland.
Przegląd Mech.	Przegląd Mechaniczny. Warsaw, Poland.
Przemysł Chem.	Przemysł Chemiczny. Warsaw, Poland.
Przemysł Naftowy.	Przemvsł Naftowy (Rock Oil Industry). Lwów, Poland.
Pulp and Paper Mag. Canada	Pulp and Paper Magazine of Canada. Toronto and Montreal.
Quím e Indus.	Química e Industria. São Paulo, Brazil.
R. Scuola Super. Agr. in Portici, Ann.	Regia Scuola Superiore di Agricultura in Portici. Annali. Naples.
Rass. Med. Appl. Lav. Indus.	Rassegna di Medicina Applicata al Lavore Industriale. Turin.
Rass. Min. e Metall. Ital.	Rassegno Mineraria e Metallurgica Italiana. Rome.
Rev. Agr. de l'Ile Maurice	Revue Agricole de l'Ile Maurice. Port Louis, Mauritius.
Rev. Brasil de Quím. (Sci. & Indus.)	Revista Brasileira de Química (Sciencia & Industria). São Paulo, Brazil.
Rev. de Agr., Com. y Trab. [Cuba]	Revista de Agricultura, Comercio y Trabajo. Havana.
Rev. de Aluminium	Revue de Aluminium et de ses Applications. Paris.

Rev. de Indus. Minérale	Revue de l'Industrie Minérale. St. Etienne, Loire, France.
Rev. de Ingen. Indus. [Madrid]	Revista de Ingenieria Industrial. Madrid.
Rev. de l'Ingén. et Index Tech.	Revue de l'Ingénieur et Index Technique. Brussels.
Rev. de Métall.	Revue de Métallurgie. Paris.
Rev. des Combustibles Liquides	La Revue des Combustibles Liquides. Paris.
Rev. des Prod. Chim.	La Revue des Produits Chimiques. Paris.
Rev. Gén. des Sci. Pures et Appl.	Revue Généralle des Sciences Pures et Appliquées. Paris.
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Rev. Pétrol.	La Revue Pétrolifère. Paris.
Rhodesia Agr. Jour.	Rhodesia Agricultural Journal. Salisbury.
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Ricerche Sez. Sper. Zuccheri, R. Univ. Studi Padova. Inst. di Chim. Indus.	Ricerche della Sezione Sperimentale Zuccheri Sotto il Patrocinio del Consiglio Nazionale delle Ricerche, R. Universita degli Studi di Padova Instituto di Chimica Industriale. Padua.
Riv. Aeronautica	Rivista Aeronautica. Ministerio de Aeronautica. Rome.
Riv. Ital. del Petrol.	La Rivista Italiana del Petrolio. Rome.
Roy. Soc. Arts Jour.	Royal Society of Arts Journal. London.
Roy. Soc. London. Proc. Ser. A	Royal Society of London. Proceedings Series A, Mathematical and Physical Sciences. London.
Schweiz. Tech. Ztschr.	Schweizerische Technische Zeitschrift. Basel.
Schweiz. Ver. Gas- u. Wasserfach. Monats-Bul.	Schweizerischer Verein von Gas- und Wasserfachmännern. Monats-Bulletin. Zurich.
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Sci. and Indus. [Australia]	Science and Industry. [Australia]. Melbourne.
Sci. and Indus. Res. [India] Jour.	Scientific and Industrial Research. Journal. New Delhi, India.
Sci. et Indus. Tech. des Indus. du Pétrole	Science et Industrie. La Technique des Industries du Pétrole. Paris.
Sci. Lubrication	Scientific Lubrication and Liquid Fuel. Chicago.
Sci. News Letter	Science News Letter. Washington.
Science	Science. New York.
Science [China]	Science. Science Society of China. Shanghai.
Scientia	Scientia. Valparaiso, Chile.
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So. African Engin.	South African Engineering. London.
So. African Inst. Engin. Jour.	South African Institution of Engineers. Journal. Johannesburg.
So. African Jour. Indus.	South African Journal of Industries. Pretoria.
So. African Jour. Sci.	South African Journal of Science. Johannesburg.
So. African Sugar Jour.	South African Sugar Journal. Durban.
So. African Sugar Technol. Assoc. Proc.	South African Sugar Technologists' Association. Proceedings. Durban.
Soc. Automotive Engin. Jour. Quarterly Trans.	Society of Automotive Engineers. Journal, Quarterly Transactions. New York.
Soc. Chem. Indus. [Japan] Jour.	Society of Chemical Industry Japan. Journal. Tokyo.
Soc. Chem. Indus. Jour., Chem. and Indus., Trans. and Commun.	Society of Chemical Industry Journal, Chemistry and Industry, Transactions and Communications. London.
Soc. Chem. Indus. [Victoria] Proc.	Society of Chemical Industry of Victoria. Proceedings. Melbourne, Australia.
Soc. Chim. de France, Bul. Doc., Bul. Mém.	Société Chimique de France. Bulletin . . . Documentation, Bulletin . . . Mémoires. Paris.
Soc. Cubana de Ingen. Rev.	Sociedad Cubana de Ingenieros. Revista. Havana.
Soc. d'Encouragement pour Indus. Natl. Bul.	Société d'Encouragement pour l'Industrie Nationale. Bulletin. Paris.
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Soc. dei Naturalisti e Mat. di Modena	Società dei Naturalisti e Matematici di Modena. Italy.
Soc. des Brasseurs. Ann.	Soc. des Brasseurs pour l'Enseignement Professionel. Annales. Ghent, Belgium.
Soc. des Ingén. de l'Auto. Jour.	Société des Ingénieurs de l'Automobile. Journal. Paris.
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Soc. Indus. de l'Est. Bul.	Société Industrielle de l'Est. Bulletin. Nancy.
Soc. Mech. Engin. [Japan] Trans.	Society of Mechanical Engineers. Transactions. Tokyo.
Soc. Quím. del Peru Bol.	Sociedad Química del Peru. Boletin. Lima.
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Sugar Cent. and Planters News	Sugar Central and Planters News. Manila.

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