APPRAISAL OF TREATED BURLAP BAGS *for Shipping Wool*

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U. S. DEPARTMENT OF AGRICULTURE
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MARKETING ECONOMICS DIVISION

PREFACE

This report presents the results of concerted efforts of the wool industry and the U. S. Department of Agriculture to find the answer to the problem of jute fiber contamination of wool.

Special recognition is made to The Top Company and its affiliated subsidiary, the Barre Wool Combing Company, and The North Central Wool Marketing Cooperative for obtaining the wool used in the study and assisting in the research. Also contributing in the research were the U. S. Department of Agriculture's Agricultural Research Service, Western and Southern Utilization Research and Development Divisions, and Agricultural Marketing Service, Denver Wool Laboratory.

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SUMMARY

Regular burlap bags and latex rubber-treated bags were tested for suitability as shipping containers for wool by measuring, counting, and identifying contaminating matter appearing in fabrics made from wool shipped in each type of bag. The results did not justify changing to the rubber-treated bags, because defects still appeared in the cloth that was made from the wool shipped in the treated bag. These defects were identified as being from native grasses. The treated burlap did sharply reduce the degree of jute contamination but not enough to justify the added cost of new containers.

Tests and observations made in the study provided the wool industry with greater understanding of the sources of vegetable contamination and showed where effort should be directed in working on a solution to this problem.

When wool fabrics made from both the test and control lots were first examined using only a low-power magnifying glass, a large percentage of the defects were classified as jute. Further analysis, however, by means of a microscope, showed that less than 4 percent of these defects, all but one of which were in the control lot, were actually jute, the rest being native grasses. Even though the cloth made from the wool shipped in the test bags contained almost no jute, the test bag had little effect in eliminating defects in wool caused by other contaminants.

Fiber contamination differs according to source of wool; the degree of contamination depends on the husbandry of the sheep and the care with which wool is handled, warehoused, and processed. If a rapid method for analyzing contaminant fiber could be devised, this would help to identify these sources more easily. A practical method of grading wool that more adequately reflects the presence and type of contaminating fibers is also needed.

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INTRODUCTION

The Wool Contamination Problem

Contamination of wool is a serious problem in the wool industry. It is not a new problem; it has become more significant in recent years because of the competition between wool and synthetic fibers for use in apparel and household-use fabrics.

Synthetic fiber and fabric producers can make and handle their products in contaminant-free environments. Their fabrics have strong visual appeal because of their purity and freedom from appearance-detracting defects.

Wool fiber, on the other hand, is produced in the environment of the living sheep, and a part of this environment is carried with it into the processing plant and into the wool fabric. For example, range flocks are branded with painted letters on the wool of the sheep's back. After the sheep are sheared, the fleeces are tied with twine (now mostly paper twine is used, but sisal twine or cotton string is still used occasionally) and packed into a burlap bag for shipment to the market. Between 30 and 80 percent of the total weight of the greasy wool is made up of nonwool material.

Over the years wool processors have found ways to separate most of these nonwool materials from wool without damage to the wool. Fleece ties, nonscourable paint brands, stones, pieces of wire, and many other extraneous items are removed from the wool by hand sorting, or on trappers' tables. Grease, dirt, and scourable paints are scoured out of the fleeces; most of the burrs, straw, and seeds in the wool are separated during carding, pin drafting, and gilling. Combing removes short fibers of wool and small pieces of chaff or paint.

Processes have been devised to remove every form of material that contaminates wool except fibers that behave like wool. These fibers can be processed along with the wool and become an integral part of the woven fabric. Only after the fabric is dyed do these nonwool fibers usually become strikingly evident.

Wool is a protein fiber, and dyes suited to wool react differently on vegetable fibers. Therefore, when a wool fabric with some vegetable fiber in it is dyed, the vegetable fibers show up as undyed specks or flaws of a different color.

Processors have used many procedures in an effort to correct this problem. Some of them are:

1. A carbonizing treatment to degrade vegetable fibers. After the carbonization, the vegetable fibers are dusted out.

2. A two-dye system, one a wool dye and one a vegetable dye of the same color.

3. Shipping fleeces to the processing plant in bags made out of wool.

4. Making wool fabrics that are a mixture of white and dyed fibers, such as oxford gray.

Each of these procedures, although useful to some degree, has been found wanting in one or more respects.

Carbonizing would work except for certain drawbacks. For not only does the acid bath degrade vegetable fibers, but it can degrade wool fibers too, depending on the time, temperature, and strength of the acid. Hard vegetable fibers, such as jute, require more severe conditions to carbonize them than chaff, burrs, or straw, and the wool fibers are degraded in the process.

Wool fibers are often blended with cotton, acetate, or synthetic fibers in the fabric. Many of these blends cannot be given a carbonizing treatment because it would destroy the nonwool fibers.

Carbonizing the wool fibers before spinning or weaving is not usually satisfactory, especially for worsted system processors, because the treatment reduces the spinning and weaving qualities of the wool fibers too greatly.

A two-dye system is not satisfactory. In addition to the costs involved, the processes for dyeing cellulosic fibers are not sufficiently different from the wool dyeing processes to make the wool unaffected by the next dye bath.

The apparel industry wants light-weight fabrics that are single-dyed in pastel colors. However, defects in wool are much more likely to show in such pastel fabrics. This tends to limit the use of wool to heavy dark fabrics.

Shipping containers made of wool are believed to be intolerably expensive for "one-time" use. Trade practice requires the producer or shipper to furnish the containers which then become the property of the processing plant. These containers are sold or used for other purposes. If a reusable container for the wool shipments was adopted by the industry, not only would rehandling costs be involved, but also loss in income by the processing plants from the sales of the used containers.

A new type of container for wool shipments offers the most logical way of preventing jute contamination of the wool. The latex-treated bag devised in this study was tested as such a container. This report contains the results of these tests.

Design of a New Type of Wool Bag

It was recognized that the surest way to dispose of the jute problem was to use another kind of container. But every alternative material tested was discarded because of economic, technical, or physical limitations. Burlap had better economic and physical attributes for the job than any other known material. If a fiber-bonding technique could be devised that would overcome the technical problem of jute fiber shedding onto wool, such a modified burlap might offer the best alternative to the untreated burlap. A latex-rubber impregnating process, already used in making other textile products, was tried on burlap. After several attempts, a procedure was devised that yielded a treated burlap with fibers strongly bonded, "open windows" in the weave, and a nontacky surface free of loose fibers.

Preliminary tests on this treated burlap showed that it was almost 20 percent stronger and had flex abrasion strength about equal to untreated burlap of the same weight. The treated burlap was heavier; bags made with it weighed approximately 15 percent more than bags made with untreated burlap. Enough burlap was treated to make 100 standard dimension bags (40 x 88 inches) for the experiment.

HANDLING OF WOOL DURING THE TEST

The Top Company and the North Central Wool Marketing Cooperative, working together, obtained enough wool from one ranch in South Dakota for approximately 200 bags. The entire wool lot was then divided into two equal parts -- one part was put into the 100 treated bags and the other part was put into 100 regular, or untreated, burlap bags. The Department of Agriculture participated in the testing of the bags, beginning with the shearing, and on through all stages of processing the wool into cloth. The Department analyzed the defects in each lot of wool cloth produced.

Shearing and bagging.--The wool was sheared in June 1960. Before the shearing started, the shearing shed was thoroughly cleaned; all sheep barriers made of burlap and other items such as sisal twine and hay baling strings were removed from the shed.

The shearing crew was given a short description of the job to be done. Among other things, the crew was required to use leather instead of the usual ropes for tying the legs of the sheep; the wranglers were required to use pieces of heavy paper instead of pieces of burlap to rustle the sheep into pens.

All the sheep that were sheared were ewes with 14 months growth of wool. They were all from the same ranch and range and provided an even-running lot of 3/8's and mostly 1/2-blood wools for the test.

The test bags were filled first, and were moved to the warehouse in Belle Fourche, S. Dak., separately from other bags of wool. The control lot was also handled separately from other wools and, like the test lot, excluded tags, floor sweepings, and black face or black spot fleeces.

Warehousing and shipping.--At the warehouse, the test and control lots were stored adjacent to, but separate from each other, and from other bags of wool. A cover was put over the tops of bags in each lot to protect the wool from being contaminated with lint and airborne trash.

The test lot was shipped to Woonsocket, R. I., in a specially cleaned railroad car used exclusively for the 100 bags of wool. The control lot was combined with another lot in regular burlap bags to make up a full carload. At The Top Company's wool warehouse in Woonsocket the two lots of wool were segregated, covered, and stored for 16 months, while arrangements for processing and testing were made.

In September 1961, the two lots were moved from Woonsocket to the Barre Wool Combing Company and again kept apart from other lots of wool.

Opening and sorting.--In October 1961, the two lots of wool began to move through processing into top. Employees of the plant handling the test and control lots were told about the cleanliness and care needed for the test and control lots to assure a fair test. An additional supervisor for each processing section and for each work shift was provided to assist in maintaining much-stricter-than-normal conditions for wool processing.

On the grading and trapping tables, fleeces of each lot of wool were untied and sorted. Fleeces graded 58's and below were discarded. Paint brand spots were pulled from fleeces, and fribs (dungy locks, stones, and pieces of dried clay) were shaken out. Table 1 shows the results of hand sorting and opening of fleeces during the processing of the greasy wool.

Table 1.--Materials removed from fleeces during sorting and trapping, test and control lots

Item	Lot L-226 (test bags)	Lot L-227 (control bags)
	Pounds	Pounds
Gross weight of original lots	28,734	26,877
Paint wool removed	443	618
Off sort 58's and under (whole fleeces)	3,232	2,468
58's (pieces of fleeces)	176	105
Brown ends (tags)	52	49
Burry	97	45
String	143	134
Black wool	.5	---
Drier speckings (after scouring)	.5	.5
Net weight of grease wool scoured	24,590	23,457.5

Source: Grease wool report "The Wool Room" - Barre Wool Combing Company, Oct. 23-28, 1961

Scouring, carding, and combing.--Before scouring began, feeder, bowls, and dryer were painstakingly cleaned. Clean water and fresh detergents were used in the bowls. Cards, pindrafters, combs, gilling machines, and sliver canisters were similarly cleaned, as well as all the work zones through which the test lots were to move as they were converted into top.

The wool was noble-combed, and canisters of the comb sliver of each lot were commingled to produce a homogeneous mixture of the wool in each lot in top form. Ends from 20 to 30 comb sliver cans were fed together into the gilling machine and into each single strand of top.

Twelve 1/2-ounce and six 1-pound samples of top from each lot were analyzed for staple length, fiber diameter, and contaminants at the time of processing. These samples showed the two lots to be identical (within the tolerance for sampling error) in all of these respects. A summary of these analyses is shown in figure 1. Five

WOOL BAG EXPERIMENT

ANALYTICAL REPORT

TEST LOT RUBBER LATEX TREATED BAGS								CONTROL LOT REGULAR BAGS						
Individual tests									Individual tests					
6	5	4	3	2	1	Ave.		Ave.	1	2	3	4	5	6
LOT 226							ANALYSIS	LOT 227						
			23.2	22.7	22.7	22.9	FINENESS Average width (in microns)	23.1	22.8	23.1	23.3			
			90.8	91.8	91.7	91.4	Width distribution 10 to 30 microns (Percent)	90.4	92.7	89.8	88.8			
			9.2	8.2	8.3	8.6	30.1 to 40.0 microns (Percent)	9.6	7.3	10.2	11.2			
			1.0	0.5	0.3	0.6	40.1 microns and over (Percent)	0.5	0.2	1.0	0.3			
			5.2	4.9	4.7	4.9	Standard deviation	5.0	4.7	5.2	5.0			
			3.41	3.48	3.45	3.45	LENGTH Average--inches	3.22	3.29	3.18	3.20			
			1.304	1.294	1.300	1.299	Standard deviation	1.257	1.239	1.259	1.272			
			38.2	37.2	37.7	37.7	Coefficient of variation	39.7	39.7	39.6	39.8			
			16.3	14.1	15.0	15.1	2 inches and under (Percent)	18.1	16.0	18.9	19.5			
0	4	3	3	3	3	2.7	VEGETABLE* Per ½ oz. sample - pieces over one inch (Number)	3.5	10	2	2	4	3	0
59	98	80	110	84	74	84	Pieces under one inch (Point-rating scale)	71	68	87	78	63	63	67
3	2	2.5	2	3	4.5	3.0	PAINT Per ½ oz. sample pieces (Number)	2.3	2.5	1	4	1	2	3.5

*No burlap fiber positively identified in any test.

Figure 1.--Analytical report of the wool bag experiment furnished by The Barre Wool Combing Company, So. Barre, Mass.

balls of top (approximately 20 pounds each) were picked at random to represent the top made from each lot of wool. These were used to represent the two lots in subsequent wool cloth manufacture and dyeing processes. They were shipped to the U. S. Department of Agriculture's Western Utilization Laboratory for drawing, spinning, knitting, and dyeing into finished fabric in the wool processing pilot plant.

Spinning, knitting, and dyeing.--The pilot plant personnel performed all the operations and followed the separation and cleanliness procedures required for each lot. The knitted worsted cloth produced from each sample lot was divided into three equal pieces to be dyed green, blue, and black. A single dye batch for each color was prepared and divided into two equal parts -- one part used for the fabric made from wool shipped in the test bag and the other for the control. In this manner match-dyed pieces of cloth for each color were obtained, one for each lot, without mixing the two lots together even in fabric form.

The three colors of the dye, green, blue, and black, were used because vegetable fiber defects have been noticed most often in fabrics dyed these colors. No significant difference was noted during the tests among the three colors.

Test procedures used were not commercial practices.--In the handling, processing, and sampling procedures described for the commercial operations involved in the bag test, it is obvious that these lots were not handled in a "normal" commercial procedure. There is no normal commercial procedure common to all lots of wool and no test procedure could be devised which would be considered normal by all segments of the industry. For this reason the procedures devised and described for the test were meant to be the best that could be applied to prevent contamination of wool when it was in an ordinary burlap bag -- in this case, the control lot. The test bag lot was to be compared to this. If the treated bags proved to be better than untreated ones in the test, then they would be much better than regular bags with standard handling.

FOREIGN MATTER IN FABRICS

A sequence of observations and procedures were used to measure, count, and determine the nature of contaminating matter in fabrics from each sample lot. These procedures are not used in standard commercial practice. They are used here to make an exhaustive study of the jute fiber contamination problem and to measure the effect the test bag had on this contamination.

In the first step, each piece of cloth was drawn across a tabletop which was lighted from above and from oblique angles at each side with white flourescent lights. Two operators drew the cloth across the table and scanned first the front and then the back for defects. Each defect was circled with chalk.

Next, the defects were examined with a low-power magnifying glass to determine their nature. Beginning from a point at random on the face surface of each piece of cloth tested, 100 premarked defects were examined in detail. A total of 300 defects from each lot of wool (100 defects from each color or piece) were used to compare the two lots and to measure the performance of the test bag. If a defect was suspected to be a jute fiber, it was cut out of the cloth and sent to the Department's Southern Regional Laboratory in New Orleans for further examination. Fiber identification specialists examined these defects under a microscope and made a more accurate identification. Their findings are summarized in table 2.

Table 2.--Analysis of 100 defects per piece of cloth made from wool in the control lot and the test lot, using a low-powered magnifying glass and a microscope

Contaminant	Fabric made from control lot				Fabric made from test-bag lot			
	Blue	Green	Black	Total	Blue	Green	Black	Total
	Defects	Defects	Defects	Defects	Defects	Defects	Defects	Defects
	Original Analysis Using Low-Powered Magnifying Glass							
Vegetable fiber, other than jute	63	62	55	180	84	86	78	248
"Suspected" jute	26	30	23	79	9	10	14	33
Kempy wool	1	0	13	14	2	2	4	8
Paint	5	4	2	11	3	0	2	5
Other 1/	5	4	7	16	2	2	2	6
Total	100	100	100	300	100	100	100	300
	Analysis of "Suspected" Jute Using Microscope							
Darnel fiber	16	17	20	53	9	10	12	31
Kempy wool	5	7	2	14	0	0	1	1
Synthetic fiber	0	0	1	1	0	0	0	0
Jute	5	6	0	11	0	0	1	1
Total 2/	26	30	23	79	9	10	14	33
	Revised Findings of Contaminants in Fabric							
Vegetable fiber, other than jute	79	79	75	233	93	96	90	279
Kempy wool	6	7	15	28	2	2	5	9
Paint	5	4	2	11	3	0	2	5
Other 1/	5	4	8	17	2	2	2	6
Jute	5	6	0	11	0	0	1	1
Total	100	100	100	300	100	100	100	300

1/ Cotton thread, neps, dye-blocked yarn, and other defects not specifically listed.
2/ Report of findings by Southern Utilization Research and Development Division, ARS, Fibers Laboratory, New Orleans, La., July 1962.

A somewhat larger numerical sample of fabric defects could have been obtained if all the defects noted on each surface of the cloth were included. However, many of the defects appeared on both surfaces and would have been counted twice. On account of the bias that could have been introduced by analyzing a larger number of defects, the random group of 100 defects from the face of each piece of cloth was used.

RESULTS OF TEST

The treated bag proved on the basis of analysis of 100 specks of foreign matter from each piece of fabric tested to be at least 10 times better than a regular jute bag in preventing jute contamination. The one instance of jute contamination found in the test lot was a 2-millimeter length piece of fiber.

Size of defects in wool is considered in commercial calculation of the amount of defect in wool too. Eliminating defects less than 5 millimeters (approximately 1/5 inch) in length from scoring greatly reduces the number and changes the ratios of defects found among the 600 contaminant pieces analyzed (table 3).

Table 3.--Kinds of defects 5 millimeters long and longer found in fabrics made from wool shipped in the test bag, and from wool in the control lot

Contaminant	Control lot				Test-bag lot			
	Blue fabric	Green fabric	Black fabric	Total	Blue fabric	Green fabric	Black fabric	Total
Vegetable matter (other than jute)	16	9	7	32	10	13	8	31
Kempy wool	5	5	3	13	0	2	2	4
Paint	0	0	0	0	0	0	0	0
Other 1/	0	0	1	1	0	0	0	0
Jute	4	4	0	8	0	0	0	0
Total defects	25	18	11	54	10	15	10	35

1/ Cotton thread, neps, dye-blocked yarn and other defects not specifically listed.

The significant item in table 3 is the "vegetable matter other than jute." It can be assumed that there is no real difference in the two lots for this item since both test and control lots came from the same ranch. A large part of the fiber material reported here has been identified as a grass fiber belonging to a plant group called "darnel." Species of grasses in this class include fescues and other grasses that are quite common in sheep grazing areas and in harvested forage crops, such as meadow hay.

Because grass fibers occurred so frequently and were difficult to distinguish from the jute fibers in wool, a large number of the "suspected jute" defects in the first identification with a low-powered magnifying glass were not actually jute but grass fibers.

Fibers analyzed in the test and control lots of wool showed that eliminating jute from the bag will not eliminate the problem of wool contamination by jute-like vegetable fibers. The results of this test do not justify changing the design or type of container for shipping wool. There is evidence, however, that further research is needed on this problem.

The wool trade has already noted that fiber contamination in wools differs among sources. The wool is contaminated to different degrees according to the husbandry of the sheep and to the care with which wool is handled, warehoused, and processed.

If wools were sampled and tested by area and source, this would indicate where the problem was most acute, and would identify the fiber contaminants needed to be eliminated. A rapid and easy method for analyzing contaminant fibers would help to make these areas and sources more easily identifiable.

A feasible method for grading wool that more adequately reflects the presence and types of contaminating vegetable matter needs to be devised. A procedure for identifying contaminants in wool before the lots are mixed together for processing could aid producers, warehousemen, and buyers in distinguishing which lots of wool would be a problem in making single-color wool and wool-blend fabrics. Since only a part of wool now produced goes into these types of fabrics, being able to select lots of uncontaminated wool for them in advance would be a step forward.

Carbonizing vegetable matter from wool may be improved. If the vegetable fibers of native grasses could be carbonized with a less harsh procedure than that needed for jute fibers, then this process, plus the use of a shipping container that will not contaminate the wool with jute, should yield a clean product. Further study is needed to solve the problem of contamination of wool.