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FINANCIAL IMPLICATIONS OF WASTE MANAGEMENT SYSTEMS FOR SHELLFISH PROCESSING*

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Shellfish harvesting, processing and marketing are components of an old, established industry in southeastern coastal areas. This traditional industry, with proven production records and established markets for its high-quality shrimp, is being subjected to difficult circumstances which could result in a significant restructuring of various segments of it. Processors are faced with very expensive control outlays required to reduce pollution levels in coastal waters. These pollution control problems are particularly perplexing for both old and new firms, since solutions lead only to higher processing costs in a competitive market, heavily influenced by international conditions.[1]

Financial effects of effluent discharge guidelines are already being felt by processors in those states where early compliance dates are being specified by State environmental protection agencies. In many instances State standards are more stringent than those of the Environmental Protection Agency (EPA). In addition, alternative waste treatment methods have been rejected by some State agencies, resulting in higher costs for meeting specified effluent discharge guidelines.

FINANCIAL IMPLICATIONS OF PRIVATE WASTEWATER TREATMENT FACILITIES

The principal interest of this paper is to demonstrate financial (cash flow basis) implications of private construction of wastewater treatment facilities for processing firms, given their existing technological state in wastewater treatment systems, expected effluent standards, residuals recycling and capital markets. This financial approach to choosing alternative waste disposal systems will assist firms in a timely decision to either build treatment facilities or to cost-share with a municipality on a least-cost basis to the firm. Nonfinancial factors in this decision (not discussed in this paper) would include such considerations as (1) length and security of the contract with the municipality, (2) any additional constraints, delays or nuances expected in negotiating a suitable contract, and (3) attitudes of state regulatory agencies.

Water pollution control equipment may cost as much as 25 to 50 percent of existing plant investment for Gulf Coast seafood plants. In Alaska, costs are estimated at 200 to 300 percent of present plant investment [2]. Estimates by Georgia seafood processors (shrimp and crab) indicate that 20 to 30 percent of total plant investment will be required for additional water pollution control equipment.[2] In addition, those firms required by State agencies to discharge only into a municipal treatment system may incur additional and excessive annual operation and maintenance charges.

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[1]National Marine Fisheries Service data for 1974 indicate that 56 percent of shrimp landings and imports in the U.S. were imports. This is a 17 percent increase in imports over 1971 when imports were only 48 percent of landings and imports (Prochaska, 1974).

[2]Obtained through personal interviews with major processors in the Brunswick, Georgia area.

The need for large injections of capital for pollution control in shellfish processing had complex origins. Many older and smaller firms installed no equipment for reducing biochemical oxygen demand (BOD_5), total suspended solids (TSS), oil and grease (O&G) and acidity (pH).[3] Of six Gulf and Atlantic Coast processing firms (3 shrimp, 3 crab) surveyed in 1972, only one was utilizing secondary treatment of its wastes. The remaining five, all of which processed higher tonnages, discharged directly into rivers or bayous. Five of the six were only screening solids, a primary level of treatment. The one secondary treatment facility (an oxidation pond) was inadequate at only about one-third the necessary size to properly treat discharged wastes [4]. This study of the financial implications of alternative waste management systems is based largely on recently established effluent guidelines.

SHELLFISH PROCESSING WASTE DISPOSAL

The effluent limitations required by July 1, 1977 are based on the best biological or physical-chemical treatment technology currently available.[4] EPA indicates that this technology is represented by screening [5, p. 364]. The July 1, 1983 limitations are based on the best physical-chemical and biological treatment and in-plant control, as represented by reduced water use, and enchanced treatment efficiencies in pre-existing systems as well as on new systems.

The waste disposal problem can be broken into two sub-problems: disposal of solids and disposal or treatment of liquids (or wastewater effluents). In shrimp processing, solids may consist of combinations of the following: heads, shells, meat scraps and, in some cases, shrimp breading wastes. Normally, the solids can be screened out of process and clean-up water by an in-plant screening process (primary treatment). Approximately 90 percent of solids can be removed by the screening process.

Liquid wastes consist of process and clean-up water, which, after screening, continues to carry suspended particles, oil and grease, etc. These wastes must, in order to meet 1977 and 1983 EPA standards, be submitted to secondary treatment and possibly tertiary treatment or delivered to a municipal system where the municipality must treat for compliance with State and/or Federal effluent standards. It is the effluents discharged into navigable waters with which we are immediately concerned.

Historically, seafood processing firms have been located as close to the dock as possible in order to shorten the time interval from the catch to product use or preservation. Although many raw shrimp are preserved on the boat or by handlers who specialize only in temporary preservation for future processing by another firm, the majority of wastes are still generated at or near dockside.

Until recently, handling and processing firms located at or near the dock had a virtual costless (to the firm) method of waste disposal. A pipe or open trough was used to carry heads, shells, scraps, etc. directly into a bay or river where the tides, fish and other natural systems were expected to recycle the effluent. Certainly a portion of seafood wastes can be disposed of in a natural system but there must be a concerted effort to balance the input wastes with the system's ability to assimilate and/or recycle the material. The waste residual cannot be accumulated in quantities harmful to aquatic life. Thus it would seem that indiscriminate dumping of processing wastes leads, in most cases, to the imbalance of a natural system and larger costs to the industry, including the reduced productivity of the fishery.

Wastewaters in shrimp processing are produced directly as: transport water for conveyance, for grading, for peeling and for deveining; process water in cleaning and cooling; wastewater for cleanup, sanitation, waste conveyance and waste processing. A shrimp processing plant requires widely varying quantities of water in processing (Table 1). A typical automatic type plant (automatic peeler-deveiners) requires about 110 to 680 GPM (gallons per minute) or 1 to 2 gallons of water per pound of unprocessed

[3]While there are other parameters such as chemical oxygen demand (COD), settleable solids (SS) etc., BOD_5, TSS, O&G and pH have been selected as "significant parameters." [3, p.4710].

[4]Effluent limitations for discharge to navigable waters are based in general on the characteristics of well-operating screening systems, dissolved air flotation units, and biological treatment systems. Parameters designated to be of significant importance to warrant their routine monitoring in this industry are 5-day biochemical oxygen (BOD), total suspended solids (TSS), oil and grease (O&G) and pH [5, p.3].

(deheaded, raw) shrimp. A typical manually operated peeler-deveiner equipped plant will require only ½ to 1 gallons per pound of unprocessed shrimp. The estimated costs of treatment of these amounts of wastes are used to define the model treatment plant in the financial analysis which follows.

Table 1. TYPICAL SHELLFISH PROCESSING WASTES PRODUCED IN SOUTHEASTERN SHRIMP PROCESSING PLANTS BY SIZE AND TYPE OF OPERATION

Plant Size	Type of Operation	Daily Operating Parameters	Total Effluent	Shrimp Processed	Effluent/ 1000 # Shrimp Processed	Biological Oxygen Demand (BODS) Total	Biological Oxygen Demand (BODS) Per 1000 # Shrimp	Total Suspended Solids (TSS) Total	Total Suspended Solids (TSS) Per 1000 # Shrimp
			(gpd)	(lbs/day)	(gal)	(lbs/day)	(lbs)	(lbs/day)	(lbs)
A	Automatic	Mean	53,425	7,437	7,184	185	25.6	51	7.3
		Max.	121,014	13,000	9,309	465	43.6	134	20.2
		Min.	24,659	3,000	8,220	61	10.5	14	1.8
	Manual	Mean	37,388	8,673	4,311	267	35.4	111	13.6
		Max.	80,160	17,000	4,715	511	100.4	279	39.8
		Min.	18,930	3,000	6,310	107	16.5	31	3.2
B	Manual	Mean	43,810	6,308	6,945	111	13.4	55	11.8
		Max.	63,490	7,352	8,636	148	21.4	92	27.3
		Min.	36,900	4,050	9,111	87	6.7	13	3.3
C[1]	Automatic	Mean	326,040	12,206	26,711	1,879	210.0	2,490	244.3
		Max.	370,800	14,633	25,340	3,715	257.0	4,563	396.0
		Min.	185,770	10,819	17,171	915	70.3	1.008	74.4

[1]The effluent from this plant was not screened and it appears to be the least efficient in its effluent handling.

Note: Estimated secondary treatment costs for the mean size plant above, based on standard municipal treatment practices which include food processing wastes.

A = 53,425 gpd = $16.02/day 0.22/lb. shrimp processed
A = 37,388 gpd = $11.22/day 0.15¢/lb. shrimp processed
B = 43,810 gpd = $13.14/day 0.21¢/lb. shrimp processed
C = 326,040 gpd = $97.81/day 0.80¢/lb. shrimp processed

Sources: Physical measurements in table were derived from Charles R. Horn, *Characterization and Treatability of Selected Shellfish Processing Wastes.* Georgia Inst. Tech., Atlanta, 1972.

ALTERNATIVES FOR COMPLIANCE WITH EFFLUENT STANDARDS

Various alternatives and combinations of alternatives exist for individual firms facing compliance with Federal or State effluent standards. Consideration should be given to initial capital outlay, operation, maintenance and replacement charges, depreciation, tax advantages[5] and methods of financing. While

[5]The Revenue Code of 1970 has been interpreted in IRS guidelines to provide tax subsidy and relief for the installation of pollution control equipment by food processing firms. Such provisions may induce certain firms to elect for in-plant wastewater treatment systems rather than to discharge to municipal systems when cash flow results are advantageous. Pollution equipment receiving accelerated depreciation treatment (ADR) over normal depreciation (NDR) receives subsidy of approximately 17 percent of the acquisition costs or a net savings (after tax) of 8.5 percent. For example, a 40 percent ADR provides a gross first year capital savings of 17 percent and a net savings of 8.5 percent over the use of normal depreciation rates at an effective marginal tax rate of 50 percent. Additional capital savings and cash flow enhancement are provided by the additional first year depreciation allowance and particularly by the liberal investment credit provisions.

Eligibility for special IRS treatment of pollution control equipment requires that: (1) the facility must be certified by a certifying agency such as a state water quality control agency, (2) both investment credit and additional first year depreciation may be claimed on all costs exceeding 15-year expected life, (3) amortization of first 15 years of useful life of equipment may be accelerated to 5 years between 1969-1975 (this seems to result in forfeiture of investment credit), (4) any gains from subsequent sale of equipment or facility is subject to recapture and all amortization benefits are subject to the minimum tax-on-tax preference items. These provisions will be applied in the following considerations of capital and operating costs and cash flow analyses of waste treatment systems available to processors.

net present value analysis would normally point to the lowest cost alternative, a firm should look further at effects on cash flow, profits (short-term and long-term) and other relevant financial considerations.

The seafood processing industry faces two basic choices in meeting the proposed effluent standards — discharge to a municipal system or construct private treatment facilities. In the first, a firm must cost-share, with the municipality, both construction and operating costs if such municipal facilities have received recently or will receive Federal funds for sewage treatment works.[6] This means that contracts must be negotiated between the processing firms and the municipality. Such contracts must allocate treatment facility construction and operating costs (including collector systems) to the using firm.

These cost allocations may be negotiated on the basis of several combinations. Widely varying rules may be established, depending on the sophistication of the negotiators, data available to them and the municipal treatment plant design. The cost allocation may take any or some combination of the following forms:

(1) allocation of construction and operations maintenance and replacement (OM&R) costs on the basis of proportional waste loading (BOD, TSS, O&G, etc.);
(2) allocation of costs on the basis of proportional total effluent (gross volume);
(3) charge per established rates or by adding sewage surcharge either to metered effluent or to water supply;
(4) some combinations or 1, 2 or 3;
(5) require using firm to construct some capital items such as collection system and screening and share treatment plant capital and OM&R costs through some combination of 1, 2 or 3 with 5.

At this time there are few, if any, contracts for industrial repayment of Federal wastewater treatment costs. The decision to accept this alternative must be based on a thorough financial analysis of the major alternative, the construction of an independent treatment plant by the shrimp processor.

THE FINANCIAL ANALYSIS

Data have been organized from work by Horn to establish a magnitude of shellfish wastewater processing requirements (Table 1). A series of model processing plants (manual and automatic) were developed for design and cost parameters (Table 2). These plant requirements were converted to expected capital and operating (OM&R) costs to illustrate the financial (cash flow) implications of meeting effluent discharge standards with in-plant wastewater treatment systems for the smallest feasible plant (Table 3 and 4). These financial costs, adjusted for individual plant requirements, should be compared with any proposed cost-sharing or sewage charge contract with a municipality to determine the attractiveness of the contract to the shellfish processing plant.

Table 2. CAPITAL COSTS AND OPERATING COSTS (OM&R) EXPECTED PER MGD OF INSTALLED TREATMENT CAPACITY FOR IN-PLANT TREATMENT OF SHRIMP PROCESSING WASTEWATERS

Size of Treatment Facility	Total Capital Costs	Annual Capital Costs[1]	Annual OM&R Costs	Annual Capital and OM&R
	- - - - - -	dollars per MGD capacity	- - - - -	
up to 0.5 MGD	600,000	80,400	42,857	123,257
0.5 to 2.5 MGD	504,545	67,609	30,241	97,850
over 2.5 MGD	484,848	64,933	19,697	84,630

Source: Quick and Shick [6, p. 220].

[1]Annualized on the basis of capital recovery (CR) without salvage at 12 percent discount rate and 20 year project life.

[6]Prior to July 1, 1970 contributions by industrial users toward recovery of capital and operating costs were not required under Federal law. Any recovery of costs from industrial users was through property taxes or other indirect assessments. For waste treatment systems funded between July 1, 1970 and May 1, 1973 the industrial use portion (both capital and operating costs) of the local share of federally assisted waste systems is required to be recovered from industrial users [PL 84-660]. Subsequent to May 1, 1973 the Federal share as well as the local share of industrial use (capital and operating costs) is to be recovered from industrial users [PL 92-500].

One should note the large magnitudes of variation in in-plant processing efficiency among different plants, among different operating levels within each plant and between manual versus automatic type operations (Table 1). One must conclude from these data that improved in-plant handling of the shrimp processing is the most relevant, fruitful and perhaps the least cost method of meeting a large part of the effluent discharge standards. Plant C in the Horn [4] data would obviously incur high costs of meeting effluent standards whether using a municipal facility or building a private facility.

There are considerable economies of scale, given existing wastewater treatment technologies (Table 2). These scale economies in the treatment plant must be weighed against the combined sewage charge imposed by a municipality plus any collection and conveyance costs required to enter the municipal treatment system. It unlikely that a shrimp processing plant would achieve the economy of scale necessary to offset any reasonable charges for municipal discharge. However, such economies could easily be realized by a cooperative waste treatment system in the processing area.

An on-site wastewater treatment system for the larger automated processing plant (size C in Table 1) would require an initial investment of about $240,000 with a direct investment tax credit of $16,800 or a net after tax capital cost of $223,200 (Table 3). These costs were annualized on a capital recovery basis at $30,319 per year, equivalent to about one cent per pound of raw shrimp processed. An additional operating cost of 0.6 cents per pound would be incurred for a total cost of 1.6 cents per pound of deheaded, raw shrimp processed. This cost, net of special tax provisions, would be about twice the going rates of standard municipal effluent treatment costs of 0.8 cents per pound of shrimp processed. However, this 0.8-cent rate is exclusive of capital costs to enter the municipal treatment system. These figures may be compared with any proposed sewage treatment charges for estimating the least cost alternative to the firm. These estimates must be adjusted for individual in-plant processing and effluent handling inefficiencies similar to those observed for plants in Table 1.

The most critical issue demonstrated in this financial analysis is the cash cost of effluent treatment after considering expenditures and expenses adjusted for special tax treatments (Table 4). The first year net cash costs are only 0.4 cents per pound for net capital and operating costs. The average cash costs for the first five years would be only 0.8 cents per pound of shrimp processed, equivalent to the average municipal treatment cost (Table 3 note). The cash costs for years 6 through 20 would be $49,742 annually, or 1.7 cents per pound, the approximate average economic cost for the treatment plant capital and operating costs (Table 3). It is the combination of total costs (Table 3) and total expenditures (Table 4) which must be considered by the firm in its decision to construct its own system or to use municipal facilities.

Table 3. EXPECTED COSTS OF CONSTRUCTING AND OPERATING IN-PLANT WASTEWATER TREATMENT FACILITIES FOR SHRIMP PROCESSING (BASED ON 400,000 GPD EFFLUENT, CR @ r = 12%, t = 20 YEARS)

Cost Category	Total	Annual	Product Cost per Pound of Shrimp Processed[2]
Capital expenditure	$240,000	$32,602	1.1¢
Investment credit/amortization	16,800	-	-
Net capital cost	223,200	30,319	1.0¢
OM&R costs	-	17,142	0.6¢
Total (net capital basis)[1/]	223,200	47,461	1.6¢

[1]Direct total cost estimates for 90% BOD removal, @ 30¢/1000 gal. = $24,000/yr. =0.8¢/lb. of shrimp processed, input weight, deheaded (Table 1).

[2]Product input weight, deheaded, equivalent to approximately 3 million pounds of shrimp annually or 15,000 pounds daily for 200 processing days.

Table 4. CASH FLOW ANALYSIS FOR A TYPICAL MECHANICAL PROCESSING SYSTEM AT 15,000/LB. OF SHRIMP DAILY (PURCHASE WITH REFUNDABLE CASH DEPOSIT, WITH FULL CAPITAL PAYMENT IN 20 YEARS @ 12%)

	Year 1	Year 2	Year 3	Year 4	Year 5
	dollars				
Cash deposit	24,000	-	-	-	(24,000)
Repayment	32,600	32,600	32,600	32,600	32,600
OM&R costs	17,142	17,142	17,142	17,142	17,142
Tax credit	(16,800)	-	-	-	-
Adjustment for accelerated depreciation	(43,000)	(30,000)	(17,000)	(10,000)	(6,000)
After tax cash outflow	13,942	19,742	32,742	39,742	19,742
	cents per pound				
Cash outflow per pound of shrimp processed	0.4	0.7	1.1	1.3	0.7

*Note: Payments and OM&R expenditures continue 20 years. Tax based subsidies and deposit refunds are not a significant factor after 5 years. The cash deposit in Year 1 is a surety deposit usually required of small leasees. The deposit is usually refunded at some point in time or serially, sometimes with interest paid to the leasee in a full, capital recovery lease such as the one illustrated here.

Given the dynamics of investment and cash flow opportunities for well capitalized firms and the present values of cash reserves, it is quite feasible that an in-plant treatment facility would be financially superior to the next alternative of discharging to a municipal system. Each plant's management must make a financial analysis of the firm's cash flow expectations and net cash costs after favored tax adjustments to determine its own least cost solutions to the problem of reducing pollution in coastal waters. Only the best solution for the treatment of effluents from shellfish processing will allow the firm to remain competitive.

CONCLUSION

The most important decision factors for the shellfish processing firm are (1) initial capital investment, (2) finance costs and terms (i.e., availability of funds, interest rates), (3) cash flow impacts, (4) impact on firm's total capital structure (debt vs. equity and liquidity), and (5) profitability. The most critical factor is the expected cash flow of an in-plant treatment system relative to the alternative of municipal treatment expenditures. The firm must also make its own evaluation of relative risks between the two alternatives. These risks include those of escalating municipal charges versus escalating construction and OM&R costs as well as the firms' ability to manage effectively the treatment system to meet effluent standards and avoid penalties or litigation over a malfunctioning or loosely monitored system.

The demonstration in this paper illustrates the methods of comparing wastewater treatment alternatives for shrimp processors faced with meeting the stringent EPA effluent standards already developed for the industry.

REFERENCES

[1] Prochaska, F.J. and C.O. Andres. "Shrimp Processing in the Southeast: Supply Problems and Structural Change," *Southern Journal of Agricultural Economics,* Vol. 6, No. 1, pp. 247.252, July 1974.

[2] Whitaker, Donald R. "Economic Impact of Effluent Guidelines on Seafood Processors: With Particular Reference to the Gulf," Proceedings of the Technology Transfer Conference on Upgrading Seafood Processing Facilities to Reduce Pollution, New Orleans, Louisiana, March 6, 1974.

[3] *Federal Register,* Vol. 39, No. 26, February 6, 1974.

[4] Horn, C.E. *Characterization and Treatability of Selected Shellfish Processing Wastes,* Atlanta, Ga.: Georgia Institute of Technology, August 1972.

[5] U.S. Environmental Protection Agency. *Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Catfish, Crab, Shrimp and Tuna Segment of the Canned and Preserved Seafood Processing,* Washington, D.C., June 1974.

[6] Quick, T.P. and J.E. Shick. "Economic Guidelines for Analysis of Joint Industrial-Municipal Collection and Treatment Systems," *Costs of Water Pollution Control,* Raleigh, N.C.: North Carolina Water Resources Institute.