An Economic Analysis of Fluid Milk Processing in Alaska

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Bulletin 65 June 1985

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Table of Contents

Figure

Tables

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Introduction

Alaskan fluid milk is processed for market by a two-firm industry. In Delta Junction, the Northern Lights Dairy obtains milk from two producers and services an Interior market from Delta to Fairbanks. In Anchorage, Matanuska Maid (M-M) obtains milk from 11 producers and markets its products largely in southcentral Alaska and, to a less extent, in Fairbanks. Direct competition between the two is minimal. The principal source of competition is preprocessed fluid milk shipped in from Puget Sound.

In 1961, 80 farms with 2,900 cows produced 23 million pounds of milk. In 1983, 10 dairies with 1,000 cows produced 13.5 million pounds. This decline, caused in large part by disruptions in the factor markets — particularly land,[1] has had a debilitating effect on the processing arm of the remaining Southcentral producers, Matanuska Maid. Indeed, M-M has been difficult financial straits, and, in November 1983, M-M filed under Chapter 11 of the Bankruptcy Act.[2] In November 1984, the State of Alaska assumed financial and managerial control of M-M with the intent of dispensing of its interest within a year. It is thought that this action will cause the fewest disruptions in the product market for the dairy farms, some of which are heavily indebted to the state for development and operating loans.

Several factors account for M-M's troubles. Competition is keen, coming as it does from the surplus of fluid milk in the Puget Sound area. Improved transportation efficiencies result in continual reduction of competitors' freight rates. Both volume and nonvolume related costs are high at M-M. The plant, some 20 years old, is serviceable, but lacks state-of-the-art computer technology. More important, decreased

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[1] *Farmers in the Matanuska Valley have been leaving farming, encouraged no doubt by high opportunity costs for land fostered by urban development.*

[2] *Chapter 11 allows a firm an opportunity to reorganize and refinance under protection from creditors.*

throughputs result in an inability to reduce average fixed costs; this results in higher per-unit costs of production. Costs are so high, in fact, that losses have eroded long-term assets and resulted in an ever-increasing debt load in order to meet current obligations. In early 1985, M-M processed about 46,000 gallons per week, or 63 per cent of capacity.

On the other hand, M-M has some real advantages. First, it is located 1,500 miles closer to the Alaskan market than are its Puget Sound competitors. Freight rates of roughly 10 cents per pound result in a per-gallon freight advantage of 86 cents. Second, M-M products maintain considerable brand loyalty among Alaska consumers. M-M milk moves from retailer's shelves in spite of a per-gallon price premium of 20 to 40 cents. Third, after a detailed June 1984 study, the Washington State University Small Business Development Center (WSU) concluded that M-M could be a viable processor given a combination of cost reductions and increased throughput (Owens 1984).

The current predicament in milk processing was predicted several years ago, resulting in support for and eventual establishment of the Point MacKenzie Agricultural Project. The primary purpose of this project, planned for 19 dairy farms and 3,000 cows, is an expanded and stable milk supply base sufficient to achieve processing-throughput efficiencies. The project was scheduled to begin production in 1981, but legal proceedings abrogated the original land sale, delaying start-up until 1983. In addition to this delay in new milk production, more Matanuska Valley farmers ceased production. This further served to stress M-M's financial status to the point of filing under Chapter 11.

Following the WSU groups's recommendation of reorganization tactics (Owens 1984), the State of Alaska, a major creditor of M-M and thus a party to any reorganization plan, must decide the best route to take in terms of optimal public policy. At this juncture, there are several alternatives for processing of fluid milk in southcentral Alaska. First, there is the obvious alternative of transferring to Chapter 7 of the Bankruptcy Act, liquidating the assets, and satisfying the unsecured creditors as far as possible. It is possible that a purchaser may be found who, at distress-sale prices, may find it profitable to continue plant operations. Otherwise the existing dairy farmers would either cease production or develop alternative marketing means. A second option would be to refinance the present operation, upgrade the plant to achieve all possible cost savings, and operate at a throughput level which will minimize per unit processing cost. A third alternative may be to continue present operations while building a new plant designed specifically for prospective throughput levels.

This report describes the results of an economic analysis of the last two alternatives. We have combined the results of the WSU study (Owens 1984) with further data obtained from M-M and information obtained from persons knowledgeable in processing fluid milk throughout the country, and have estimated the potential per-unit processing cost that would result if all possible cost savings and production efficiencies were realized in the present plant. These costs are those related to the milk volumes expected from a combination of Matanuska Valley and Point MacKenzie farmers. In addition, costs of constructing, equipping, and operating a new plant in southcentral Alaska were estimated. Data were compiled for three alternative sizes of plant: 50,000; 87,000; and 200,000 gallons per week.

The following section describes some of the background events leading up to the current crisis situation in southcentral Alaska's fluid-milk industry. Section three describes the procedures and data used to estimate construction and operating costs of new fluid-milk plants. The per-unit cost of operating three plants of different sizes is compared with that of the current plant located on Anchorage's Northern Lights Boulevard. The final section summarizes the analysis and draws from it conclusions and recommendations for a course of action in terms of public policy.

Background

The Point MacKenzie dairy project was examined in a 1979 feasibility study (Lewis et al. 1980). At that time milk production was scheduled to begin in 1981. The Alaska State Legislature approved and funded the project in 1980. M-M received a $2 million loan in October 1980 for plant improvements needed to handle the greater volume that was associated with the planned start-up of Point MacKenzie.

Point MacKenzie did not start up in 1981. There were legal challenges in state courts on timber use, land clearing, and, most significantly, on the state land sale itself. In fact two land sales were required before the project was underway, the second of which occurred on September 11, 1982. The first was nullified by a lower court after an appeal to the Alaska Supreme Court because the state government was found to be in violation of its own regulations by requiring farm development and conservation plans prior to the sale date of March 6, 1981.

However, two farm tracts adjacent to the project were sold by the Matanuska-Susitna Borough at this time. These were not affected by the court action, and one is now the site of the first dairy farm associated with the Point MacKenzie Project. Milk production began on this farm in 1983. Of the seventeen dairy tracts sold in the second sale, three farms began producing milk in 1984. The remainder must be in production by 1985, according to the sale contracts.

Pricing in the Alaska milk market must be related to the competition; however M-M has had no local plant competition since 1983. To remain competitive it must price its products in line with Washington imports.This means a price comparable to "Seattle plus freight." Payment to local milk producers must be at a level which will allow M-M to price competitively at the wholesale level. The WSU study suggests relating local milk price to local production cost. An efficient plant will keep production costs down and allow the farmers to receive the highest price possible for their milk. It is assumed that maximum farm gate price is a major goal of dairy farmers supplying milk to M-M and that the dairy farmers involved will retain M-M as their marketing outlet.

As emphasized in the WSU study, the first problem the plant faces is to get out of bankruptcy. That study indicated that the plant could be economically viable in the Alaska fluid milk market, and there is no significant reason to disagree. The task of the group was to consider the processing costs of the present plant and to contrast them with those of a new plant in another location in southcentral Alaska. The competitiveness of the industry will be assessed once these processing costs are identified.

Fluid Plant Cost Comparisons

As mentioned earlier, the cost of throughputting fluid milk in the M-M plant was compared with the cost of three sizes of alternative plants: 50,000; 87,000; and 200,000 gallons per week; an analysis of M-M follows.

New Plants

Investment costs for the three plants range from $4.1 million to $8.8 million (data sources and detailed calculations are shown in Appendix A). This cost includes purchase of land, building construction, plant equipment, trucks, and product delivery cases based on 1984 Alaska prices/costs. Operating costs were estimated to range from $1.01 down to $0.70 per gallon from the smallest to the largest plant, based on full production. Investment and operating costs for three new plants are shown in Table 1.

Table 1. Estimated new plant investment and operating cost by plant size.

Plant	Capacity	Capital Investment	Operating Cost[1]		
			Annual	Per gallon	Per cwt
	(gal/wk)	($)	($)	($)	($)
Plant I	50,000	4,083,658	2,636,900	1.014	11.79
Plant II	87,000	5,434,361	3,904,762	0.863	10.04
Plant III	200,000	8,760,612	7,291,276	0.701	8.15

[1] Assuming operation at full capacity.

Current Plant

M-M processed approximately 46,000 gallons of fluid milk per week during June 1984. The optimum for one-shift plant operation is estimated by WSU to be 70,438 gallons per week. The WSU study concludes that increased market share could be obtained by M-M. The name identification and freshness factors appear to be significant attributes. The chief requirements for M-M are to price competitively and to advertise at a "modest" level. The increased volume from Point MacKenzie is expected to occur soon after the plant is reorganized. As volume increases, there should be savings in processing costs. Eventually these costs could drop significantly. WSU estimates a processing cost of $11.12 per CWT within six months of reorganization (table 2). The WSU study indicates this will require a capital investment in new equipment of $325,000 within 18 months of the reorganization. The authors agree with this assessment but suggest that new investment requirements may be nearer $475,000 (table 3).

Table 2. Estimated processing costs for Matanuska Maid Plant after recommended reorganization.

		Operating Cost[1]		
Phase	Volume	Annual	Per gallon	Per cwt
	(gal/wk)	($)	($)	($)
Phase I[2]	70,438	3,501,614	0.956	11.12
Phase X[3]	70,438	3,340,452	0.912	10.60

[1] Assuming operation at full capacity, with one 8-hour shift.
[2] Six months after reorganization.
[3] Five years after reorganization.
Source: Owens (1984).

Table 3. Estimated investment required to upgrade Matanuska Maid fluid milk processing plant.

Item	Cost
	($)
Trucks (4)	200,000
Roof repair	50,000
Clean-in-place equipment	35,000
Half-gallon packaging machine	40,000
Casers (2)	50,000
Conveyors	100,000
Total	475,000

Source: Estimated by O.E. Schock.

While plant upgrade is expected to total something under half a million dollars, the total amount of new financing required is greater because of outstanding obligations. The WSU study concluded that a new $1.1 million loan is required for a successful reorganization. The authors concur, but suggest that an additional $500,000 may be needed to cover accounts receivable resulting from the expected increased sales.

Processing Efficiencies and Processing Costs

We alluded that M-M's processing costs per unit are high because of low throughput volume.[3] This is because overhead (or "fixed") costs are spread over fewer units of throughput than the plant was designed for. This is illustrated in Table 4 for the three new plant sizes discussed earlier. For example, Plant I is estimated to have annual operating cost of $2.7 million, $0.9 million fixed and $1.8 million cash (or "variable"). If the plant processes 45,000 gallons per week, total costs go down but cost per processed gallon increases by 4 cents. Margins such as this can be devastating in the competitive marketplace.

The advantage of proper plant size can be shown using Plant II (87,000 gallons). If, for example, this plant operated at 50,000 gallons per week (or 57.5 per cent of capacity), the per-gallon cost would be $1.06, 3 cents higher than the smaller plant. Similarly, if Plant III operated at 87,000 gallons per week, its costs would be 4.5 cents per gallon higher than Plant II operating at that level.

The three plant sizes and their cost/volume relationships are shown in Figure 1, along with that of the M-M plant after reorganization. Here, the cost savings that can result from matching throughput to plant design can be readily seen. Note that the cost savings are more dramatic for the smaller plants.

M-M's estimated processing cost after reorganization compares favorably with the cost of competitors' prepackaged milk which we estimate at $32.19 per CWT landed at Anchorage in October 1984 (table 5). M-M can pay up to $21.07 ($32.19 less $11.12 from Table 2) for raw milk and remain price competitive. This exceeds the $19.50 paid in October 1984 to producers at the farm gate. M-M does not have to be totally price competitive with "Outside" milk because M-M offers

[3] *There also are nonvolume related costs in the M-M operation. Recommendations for reducing them were tendered to M-M's management both by the WSU study and by O.E. Schock directly.*

Table 4. Annual plant operating cost by throughput level.

Plant	Throughput	Fixed	Variable	Total	Per gallon	Per cwt.
	(gal/wk)	($)	($)	($)	($)	($)
Plant I						
100% cap.	50,000	867,959	1,768,941	2,636,900	1.014	11.79
90% cap.	45,000	867,959	1,592,047	2,460,006	1.051	12.22
80% cap.	40,000	867,959	1,415,153	2,283,112	1.098	12.76
Plant II						
100% cap.	87,000	1,119,090	2,785,672	3,904,762	0.863	10.04
90% cap.	78,300	1,119,090	2,507,105	3,626,195	0.891	10.36
80% cap.	69,600	1,119,090	2,228,538	3,347,628	0.925	10.76
Plant III						
100% cap.	200,000	1,655,064	5,636,212	7,291,276	0.701	8.15
90% cap.	180,000	1,655,064	5,072,591	6,727,655	0.719	8.36
80% cap.	160,000	1,655,064	4,508,970	6,164,034	0.741	8.61

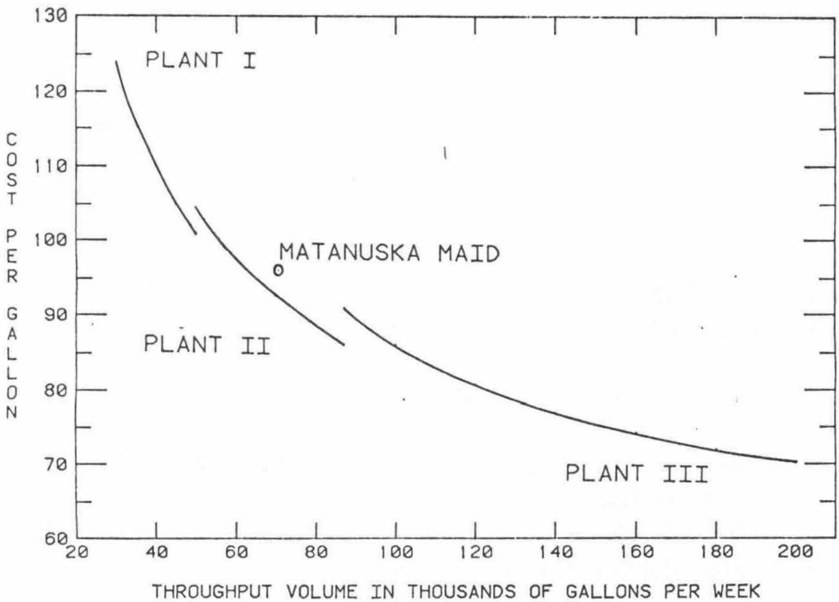

Figure 1. Cost/volume relationships for Alaska milk processing.

Table 5. Estimated cost of prepackaged fluid milk products landed at Anchorage.

	Cost per cwt
	($)
Puget Sound Federal Market Order Class I price[1]	14.35
Average "lower 48" processing and distribution cost	8.00
Freight tariff[2]	9.84
Total	32.19

[1] During October 1984.
[2] Favored rate for high-volume shippers. Low-volume (one van) shippers pay up to $10.76/cwt.
Sources: U.S.D.A., Economic Research Service, "Food Cost Review, 1983," Agr. Econ. Report 514, June 1984, p. 42. Alaska Sales Office, Sealand Transport.

a pickup and return service for unsold products, a service not available with prepackaged milk shipped in from the Lower 48 states.

Supply Potential

During 1983, Matanuska Valley herds produced an average of 26.4 thousand gallons per week with 900 cows (Alaska Crop and Livestock Reporting Service 1984). The herd size from the Pt. MacKenzie project is expected to range from 1,411 to 3,000 head (project sales brochure, Lewis et al. 1980) making the future southcentral Alaska herd somewhere between 2,300 and 3,900 animals. If average production is 14,000 pounds per animal per year, then weekly production ranging from 72,000 to 122,000 gallons can be expected. The M-M plant can readily accomodate the lower figure with one eight-hour shift per day. Two shifts could accomodate the higher figure.

Conclusions and Recommendations

The purpose of this study was to compare two possible alternatives for milk processing in southcentral Alaska: upgrading the existing Matanuska Maid creamery in Anchorage or building a new plant at an undetermined location. The economic analysis of these two alternatives indicates that the former is preferable.

The dairy industry in Alaska depends on the viability of in-state processing. Existing milk producers in the Matanuska Valley and the new dairies at Pt. MacKenzie require a functioning creamery. This study demonstrates that a new plant could be constructed, would require an investment of between $4 and $8 million, and would take at least a year to build. Alternatively, M-M could be refinanced and upgraded at a cost of $2 million or less. This is particularly attractive because it could be accomplished while the plant continued to operate. Further, M-M has the capability for making cheese and ice cream, a capability not included in the cost estimates for the new plant. While operating costs for M-M would be higher than for a new plant, they appear not to be excessive for successful operation. This supports the findings of the Washington State University Small Business Development Center.

If a dairy industry, enhanced by production at Pt. MacKenzie, should prove successful over the next few years, the situation can be reassessed. Expanding markets in the Matanuska-Susitna Borough, adjustments in the relative costs of freight and other inputs, or high opportunity costs resulting from rising Anchorage real estate values may well make a new plant an attractive alternative. If, for a variety of reasons, an Alaskan dairy industry does not prove feasible, then there is much less "up front" capital at risk in the alternative recommended here.

In general, the Alaska milk industry can survive in competition with products shipped in from out of state. The key element will be efficient management of both the fluid milk processing sector and the individual dairy farms. These efficiencies are within the state-of-the-art, are attainable, and are an absolute must if the industry is to be competitive in the Alaska milk market.

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APPENDIX

Cost Estimates for New Fluid-Milk Processing Plants, Alaska

For purposes of comparison with Matanuska Maid's present plant, costs were estimated for constructing and operating a new plant for each of three different throughput capacities: 50,000; 87,000; and 200,000 gallons per week. To arrive at a final cost per processed unit, it is necessary to, first, estimate the investment required to open the doors on a ready-to-use plant and, second, estimate the cost to operate the plant in terms of labor, utilities, materials, etc. To accomplish this, the authors relied extensively on the work by Fischer et al. (1979) who estimated costs for processing fluid milk in Minnesota. This appendix details the methods used in estimating the investment costs and annual operating costs which were reported in the main body of this report. Inflation was not explicitly accounted for in the calculatons. If inflation occurs, all prices should be affected simultaneously, leaving the results and conclusions valid.

Capital Investment

Milk processing requires a combination of several types of capital goods in order to commence operations. They include the land, structure, equipment, and product shipping cases. The procedures used to estimate the cost of each is discussed in this section.

Structure. Drawing on the Fischer et al. (1979) study, three building sizes were estimated at 13,530; 18,540; and 33,571 square feet. The areas of the various sectors of the buildings are detailed in Table A-1. Construction costs were estimated at $100 per square foot.

Table A-1. Comparison of space requirements and building investment for three model milk processing plants.

	Plant I	Plant II	Plant III
	(square feet)		
Raw milk receiving	1,792	1,905	2,244
Processing area	860	945	1,200
Filling area	1,505	1,881	3,010
Laboratory	72	121	267
CIP room	220	242	309
Cold room	1,787	2,769	5,715
Case storage	1,032	1,806	4,126
Dry warehouse	830	1,392	3,078
Container storage	858	1,107	1,855
Refrigeration equipment room	633	764	1,155
Boiler room	462	578	924
Mechanical and electrical	475	513	627
Truck maintenance garage	1,353	1,691	2,706
Men's locker room	205	205	205
Women's locker room	96	123	205
Corridor	122	153	245
Offices, lunchroom, reception area	1,228	2,345	5,700
Total space	13,530	18,540	33,571
Total building investment	$1,353,000	$1,854,000	$3,357,100
Building investment per gallon processed weekly	$18.94	$14.92	$11.75

Source: Fischer et al. 1979. Alaska construction cost calculated at $100 per square foot.

Land. Land needs were assumed to be five times the size of the buildings. Thus, areas of 1.6, 2.2, and 3.9 acres will be required for the three plants. At $22,000 per acre, total investment requirements will be $35,200; $48,400; and $85,800, respectively.

Equipment. Some fifty separate equipment items were listed in the Fischer et al. (1979) study for fluid plants. The 1978 Minnesota cost was indexed, first to 1984, then for Alaska using the Consumers' Price Index and an estimated Alaska cost index. Equipment costs for the three plants are detailed in Tables A-2, A-3, and A-4. Total costs for equipment were estimated at $2.2, $2.8, and $4.2 million.

Trucks. Trucks were estimated at a flat $50,000 each. The three plants require eight, eleven, and sixteen trucks. Truck investment and annual fixed costs are shown in Table A-5. Variable costs were estimated at $0.68 per mile.

Cases. Milk is delivered in heavy plastic cases holding approximately 4.25 gallons each. They are left at the store and picked up with the next delivery. For every case loaded at the plant, approximately six await pickup (Fischer et al. 1979). This comes to seven cases per 4.25 gallons or 1.65 cases per gallon of daily output. At $5.50 per case, the three plants will require investments of $90,750; $157,905; and $363,000.

Total Investment. Total plant investment for the five categories is shown in Table A-6. Costs range from $4.1 to $8.8 million.

Annual Operating Cost. Plant operating cost is the sum of each year's portion of the capital costs and the cost of that year's purchases of variable inputs. Capital (fixed) costs occur whether or not the plant operates. They include depreciation, interest on investment, taxes, insurance, and administrative costs. Variable (cash) costs include hourly labor, containers, supplies, and fuel. Estimates of all these costs were made for the three plants.

Capital Cost. 1. Depreciation: estimated by the equation: (cost − salvage) ⅓ useful life. Equipment depreciation is shown in Tables A-2, A-3, and A-4. Truck depreciation is shown in Table A-5.
2. Interest: estimated at 12 per cent of average investment over the lifetime of the item. Average investment equals: (cost + salvage) / 2.
3. Taxes: estimated at 10.1 mills (or 1.01 per cent of average investment) from Matanuska Maid's records.
4. Insurance: average investment multiplied by the insurance rate estimated from M-M's records (1.9 per cent).
5. Repairs: 1 per cent of building cost, 2 per cent of equipment cost, 4 per cent of truck cost.

Variable cost. 1. Labor: labor requirements for the three plants are shown in Table A-7. Hourly wages were estimated at $13.75 plus benefits of 24 per cent. Overtime was estimated at 5 per cent of direct plant labor.

Table A-2. Itemized equipment requirements for Plant I.

Item	Investment cost	Life	Salvage	Annual Cost: Depre- ciation	Annual Cost: Taxes and ins.	Annual Cost: Interest	Annual Cost: Repairs
	($)	(yrs)	(%)	($)	($)	($)	($)
100-GPM receiving pump	3,630	10	30	254	69	283	73
2-tank CIP unit[1] (2)	57,200	10	10	5,148	915	3,775	1,144
CIP transport tank washer	5,280	10	10	475	85	348	106
COP portable tank (2)	6,600	10	10	594	106	436	132
5,000-gal. raw storage tank[2] (2)	66,000	15	50	2,200	1,440	5,940	1,320
2,000-gal. raw storage tank[2]	24,200	15	50	807	528	2,178	484
2,000-gal. cream storage[2]	24,200	15	50	807	528	2,178	484
4,000-gal. cold wall surge	28,600	15	50	953	624	2,574	572
2,000-gal. cold wall surge	22,000	15	50	733	480	1,980	440
1,000-gal. cold wall surge	18,700	15	50	623	408	1,683	374
1,500-gal. pasteurizing vat	36,300	15	50	1,210	792	3,267	726
1,000-gal. pasteurizing vat	29,700	15	50	990	648	2,673	594
Storage-tank mounts (7)	7,700	15	50	257	168	693	154
Hot water set for HTST	12,980	10	10	1,168	208	857	260
Transfer pumps (2)	1,980	10	10	178	32	131	40
Clarifer/separator	86,900	12	30	5,069	1,644	6,778	1,738
60-gal. balance tank	2,420	10	10	218	39	160	48
Plate heat exchanger: 85% regen.	38,500	10	30	2,695	728	3,003	770
Timing pump	10,120	10	30	708	191	789	202
Flow-diversion valve	2,860	10	10	257	46	189	57
Holding tube	5,111	10	30	358	97	399	102
Tailer sensor and controls	6,417	10	10	578	103	424	128
15,000 #/hr. homogenizer	46,750	10	30	3,273	884	3,647	935
30-cpm. gal. filler	198,000	12	40	9,900	4,033	16,632	3,960
33-cpm. gal. & ½-gal. filler	165,000	12	30	9,625	3,121	12,870	3,300

75-cpm. ½-pt. & -qt. filler	187,000	12	30	10,908	3,637	14,586	3,740
Handle applicator	16,500	5	10	2,970	264	1,089	330
4/min. 5-gal. filler	11,000	10	20	880	192	792	220
Carton conveyors (120')	31,680	10	10	2,851	507	2,091	634
Automatic casers (3)	85,800	12	20	5,720	1,498	6,178	1,716
Case stackers (3)	66,000	12	20	4,400	1,152	4,752	1,320
Case inverters (3)	13,200	12	20	880	230	950	264
20-per min. case washer	15,400	12	20	1,027	269	1,109	308
20-per min. case unstacker	22,000	12	20	1,467	384	1,584	440
Case conveyors and drives (400')	132,000	10	20	10,560	2,305	9,504	2,640
Conveyor hydraulic unit	9,900	10	20	792	173	713	198
Process-control panel	2,299	5	10	414	37	152	46
Receiving-control panel	5,720	5	10	1,030	92	378	114
Sanitary lines and valves	33,000	10	10	2,970	528	2,178	660
Boilers: 75 bhp. (2)	70,400	20	30	2,464	1,332	5,491	1,408
Ammonia receiver, compressor	29,502	20	10	1,328	472	1,947	590
Condensor, pumps, piping	33,748	20	10	1,519	540	2,227	675
Ice builder	35,420	12	10	2,657	567	2,338	708
Cooling units—cold room	17,688	12	10	1,327	283	1,167	354
Cooling units—tanks	7,381	12	10	554	118	487	148
Controls	7,480	10	10	673	120	494	150
Mechanical[3]	84,700	15	0	5,647	1,232	5,082	1,694
Installation[4]	358,182	15	0	23,879	5,212	21,491	7,164
Miscellaneous	21,560	15	0	1,437	314	1,294	431
Total equipment cost	$2,204,708			$137,432	$39,375	$161,962	$44,094

[1] Includes pumps, valves, and control panels.
[2] Includes liquid scale gauges.
[3] Includes air compressors, refrigerators, electrical cost for running power to motors, and mechanical cost for utility hookup of machines.
[4] Calculated at 20 per cent of cost of storage and surge tanks, 40 per cent of cost of processing, and CIP equipment, and 30 per cent of cost of mechanical, refrigeration, and case-handling equipment. Filling-equipment prices include installation.

Table A-3. Itemized equipment requirements for Plant II.

Item	Investment cost	Life	Salvage	Annual Cost: Depre-ciation	Annual Cost: Taxes and ins.	Annual Cost: Interest	Annual Cost: Repairs
	($)	(yrs)	(%)	($)	($)	($)	($)
100-GPM receiving pump	3,740	10	30	262	71	292	75
2-tank CIP unit[1] (2)	61,600	10	10	5,544	986	4,066	1,232
CIP transport tank washer	5,280	10	10	475	85	348	106
COP portable tank (2)	6,600	10	10	594	106	436	132
5,000-gal. raw storage tank[2] (2)	99,000	15	50	3,300	2,161	8,910	1,980
2,000-gal. raw storage tank[2]	24,200	15	50	807	528	2,178	484
2,000-gal. cream storage[2]	24,200	15	50	807	528	2,178	484
4,000-gal. cold wall surge	28,600	15	50	953	624	2,574	572
2,000-gal. cold wall surge	22,000	15	50	733	480	1,980	440
1,000-gal. cold wall surge	18,700	15	50	623	408	1,683	374
1,500-gal. pasteurizing vat	36,300	15	50	1,210	792	3,267	726
1,000-gal. pasteurizing vat	59,400	15	50	1,980	1,296	5,346	1,188
Storage-tank mounts (7)	7,700	15	50	257	168	693	154
Hot water set for HTST	12,980	10	10	1,168	208	857	260
Transfer pumps (2)	2,200	10	10	198	35	145	44
Clarifer/separator	110,000	12	30	6,417	2,081	8,580	2,200
60-gal. balance tank	2,420	10	10	218	39	160	48
Plate heat exchanger: 85% regen.	55,000	10	30	3,208	1,040	4,290	1,100
Timing pump	10,120	10	30	708	191	789	202
Flow-diversion valve	3,300	10	10	297	53	218	66
Holding tube	6,600	10	30	462	125	515	132
Tailer sensor and controls	6,417	10	10	578	103	424	128
15,000 #/hr. homogenizer	66,000	10	30	4,620	1,248	5,148	1,320
30-cpm. gal. filler	198,000	12	40	9,900	4,033	16,632	3,960
33-cpm. gal. & ½ gal. filler	217,800	12	30	12,705	4,120	16,988	4,356

75-cpm. ½ pt.& -qt. filler	187,000	12	30	10,908	3,637	14,586	3,740
Handle applicator	19,800	5	10	3,564	317	1,307	396
4/min. 5-gal. filler	11,000	10	20	880	192	792	220
Carton conveyors (120')	44,000	10	10	3,960	704	2,904	880
Automatic casers (3)	88,000	12	20	5,867	1,536	6,336	1,760
Case stackers (3)	66,000	12	20	4,400	1,152	4,752	1,320
Case inverters (3)	13,200	12	20	880	230	950	264
20-per min. case washer	22,000	12	20	1,467	384	1,584	440
20-per min. case unstacker	24,200	12	20	1,613	423	1,742	484
Case conveyors and drives (400')	165,000	10	20	13,200	2,881	11,880	3,300
Conveyor hydraulic unit	12,100	10	20	968	211	871	242
Process-control panel	2,299	5	10	414	37	152	46
Receiving-control panel	6,160	5	10	1,109	99	407	123
Sanitary lines and valves	55,000	10	10	4,950	880	3,630	1,100
Boilers: 75 bhp. (2)	81,400	20	30	2,849	1,540	6,349	1,628
Ammonia receiver, compressor	55,000	20	10	2,475	880	3,630	1,100
Condensor, pumps, piping	44,000	20	10	1,980	704	2,904	880
Ice builder	55,000	12	10	4,125	880	3,630	1,100
Cooling units—cold room	44,000	12	10	3,300	704	2,904	880
Cooling units—tanks	11,000	12	10	825	176	726	220
Controls	7,480	10	10	673	120	494	150
Mechanical[3]	172,260	15	0	11,484	2,506	10,336	3,445
Installation[4]	528,000	15	0	35,200	7,682	31,680	10,560
Miscellaneous	22,000	15	0	1,467	320	1,320	440
Total equipment cost	$2,824,056			$176,582	$49,704	$205,156	$56,481

[1] Includes pumps, valves, and control panels.

[2] Includes liquid scale gauges.

[3] Includes air compressors, refrigerators, electrical cost for running power to motors, and mechanical cost for utility hookup of machines.

[4] Calculated at 20 per cent of cost of storage and surge tanks, 40 per cent of cost of processing, and CIP equipment, and 30 per cent of cost of mechanical, refrigeration, and case handling equipment. Filling equipment prices include installation.

Table A-4. Itemized equipment requirements for Plant III.

Item	Investment cost	Life	Salvage	Annual Cost: Depre-ciation	Annual Cost: Taxes and ins.	Annual Cost: Interest	Annual Cost: Repairs
	($)	(yrs)	(%)	($)	($)	($)	($)
200-GPM receiving pump	3,740	10	30	262	71	292	75
2-tank CIP unit[1]	28,600	10	10	2,574	458	1,888	572
3-tank CIP unit[1]	38,500	10	10	3,465	616	2,541	770
COP portable tank (2)	6,600	10	10	594	106	436	132
CIP transport tank washer	5,280	0	10	528	77	317	106
20,000-gal. cold wall silo[2] (2)	101,640	15	50	3,388	2,218	9,148	2,033
5,000-gal. raw storage tank[2] (2)	66,000	15	50	2,200	1,440	5,940	1,320
5,000-gal. cream storage[2]	33,000	15	50	1,100	720	2,970	660
10,000-gal. cold wall surge silo	38,500	15	50	1,283	840	3,465	770
5,000-gal. cold wall surge	30,800	15	50	1,027	672	2,772	616
2,000-gal. cold wall surge	22,000	15	50	733	480	1,980	440
2,500-gal. pasteurizing vat	46,200	15	50	1,540	1,008	4,158	924
2,000-gal. pasteurizing vat	41,800	15	50	1,393	912	3,762	836
Storage-tank mounts (7)	7,700	15	0	513	112	462	154
Silo mounts (3)	19,800	15	0	1,320	288	1,188	396
HTST feed pump	990	5	10	178	16	65	20
Hot water set for HTST	12,980	10	10	1,168	208	857	260
Transfer pumps (2)	2,420	10	10	218	39	160	48
Clarifer/separator	260,700	12	30	15,208	4,931	20,335	5,214
60-gal. balance tank	2,420	10	10	218	39	160	48
Flow diversion valve	4,180	10	10	376	67	276	84
Plate heat exchanger: 85% regen.	77,000	10	30	5,390	1,456	6,006	1,540
Holding tube	8,367	10	30	586	158	653	167
Homogenizer	84,590	10	30	5,921	1,600	6,598	1,692
75-cpm. ½-gal. filler	217,800	12	40	10,890	4,437	18,295	4,356

160-cpm. ½-pt. & -qt. filler	503,800	12	30	29,388	9,529	39,296	10,076
4/min. 5-gal. filler	7,370	10	20	590	129	531	147
Handle applicator	19,800	5	10	3,564	317	1,307	396
Carton combiner	8,800	5	10	1,584	141	581	176
Carton conveyors (200')	52,800	10	10	4,752	845	3,485	1,056
Automatic casers (3)	103,400	12	20	6,893	1,805	7,445	2,068
Case stackers (3)	66,000	12	20	4,400	1,152	4,752	1,320
Case inverters (3)	13,200	12	20	880	230	950	264
40/min. case washer	33,000	12	20	2,200	576	2,376	660
20/min. case unstacker	26,400	12	20	1,760	461	1,901	528
Case conveyors and drives (700')	231,000	10	20	18,480	4,033	16,632	4,620
Conveyor hydraulic unit	17,600	10	20	1,408	307	1,267	352
Process-control panel	2,300	5	10	414	37	152	46
Receiving-control panel	6,160	5	10	1,109	99	407	123
Sanitary lines and valves	55,000	10	10	4,950	880	3,630	1,100
Boilers: 200 bhp. (2)	96,800	20	30	3,388	1,831	7,550	1,936
Ammonia receiver, compressors	66,341	20	10	2,985	1,062	4,379	1,327
Condensor, pumps, piping	53,977	20	10	2,429	864	3,562	1,080
Ice builder	57,640	12	10	4,323	923	3,804	1,153
Cooling units	53,680	12	10	4,026	859	3,543	1,074
Controls	9,240	10	10	832	148	610	185
Mechanical[3]	394,240	15	0	26,283	5,736	23,654	7,885
Installation[4]	694,980	15	0	46,332	10,112	41,699	13,900
Tailer controls and sensors	6,417	10	10	578	103	424	128
60-cpm. gal. filler	385,000	10	20	30,800	6,722	27,720	7,700
Miscellaneous	28,160	15	0	1,877	410	1,690	563
Total equipment cost	$4,154,712			$268,298	$72,280	$298,071	$83,094

[1] Includes pumps, valves, and control panels.

[2] Includes liquid scale gauges.

[3] Includes air compressors, refrigerators, electrical cost for running power to motors, and mechanical cost for utility hookup of machines.

[4] Calculated at 20 per cent of cost of storage and surge tanks, 40 per cent of cost of processing, and CIP equipment, and 30 per cent of cost of mechanical, refrigeration, and case-handling equipment. Filling-equipment prices include installation.

Table A-5. Truck investment and operating costs.

						Annual fixed costs					
Plant	No. trucks		Cost per truck	Total cost	Miles driven	Depreciation	Repairs	Taxes & licenses	Insurance	Interest	Total
	(ea)		($)	($)	(mi/yr)	($)	($)	($)	($)	($)	($)
Plant I	8	×	50,000	400,000	257,400	40,000	16,000	2,080	29,600	24,000	111,680
Plant II	11	×	50,000	550,000	448,500	55,000	22,000	2,860	40,700	33,000	153,560
Plant III	16	×	50,000	800,000	1,075,700	80,000	32,000	4,160	49,200	48,000	223,360

Table A-6. Total plant investment.

Plant	Building	Land	Equipment	Trucks	Cases	Total
	($)	($)	($)	($)	($)	($)
Plant I	1,353,000	35,200	2,204,708	400,000	90,750	4,083,658
Plant II	1,854,000	48,400	2,824,056	550,000	157,905	5,434,361
Plant III	3,357,100	85,800	4,154,712	800,000	363,000	8,760,612

Table A-7. Labor requirements.

	Plant I	Plant II	Plant III
	--------------	(number of persons)	--------------
Plant Manager	1	1	1
Plant Workers	6	9	18
Laboratory Technician	1	1	1
Drivers	8	11	16
Dock Workers	3	4	5
Subtotal labor	19	26	41
General Manager	1	1	1
Sales Manager	1	1	1
Administrative and Clerical	4	5	6
Total	25	33	49

2. Containers: container requirements for the three plants are shown in Table A-8. The container prices are those currently paid by M-M.
3. Case replacement: distribution cases must be replaced continually because of loss or damage. The replacement rate was reported by Fischer et al. (1979) at 12 per cent annually. The amounts for the three plants are shown in Table A-9.
4. Electricity, fuel, water, and sewer: the rates for these utilities were estimated from M-M's records and from contacting Anchorage utility firms. The amounts are shown in Table A-9.
5. Supplies: estimated on a per-gallon basis from Fischer et al. (1979) and updated to 1984. They include cleaning, laboratory, janitorial, and office supplies. The total for this item is shown in Table A-9.
6. Product loss: product loss, either in-plant or in-transit, was estimated by Fischer et al. (1979) at 0.6 per cent of throughput volume. At $20.50 per cwt, this item would total $27.5, $47.9, and $110.0 thousand annually as shown in Table A-9.
7. Total operating cost: total cost (table A-9) of operating the three plants amounts to $2.6, $3.9, and $7.3 million, or $1.01, $0.86, and $0.70 per gallon, respectively, based on full production.

Table A-8. Weekly container requirements.

Container type	Proportion of output	cost per container	Plant I no/wk	Plant I cost/wk	Plant II no/wk	Plant II cost/wk	Plant III no/wk	Plant III cost/wk
	(%)	($)	(ea)	($)	(ea)	($)	(ea)	($)
Gallon	40	0.320	20,000	6,400	34,800	11,136	80,000	25,600
Half-gallon	24	0.100	24,000	2,400	41,760	4,176	96,000	9,600
Quart	6	0.060	12,000	720	20,880	1,253	48,000	2,880
Half-pint	7	0.026	56,000	1,456	97,440	2,533	224,000	5,824
Twin pak	12	0.200	6,000	1,200	10,440	2,088	24,000	4,800
Six-gallon bag	11	1.580	917	1,449	1,595	2,520	3,667	5,793
Totals				13,625		23,706		54,497

Table A-9. Annual plant operating cost.

	Plant I	Plant II	Plant III
		($)	
Direct labor	673,816	922,064	1,454,024
Overtime	33,691	46,103	72,701
General Manager	70,000	75,000	80,000
Sales Manager	60,000	65,000	70,000
Administrative/Clerical	106,392	141,856	177,320
Subtotal labor	943,899	1,250,023	1,854,045
Equipment depreciation	137,432	176,582	268,298
Building depreciation	45,100	61,800	111,903
Truck fixed costs	111,680	153,560	223,360
Truck variable costs	175,032	304,980	697,476
Taxes and insurance:			
equipment	39,375	49,704	72,280
building	39,372	53,951	97,692
land	352	484	858
Interest:			
equipment	161,962	205,156	298,071
building	81,180	111,240	201,426
land	4,224	5,808	10,296
cases	10,890	18,949	43,560
Repairs:			
equipment	44,094	56,481	83,094
building	13,530	18,540	33,571
Containers	708,500	1,232,712	2,833,861
Case replacement	10,890	18,949	43,560
Electricity	21,677	33,398	67,752
Fuel	27,600	48,024	110,400
Water/sewer	4,736	7,790	18,362
Supplies	27,872	48,776	111,400
Product loss	27,503	47,855	110,011
Total	2,636,900	3,904,762	7,291,276
Per gallon	1.014	0.863	0.701
Per cwt.	11.79	10.04	8.15