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# GALLON JUG MILK SALES ON PENNSYLVANIA DAIRY FARMS Processing and Selling Costs



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#### Digest

Costs per gallon for processing and selling milk at farms in gallon jugs were calculated for a number of operations. The effects of volume on costs were determined for each. In two operations, investments and operating costs were compared when new and reconditioned equipment were used. Frequency of processing also was varied to determine effects on unit costs.

If new equipment was used and one vat or part of one vat of milk was processed each day, the cost per gallon was 20.2 cents when 200 gallons were processed and sold and 38.3 cents when the volume was 100 gallons. Similar wide variations with differences in volume were observed for each of the operations.

Most costs did not vary with the amount of milk processed and sold. Building and equipment costs were fixed. Any reduction in the quantity of milk processed merely resulted in the same total costs being spread over fewer units. The amount of labor used in processing generally was constant at low levels of output and was determined largely by the length of time required to set up, sanitize, tear down and wash equipment, and not by the amount of milk processed. At higher levels of output, processing time varied with the amount of milk processed but not proportionately. The amount of time required in the sales room was determined by the period during which the sales room was open rather than by the volume of milk sold.

Installation of some secondhand instead of new equipment made small savings possible. At a daily volume of 200 gallons, the saving in operating cost was only 0.7 cents per gallon. Increased repairs somewhat offset the lower charge for investment. An important consideration in installing used equipment was the lower total investment and consequent lesser risk.

A model plant was designed to process 200 gallons per day, the pasteurizing vat being used only once. For greater volumes, the alternatives of using the processing vat for a second batch or adding an additional secondhand pasteurizing vat were considered. Use of a second vat, an enlarged building, and some higher capacity equipment gave a slightly lower cost than reuse of a single vat.

For small volumes, every other day and every third day processing were considered as alternatives to processing each day. Processing 100 gallons each day cost approximately 4.8 cents per gallon more than processing 200 gallons every other day. Processing 130 gallons every day cost 2.2 cents per gallon more than adding a second pasteurizing vat and processing 260 gallons every other day, and 3.2 cents per gallon more than adding a second pasteurizing vat and processing 390 gallons every third day.

Processing less frequently than daily permitted savings in the use of processing labor, of a part of the fuel cost and costs of cleaning equipment. Many costs, including interest on investment, depreciation, taxes, insurance and sales room labor, occurred whether or not processing actually took place daily.

### Gallon Jug Milk Sales on Pennsylvania Dairy Farms Processing and Selling Costs

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Many Pennsylvania dairy farmers process and sell milk on their farm premises. Such sales represent significant opportunities to an increasing number of dairymen. Despite this growth in on-farm sales, the volume of milk processed and distributed in this manner is, and is likely to continue to be, a relatively unimportant part of the total milk produced in this State and the total milk purchased by Pennsylvania consumers.

Pennsylvania dairy farmers processing and selling milk on their farm premises do not come under the pricing jurisdiction of the Pennsylvania Milk Control Commission. Dairy farmers using this marketing method tend to sell milk at their farms at prices well below those established for milk sold at stores or delivered to homes by milk distributors regulated by the Pennsylvania Milk Control Commission. In order to be exempt from minimum price regulation, farmer gallon jug operators must sell only the milk they produce on their own farms, and it must be processed on the farm premises and sold in packages supplied by consumers. In order to be licensed to retail milk, these farmers must meet Department of Agriculture standards for plants processing milk for fluid consumption.

A farmer considering on-farm sales of milk should consider probable costs and returns from this method of sale in comparison with costs and returns from existing and other possible outlets. The gallon jug operation requires considerable additional investment. He must devote a part of his time to the solution of problems associated with processing and selling. He must attract customers to his farm and satisfy them so that they will return. For the enterprise to be profitable in the long run, additional returns from the sale of milk at the farm must continue sufficiently long to amortize any additional investment.

Many dairy farmers have been seeking information concerning the investment required for on-farm sales of milk and the costs involved in such an operation. This report presents investment and operating costs for hypothetical gallon jug operations. The data are presented in sufficient detail to permit the individual dairy farmer to make judgments as to the investment and costs he would undertake in his particular situation by going into a gallon jug operation.

While this study was not undertaken to consider such problems as variety of products, sales techniques, and the balance of production and sales, this report includes some information on these factors, based on contacts with gallon jug operators.

#### Procedure

A study of gallon jug operations on Pennsylvania dairy farms was started in the summer of 1961. The first step was a State-wide survey of the larger operations selling pasteurized milk. Later a model plant was designed and equipment selected to operate it. To determine labor schedules for operating the model plant, time studies were conducted on several recently constructed plants where operating procedures conformed to the model. A number of variations were made in the model plant to determine how such variations would affect investment, labor requirements, and costs per gallon of output. The authors made arbitrary decisions in such matters as quantities to be processed and wage rates to be paid to labor. Variations in these would affect unit costs. They hope that data are presented in sufficient detail to permit an individual dairy farmer to judge how the particular situation he faces would affect investments and costs.

Model plant — The State-wide survey provided specific information on buildings and equipment used, operating methods, labor requirements, sources of labor, and other information pertinent to onfarm, gallon jug milk selling. The results of this survey, together with information supplied by dairy engineers and dairy technologists, were used by the authors to synthesize a fully-equipped model plant and to make modifications in it.

The initial model plant, the layout of which is shown in figure 1, was designed to process the production of 35 to 40 cows, a volume of milk up to approximately 200 gallons per day. Equipment with capacity to handle this volume was selected. A building with sufficient floor space to meet equipment needs, permit ease of operation and clean up, accommodate the selling operation, and provide space for a desk, filing cabinet, and telephone was needed.

The "model" does not represent the "average" plant in the survey. Rather, it is an attempt to show the most efficient jug operation possible for the selected sales volume. Incorporated in it are several building and equipment features found only in the more recently constructed plants included in the survey.

Labor schedules — Time standards based on studies of actual operations were established for each of the many tasks that comprise a complete milk processing operation. In general, this was accomplished by relating each task to a major piece of equipment. Most jobs fell into the category of set up, sanitize, check operation, or tear down and wash. Table 1 shows the time allotted to each task when one batch of milk was processed daily (operation A). The time allotted to a specific task was the labor allowance and not the time a particular piece of equipment was in operation.

In determining plant operating procedures, the principal objective was to get the milk processing underway as quickly as possible and to keep it progressing without delays. Once the milk was in the pas-



Fig. 1 — Layout of model plant. Equipment is identified by number and corresponds to items listed in table 2.

teurizing vat, the operator was required to tear down and wash the milk pump and clarifier and engage in general clean up in the processing and sales area. The operator was expected to spend one-half hour during or after the processing operation performing necessary management and supervisory tasks, such as record keeping and making repairs.

**Operations considered** — Processing and selling costs per unit of product were determined by budgeting the operation of the model plant, designated as operation A in this report, with output varied by 10-gallon increments between 80 and 200 gallons.

A number of step by step modifications in operation A were made and unit costs for different volumes of output were calculated. Thus, operation B was identical to operation A with the single exception that new equipment was, in the main, replaced with secondhand pieces

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having the same physical specifications. Operation B, requiring used equipment, was more representative than operation A of existing facilities found in the survey.

Succeeding operations designated as C, D, E, and F were budgeted with used equipment and are variations of operation B.

Outputs in excess of 200 gallons daily — Two alternative methods of obtaining outputs greater than 200 gallons and up to 400 gallons per day were budgeted as operations C and D. In operation C, the 200-gallon pasteurizing vat and other secondhand processing equipment of operation B were reused to immediately process a second batch of milk. For operation C, 100 gallons of additional bulk storage capacity for processed milk and larger refrigeration equipment were required, but no changes in size of building were necessary. Investment increased over operation B by \$475.

In the other method of obtaining outputs as high as 400 gallons per day, operation D, a second used pasteurizing vat, larger storage tanks, and larger refrigeration equipment as well as a 100-square-foot increase in size of the processing area were necessary. The total investment for building and equipment rose by \$2,188 over that for operation B.

A number of changes in the labor schedule made between the initial operation A and operations C and D require further comment. In general, with the exception of operation C, processing labor time requirements for each individual operation were constant at the lower levels of output and did not depend on the volume of milk processed. For example, additional processing labor was not required in operation A until output exceeded 87 per cent of capacity. Operation C differed in that total time required for processing increased with all increases in output.

Comparisons between operations C and D were made at output volumes ranging from 230 to 400 gallons of milk.

Less frequent than daily processing — Existence of capacity to process 200 gallons of milk per day with operations A and B, or 400 gallons per day with operations C or D, raised a question as to the most economical method of operation when daily milk production was half or less of daily processing capacity. The survey indicated that a number of operators with excess plant capacity resolved this problem by processing less frequently than daily. Their actual processing schedules often depended not only on size of pasteurizing vat but on other factors including the availability of storage facilities for raw and processed milk.

Two operations were developed to determine costs when the plant capacity was not fully utilized: operation E designed for processing on alternate days when daily sales volumes ranged from 120 to 200 gallons, and operation F which was adequate to handle average daily sales of 80 to 130 gallons by processing every 3 days.

Task or job center	Set up	Sanitize	Check operation	Tear down and wash	Other	Total	Proportion of total
	-	-12/2	- — min	utes — —			per cent
Change clothes					10	10	3.1
Personal time					13	13	4.0
Boiler	2					2	0.6
Clarifier	10	3		15		28	8.6
Pasteurizer	1	4	3	19		27	8.3
Homogenizer	15	2	2	16		35	10.8
Plate cooler	8	1	1	16		26	8.0
Bulk tank storag	e 1	3		16		20	6.2
Jugging equipment	4	1		3		8	2.5
Receiving	13	5	2	-36		56	17.3
Sanitary lines	10	1	1	21		33	9.9
General clean u Processing are	P.				15	15	4.6
Boiler area					5	5	1.5
Sales area					15	15	4.6
Exterior area					5	5	1.5
Pump-water Conditions	1					1	0.3
Administrative ti	ime				25	25	8.0
Summation	65	20	9	142	88	324	
Per cent of time	20.1	6.2	2.8	43.8	27.1		100.0

Table 1 — Time spent at required tasks in minutes and percentages; model gallon jug dairy plant, operation A.

With the exception of reductions in frequency of processing, the same physical plant, equipment, and processing routine were utilized in operations E and F as in operation D.

Modifications were made in operations B and D to ascertain costs incurred in processing an average of 100 gallons daily by different alternatives. Operation B provided one alternative where 100 gallons was processed each day. Others considered were:

1. Processing 200 gallons every other day.

2. Processing 300 gallons every third day and reusing the pasteurizing vat.

3. Processing 300 gallons every third day but using a second vat, a modification of operation D.

4. Processing 200 gallons or less 4 days per week.

5. Processing 3 days per week and reusing the pasteurizing vat 1 of the 3 days.

Consideration was given also to the effects on unit costs of operating the sales room on several different schedules.

#### **Physical Plant Specifications**

Building — On the basis of the survey, a single story, concrete block processing plant and sales room was planned. It had a flat, built up roof and provided 860 square feet of floor space, fig. 1. Five hundred square feet of floor space were available for processing operations while 150 square feet were used for the sales area. An additional 100 square feet were used for storage of supplies and as a room for a desk and other office equipment. A boiler area of 110 square feet also housed a pump, water treatment equipment, and toilet facilities. A cement slab at the rear of the plant provided a foundation for refrigeration equipment. Table 5 lists the quantities and costs of materials used in the construction of such a building. The plant was located adjacent to an existing milk house. Some preliminary grading was required before excavating for the footers. The walls were of regular concrete blocks with large plate glass windows and combination steel and glass doors in front; glass block or steel sash was used in side and rear windows. Steel doors were used at both entrances to the processing area. Plywood panels were installed at two points to facilitate movement of equipment in or out of the building.

The roof was insulated and the insulation was protected from dampness by both a plastic vapor barrier and external ventilation. Moisture resistant asbestos cement board was used on the ceilings except in the sales area where both ceiling and walls were furred and covered with tile board. Walls of the processing area were coated with a plastic paint designed to facilitate cleaning operations as well as to eliminate porous wall surfaces. Other exterior and interior walls were painted.

Floors were 5 inches of cement over a gravel base with floor tile in the sales area.

A sizable sewage system was installed permitting separate disposal of waste from the processing operation. This procedure is not necessarily usable in all areas of the State. In fact, in some localities where drainage conditions are poor or other restrictions apply, the cost of an acceptable sewage system may be prohibitive.

A stone based, black topped parking lot provided 2,000 square feet of parking space. Funds were included for a lighted roadside sign. A new well was required, and its cost was included with items of equipment.

The plant was constructed on a single contract basis. A lower total cost might have been achieved by the owner assuming responsibility for supervising the construction or by furnishing some of the labor.

The only modification made in the original plant was to provide an additional 100 square feet of floor space to house a second pasteurizing vat in connection with operation D, E, or F.

Equipment required — The major items of equipment and costs

new for operation A, are given in table 2. Included are one clarifier, one vat pasteurizer, one homogenizer, one plate cooler with ice bank refrigeration equipment, two farm bulk storage tanks, one boiler, and one pump and water conditioning equipment. The clarifier, water softener, and chlorinator are not essential items of equipment but were recommended by dairy technologists as desirable aids in maintaining a high-quality product. In planning the operation, it was assumed that bulk facilities for raw milk already existed and could be utilized, and that customers would furnish their own milk jugs.

Identity ing number	- Item	Rating or capacity	Included accessories	Itemized cost	Total cost per unit°
1	Batch pasteur- izing vat	200 gallons	Base price (with spray ring) 2-speed motor Air space heater No foam inlet Circulating pump Stem thermometer	\$2,470 110 190 38 225 52	\$3,085
2	Homogenizer	200 gal./hr.	Base price Motor, single phase 7½ HP Motor starter	2,880 2 450 35	3,365
3	Boiler	15 HP	Base price Low pressure steam control Feed water return system	1,680 n 35	1 000
4	Plate cooler	2,000 lb./hr.	Painted hex frame Base price Connection plates	168 1,779 135	1,883
5	Ice bank	1,000 lb. ice	Base price 2 HP comp.	710 350	1,060
6	Bulk storage	200-300 gallon farm type	(\$2,095 each)		4,190
7	Recording thermometer			215	215
8	Fuel oil tank	500 gallons		33	-33
9	Water treat- ment system	10 gal./min.	Softener, base pric Chlorinator, base	e 400	
			Installation costs	66	766
10	Exhaust fan			180	180
11	Hot water heaters	44,000 BTU/hr. 25,000 BTU/hr.	1 @ \$106 2 @ \$78 3 controls @ \$16	106 156 48	310

Table 2 — Prices of new equipment used in the model gallon jug dairy plant.

#### Table 2 - (continued)

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10	BU	u,	1 y -

ing number	Item	Rating or capacity	Included accessories	Itemized cost	Total cost per unit°
12	Milk pump	20-180 gal./ min.	1/2 HP motor	150	150
13	Coolant pump		3/4 HP motor	140	140
14	Sanitary pipe Assorted fittings	Stainless steel	60 ft. @ \$3/ft. 20 @ \$22 4 @ \$13 20 @ \$5	180 440 52 100	180 440 52 100
15	Milk clarifier	3,000 lb./hr.	2 HP motor	2,500	2,500
16	Water well	75 ft. depth 10 gal./min.	\$10/ft. ¾ HP pump Tank (200 gallons'	750 400 ) 175	1,325
17	Fittings stand		Casters	100	100
18	Step ladder			15	15
19	Wash tank & pipe rack	Stainless steel	Casters	510	510
20	Sink—sales room	Stainless steel		100	100
21	Jug fillers	Stainless steel	2 @ \$95 Fittings	190 62	252
22	Sales room counter			50	50
23	Cash register			250	250
24	Desk			125	
	Chair Filing cabinet			25 50	200
25	Miscellaneous tools Wrenches Gauges Usees				200
	noses		Total equipment c	ost	\$23,565

" The total cost of any unit of equipment includes the cost of installation.

Used equipment was largely substituted for new in operation B, as shown in table 3. Various pieces of equipment were purchased new when the installation of secondhand equipment was not recommended, as in the case of the boiler, or when used equipment was not likely to be available.

In operations C, D, E, and F, the same general items of used equipment were suggested as in operation B, but some modifications in sizes were required for operations D, E, and F. A second pasteurizing vat also was necessary. Table 4 lists specifications and approximate prices for new equipment not budgeted in this report but required by alternative types of jug operations. These involve the substitution of high temperature short time pasteurizers for batch pasteurizers and addition of bottle washing, filling, and storage equipment where prefilled one-half gallon bottles are exchanged for customers' empty containers.

#### **Fixed and Variable Costs**

Individual cost items were designated either as fixed or variable. Fixed costs were defined as those that did not vary in amount with the volume of milk processed in a given operation. Interest on investment, depreciation and repairs, insurance, and real estate taxes were fixed costs. Sales labor was considered a fixed cost but processing labor was a variable cost. Variable costs were defined as those which increased in amount with an increase in volume handled by the operation. For example, the cost of bottle caps varied directly with output.

Portions of the cost of certain items such as electricity and fuel oil were fixed while the remainder varied with the volume of milk

dentifying number	Item	Cost
1	Batch pasteurizing vat	\$1,190
2	Homogenizer	1,100
3	Steam boiler	1,883
4	Plate cooler	638
5	Ice bank	360
6	Bulk storage tanks (2)	2,095
7	Recording thermometer	215
8	Fuel oil tank	- 33
9	Water softening system	766
10	Exhaust fan	180
11	Hot water heaters (3)	310
12	Milk pump	150
13	Coolant pump (circulating)	140
14	Stainless steel pipe fittings	180 592
15	Milk clarifier	850
16	Water well pump and 200-gallon tank	1,325
17	Fittings stand - on wheels	100
18	Step ladder	15
19	Wash tank and pipe rack	510
20	Sink — sales room	100
21	Jug fillers (2) and fittings	252
22	Counter	50
23	Cash register	250
24	Chair, desk, filing cabinet	125
25	Miscellaneous tools	200
	Total equipment cost	\$13,609

Table 3 — Prices of used equipment employed in operation B and succeeding operations."

· Specifications for this equipment are the same as listed for similar equipment in table 2.

Ide	ntifying umber	Item	Rating or capacity	Included I accessories	temized cost	Total cost per unit †
26		High temperature short time pasteurizer	2,500 lb/hr. 80% regeneration	Base price Panel board Balance tank Holding tube Steam condensate	3,401 540 595 525	
			set Control equipment Installation costs	430 1,737 1,590	\$8,8181	
	27 a	Bottle washer	120 cases/hr. 4 compartment semi-automatic	Base price 3 HP motor	1,570 248	1,818
	b	Bottle washer	60 cases/hr. 3 compartment Manual	Base price 3 HP motor	1,270 248	1,518
	28	Jug filler	Manual		525	525

Table 4 — Prices of new equipment required by alternative types of processing operations.\*

 This equipment, not found in the model plant, might be required by alternative types of gallon jug operations.

I Except where noted, the total cost of the unit is assumed to cover the cost of installation.

1 If the high temperature short time pasteurizer is not timed with the homogenizer, add \$900; for a better frame, add \$415.

processed and sold. Thus, the electricity and fuel oil required to heat the building did not vary with the volume of milk handled but the electricity required to homogenize and cool the milk did. Processing labor while considered a variable cost did not vary at low levels of output and at higher levels did not vary proportionately with the volume of milk processed.

Variable costs, other than processing labor, were calculated on the basis of processing and selling a 10-gallon unit of milk. This cost was multiplied by the number of 10-gallon units processed and sold. The result plus the cost of processing labor were added to the fixed cost to determine the total costs for each operation.

#### **Fixed Cost Items**

Interest on investment — An annual interest charge of 6 per cent of the average investment in land, building, equipment, and supplies was made. This charge was a fixed cost, varying in amount only with total investment. For operation A, the total investment was \$39,671. Replacing new equipment with used, in operation B, reduced the capital outlay to \$29,715.

**Depreciation and repairs** — The total annual charge for depreciation and repairs for the building was set at 4 per cent, for new equipment at 10.5 per cent, and for secondhand equipment at 16.9 per cent of the initial investment. While used equipment was purchased at one-third to one-half the price of new equipment and reduced the investment required, the total charge for depreciation and repairs was reduced only slightly. In general, increased equipment repair costs for secondhand equipment offset reduced depreciation charges.

Real estate taxes — For purposes of determining real estate taxes, the building was assumed to be assessed at 90 per cent of its original cost, that the tax valuation was the 1960 State-wide average of 42.3 per cent of market value, and that the tax was 45 mills.

Detergents, sanitizers, etc. — Requirements for various cleaning substances were fixed by type of operation. Appreciable changes occurred only when additional equipment or building space was needed or sales and processing frequencies were altered.

Within each operation water requirements varied with volume of output, and water treatment costs were expected to vary accordingly. However, resulting changes in the total cost of water treatment was held to be insignificant. Water treatment costs were considered as fixed.

Sales labor — In operations A through F, the sales room was open daily from 1:00 to 9:00 p.m. with one person on duty at all times and a second individual available for two additional hours in rush periods. Two more hours were allocated when daily sales were considered to be in excess of 200 gallons of milk. A wage rate of \$1.15 per hour for sales help was in general agreement with hourly labor costs observed in the State-wide survey. The cost effects of keeping the sales room open less than 70 hours per week were considered in connection with modifications made in processing operations to handle small volumes.

Electricity — The fixed portion of the cost of electricity went for lights and for motors that had fixed operating times. Motors operating pasteurizers, water pumps, heaters, or exhaust fans were included in this category. One motor horsepower was considered to require 1 kilowatt of electricity per hour at a farm rate cost of 2 cents per kilowatt.

Fuel oil — The boiler produced steam for heating and hot water for cleaning. Fuel oil needs for heating were based on the assumption that the building would be heated one-half of the year, room temperatures would drop over night, and customer traffic would double the heat loss in the sales area. Adding a 10 per cent factor for other heat losses resulted in an average daily heating requirement of 8 gallons of fuel oil at a cost of 13.5 cents per gallon.

Fuel oil for hot water production, used principally in cleaning equipment, was calculated at slightly more than 1.5 gallons per day.

Steam for pasteurizing was considered to involve a variable cost for fuel oil.

		Quantity		Cost		Cost	
Item	Area or No. of	pieces Net	Gross*	Price per unit	Cost	\$100	
Hot water lines	90′ - 1″ galvani	zed				90 392	
	pipe		90 ft.	.33/ft.	30	30	
Valves & fittings					132	266 30	
Electrical						16 14	
Lighting outlets			56	13.00 ea.	728	36	
Fluorescent fix.			9	30.00 ea.	270	8	
Incandescent fix.			16	4.00 ea.	64	46	
Sign			12	150.00 ea.	150	40	
Motor wiring outlets (16 motors)			141/3 HP	36.00/HP	480	201 135 208	
Lavatory commode						230	
and fittings	1				92	162 3	
Mastic floor tile	250 sq. ft.	250 sq. ft.	265 sq. ft.	.45 sq. ft.	120	14	
Total materials	with		1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -		7 6961	64	
Total materials (					1,0001	28 116	
uantities of materials permit where	applicable as much as a	a 10 per cent allowance	for waste in construc	ction.		231	
of the completed building who	a anotherital here cleat		This tool and a det	00 -11	1096	288	
f labor priced at \$3 per hour.	n constructed by a surgie	e contract was \$10,100.	This included a 55	oo anowance for the site	plus 1,084	2	
- Dollars + Carely and Ale + the industry						72	

Table 5 (continued) - Quantities and costs of materials used in construction of model gallon jug dairy plant.

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Other fixed costs — A flat rate of 10 cents per day was charged for the use of cleaning equipment. An annual expenditure of \$25 was made for special clothing.

Survey data provided rather meager information on costs of licenses and fees. An annual charge of \$100 was made.

A farm insurance rate of 35 cents per \$100 of investment in building, equipment, and supplies at 80 per cent of their original value was applied.

Liability insurance was found to be obtainable at a minimum farm rate of \$54 per year. Annual premiums did not depend on gross sales.

An annual allowance of \$50 was made for expenses associated principally with record keeping, correspondence, and other office work.

Telephone costs were set at \$52 annually or \$1 per week.

An annual allowance of \$50 was made for advertising. Survey information indicated that many of the present jug operations used little direct advertising after the businesses opened.

#### Variable Cost Items

Variable costs included those of processing labor, bottle caps, a portion of the total cost of fuel oil and electricity, and miscellaneous charges. All costs varied directly with output with the exception of processing labor charges. Costs for items other than processing labor were determined to be 16.8 cents for each 10-gallon unit of milk processed and sold. Total variable costs for each level of output were calculated by multiplying the number of 10-gallon units in the total output by 16.8 cents and added to that result the cost of processing labor, appendix table 15.

**Fuel oil** — Under the assumption that 10.75 pounds of steam would pasteurize 10 gallons of milk, and that 80 per cent efficiency would be attained in heat transfer, .134 gallons of fuel oil were required per 10-gallon unit. Use of 1 pint of hot water in the sales room per gallon of milk sold created a need for an additional .0094 gallons of fuel oil per 10 gallons of milk. At 13.5 cents per gallon of oil, total variable fuel costs amounted to 1.936 cents per 10 gallons of milk.

Electricity — The initial plant had seven motors, the operating time of which varied with the amount of milk processed. Electrical demand was estimated to be 1 kilowatt hour per motor horsepower. At 2 cents per kilowatt hour, the cost for electricity amounted to 2.648 cents per 10 gallons of output.

**Bottle caps** — Costing .625 cents each, bottle caps were an important contributor to total variable costs amounting to 6.25 cents per 10 gallons of milk.

**Processing labor** — Processing was considered a one-man operation performed by the owner or manager. With the previously noted exception of operation C, total processing labor time was constant at the lower output volumes. As volume increased, a point was reached above which processing labor requirements also increased with increased output. In operations A and B, this point was about 175 gallons or 87.5 per cent of capacity, table 6.

At any output of less than 175 gallons, performance of all necessary processing tasks required 321 minutes. This was more time than was needed to physically receive, pasteurize, homogenize, cool, and store the milk. For outputs greater than 175 gallons, the processor was idle for a period of time while he waited for completion of the physical operation. Consequently at outputs of 175 gallons or less, the time of the processor created a fixed cost while at outputs above 175 gallons the charge for processing labor became a variable cost. Had the processor been able to undertake jobs outside the plant during these idle periods, processing labor costs would have been constant at all levels of output.

#### Total Costs Per Gallon

Development of a series of budgets for hypothetical gallon jug operations permitted comparisons of unit costs as they varied both with the level of output within a given operation and with modifications of the operation. The total annual fixed costs for each of the operations A through F are given in table 7. The variable costs were 1.68 cents per gallon plus the cost of the operator's labor, appendix table 15. Costs per gallon were calculated by dividing the total annual fixed costs plus processing labor costs by the quantity of output in gallons and adding 1.68 cents. Table 8 lists costs per gallon at various levels of each operation.

In each of the operations, the per gallon unit cost declined with increased output. Figure 2 shows the relationship of volume to unit costs for each of the operations. Operation A at 50 per cent of capacity or 100 gallons per day had a unit cost of 38.3 cents per gallon; at 75 per cent of capacity or 150 gallons per day, 26.1 cents; at 100 per cent of capacity or 200 gallons per day, 20.2 cents. In operation B, identical to operation A but with considerable secondhand equipment substituted for new, unit costs were under those of operation A 0.7 cent per gallon at an output of 200 gallons, 0.9 cent at the 150 gallons level, and 1.3 cents at 100 gallons.

Outputs between 200 and 400 gallons per day required certain modifications in the model plant operation, since these outputs exceeded its initial capacity. Unit costs were determined for two alternative methods of achieving this range in output: operation C which required the immediate reuse of facilities to process an additional quantity of milk, and operation D in which certain processing facilities were reused and a second pasteurizing var was added. Unit costs

Daily volume	Operation A	Operation B	Operation C	Operation D
- gallons -		minutes	per dav	
80	321	321		
90	"	22		
100	<i>p</i> -	"		
110		-28		
120		.0		
130	0.			
140		-99		
150		.00		
160		24.		
170				
180	394	394		
190	329	329		
200	333	333		
222				
230			415	354
240			420	
250			425	**
260			429	
270			434	
280			439	
290			443	
300			448	359
310			453	363
320			457	368
330			462	372
340			467	377
350			471	382
360			476	386
370			481	391
380			485	396
390			490	399
400			495	402
• Operation A.	Original plant, all daily.	new equipment, o	ne 200-gallon pas	teurizer used once
Operation B.	Original plant, seco daily.	ndhand equipment,	one 200-gallon pa	steurizer used once
Operation C.	Original plant, see	ondhand equipment	t, one 200-gallon	pasteurizer reused

Table 6 — Labor requirements at various levels of output for the original milk processing operation and for three modifications."

Survey data indicated a wage rate of \$1.50 per hour for processing labor when hired. In this analysis, the wage rate was raised to a gross figure of \$1.65 per hour to allow for additional costs of social security, insurance, and other benefits that make up actual labor costs.

Enlarged plant, secondhand equipment, two 200-gallon pasteurizers used once

Operation D.

daily.

Miscellaneous costs — In previous studies of milk plant operations, existence of many small items of expense that individually are unimportant but which become important when aggregated has been noted. A figure of 6 cents per 10 gallons of output was used in planning gallon jug operations to cover such costs.

#### Total Costs Per Gallon

Development of a series of budgets for hypothetical gallon jug operations permitted comparisons of unit costs as they varied both with the level of output within a given operation and with modifications of the operation. The total annual fixed costs for each of the operations A through F are given in table 7. The variable costs were 1.68 cents per gallon plus the cost of the operator's labor, appendix table 15. Costs per gallon were calculated by dividing the total annual fixed costs plus processing labor costs by the quantity of output in gallons and adding 1.68 cents. Table 8 lists costs per gallon at various levels of each operation.

In each of the operations, the per gallon unit cost declined with increased output. Figure 2 shows the relationship of volume to unit costs for each of the operations. Operation A at 50 per cent of capacity or 100 gallons per day had a unit cost of 38.3 cents per gallon; at 75 per cent of capacity or 150 gallons per day, 26.1 cents; at 100 per cent of capacity or 200 gallons per day, 20.2 cents. In operation B, identical to operation A but with considerable secondhand equipment substituted for new, unit costs were under those of operation A 0.7 cent per gallon at an output of 200 gallons, 0.9 cent at the 150 gallons level, and 1.3 cents at 100 gallons.

Outputs between 200 and 400 gallons per day required certain modifications in the model plant operation, since these outputs exceeded its initial capacity. Unit costs were determined for two alternative methods of achieving this range in output: operation C which required the immediate reuse of facilities to process an additional quantity of milk, and operation D in which certain processing facilities were reused and a second pasteurizing vat was added. Unit costs were somewhat lower for operation D at all levels of output, ranging from 0.3 cent to 0.5 cent per gallon. Operation D had the greatest cost advantage over operation C when output was between 280 and 310 gallons per processing.

In view of the unit cost advantage of operation D over C under the specified conditions, operation D was selected as the basic physical plant operation to be used to process milk on an every-other-day basis. The objective was to determine whether unit costs would be lower with a given quantity processed daily or with twice the amount processed every other day.

Every other day processing, designated as operation E, reduced the unit cost by 1.3 cents over operation B at an average output of 200 gallons per day (400 gallons every other day) and 1.9 cents at an average output of 150 gallons. Every third day processing, or operation F, cut unit costs over those of operation B by 4.6 cents at an output averaging 100 gallons per day. The unit costs — output relationships for these three operations are shown in figure 2.

For each of the operations, labor was the largest cost item, table 9.



through F.

The investment and depreciation charges associated with the building and equipment were second in importance.

The use of secondhand equipment, operation B, reduced the relative importance of equipment costs but increased the relative importance of labor. Use of two pasteurizing vats every other day reduced the actual and relative importance of processing labor costs but in-

Plant operation	A	В	Ċ	D	E	F
Daily sales in gallons	80-200	80-200	230-400	230-400	120-200	80-133
Equipment purchased new or used	new	used	used	used	used	used
Number of pasteurizing vats	one	one	one	two	two	two
Number of times vats are used per processing	once	once	twice	once	once	once
Frequency of processing operation	daily	daily	daily	daily	E.O.D.†	E.T.D.‡
Interest on investment	\$1,190	\$ 892	\$ 906	\$ 971	\$ 971	\$ 971
Depreciation and repair on buildings	624	624	624	645	645	645
Depreciation and repair on equipment	2,474	2,304	2,384	2,586	2,586	2,586
Real estate tax on land and buildings	276	276	276	285	285	285
Fire insurance	111	83	85	89	89	89
Detergents, sanitizers, chlorinators	361	361	361	397	215	155
Sales labor*	4,198	4,198	5,038	5,038	4,303	4,338
Administrative supplies	50	50	50	50	50	50
Advertising	50	50	50	50	50	50
Telephone	52	52	52	52	52	52
Electricity	71	71	75	82	61	52
Fuel oil	470	470	470	517	416	385
Brushes, mops, uniforms, towels, etc.	62	62	62	62	62	62
Laboratory fees, licenses, inspections	100	100	100	100	100	100
Liability insurance	54	54	54	54	54	54
Total annual fixed costs	10,143	9,647	10,587	10,978	9,939	9,874
Fixed costs per operating day	27.79	26.43	29.01	30.08		

Table 7 - Fixed costs for operation A through F of model gallon jug dairy plant.°

<sup>o</sup> The definition of fixed costs as used here was broadened to include all costs that were constant at all levels of output for a particular operation. Processing labor costs, while nearly constant for operation A and B, were held to be variable costs.

+ Every other day.

t Every three days.

Daily volume	Opera- tion A	Opera- tion B	Opera- tion C	Opera- tion D	Opera- tion E	Opera- tion F
gallons			- cents per	gallon -		
80	47.5	45.8				40.0
90	42.4	41.0				35.7
100	38.3	37.0				32.4
110	35.0	33.7				29.7
120	32.2	31.1			28.7	27.5
130	29.9	28.8			26.6	25.6
140	27.8	26.9			24.8	
150	26.1	25.2			23.3	
160	24.6	23.7			22.1	
170	23.2	22.4			20.9	
180	22.1	21.3			19.9	
190	21.1	20.4			19.0	
200	20.2	19.5			18.2	
210		10 A ()				
220						
230			19.3	19.0		
240			18.6	18.3		
250			18.0	17.6		
260			17.4	17.0		
270			16.8	16.4		
280			16.4	15.9		
290			15.9	15.4		
300			15.5	15.0		
310			15.1	14.6		
320			14.7	14.3		
330			14.3	13.9		
340			14.0	13.6		
350			13.7	13.3		
360			13.4	13.0		
370			13.1	12.7		
380			12.8	12.5		
390			12.6	12.2		
400			12.3	12.0		
· Operation A	. Original plan	t, all new e	quipment, one	200-gallon	pasteurizer	used once

Table 8 - Unit costs at various levels of output for the original processing operation and for specified modifications."

daily.

Operation B. Original plant, used equipment, one 200-gallon pasteurizer used once daily. Operation C. Original plant, used equipment, one 200-gallon pasteurizer reused once.

Operation D. Enlarged plant, used equipment, two 200-gallon pasteurizers used once daily.

Operation E. Enlarged plant, used equipment, two 200-gallon pasteurizers used once every other day.

Operation F. Enlarged plant, used equipment, two 200-gallon pasteurizers used every third day.

creased those of interest, depreciation, and repairs because of a somewhat greater investment in building and equipment.

Unit costs developed for a series of processing and selling arrangements not considered in the preceding operations A through F are summarized in table 10. Some previously determined costs are included for comparative purposes. Unit processing and selling costs were reduced where processing operations were intermittent rather

0	peration	0		Operation	n°
A	В	Ē	A	В	E
-cen	ts per g	allon-	— per	cent of	total —
2.17	1.63	1.77	8.31	6.48	7.60
1.14	1.14	1.18	4.36	4.51	5.05
4.51	4.20	4.72	17.28	16.67	20.25
.50	.50	.52	1.93	2.00	2.23
.20	.15	.16	.78	.60	.70
5.93 7.65	5.93 7.65	3.49 7.85	22.71 29.32	23.53 30.37	14.97 33.69
.09	.09	.09	.35	.36	.39
.09	.10	.10	.36	.38	.41
.39	.39	.38	1.51	1.56	1.61
1.05	1.05	.95	4.02	4.17	4.09
.11	.11	.11	.43	.45	.49
.66	.66	.39	2.52	2.61	1.68
.62	.62	.62	2.39	2.47	2.68
.18	.18	.18	.70	.72	.78
.10	.10	.10	.38	.39	.42
.09	.09	.09	.35	.36	.39
.62	.61	.60	2.40	2.37	2.57
26.10	25.20	23.30	100.00	100.00	100.00
	O A 	Operation   A B   —cents per ga   2.17 1.63   1.14 1.14   4.51 4.20   .50 .50   .20 .15   5.93 5.93   7.65 7.65   .09 .09   .09 .10   .39 .39   1.05 1.05   .11 .11   .66 .62   .18 .18   .10 .09   .09 .09   .62 .61   .26.10 25.20	$\begin{tabular}{ c c c c } \hline Operation*\\ \hline A & B & E\\ \hlinecents per gallon-\\ \hline 2.17 & 1.63 & 1.77\\ \hline 1.14 & 1.14 & 1.18\\ \hline 4.51 & 4.20 & 4.72\\ \hline .50 & .50 & .52\\ \hline .20 & .15 & .16\\ \hline 5.93 & 5.93 & 3.49\\ \hline 7.65 & 7.65 & 7.85\\ \hline .09 & .09 & .09\\ \hline .09 & .10 & .10\\ \hline .39 & .39 & .38\\ \hline 1.05 & 1.05 & .95\\ \hline .11 & .11 & .11\\ \hline .66 & .66 & .39\\ \hline .62 & .62 & .62\\ \hline .18 & .18 & .18\\ \hline .10 & .10 & .10\\ \hline .09 & .09 & .09\\ \hline .62 & .61 & .60\\ \hline 26.10 & 25.20 & 23.30\\ \hline \end{tabular}$	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $

Table 9 — Distribution of costs per gallon among various items based on daily output or average daily output of 150 gallons.

<sup>6</sup> Operation A. All new equipment, one 200-gallon pasteurizer used once daily. Operation B. Secondhand equipment, one 200-gallon pasteurizer used once daily. Operation E. Secondhand equipment, enlarged plant with two 200-gallon pasteurizers used once every other day.

Table 10 - Unit costs under alternative methods of processing and selling where raw milk production averaged 100 gallons per day."

Days open per week	7	6	6	6
Hours of sales labor per weekf	70	70	60	48
P		cents	per gallon	
Processing trequency:		10.0 M		1.00.0
Every day	37.0	36.9	35.3	33.3
Every other day	32.2	32.0	30.4	28.5
Three days per week	32.0	31.8	30.2	28.2
Four days per week	32.8	32.6	31.0	29.0
Every third day	31.7	31.5	29.9	28.0
Every third day1	32.4	32.2	30.6	28.6

. Computed on the basis of plant and equipment of operation B, with the exceptions noted.

Intermittent processing required an additional one-half hour of sales labor every day of sales operation but no processing.

I Enlarged plant and equipment of operation D.

Table 11 — Comparative variations in unit costs of processing jug milk with rising plant and labor costs, with speed of repayment of investment, and with advancing amounts of milk sold at wholesale prices.

	Outputs of plant B Outputs of plant D						)
Costs and returns relationships	1 seco 100 — — ce	ndhand va 150 ents per gal	(gals.) 200 lon — —	2 : 250	secondhan 300 — cents p	d vats (g 350 er gallon	als. ) 400
Processing and sales costs per gallon Unit versus building and labor costs	37.0	25.2	19.5	17.6	15.0	13.3	12.0
by \$90 and unit cost by	.25	.16	.12	.10	.08	.07	.06
A \$1,000 change in used equipment cost will change total annual costs by \$202 and unit cost by	.55	.37	.28	.22	.18	.16	.14
A 25 per cent change in wage rate of processing labor will change unit costs by	2.23	1.49	1.14	.97	.83	.75	.69
Unit versus amortization To pay the investment off in 10 years a 10 per cent capital repayment per year must be made. This will increase unit costs by	6.11	4.07	3.05	2.62	2.09	1.87	1.67
To pay the investment off in 5 years, a 20 per cent capital repayment per year must be made. This will increase units costs by	14.25	9.50	7.12	6.12	5.10	4.37	3.82
Unit versus wholesale prices With 10 per cent of the milk sales sold as surplus at \$1.00/cwt. below wholesale prices, how much must be added to unit price to cover this loss?	0.95	0.95	0.95	0.95	0.95	0.95	0.95
With 25 per cent of the milk sales sold as surplus at \$2.00/cwt. below wholesale prices, how much must be added to unit price to cover this loss?	5.73	5.73	5.73	5.73	5.73	5.73	5.73

than daily, and the volume averaged only 100 gallons per day. When initial plant and equipment were utilized for every third day processing, unit costs were reduced more than 5 cents per gallon. When processing operations were restricted to a 6-day week, which in turn required processing three or four times per week, some of this advantage was lost. In general, the less frequent the processing operation was performed the lower the cost per gallon of output.

Reducing the days per week that the sales room was open from 7 to 6 without reducing the hours of sales labor required had little influence on unit costs. However, at an average of only 100 gallons a day, a 6-day week requiring approximately 48 hours of sales labor, reduced costs by more than 3.5 cents per gallon as compared with a 7-day 70-hour week.

Costs might differ for an actual operation as compared with those of the model plant. Some of the more obvious reasons for divergence and ones that would have the greatest influence on total costs are differences in building construction costs, equipment costs, and in the wage rates paid processing and sales labor. The general effect of these on total unit processing and selling costs are reported in table 11.

#### Indirect Costs Associated with a Gallon Jug Operation

In addition to costs of processing and selling milk, three other factors are important to a prospective operator in determining the price he must charge for jug milk in order to be as well off as he would be with an alternative market for his milk.

Consideration should be given to the possibility that quantities of raw milk cannot be sold as jug milk and will have to be marketed as surplus at manufacturing milk prices. In entering the jug milk business, any dairyman who has the alternative of wholesaling all of his milk at fluid rates should be cognizant of possible losses in revenue from the sale of excess milk at lower prices which must be compensated for in additional returns from that part retailed in jugs.

Risk incurred by the establishment of a gallon jug enterprise should be considered. A large capital investment is required. Farm sales of jug milk may be supplanted by other marketing methods, or otherwise rendered unprofitable, before the initial capital expenditures are fully recovered. One method of resolving this problem is to charge off the investment rapidly. The additional sales return required to repay the principle should be treated as an indirect but real cost of doing business.

A third consideration is the common practice of selling items other than milk through the sales outlet. Any gain from selling other items may be viewed as a reduction in unit cost per gallon of milk. The other items help to absorb some of the overhead costs particularly for sales labor. In the particular operations budgeted in this study, little space was available for handling products other than milk; therefore, sale of other products would necessitate additional investments. The effects of the first two of these three factors on unit costs are presented in table 11. The effect of the third would vary with the volume of products handled other than milk.

## Appendix

Table 12 -	Time schedule for operator of milk	processing plant, one pasteurizing
	vat used to process 180 gallons;	operations A and B.

Clock	time	Task	Group®	Time spent (min.)
From	To			
7:00	7:05	Change clothes	T	5
7:05	7:08	Start boiler, check water treatment system	Ĩ	3
7:08	7:09	Position fittings rack	Ĩ	1
7:09	7:24	Assemble homogenizer	Ť	15
7:24	7:27	Assemble sanitary line, pasteurizer to homogeniz	er I	3
7:27	7:35	Assemble plate cooler	Î	8
7:35	7:36	Bun wash water in empty bulk storage tank	Ť	ĩ
7:36	7:40	Assemble sanitary line homogenizer to plate cool	er I	Å
7:40	7:54	Clean bulk tank and drain	Ť	14
7.54	7.57	Assemble sanitary line plate cooler to bulk tank	Ť	14
7.57	7-59	Prepare sanitary me, plate cooler to burk tank	Ť	0
7.59	8.01	Set up milk nump in processing soon	1	0
8.01	8-11	Set up clarifier	Ť	10
8-11	8.15	Set up receiving liner in plant	Ŷ	10
8.15	8,18	Accomble inteka line, wash tools to mills nume	÷.	4
8.18	8.10	Somitize receiving equipment	4	0
8.10	8.90	Sanitize receiving equipment	1	1
8.00	8.94	Sanitize pasteurizing vat	1	3
8:24	8:24	Finish sanitizing receiving system, disconnect wash tank	T	2
8:27	8:30	Connect intake line in processing room,		0
0.00	0.00	go to milk room	1	3
0:30	0:32	furn agitator on, connect intake line to bulk tank	1	2
0:32	0:33	Return to processing area, complete sanitizing	1	1
0:33	8:30	neturn to milk house, open valve, stop agitator	1	2
0:00	0:00	Start to receive raw milk	11	1
0:00	0:39	Sanitize bulk storage tank, drain	11	3
0:09	0.40	Instan temperature chart	11	1
0:40	0:00	General cleanup of sales area	111	15
0:00	9.00	General cleanup of exterior	III	5
9:00	9:05	Sanitize and assemble jug filler	III	5
9:05	9:06	Turn heat on in pasteurizing vat, finish receiving	II	1
9:06	9:11	Kinse receiving equipment including bulk tank	III	5
9:11	9:24	Dismantle and clean receiving equipment	III	13
9:24	9:35	Start to wash receiving equipment	III	11
9:35	9:36	Check pasteurizing operation	п	1
9:36	9:38	Change to holding temperature	II	2
9:38	10:00	Continue washing receiving equipment	III	22
10:00	10:03	Idle time		3
10:03	10:05	Prepare to homogenize, cool and store milk	II	2
10:05	10:07	Start final processing operations	II	2
10:07	10:17	Personal time	III	10
10:17	10:42	Perform various management duties	III	25
10:42	10:47	General cleanup of boiler area	III	5
10:47	10:57	Partial cleanup of processing area	III	10
10:57	10:59	Set up to rinse and wash processing equipment	III	2
10:59	11:02	Finish processing milk, rinse equipment	IV	3
11.02	11,04	add detergent	IV	2

Table 12 (continued)

Clock	time	Task Group*	Time spent (min.)
From	To		
11:04	11:09	Tear down sanitary lines IV	5
11:09	11:24	Scrub pasteurizer IV	15
11:24	11:39	Tear down homogenizer and scrub IV	15
11:39	11:54	Tear down plate cooler and scrub IV	15
11:54	12:09	Wash and rack sanitary lines 1V	15
12:09	12:14	Finish cleanup of processing area IV	5
12:14	12:19	Change clothes IV	5
		Rinse bulk tank and wash jug filler the previous evening	5
		Total time	324

" All tasks are included in one of the following four groups:

Group 1. Tasks. Must be performed prior to the start of the receiving operation.

Croup II. Tasks. Must be performed after the receiving operation starts and before the final processing operation is completed.

Group III. Tasks. Can be performed between the time receiving starts and the final processing operation ends.

Group IV. Tasks. Can only be performed after the final processing operation is completed.

Table 13 — Time schedule for operator of processing plant, one pasteurizing vat reused immediately to process a total of 300 gallons; operation C.

There are a

Clock	time	Task	(minutes)
From	То		
7:00	9:05	Procedure similar to operation A	125
9:05	9:06	Turn heat on in pasteurizing vat	1
1.23	4.43	Finish receiving 180 gallons of milk	
9:06	9:07	Suspend receiving operation	1
9:07	9:35	Idle time	28
9:35	9:36	Check pasteurizing operation	1
9:36	9:38	Change to holding temperature	2
9:38	10:03	Idle time	25
10:03	10:05	Prepare to homogenize, cool and store milk	2
10:05	10:07	Start final processing operations	2
10:07	10:32	Perform various management duties	25
10:32	10:59	Idle time	27
10:59	11:02	Finish processing first batch of milk	3
11:02	11:06	Prepare to receive raw milk	4
11:06	11:07	Start to receive raw milk	1
11:07	11:26	Idle time	19
11:26	11:27	Turn heat on in pasteurizing vat, finish receiving	1
11:27	11:32	Rinse receiving equipment, including bulk tank	5
11:32	11:45	Dismantle and clean receiving equipment	13
11:45	11.56	Start to wash receiving equipment	11
11:56	11:57	Check pasteurizing operation	1
11:57	11:59	Change to holding temperature	2
11:59	12:21	Continue washing receiving equipment	22
12:21	12:25	Idle time	4
12:25	12:27	Prepare to homogenize, cool, and store milk	2
12:27	12:29	Start final processing operations	2
12:29	12:46	Idle (or lunch) time	17
12:46	12:51	Cleanup of boiler area	5
12:51	1:01	Partial cleanup of processing area	10
1:01	1:03	Set up to rinse and wash processing equipment	2
1:03	1:06	Finish processing milk, rinse equipment	3
1:06	1:08	Run wash water into pasteurizing vat	2

Table 13 (continued)

Clock time		Task	Time spen (minutes	
From	То			
1:08	1:13	Tear down sanitary lines	5	
1:13	1:28	Scrub pasteurizer	15	
1:28	1:43	Tear down homogenizer and scrub	15	
1:43	1:58	Tear down plate cooler and scrub	15	
1:58	2:13	Wash and rack sanitary lines	15	
2:13	2:18	Finish cleanup of processing area	5	
2:18	2:23	Change clothes	5	
		Rinse bulk tank and wash jug filler the prev	ious evening 5	
		Total time	448	
		Unused labor time	120	

Table 14 — Time schedule for operator, two processing vats used to process a total of 300 gallons; operation D.

Clock t	ime	Task		
From	To			
7:00	8:55	Procedure similar to operation A	115	
8:55	9:03	Additional time to connect and sanitize second		
2.20		pasteurizing vat	8	
9:03	9:04	Turn heat on in pasteurizing vat, stop receiving		
	2010	raw milk in Vat I (120 gallon)	1	
9:04	9:05	Switch receiving line to Vat II	1	
9:05	9:06	Continue receiving raw milk, Vat II	1	
9:06	9:11	Sanitize and assemble jug filler	5	
9:11	9:16	General cleanup of boiler area	5	
9:16	9:21	General cleanup of exterior	5	
9:21	9:31	Personal time	10	
9:31	9:32	Install second temperature chart	1	
9:32	9:33	Check pasteurizing operation, Vat I	1	
9:33	9:35	Change to holding temperature, Vat I	2	
9:35	9:36	Turn heat on and finish receiving Vat II (180 gallon	) 1	
9:36	9:41	Rinse receiving equipment, including bulk tank	5	
9:41	9:54	Dismantle and clean receiving equipment	13	
9:54	10:00	Start to wash receiving equipment	6	
10:00	10:01	Check pasteurizing operation, Vat I	1	
10:01	10:03	Prepare to homogenize, cool, and store milk, Vat I	2	
10:03	10:05	Start final processing operation, Vat I	2	
10:05	10:07	Change to holding temperature, Vat II	2	
10:07	10:34	Finish washing receiving equipment	27	
10:34	10:39	Idle time	5	
10:39	10:40	Switch processing operation from Vat I to Vat II	1	
10:40	10:42	Run wash water into Vat I	2	
10:42	10:57	Scrub Vat 1	15	
10:57	11:22	Perform various management duties	25	
11:22	11:32	Partial cleanup of processing area	10	
11:32	11:34	Set up to rinse and wash processing equipment	2	
11:34	11:37	Finish processing milk, rinse equipment	3	
11:37	11:39	Run wash water into Vat II, add detergent	2	
11:39	12:44	Tear down and scrub sanitary lines and processing	65	
12.44	12.49	Finish cleanup of processing area	5	
12.40	12.54	Change clothes	5	
12:40	14:04	Bince bulk tank and jug filler on previous evening	5	
		Total time	350	
		Unused labor time	5	
		unused labor unie	0	

Produces Distributions

Daily production	Opera- tion A	Opera- tion B	Opera- tion C	Opera- tion D	Opera- tion E	Opera- tion F
—gallons—			dol	llars — -		
80	3222	3222				1311
90	"	**				1311
100	,,	,,				1335
110	"	,,				1378
120	"	**			1877	1425
130	>>	**			.,	1459
140	,,	>>			"	
150	>>	"			1902	
160	,,	>>			1947	
170	,,	"			1992	
180	3252	3252			2039	
190	3302	3302			2088	
200	3342	3342			2118	
230			4166	3553		
240			4216	>>		
250			4266	"		
260			4306	"		
270			4356	**		
280			4406	33		
290			4447	>>		
300			4497	3603		
310			4547	3644		
320			4587	3694		
330			4637	3734		
340			4688	3784		
350			4728	3834		
360			4778	3875		
370			4828	3925		
380			4868	3975		
390			4918	4005		
400			4969	4035		

Table 15 — Annual costs of processing labor at various levels of output for the original processing operation and for specified modifications.°

٥	Operation A.	Original plant, all new equipment, one 200-gallon pasteurizer used once daily.
	Operation B.	Original plant, used equipment, one 200-gallon pasteurizer used once daily.
	Operation C.	Original plant, used equipment, one 200-gallon pasteurizer reused once.
	Operation D.	Enlarged plant, used equipment, two 200-gallon pasteurizers used once daily.
	Operation E.	Enlarged plant, used equipment, two 200-gallon pasteurizers used once every other day.
	Operation F.	Enlarged plant, used equipment, two 200-gallon pasteurizers used every third day.

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