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A Comparison of Fluid Milk Processing 6 and 3 Days Per Week in One Small Plant, Utah 1953

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A COMPARISON OF FLUID MILK PROCESSING 6 AND 3 DAYS PER WEEK IN ONE SMALL PLANT, UTAH 1953

by

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John L. Willis

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INTRODUCTION

Many of the fluid milk processing plants in Utah are relatively small. The typical small plant in Utah is generally family operated with some hired help. Although most of the small plants are individually owned, some are operated as partnerships. Often the same man picks-up, processes, and then delivers the milk. Some of the processors also own dairy herds. In these cases the same man performs all the functions necessary to carry the milk products from the farm to the consumer's door. It is not uncommon to find the plant owner and manager performing all these duties himself.

Larger floor space and the purchase of more modern equipment is often not justified in the small plant because of small volume. As a result, some small plants process milk in crowded space, bottle milk with a hand machine, and wash the bottles with a motor-driven brush. Some small plants have purchased modern equipment in order to compete with the larger dairies in quality control and consumer preference. However, the small plant usually does not market enough to keep unit costs low.

The small processors are forced to diversify and integrate their business to compete with the larger dairies. Fluid milk is the principal product, but in addition some of the small plants process other products such as ice cream, chocolate milk, cottage cheese, low fat milk, and orange ade.

Milk is supplied to small plants from farmer-producers who are usually located within a few miles of the plant. In some cases part

of the milk comes from the processor's own dairy herd.

The small processor's principal market is house to house delivery. In some cases the milk products are sold through a sales room, owned and operated in conjunction with the processing plant. In some areas milk is bottled in half pints and delivered to school lunch programs, and a small percent is sold to retail stores.

In contrast to small plants described above, there are about 6 fluid milk plants in Utah that operate on a large scale basis. A plant manager or superintendent is hired and devotes full time to administrative duties. Milk is processed by a crew of men in a modern and up-to-date plant with modern equipment. Another crew of men deliver the milk both on wholesale and retail routes. A fleet of trucks is necessary to pick up and distribute the large volume of milk handled. The raw milk is obtained from farmer-producers located up to several hundred miles from the plant. Some of this same milk is later trucked back to these outlying communities as cartoned homogenized milk. The large dairy handles a variety of other dairy products as well.

Problems of small plants

Many of the technological improvements and changes that have occurred recently in milk processing appear to give the larger dairies the competitive advantage. In 1950, there were 87 plants in operation in Utah. By the end of 1952 the number had declined to 72, a reduction of 15 plants during this 2-year interval. The decline in number of plants was due to small processors going out of business.

Some changes in the dairy industry that have contributed to reduction in plant numbers are:

1. Introduction of more modern equipment. Small plants find it difficult to afford new equipment such as flash pasteurizers and

carton bottling machines. A plant must have sufficient volume to keep unit costs low when investing in expensive machinery. The more modern equipment has made it possible for the larger dairies to operate even more efficiently. Because of the increased popularity of the carton container, the larger dairies have been able to increase their volume, often at the expense of the small dairies. The carton container is used mainly in selling milk through retail stores.

2. Improved transportation. The roads throughout Utah and particularly in the smaller communities have been improved considerably. Larger and more modern trucks are available today. The large plants have capitalized on this and are transporting milk long distances at low costs. Prior to this time the small plants gathered, processed, and delivered to the consumer all the fluid milk in the remote areas.

3. Health standards. The State Department of Agriculture and the City Health Department are interested in improving the quality of milk. The requirement of pasteurized milk, more sanitary capping facilities, and other improvements have meant changes or additions to the plant and equipment. These changes require additional expense to the processing plant, and if volume is low, unit costs are raised more than when the volume is large.

4. Consumer preference. The housewife is demanding a wider variety of milk products (e.g., creamline, homogenized, and low-fat milk) and the small plants have to supply a wide variety of products to keep their customers. Here again, it is more costly per unit volume to the small plants than to the larger ones.

Purpose of study

This study was made because small plants play an important part in our economy. (1) They are a part of industry and perform a service to the public. (2) They perform a service to rural and remote areas that larger plants cannot always serve. (3) They offer Grade A price for the farmer's milk that otherwise might have to be sold for manufacturing milk. (4) They exemplify the American way of life under the system of free enterprise.

In recent years small plants are becoming of less importance and fewer in number. Much of the difficulty of the small processor is in high unit operating costs and low volume. It is hoped that by processing fewer days per week, these plants can better utilize plant, equipment, materials, and labor, thereby increasing efficiency of the plant's operation.

Review of literature

There have been studies made in the fluid milk industry in an effort to reduce costs. None of them have had the same objective in mind as this study. Most other studies have been concerned with reducing distributing costs instead of processing costs. The purpose of this study was to determine if small plants could process fewer days, that is 3 days per week, and thereby reduce unit costs. There have also been some work simplification studies made in other agricultural enterprises.

Dr. Roice Anderson and Dr. Leland Spencer made a study and pointed out ways of reducing milk distributing costs in New York (1). Their study showed that by adoption of alternate day delivery fluid milk plants could expect from 20 to 35 percent savings. It was studies of this nature, and the fact that the fluid milk industry was practicing

alternate day delivery to an advantage that prompted the study of alternate day processing.

The text, Motion and Time Study (2), by Barnes and a booklet, "Work Simplification" (7), put out by the Maytag Company were very helpful in methodology in setting up the study. They were especially helpful to the author in designing a flow process chart to use in gathering the data. They were also helpful in breaking the study down for purpose of analysis.

OBJECTIVES

The objectives of this study are to: (1) compare the time required for 3 day a week with 6 day a week processing of milk; (2) compare fuel and cleaning supplies consumed in 3 day a week with 6 day a week processing; (3) determine the difference in cost of 3 day and 6 day a week fluid milk processing in small plants in terms of labor, fuel, and cleaning supplies.

METHOD OF PROCEDURE

The data for this study were collected by work simplification method. The nature of the study lent itself to a case study; therefore, only 1 fluid milk processing plant was used. The processing plant is located in Cache Valley.

The results of this study will be of concern primarily to small plants. The labor requirement, volume of business, size of plant, and type of equipment places this particular plant in the category of small plants.

Tools and material used to gather data were: (1) one clip board, (2) two stop watches (calibrated to hundreths of a minute), (3) flow process charts (designed especially for this study, see appendix).

Prior to this study the plant manager was operating on a 6 day week schedule. It was proposed that he convert to a 3 day per week operation. These 2 methods of processing are more commonly referred to throughout this thesis as ED (every day) and EOD (every other day) processing.

The ED method of processing was studied first for a period of 1 week. Then the plant was converted over to EOD processing and 3 weeks were allowed for the men to familiarize themselves with the new method. Following the familiarization period the plant was studied for 1 week on the basis of EOD processing. After a 1-year interval, the plant was again studied as a check and to substantiate the data of the first study. A 1-week period was studied for each method of processing.[1]

1. Same person who made first study.

Data from the 2 studies were combined and analysed.

The study consists of a time analysis of all the steps necessary in the processing of fluid milk. The analysis starts with the unloading of milk off the truck into the receiving room and ends with the plant and equipment being cleaned.

The study was divided into 7 major processes: (1) receiving, (2) standardizing, (3) pasteurizing, (4) homogenizing, (5) cooling, (6) bottling, and (7) storing. Each process was subdivided into operations: (1) make ready, (2) do, and (3) clean up and put away.

A number code was given each process and operation to make it easier in collecting and assembling data. The number codes were entered on the work sheet before each day's activities began. They were placed as much as possible in the order in which jobs were performed throughout the work day. As the operator would perform a certain task, the time spent was recorded opposite the process or operation under which it came. The time spent on one operation at a particular time varied from a few seconds to possibly an hour. So at the end of the day the several different times were totaled for each operation.

A process chart for man analysis was used in collecting the data. This is an analysis of what the operator does and shows the steps he performs in turning out the finished product.

Data for the entire study was collected by one man. Three different employees were followed and timed as they performed the various phases of the fluid milk processing. There were anywhere from 1 to all 3 men working at the same time. A stop watch was used to time each of 2 men. When a third man was working it was always on a job that involved several minutes of continuous time, thereby helping to

simplify time keeping. When 3 men were working, 2 of the men's time was kept on 1 watch.

Data were tabulated and totaled according to process and operation. The time involved was analysed and checked for discrepencies and errors in calculation. The total time for each process and operation of EOD processing was compared with the time for corresponding phase of ED processing. These data were analysed on the basis of total time spent in minutes, savings in minutes, percent savings, and the percent each operation is of the process, and the percent each process is of the total processing time.

Adjustments were made in certain operations where time required was related to volume in order to make fair comparisons. The average time required per unit of volume while processing ED was the basis for adjustment. For instance, if 2 more cases of quart bottles were filled EOD than ED then the time required for those 2 cases would be subtracted from EOD bottling time.

An account was made of the materials used. The cleaning compounds and sterilizer were weighed prior to each week's study and then again at the end, the difference being the amount used. The fuel was figured on an annual basis rather than just a week because of different weather conditions and not knowing how much of the fuel went to heat the plant and sales room. The coal receipts of the previous year and the year following the change-over to EOD processing was used in figuring the fuel consumption.

DESCRIPTION OF PLANT OPERATIONS

Volume of milk

The volume of production, approximately 9,000 pounds per week, was fairly constant during the 4 weeks of the study. Approximately 13 percent of the volume was bottled in half pints, 60 percent in quarts, and 27 percent in 2-quart containers. About 2 or 3 percent of the fluid milk volume was skim milk. The time required to process the skim milk is included in the total processing time.

The yearly volume was estimated at about 455,000 pounds. The yearly figure was based on 9,000 pounds per week less the half pint volume for 12 weeks. The half pints were sold to the school lunch program so there was no market for half pints during the summer vacation.

Labor and management

The plant was owned and operated by a father and 2 sons. The older son acts in the capacity of plant manager. Two other men were hired part time for work in the plant and on the delivery routes.

The fluid milk processing required 1 full-time and 2 part-time men while on the 6 day a week processing. The EOD method of processing utilized 2 full-time men and 1 part-time man, but only every other day instead of every day. There were from 1 to 3 men working at the same time. The time spent by each man on a specific operation of the processing was kept and recorded. Some of the tasks were performed intermittently throughout the processing of the fluid milk and some were performed several times a day.

By changing to EOD processing the family could spend more time on the farm and in the sales front.

Plant and equipment

The plant included 4 rooms that were used in the fluid milk processing: a receiving room 8 by 14 feet, a processing room 15 by 17 feet, a wash room 14 by 16 feet, and a refrigerator room 9 by 10 by 8 feet (figures 1 and 2).

The equipment includes: 1 receiving vat; 2 pasteurizers -- 1 Cherry Burrell 110 gallon capacity, and 1 Creamery Package 100 gallon capacity; 1 Specialty Brase automatic bottler, 1 case per minute capacity; 1 cooler 4 feet wide; 1 Cherry Burrell homogenizer; 1 wash vat for cans; 1 wash vat for pipes and fittings; and, 1 case bottle washer (figures 3, 4, and 5).

No additional cost for equipment or plant layout was necessary in change-over to EOD processing.

Delivery and market for milk

Milk was delivered every other day to the customer's door. Two men handled the delivery routes, 1 delivering Monday, Wednesday, and Friday, and the other Tuesday, Thursday, and Saturday. The change to EOD processing made it possible to release the hired man delivering Tuesday, Thursday, and Saturday. One of the sons working in the plant was able to take the delivery route because processing was done on Monday, Wednesday, and Friday. A delivery was made 5 days a week to the school lunch program. Milk was also sold through the sales front, which was in connection with the plant.

Milk was stored 1 day before delivery with ED processing and part of it 2 days with EOD processing.

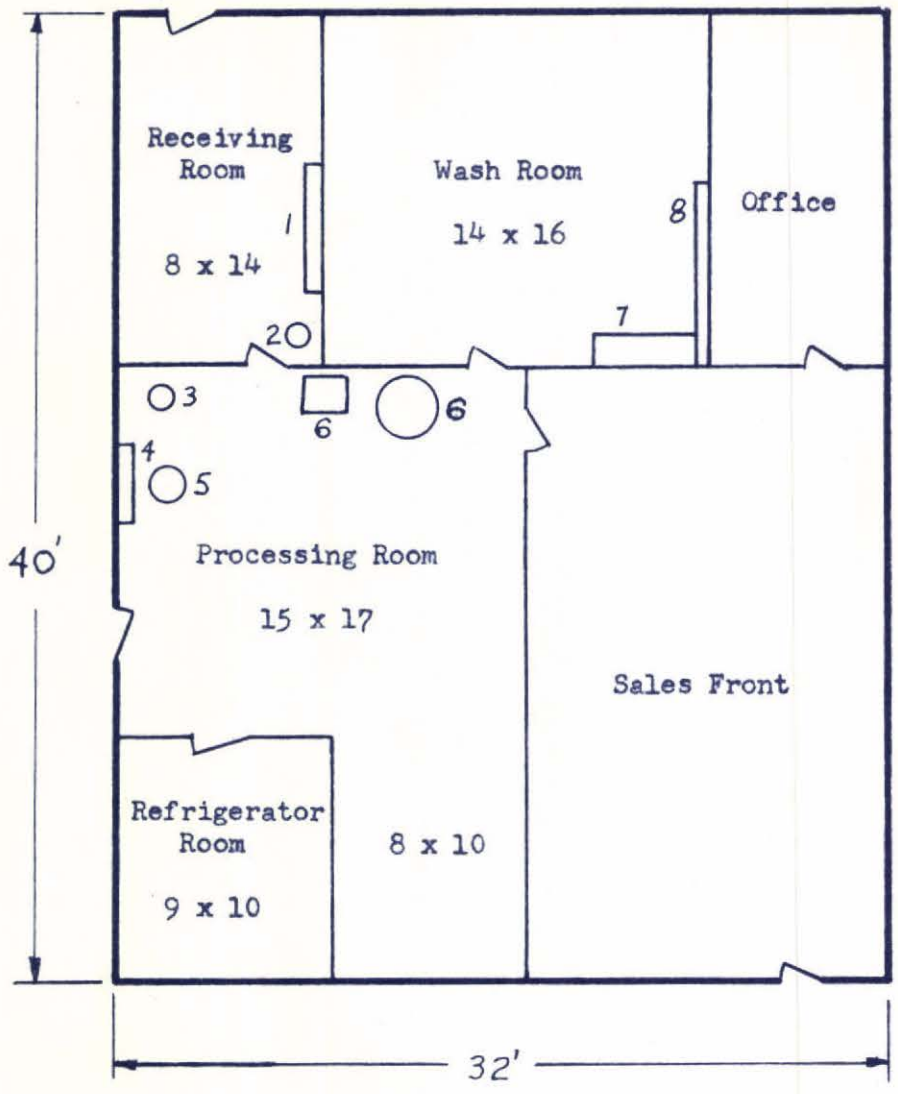

Figure 1. A map showing arrangement of dairy plant and equipment

1. Can washing vat
2. Receiving vat
3. Homogenizer
4. Cooler
5. Bottler
6. Pasteurizer
7. Bottle washer
8. Pipe washing vat

Scale 1 inch = 8 feet

Figure 2. Refrigerator room

Figure 3. Receiving room showing pasteurizer, homogenizer, cooler and bottler

Figure 4. Receiving room showing can washing vat and receiving vat

Figure 5. Wash room showing pipe washing vat and bottle washer

Source and pick-up of raw milk

The owner of the processing plant produced about half of the raw milk used in the fluid milk. The balance of the milk came from 2 local farm producers.

All the milk was picked up every day when processing 6 days per week. On the EOD processing, about one-third of the milk was picked up every day and the rest every other day.

Other interests and products

A dairy farm and confectionery store is operated in conjunction with the fluid milk plant. Ice cream, whipping cream, skim milk, and orange ade are produced in the plant and sold along with the fluid milk.

ANALYSIS AND PRESENTATION OF DATA

These data were analysed to determine if savings would result by changing from ED to EOD processing. Labor savings was of primary importance in this study. Other savings that will be considered will be in cleaning materials and fuel.

Labor savings

A general trend of wages is upwards and has been for some time. Processing costs account for the biggest share of the dairy plants' total operating costs, and labor is the largest item of expense in processing milk. Therefore, if labor can be minimized by processing EOD, unit costs will be reduced and dollar savings will result.

The labor shown in the following tables will be actual working time. They do not include idle, visiting, or rest time. They also exclude time spent on operations other than milk processing.

The study was divided into 7 processes: (1) receiving milk, (2) standardizing milk, (3) pasteurizing milk, (4) homogenizing milk, (5) cooling milk, (6) bottling milk, and (7) storing of milk, to determine where and why the savings in time occurred.

The bottling of milk was by far the most important process in time required, accounting for 38 percent of the total fluid milk processing time (table 1). Next in importance was receiving, then pasteurizing, and then homogenizing. Combined these account for 42 percent of the total time. Of least importance were storing and cooling, and they amounted to less than 10 percent of the total time required.

Table 1. A comparison of labor used in the various processes when processing milk 6 days per week, 1 Utah plant, 1953

Processes	Hours per week	Percent of Total
Receiving	7.8	16
Standardizing	4.5	9
Pasteurizing	6.7	14
Homogenizing	5.9	12
Cooling	2.0	4
Bottling	18.6	38
Storing	1.3	3
Unclassified*	1.9	4
Total	48.7	100

* Includes time of operator in personal preparation and clean up and a general clean up of the plant.

The change to EOD processing saved the manager 12.9 hours per week. Most of the time saved came from pasteurizing and homogenizing milk, and these 2 processes represented 45 percent of the total savings (table 2). Cooling showed the highest percent savings but amounted to only 8 percent of total savings. Storing of milk did not show any saving when processing EOD.

Table 2. Comparison of labor used in processing milk 6 and 3 days per week, 1 Utah plant, 1953

Processes	Hours Required per week		Savings by Processing EOD		Percent of Total Savings
	ED	EOD	Hours	Percent	
Receiving	7.8	6.3	1.5	19	12
Standardizing	4.5	3.2	1.3	29	10
Pasteurizing	6.7	3.5	3.2	48	25
Homogenizing	5.9	3.2	2.7	45	20
Cooling	2.0	1.0	1.0	50	8
Bottling	18.6	16.3	2.3	12	18
Storing	1.3	1.3	0.0	0	0
Unclassified*	1.9	1.0	.9	48	7
Total	48.7	35.8	12.9	27	100

* Includes time of operator in personal preparation and clean up and a general clean up of the plant.

Each process was studied and analysed on an operational basis of (1) "Make Ready" time, (2) "Do" time, and (3) "Clean up and Put away" time to determine in which of these areas the greatest savings would come.

"Make Ready" was the effort and time put into setting up the equipment and pipes. "Do" represented the actual work done which adds value to the product. "Clean up and Put away" was the stripping down, cleaning, and putting away of the equipment.

The greatest room for improvement lies in eliminating the "Do" operation, for if you can remove this one, you automatically eliminate the "Make Ready" and "Clean up and Put away" that goes with it. "Make Ready" and "Clean up" add to the cost but not to the value of the product.

By processing EOD, the number of times the "Do" operations were performed was reduced by half. However, most of the "Do" operations took the same amount of time because they were related to volume processed. The "Make Ready" and "Clean up and Put away" operations, with the exception of cleaning cans and bottles, were reduced by half because they are related to the number of times the operation was performed. Time for cleaning cans and bottles was related to the number of cans and bottles used, which was related to volume.

"Clean up and Put away" amounted to 49 percent of the total processing time, and accounted for 52 percent of the time saved by processing EOD (table 3). Although 49 percent of the "Make Ready" time was saved by EOD processing this operation represented only 25 percent of the total time saved.

Table 3. A comparison of labor used in "Make Ready", "Do", "Clean up and Put away" while processing milk 6 and 3 days per week, 1 Utah plant, 1953

Operations	Hours Required per week		Percent of Total	Savings by Processing EOD		Percent of Total
	ED	EOD	ED Time	Hours	Percent	Savings
Make Ready	6.5	3.3	13	3.2	49	25
Do	19.0	16.0	38	3.0	16	23
Clean up and Put away	23.2	16.5	49	6.7	29	52
Total	48.7	38.8	100	12.9	27	100

Receiving. The receiving process involved taking the milk from the truck and getting it ready to go to the pasteurizer.

The setting up of the receiving vat consisted of putting together the receiving vat port, milk release valve and a pipe connecting the receiving vat with the pasteurizer.

The "Do" operation included the physical handling of milk cans from the truck to the receiving room, weighing, dumping, sampling milk, and recording weights, turning on and off the motor which pumps milk to the pasteurizer, opening and closing the milk flow valve, and adjusting the pipes and connections to stop milk from leaking.

"Clean up and Put away" operation includes preparing the can washer, washing the cans and the receiving vat.

The can washing vat was filled with water from a hose and heated by opening a steam valve located above the wash vat. The wash vat was divided into 3 compartments. The cans and lids were washed in 1 vat, rinsed in another, sterilized in a third compartment, and then stacked on racks. Sometimes the water in the first compartment had to be changed 2 or 3 times a day, depending on how many cans were washed.

The receiving vat port, the milk release valve, and the pipe connecting the receiving vat with the pasteurizer were stripped from the receiving vat and washed in the can washing vat. A bucket of hot cleaning solution from the wash vat and a brush was used to clean the receiving vat itself. Each day, just before the milk was dumped into it, the receiving vat was rinsed with a sterilizing solution.

The "Do" operation showed a 13 percent loss in time by EOD processing (table 4). This was due to handling part of the raw milk in cans twice. In the case of alternate day processing, about one-third of the milk was stored in the refrigerator room on the off day of processing. There was not adequate storage space on the farm. If all the milk from the off day processing of EOD had been stored in the

refrigerator room it would have meant an even greater loss in time. The efficiency of this operation could be increased by alternate day pick-up of all the milk from the farm.

Table 4. A comparison of labor used in receiving milk 6 and 3 days per week, 1 Utah plant, 1953

Operations	Minutes Required per week		Savings	
	ED	EOD	Minutes	Percent
Make Ready	60.8	30.1	30.7	50
Do	106.3	120.3	-14.0	-13
Take milk off truck	26.3	48.9	-22.6	-86
Weigh and dump milk	59.5	58.6	.9	1
Sample milk and record weights	12.2	7.6	4.6	38
Adjust and control receiving vat	8.3	5.2	3.1	37
Clean up and Put away	302.1	227.8	74.3	25
Receiving vat	121.6	60.4	61.2	50
Cans	180.6	167.4	13.1	7
Total	469.2	378.2	91.0	19

The cleaning of the receiving vat showed a 50 percent savings against 7 percent for the cans. Can washing was related to volume of milk handled, whereas the other clean up was related to number of times performed.

Standardizing. The standardizing comprised of testing the milk by the Babcock method, separating, and pouring of the skim milk into the pasteurizer. The standardizing process was performed in order to

take advantage of the high butterfat testing milk. About half the milk produced for the dairy came from Guernsey cows testing above 5 percent. The state requirement is 3.2 percent and permits standardization.

To "Make Ready" for standardizing, the separator stand had to be moved from the receiving room to a place between the pasteurizer and homogenizer. The bowl, discs, tank, and spouts were carried out and assembled. The "Make Ready" also included setting up of the pipe line from the pasteurizer to the separator so that milk could be pumped directly from the pasteurizer to the separator.

The "Do" operation was concerned with sampling and testing the milk, getting the separator started, starting the milk through, changing the skim milk cans, regulating the separator, making calculations, and pouring the skim milk into the pasteurizer. A man was not required to be there all the time that the milk was being separated.

"Clean up and Put away" under this process involved disassembling and washing the various separator parts, bowl, discs, tank, spouts, and float. The parts were then rinsed in a sterilizing solution.

The time spent in this process was directly proportional to the number of batches of milk pasteurized and the number of times milk was separated. Milk was not separated every processing day. Milk was separated on an average of 3 times while processing ED and 2 times with EOD. By processing EOD the pasteurizers were filled to capacity more times than with ED. There were about one-fourth less batches when processing EOD. The one-fourth fewer batches and one-third less separating days resulted in a 29 percent savings (table 5).

Table 5. A comparison of labor used in standardizing milk 6 and 3 days per week, 1 Utah plant, 1953

Operations	Minutes Required per week		Savings	
	ED	EOD	Minutes	Percent
Make Ready	42.3	27.3	15.0	35
Do	160.7	114.9	40.8	26
Clean up and Put away	65.5	43.0	22.5	34
Total	268.5	190.3	78.2	29

Pasteurizing. The pasteurizing process included setting up, adjusting, controlling, and cleaning of the pasteurizer.

The setting up of the pasteurizer included carrying the pipes from the wash room, connecting the 2 pasteurizers together, connecting the pasteurizer with the receiving vat, and connecting the pasteurizer with the homogenizer.

Before pasteurization began the chart on the recording thermometer was changed and set. Pasteurization was accomplished by heating the milk to 143° F. and holding for half an hour. The milk was heated by water and steam being turned into a jacket around the pasteurizer. The agitator was turned on so that the milk would be heated evenly. Cold water was run through the jacket to cool the milk down after pasteurization. One of the pasteurizers took care of these operations automatically, but the other one was manually operated. The temperature gauge and recording thermometer had to be checked very closely by the operator while using the manual operated pasteurizer.

The automatic pasteurizer was used as much as possible because it required less of the operator's time. The pasteurizer was filled to capacity more times when processing EOD and resulted in about one-fourth less batches.

"Clean up and Put away" was the biggest operation under pasteurizing. The pipes leading to and from the pasteurizers had to be disconnected. The pipes and connections were carried to a wash vat in the wash room and cleaned with a hand brush. Pipes connecting the 2 pasteurizers were set up immediately after washing. The other pipes were stacked on a rack behind the wash vat.

The pasteurizers were filled with cold water from the hose. Cold water was then pumped through the lines to rinse the homogenizer, cooler, and the bottler, as well as the pasteurizer. The pasteurizers were next scrubbed by hand with water and a brush brought from the wash room. Four trips to the wash room were necessary each processing day to accomplish this job. After all the equipment was washed the operator would get the steam hose from the wash room and steam each piece of equipment.

The pasteurizer was rinsed out with a sterilizing solution just before the next day's operation began. This sterilizing solution was pumped from the pasteurizer through the pipe lines to sterilize the homogenizer, cooler, and bottler.

All pasteurizing operations were related to the number of times the operation was performed. Reducing the number of operations by approximately half resulted in a 48 percent savings for this process (table 6).

Table 6. A comparison of labor used in pasteurizing milk 6 and 3 days per week, 1 Utah plant, 1953

Operations	Minutes Required per week		Savings	
	ED	EOD	Minutes	Percent
Make Ready	66.3	32.4	33.9	51
Do	152.7	85.8	66.9	44
Clean up and Put away	183.9	92.5	91.4	50
Total	402.9	210.7	192.2	48

Homogenizing. Homogenizing milk involved setting up, adjusting, controlling, and cleaning the homogenizer.

There were many small parts involved in making ready the homogenizer, such as valves, port covers, and piston rods. Setting up pipe and check valve leading to the cooler was also included in this operation.

The "Do" operation consisted of adjusting pistons and valves, adjusting the pressure to 2500 pounds per square inch for homogenized milk, and adjusting the check valve for pasteurized milk.

This operation was dependent upon the number of batches run through and the amount of trouble encountered with each batch. One time it would take longer to adjust the homogenizer to the desired pressure for homogenizing milk than another. It is sometimes difficult to get the pistons and valves adjusted to prevent the milk from leaking out. Sometimes it required 2 or 3 adjustments to get the gasket in the check valve to fit tightly so the milk wouldn't leak out. The check valve located between homogenizer and cooler regulated the flow

of milk to the bottler.

Cleaning up and putting away the homogenizer included stripping down the parts, along with a check valve and a pipe connecting the homogenizer with the cooler and carrying them to the wash room and washing. A hand brush and cleaning solution was used to wash the inside of the homogenizer. The homogenizer was set up immediately after washing and then steamed. A sterilizing solution was run through the homogenizer at the beginning of the next day of processing.

EOD processing meant making ready and cleaning the homogenizer half as many times. These operations showed a saving proportionately, and the entire process resulted in a 45 percent savings of time (table 7).

Table 7. A comparison of labor used in homogenizing milk 6 and 3 days per week, 1 Utah plant, 1953

Operations	Minutes Required per week		Savings	
	ED	EOD	Minutes	Percent
Make Ready	120.8	58.9	61.9	51
Do	98.2	67.7	30.5	31
Clean up and Put away	132.2	67.6	64.6	49
Total	351.2	194.2	157.0	45

Cooling. The cooling of the milk was accomplished by setting up the cooler, turning on and off the water and a refrigerant to the cooler, and cleaning up the same equipment.

"Make Ready" of the cooler was simple and least time consuming of any of the equipment. A trough and cooler distributer pipe were carried from the wash room, put in place, and port covers pulled together to cover the cooler.

The "Do" operation was very minor as far as time was concerned, consisting of adjusting flow of water and refrigerant to the cooler. Forty-nine percent of the cooling time was saved by EOD processing, and each of the cooling operations was similar in percent savings (table 8).

Table 8. A comparison of labor used in cooling milk 6 and 3 days per week, 1 Utah plant, 1953

Operations	Minutes Required per week		Savings	
	ED	EOD	Minutes	Percent
Make Ready	22.7	11.2	11.5	51
Do	3.8	2.1	1.7	45
Clean up and Put away	92.4	47.6	44.8	49
Total	118.9	60.9	58.0	49

The cleaning up was by far the biggest job under the cooling process. The cooler was disassembled by taking the trough from the bottom and the distributor pipe from the top of the cooler. These pieces were carried to the wash room and cleaned. The cooler and covers were scrubbed with a cleaning solution and then steamed. A sterilizing solution was run over the cooler before using it again.

The 49 percent saving resulting under this process was due to cooling milk only half as many times with EOD processing.

Bottling. The bottling process included setting up the bottler, bottling the milk, and then cleaning the bottles and bottler.

"Make Ready" consisted of setting the lid on the gravity tank, connecting the cooler and the bottler with the pipe, setting the capper head in place, inserting the filler valves, setting the star wheels in place for the desired bottle size, and filling the capper with caps. Several stacks of caps were brought from the storage room before starting to bottle and set on a bench about 10 feet from the bottler. There were 100 caps per stack and usually 2 stacks were put in the holder at a time.

The "Do" operation involves trucking the empty bottles to the bottler, adjusting the bottler table, changing star wheels and adjusting the capper for the different size bottles, turning on and off of the motor which ran the bottler, taking care of any stoppages or minor repairs, and filling the bottles with milk (figure 6). Half pint, quart and 2-quart containers were used.

"Clean up and Put away" involved getting the bottler and bottles cleaned. The various bottler parts were disassembled and washed with a hand brush. The rest of the bottler was washed in place with a cleaning solution and a brush. The bottler was steamed after washing and then sterilized before using again.

The bottle washer was prepared by turning cold water into the compartments and then turning the steam on to heat the water. The water and steam were controlled by valves above the compartments. A cleaning compound was put into one compartment and a sterilizing solution into another.

The washing of bottles began with the empty cases being stacked on dollies in the wash room. The dollies were rolled over by the

Figure 6. Filling bottles with automatic bottler

Figure 7. Washing bottles in case bottle washer

bottle washer. The bottles were turned upside down in the case ready for washing. The case was then pushed into the first compartment to be washed. Another case of bottles was turned over while the operator was waiting for the first case to wash. Each case of bottles was washed, rinsed, and sterilized as they rotated through the bottle washer (figure 7). As the bottles came out of the bottle washer, they were loaded onto dollies ready to go to the bottler.

Some bottles were dirtier than others and it necessitated putting a whole case back into the washing compartment 2 or 3 times to get them clean. If the dirtier bottles were put into separate cases when picked up on the delivery route it would increase the efficiency of bottle washing.

The bottling process showed only a 12 percent savings (table 9).

Table 9. A comparison of labor used in bottling milk 6 and 3 days per week, 1 Utah plant, 1953

Operations	Minutes Required per week		Savings	
	ED	EOD	Minutes	Percent
Make Ready	24.5	12.6	11.9	49
Do	539.3	587.0	52.3	10
Empties to bottler	26.4	25.7	.7	3
Adjust and control bottler	79.0	49.4	29.6	37
Fill bottles	433.9	411.9	22.0	5
Clean up and Put away	554.4	479.6	74.8	14
Bottles	441.8	422.7	19.1	2
Bottler	112.6	56.9	55.7	50
Total	1118.2	979.2	139.0	12

The lower savings was because most of the time spent under this process was with operations that were related to volume, such as empties to bottler, filling bottles, and cleaning bottles. "Make Ready" and "Clean up" of the bottler was where the greatest percent savings resulted. These operations were performed only half as many times while processing EOD.

Storing. Storing of milk included stacking the bottled milk on dollies, rinsing the bottles off, and trucking into the refrigerator room.

The time required for this process was all "Do" time with no "Make Ready" or "Clean up". No savings resulted because of being related to volume. The same amount of milk was handled under both processing methods.

Other savings

There were also savings in materials and fuel such as cleaning compounds, sterilizer, and coal.

The cleaning supplies showed about a 50 percent savings because the same amount was used each processing day regardless of volume of milk handled (table 10).

The coal consumption shown in table 10 was the fuel required to heat the plant and sales front as well as provide steam for processing. The 33 percent savings resulted from processing fewer days.

Other items could be considered such as water, electricity, and depreciation of building and equipment. However, these items would be harder to calculate. It was felt processing fewer days had little or no effect on the difference in cost of operation.

Table 10. A comparison of cleaning materials and fuel used in processing 6 and 3 days per week, 1 Utah plant, 1953

Materials	Weekly Requirements		Savings	
	ED	EOD	Quantity	Percent
Can and Equipment cleaning compound (pounds)	3.75	2.75	1.50	40
Bottle cleaning compound (pounds)	9.00	4.50	4.50	50
Sterilizer (gallons)	1.00	.50	.50	50
Coal (tons)	.81	.54	.27	33

Economic savings

The plant manager figured the average hourly wage for the operators, including himself, at $1.25. Based on productive time[1] only, this would mean a savings of $16.13 per week in labor (table 11). Labor was the important saving factor in the study, accounting for 78 percent of the total dollar savings.

Cleaning materials and fuel were figured at the present price level. By processing EOD the plant manager saved about $5.00 per week in cleaning supplies and fuel.

The total weekly dollar savings from labor, materials, and fuel was $20.57. If this were a representative week of the year around operation, it would mean a net profit of about $1,000 annually for the plant manager.

1. Actual working time. This does not include idle, rest, or visiting time.

Table 11. Dollar savings per week by processing 3 instead of 6 days, 1 Utah plant, 1953

	Saved by EOD	Cost per Unit	Dollar Savings	Percent of Total Savings
Man hours of labor	12.9	$ 1.25	$16.13	78
Cleaning materials			1.74	9
Can and equipment compound (lbs.)	1.50	.25	$ .38	
Bottle compound (lbs.)	4.50	.18	.81	
Sterilizer (gals.)	.50	1.10	.55	
Tons of coal	.27	10.00	2.70	13
Total			$20.57	100

SUMMARY

1. A case study of a small fluid milk processing plant was made by a work simplification method in Cache Valley, 1953. The labor requirement, volume of business, floor space, and type of equipment places this particular plant in the category of small dairies.

2. The study was broken down into 7 different processes for the purpose of analysis. They were (a) receiving milk, (b) standardizing milk, (c) pasteurizing milk, (d) homogenizing milk, (e) cooling milk, (f) bottling milk, and (g) storing milk.

3. The characteristics of the plant included, (a) volume of production -- 455,000 pounds of milk yearly, (b) labor requirement -- 3 operators working part time, (c) equipment -- fairly modern, (d) market for milk -- delivered door to door every other day, (e) source of raw milk -- plant owner and 2 other local farmers, and (f) other interests -- dairy farm and confectionery store.

4. The plant was studied 1 week while operating on the basis of every day processing (6 days per week) and then 1 week on the EOD basis (3 days per week). The workers were given 2 weeks' time to familiarize themselves with the EOD method of processing before study was made on that basis. A year later the plant was studied again to check the results of the first study. The data was analysed and a comparison was made of the 2 methods of processing. The analysis showed that it would be to the advantage of the manager to change over to EOD processing.

5. The processing time for the ED method was 48.7 hours per week compared to 35.8 hours for the EOD method of processing. A savings of 27 percent, or 12.9 hours per week was realized. The time shown in this study was the actual processing time. The idle, rest, and visiting time was excluded.

6. The savings in materials in 1 week's time were (a) 1.5 pounds of equipment cleaning compound, (b) 4.5 pounds of bottle cleaning compound, (c) one-half gallon of sterilizer, and (d) .27 tons of coal.

7. Figuring the cost of labor and materials at the time of the study, the manager would realize a savings of $20.57 per week, or over $1,000 per year by changing over to EOD processing.

8. The bottling of milk was the most time-comsuming process. Pasteurizing and homogenizing showed the greatest savings in time, accounting for over 45 percent of the total savings. The savings were a result of reducing the number of operations by about half. Storing of milk showed the least savings because of handling the same volume of milk with both methods of processing.

9. The cleaning up operation took more time than either "Make Ready" or "Do" and actually netted more savings than these 2 combined. The same number of bottles and cans were washed each time, but the equipment was stripped down and cleaned only half as many times. The "Make Ready" operation showed the greatest percent savings, due to reducing the setting-up operations by half. The "Do" functions had to be performed just about as many times while processing EOD as with ED, thus showing the smallest savings.

10. No expense was involved with this plant by changing over to EOD processing.

11. By changing to EOD processing the men are able to spend more time on the farm and in the confectionery store.

12. The plant manager has been able to spend more time in management duties since changing to EOD. Since the time this study was completed, he has increased his volume substantially, moved to a new location with larger space and more adequate equipment, and gone into the wholesale market using gallon jugs, and a recent addition, the carton container.

CONCLUSION

The analysis of this study showed that it would definitely be to the advantage of this plant manager to change over to EOD processing. It is felt that alternate day processing in fluid milk would be profitable to most small or medium-sized plants. It is recognized that each plant has problems peculiar to its own set-up which will arise in considering changing over to alternate day processing. This particular plant had no additional cost in equipment or plant layout by changing to EOD processing. Some plants may have to invest in more or newer types of equipment or enlarge the plant facilities. One of the big handicaps would be adequate refrigeration room to store processed milk.

The percentage of savings that could be derived from the change to EOD processing would vary somewhat with different plants. Factors that might affect the amount of efficiency that could be obtained are the size of the plant, the volume of production, the type and arrangement of equipment, the efficiency of the operator, and the method of work procedure.

Information from this study, showing labor and material savings, can be used to determine how profitable the change would be for other plants with a similar set-up. The dollar and cents savings could be calculated for a current period by adjusting the money costs of labor and materials to current levels of prices. The feasibility of processing 3 days a week can be determined by the length of time required for the savings to offset the increased costs in setting up for the EOD method.

This particular plant could further increase its efficiency above the 27 percent shown for this study. Greater efficiency and profits could be realized if certain work simplification principles and techniques were incorporated. Other studies may have to be conducted in order to determine if they would be advantageous. Work simplification principles and techniques that could be applied are:

1. More modern equipment
2. Rearrangement of plant and equipment
3. Rearrangement of work procedures
4. In-place cleaning of equipment
5. EOD pick-up of milk from the farms
6. Putting the dirtier bottles in the same case when picking up on the delivery routes.

Every other day processing is not meant to be the only or ultimate answer to the problems of small plants. A further study could be made to determine the maximum volume of milk that could be processed EOD to an advantage.

After the study was completed and the analysis made, a few of the small plants were contacted throughout the state to see what their reaction would be concerning EOD method of processing. The first opinion from the managers was that it couldn't be done and they would proceed to give their reasons. With further explanation and pointing out the facts derived from the study, many of the small plant managers agreed that EOD processing could be profitable to them.

Some of the problems encountered were:

1. Competition from other plants that didn't change over, thus giving their customer fresher milk. The problem of competition is a serious one because Americans are demanding more service. Many of the plant managers have increased their volume of sales by giving more and better service.

2. Education of the housewife as to the keeping quality of milk.

This situation goes hand in hand with the problem encountered above. If the housewife were educated to the keeping quality of milk, there wouldn't be a competition problem with fresh milk. Studies have been made and it is now a proven fact that milk can be kept under proper conditions for as long as 2 weeks before spoilage will occur (8, 4).

3. Newer and better equipment and enlargement of plant facilities would be needed. Before a plant manager would want to invest in more equipment or a change in plant facilities, he should ask himself these questions: (a) How long am I going to be in the business? (b) How long will it take for the savings, which would come from fewer days processing, to offset the increased cost in plant and equipment?

4. What to do with the men on the off days from processing? Every other day processing could be very laborious where only 1 or 2 operators do all the work. It may mean working 12 or 14 hours 1 day and then have little to do the other day, and it is hard to get the kind of help the plant manager wants on a part-time basis, and he feels that the hired man should be working full time when getting full pay.

Some plants might be able to work a system of processing one day and delivering the next, thereby more fully utilizing his manpower. Or a diversification of enterprise can utilize the man on the days they are not processing, such as a farm, confectionery, dairy herd, or any other livestock enterprise. But the plant manager may not have the capital to diversify his enterprise.

These are problems that will have to be worked out for each plant separately according to the situation. It is not the purpose of this thesis to delve into these details, but rather to point out some of the problems that plants will encounter, and possible solutions in a general way.

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APPENDIX

No. of pages	FLOW PROCESS CHART Every Day vs Every Other Day Processing in Fluid Milk Plants	Page No.

Processing Plant	Date
Chart begins	Chart ends

☐ Man or ☐ Material

Details of ☐ ED ☐ EOD	Function	Movement	Beginning time	Elapsed time	Distance in feet	Number of trips	Total distance	Quan. of material per trip	Total quantity