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Early in 1959, bulk milk tanks were used by about one-third of the dairy farmers who sold Grade A milk in the Oklahoma Metropolitan Marketing Area. This proportion is expected to become larger each year.

While dollar savings have been substantial for producers who first converted from cans to bulk tank, these savings are likely to be smaller for individual producers as the market shifts toward 100 percent bulk tank usage. Many producers may have to consider the installation of a bulk tank with average or below average potential savings. The conversion to bulk for present can producers may even be required for individual producers to remain in the dairy business, particularly if they become isolated from the conventional can transportation system. In order to determine costs, break-even volumes, and savings from bulk tanks, the Oklahoma Agricultural Experiment Station studied the operations of dairy producers in the Oklahoma City milkshed. The information in this study will be useful in evaluating the probable effects on income of installing a bulk tank for individual producers still cooling and selling milk with can equipment.

How the Study Was Conducted

A list was obtained of 210 Grade A dairy producers who (1) had bulk tanks, (2) sold Grade A milk on the Oklahoma City market during January 1958, and (3) had sold Grade A milk in this milkshed for a minimum of two years prior to January 1958. These producers were subdivided into five groups according to the average quantity of milk sold per month in 1957. The following groups were selected:

Group A—0 to 9,999 lbs. per month
Group B—10,000 to 14,999 lbs. per month
Group C—15,000 to 19,999 lbs. per month

The research reported herein was done under Oklahoma Agricultural Experiment Station Project No. 938.

Group D—20,000 to 29,999 lbs. per month
Group E—30,000 lbs. and over per month

Ten farms in each size group were selected for study. This was a total of 50 farms in the sample, with 21 farms in the eastern half of the milkshed and 29 in the western half. Each dairy farmer in the sample was interviewed and detailed information related to the bulk tank purchase and operation was obtained.

Information was also provided by the Central Oklahoma Milk Producers Association, the Market Administrator, bulk tank manufacturers, the Central Rural Electric Cooperative, and other firms actively engaged in selling, installing and servicing bulk tanks. Data on actual costs of installing various sizes of bulk tanks, costs and methods of financing, and sales of milk by individual producers were obtained from these sources.

Costs: Initial Conversion

Tank: Price lists and discounts for 1958 were obtained for the four brands of bulk milk tanks which comprised about 90 percent of all tanks in the Oklahoma City milkshed. List prices less the dealer discounts for the four brands were averaged for each of 10 different size classifications and are shown in Table I. These prices were used in the study rather than actual prices paid by the producers, in order to have prices representative of a given time period. Table I also includes the cost of the tank installed, with the usual insurance and finance charges included.

Table II shows the cost of the average size of bulk tank in each

Table I. Average Prices for Ten Sizes of Bulk Tanks;* Oklahoma City Milkshed, 1958.

Size of Tank (Gallons)	Cash Price Installed: Range	Cash Price Installed: Average	Average Finance and Insurance Charges	Total Installed Price With Financing
		(dollars)		
100	1270-1604	1,437.21	191.31	1,628.52
150	1660-1840	1,734.47	230.91	1,965.33
200	1742-2006	1,924.61	256.22	2,180.83
250	1944-2110	2,042.04	271.85	2,314.94
300	2182-2351	2,279.09	303.15	2,580.24
400	2541-2645	2,610.50	347.54	2,958.04
500	2886-3289	2,991.91	399.39	3,399.30
600	3194-3790	3,396.76	452.21	3,848.97
800	3734-4785	4,226.05	562.62	4,788.67
1000	4232-4793	4,458.99	593.63	5,052.62

*Based on prices of Sunset, Blackburn, Zero and Creamery Package tanks.

Table II. Average Tank Cost, Salvage Value and Improvement Cost; Sample Farms in the Oklahoma City Milkshed.

Item	Producer Size Groups*					
	Group A 0-10,000	Group B 10-15,000	Group C 15-20,000	Group D 20-30,000	Group E Over 30,000	Average
Tank:						
Average size (gallons)	233	244	355	339	582	351
Average cost per farm ($)	1,963	2,037	2,413	2,392	3,248	2,411
Salvage Value:						
Cans ($)	34[a]	27[a]	49[a]	44[a]	70	37
Coolers ($)	123[a]	153	155	225[a]	209	172
	157	180	204	269	279	209
Improvements:						
Milkhouse:						
New Construction:						
Farms reporting (No.)	1	1	0	2	1	5
Cost per farm[b] ($)	2,000	2,500		2,750	2,500	2,500
Remodeled:						
Farms reporting (No.)	5	2	4	4	4	19
Costs per farm[b] ($)	9	15	23	10	100[a]	30
Electric Wiring:						
Farms reporting (No.)	7	7	7	1	5	27
Cost per farm[b] ($)	24	25[a]	34[a]	15	45[a]	30[a]
Purchase of Water Heaters:						
Farms reporting (No.)	6	3	4	8	7	28
Costs per farm[b] ($)	80[a]	95[a]	83[a]	71[a]	87[a]	83[a]
Improvements of Roads, Lanes:						
Farms reporting (No.)	4	5	2	3	5	19
Costs per farm[b] ($)	27[a]	30[a]	31[a]	36	30[a]	31[a]
Total Improvement Costs						
Per Farm[b] ($)	80	64	72	73	138	85

*Pounds of milk sold per month.
[a]Data not available on all farms.
[b]Average computed on basis of number of farms reporting that could provide cost data.

producer size group. If these tanks are financed, the charges for insurance and financing would increase the costs by about 13.3 percent.

The majority of the producers in the study were able to dispose of their milk cans and can coolers. The value of this equipment as shown in Table II was often sufficient to make the required down payment on the bulk tank.* Generally, the salvage value was about 8.6 percent of the cash price of the tank or equivalent to about 65 percent of the usual insurance and finance charges. Thus, for producers electing to finance the tank, approximately 4.7 percent would be added to the cash price of the tank installed to represent the total financial obligation or note for the bulk tank.

Related Improvements

Many producers need to make some changes in buildings and equipment before they install a bulk tank. In addition, some producers will make needed changes at the time of conversion, even though they are not required just for the installation of the tank. The following sections report the changes that were made by producers in the sample.

Milkhouse: There is little difference in the minimum requirements for a milkhouse under a can system and a milkhouse under a bulk tank system. However, about one-half of the producers in the sample did make some changes when they converted. Five constructed a new milkhouse and 19 remodeled the old milkhouse.

The average cost of constructing the new milkhouse was $2500 per farm (Table II). This was not included in the conversion cost, since the installation of the bulk tank did not require the building of a new milkhouse.

Excluding new construction, milkhouse improvements required average expenditures of about $30 per farm for 19 farms (Table II). The range was from nothing up to $200 per farm. Generally, these costs were for materials only, since farm labor was used and no cost allowance was made for this labor.

Electrical Wiring: About one-half the producers replaced or installed new electrical wiring in the milkhouse. This was required for the relatively large compressors on the direct expansion type tanks.

The average cost of wiring was about $30 per farm on 27 farms

*Salvage values of can equipment may decrease as the shift to bulk tank handling of milk continues.

and ranged from nothing up to $100 per farm. These costs excluded farm labor cost allowances when farm labor was used. More producers in the smaller size groups than in larger size groups reported an extra cost for wiring. The larger volume producers had previously installed a 220-volt system for operation of the larger can coolers.

Hot Water Heaters: About half the producers reported some extra expense for a hot water heater,* but only 10 could provide an estimate of the actual cost. For these 10 producers the average cost of the hot water heater was $83 per farm. Often the heater was installed with farm labor.

Sixty percent of the small volume producers, Group A, and 75 percent of the large volume producers, Groups D and E, purchased hot water heaters at the time of conversion. In contrast, only 35 percent of the medium size producers purchased hot water heaters at the time of conversion.

Farm Road and Lane: Only about 40 percent of the producers in the survey reported an expense for improvements on roads and lanes since the bulk tank installation. The average cost on these farms was about $31 per year and, with one exception, reflected the use of farm labor and machinery. These figures excluded costs on farms for hauling dirt when that practice was customary before the conversion.

There were no great differences in the average cost per farm for the various size groups, but there was a difference for location of farms in the milkshed. More farms in the eastern section incurred this expense than in the western section, and the cost per farm was greatest in the eastern section.

Total Improvement Costs: Not all producers made expenditures on each type of improvement. No improvements were made by 12 percent of the producers. One improvement was made by 20 percent of the producers, two improvements by 38 percent, three improvements by 24 percent and four improvements were made by 6 percent of the producers. The average number of improvements was two.

For all producers, the average expenditure was equivalent to about 3.5 percent of the cost of the tank. For the very large and very small producers the percentage ranged from 4.0 to 4.5. For the middle size groups, the expenditure averaged about 3.0 percent of the cost of the tank.

*Health department regulations require the use of a pressurized hot water heater when bulk tanks are installed.

Costs of Cooling

Fixed Costs:

Fixed Costs: Costs which do not change with the amount of milk cooled include depreciation, interest on the investment, taxes, and insurance.

Depreciation: Because of rapid changes in the dairy industry, depreciation due to obsolescence may be more important than depreciation due to wear-use, for equipment such as a bulk tank. Depreciation due to obsolescence can not be determined in advance, and depreciation due to wear-use could not be established in this study on the basis of the experience of the producers interviewed. Studies in other states have used from 10 to 20 years as the life of the tank and 10 years as the life of the compressor unit. An average of estimates by producers in the sample indicated an expected life of 14.5 years for the tank and 9.3 years for the compressor.

Based on these estimates the following procedure was used to determine the depreciation for each of 10 tank sizes:

The average prices of the tanks and the cooling units were determined. Five percent was deducted from the prices for salvage values. The remaining values for the tanks were divided by 15 years and for the compressors by 10 years. Depreciation values for each size of tank, including improvements, are shown in Table III. They range from about $104 per year for a 100-gallon tank up to $318 per year for a 1000-gallon tank.

The costs of improvements associated with the conversion to bulk tanks averaged about 3.5 percent of the cash price of the tank. The expected life of these improvements was quite variable. If these improvements had an average expected life of 10 years, the average annual depreciation of improvements for each size of tank would range from $5 to $16 per year. For actual tank sizes used, annual depreciation on improvements ranged from $6 for Group A producers up to $14 for Group E producers.

Interest on Investment: For computing interest on the investment in the bulk tank and improvements, the average amount of investment was defined as one-half the total investment for the expected life. An interest rate of five percent was assumed. The range was from $37 to $115 per year. (Table III).

Table III. Annual Costs of Owning and Operating Bulk Milk Tanks, Oklahoma City Milkshed.

(dollars)

Tank Size (Gallons)	Fixed Costs				Variable Costs				Total Annual Costs
	Depreciation	Interest on Investment	Taxes	Insurance	Electricity Cost	Repair	Cleaning Costs: Labor	Cleaning Costs: Supplies	
100	104.00	37.19	16.17	3.59	31.95	32.32	36.60	29.76	291.58
150	123.87	44.88	19.51	4.34	47.92	37.27	39.00	30.96	347.75
200	137.91	49.80	21.65	4.81	63.88	41.83	41.40	32.40	393.68
250	145.81	52.86	22.98	5.11	79.86	43.75	43.44	33.36	427.17
300	163.28	58.92	25.62	5.69	95.81	49.62	45.60	34.58	479.12
400	187.37	67.55	29.37	6.53	127.75	57.08	50.64	36.96	563.25
500	213.95	77.62	33.75	7.50	159.72	64.16	54.60	39.24	650.54
600	243.66	87.89	38.21	8.49	191.62	74.12	59.40	41.64	745.03
800	301.64	109.35	47.54	10.56	255.50	90.65	68.04	46.44	929.72
1000	318.33	115.38	50.16	11.15	319.38	95.70	76.44	51.24	1037.78

SOURCE: Computed from budgeted data.

Insurance: An annual charge of 0.25 percent of the initial cash price of the tank was used to calculate the cost of insurance. Annual insurance costs ranged from $4 for the 100 gallon tank to $11 for the 1000 gallon tank. This charge may result in an understatement of insurance when the tank is new and an overstatement when the tank is old. This cost is less than the cost charged by the lending agency, since the average value over the first 3 years is greater than the average value over the life of the tank.

Taxes: The assessed value of the bulk milk tank was assumed to be 25 percent of the cash price installed, and a rate of $4.50 per $100 of assessed value was used.* Taxes ranged from about $16 per year for the 100 gallon tank to about $50 per year for the 1000 gallon tank.

Variable Costs:

Variable Costs: Costs which exist only because of actual operation of the bulk tank included (1) electricity, (2) repairs, and (3) labor and supplies used in cleaning the tank.

Electricity: A number of studies of electrical consumption rates of bulk tanks have been completed in other states but none were applicable directly to Oklahoma weather conditions. Consequently, an experiment was designed to check their applicability in Oklahoma. Assistance in this experiment was obtained from the Agricultural Engineering Department, from the Central Rural Electric Cooperative, and from the Dairy Cooperative Associations with records of producer sales.*

Check meters were installed on four farms in central Oklahoma which represented different types of tanks or operating conditions. The meters were read monthly and related to the total amount of milk cooled. The experiment was initiated in August and terminated in November.

There was a large variation among the tanks in electricity consumption (Table IV). The first tank was considered as representative of ideal conditions in that it was a direct expansion type, had an air-

*The Payne County Assessor's office in Stillwater, Oklahoma, reported that a range of $3.50 to $5.40 for each $100 of assessed valuation was a common rate for farm equipment in central Oklahoma. The assessed value commonly is 30 percent or less of the original cost.

*The authors are indebted to Professor Elmer Daniel, Department of Agricultural Engineering, Oklahoma State University and Mr. Dave Goodrich of Central Oklahoma Rural Electric Cooperative for their assistance in carrying out this experiment. Richard Huggett, manager of the Payne County Creamery, Inc. (now integrated with Gold Spot Dairy, Inc.), and "Bud" Bailey, manager of Central Oklahoma Milk Producers Assn., provided production data for the farms on which the meters were installed.

Table IV. Metered Electricity Consumption and Costs for Four Bulk Milk Tanks; Oklahoma City Milkshed, 1958.

Meter Number	Time Period of Test	Percent of Tank Utilization	Amount of Milk Cooled (cwt.)	KWH Consumed	KWH per Cwt. of Milk	Average Number of Kilowatts Used per Day	Average Cost Per Farm Per Day (cents)
1[a]	Aug. 1-Nov. 3	87.81	1373.296	1105.5	.8050	16.328	40.8
2[b]	Aug. 1-Nov. 3	26.51	414.536	719.0	1.7343	7.543	18.9
3[c]	July 25-Nov. 3	66.58	554.146	667.0	1.2036	6.588	16.5
4[d]	Aug. 1-Nov. 3	85.45	587.910	830.5	1.4126	12.563	31.4
Total			2929.938	3322.0		43.022	
Average		66.59	732.484	830.5	1.1338	10.755	26.90

[a]500-gallon open top type tank; direct expansion compressor installed remote, air and water cooled. Compressor motor 3 H.P., 27.5 amps; agitator motor, 1/3 H.P., 5.6 amps; two fan motors.

[b]500-gallon vacuum type tank; direct expansion compressor installed remote, air cooled. Compressor motor, 3 H.P., 19 amps; agitator motor, 1/6 H.P., 3.41 amps; two fan motors, 1/12 H.P., 1.8 amps.

[c]255-gallon vacuum type tank; direct expansion compressor attached, air cooled. Compressor motor 1½ H.P.; agitator motor, 1/8 H.P., 2.6/1.3 amps; two fan motors.

[d]250-gallon open top tank; direct expansion compressor attached, air cooled. Compressor motor, 3 H.P.; agitator motor 1/6 H.P., amps 3.6; two cooling fans.

and water-cooled condenser, and had a high percentage of utilization. The second tank was the same size as the first, 500 gallons, but had only air cooling of the compressor and had a low utilization percentage. The electricity consumption per 100 pounds of milk cooled was about twice as large for the second tank as for the first tank.

Previous studies have indicated that small changes in percentage utilization did not significantly affect the cooling cost per 100 pounds. This study indicates that large changes in the percentage utilization will affect cooling cost. At the beginning of the test, the percentage utilization of the second tank was 16 and the kilowatts per 100 pounds were 2.5287. By the end of the test the percentage utilization for this tank was 41 and the kilowatts per 100 pounds were 1.0042. Based on the experience with the other tank, a significant part of this decrease was caused by the increase in utilization.

The third and fourth tanks were about equal in size (250 gallons). Both had direct expansion air-cooled compressors attached to the tank, but one had a much larger compressor motor than the other. The electricity consumption per 100 pounds of milk cooled was larger for the tank with the larger compressor motor.

For all tanks, an average of 1.1338 kilowatt hours was used per 100 pounds of milk cooled. This compares with 0.9728 calculated from a Michigan study for a 200- to 400-gallon tank with an average utilization of 57 percent of capacity. The difference appears reasonable when consideration is given to the normal temperature differences between the two states.

An average cost of 2.5 cents per kilowatt hour was assumed for the study. The average cost, based on this rate and the electricity consumption of the Oklahoma experiment, was 2.8345 cents per 100 pounds of milk cooled. This cost was applied to an amount of milk equivalent to 72 percent of tank capacity for 182.5 deliveries per year to determine annual electrical costs. The 72 percent permitted a seasonal peak of 10 percent above average and a provision to hold 5 milkings for an every-other-day pickup. Annual electricity costs ranged from $32 for the 100 gallon tank to $319 for the 1000-gallon tank.

Repairs: Service contracts were available to producers at $25 per year. These contracts covered mileage, time, and labor used in repair. Materials and parts were charged at wholesale price plus 25 percent. The majority of producers had these contracts.

Producers in the sample had not operated bulk tanks except under conditions when the tanks and compressors were relatively new. Few reported large repair costs, but two-thirds of the producers had had some repair work performed.

In view of the limited experience of producers with repairs on the bulk tank equipment, repair costs were estimated by the following procedure: Compressor repair costs were set at 50 percent of the original cost for the life of the unit. This is equivalent to 5.0 percent per year for 10 years. Tank and control repair cost was set at 25 percent of the original cost for the life of the unit. This is equivalent to about 1.7 percent per year for 15 years.

Total repair costs represented the sum of repair costs for the compressor and for the tank and controls. They ranged from $32 for the 100-gallon tank to $96 for the 1000-gallon tank.

Costs of Cleaning the Tank

Labor: The average time used in cleaning the bulk tank was estimated at 16 minutes by producers in the sample. The range was from 5 to 35 minutes, depending on the size of the tank.

A least squares regression equation was fitted to these estimates to obtain the cleaning time for each size tank. With labor valued at $1.00 per hour, the cost of labor used in cleaning the bulk tank ranged from $37 per year for the 100-gallon tank to $76 per year for the 1000-gallon tank.

Supplies: About half the producers could provide estimates of the cost of cleaning supplies for the bulk tank. A least squares regression equation relating costs to the size of tank was computed. This equation was used to estimate cleaning costs for each of the 10 tank sizes. These estimated annual cleaning costs ranged from $30 for the 100 gallon tank to $51 for the 1000 gallon tank.

Total Costs of Bulk Tank Cooling

The total cost of cooling milk with a bulk tank is the sum of the fixed costs and the variable costs. Total costs per year ranged from $292 for the 100 gallon tank to $1038 for the 1000 gallon tank.

Costs per 100 pounds were determined by dividing total annual costs by an amount of milk equivalent to 72 percent of capacity over a year. The costs per 100 pounds ranged from 26 cents for the 100 gallon tank down to nine cents for the 1000 gallon tank.

The annual average costs for the ownership and operation of the bulk tank were also computed for the farms in the survey. Although these costs were derived from the 1958 costs for the brand and size of bulk tank on the respective farms, they were approximately the same as the costs derived from Table III. The annual costs for the 50 producers were expressed as costs per 100 pounds of 1957 milk sales and are shown in Figure 1.

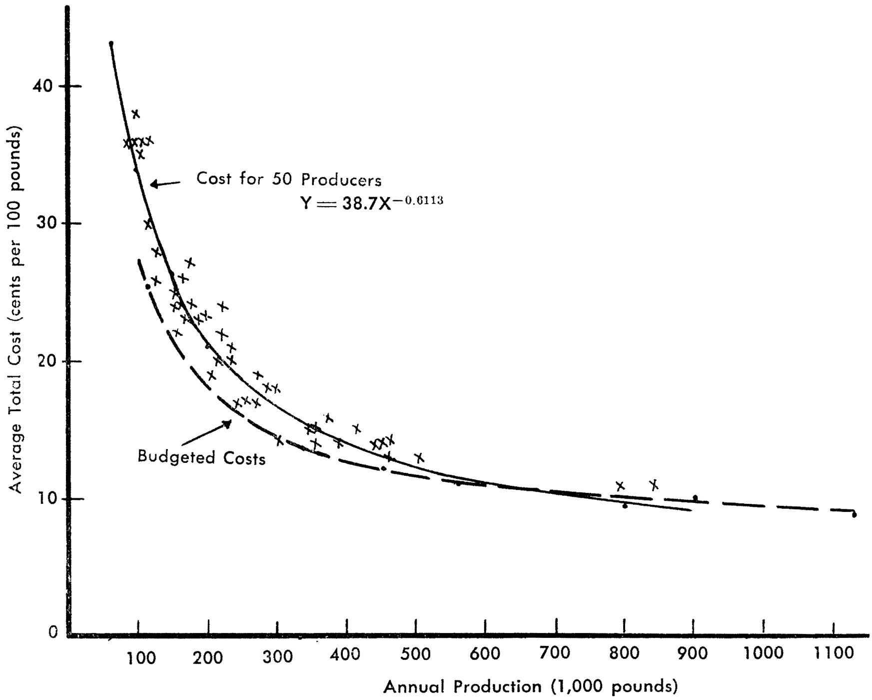

Fig. 1.—Average total cost of cooling milk with bulk tanks for 50 producers; and budgeted costs for 10 tank sizes; Oklahoma City milkshed.

A regression equation of the form $Y = a X^b$ was fitted to the farm costs. The resulting equation was:

$$Y = 38.7035X^{-0.611316}$$

where Y = cost of cooling milk with bulk tanks in dollars per 100 pounds and X = pounds of milk cooled per year.

This equation explained 94 percent of the variation in the cost of cooling milk and the regression coefficient was statistically significant at a probability level of greater than 99 percent.* The regression coefficient indicates that for each 10 percent increase in volume of milk cooled, the cost of cooling that milk will decrease about 6 percent per 100 pounds. This assumes that consideration is given to increasing the size of tank with increasing volume in about the same way as existed for the sample of producers.

A comparison of the regression line for 50 producers and the line representing budgeted costs for the 10 tank sizes indicates that large-volume producers had achieved a nearly optimum use of the bulk tank. In contrast, the small-volume producers had excess capacity with higher than optimum costs. The average size small producer with 100,000 pounds of milk sales annually, for example, could have reduced his costs by about seven cents per 100 pounds if he had purchased a tank size which would hold only the fifth milking and allow for a peak in production of 10 percent above his average production. Generally these producers had sales of only 30 percent of the tank capacity as compared with the 72 percent defined as an optimum and the 55 percent for producers with sales of 20,000 pounds or more per month.

The higher costs of cooling milk for the small-volume producers was caused primarily by the provision for expansion in production after installation of the bulk tank. Some of these producers had actually expanded their production in 1958. Also, some producers had to provide for production patterns with seasonal variations of more than 10 percent above and below average. Nevertheless, they were paying about 34 cents per 100 pounds for cooling in the short run in order to be able to double their production and reduce their long run costs to about 20 cents per 100 pounds.

Added Costs of Bulk Tanks

Not all of the total costs of cooling milk with bulk tanks are added costs. Some investment in cans and can coolers would be required for any Grade A producer who did not have a bulk tank. This investment would result in costs of interest, insurance, taxes and depreciation. In addition, variable costs such as electricity consumption, repairs on equipment, and supplies and labor used in cleaning the can equipment would be incurred.

In order to determine the extra costs of cooling milk with bulk

*The equation actually fitted was

$$\log Y = 2.5877 - \underset{(.0228)}{0.611316} \log X$$

The figure in parenthesis is the standard error of the regression coefficient.

tanks, fixed costs of cooling milk with can coolers were computed. The same procedures were used in computing the can cooling costs as were used for the bulk cooling costs.

Fixed costs represented the annual costs of new can coolers with 50 percent new cans and 50 percent retinned cans. The size and number of coolers used in these computations were selected on the basis of the combination which required the least total investment to cool a daily quantity of milk equivalent to 40 percent of the tank capacity.* The useful life of the can cooler was assumed to be 10 years. The difference between bulk tank fixed costs and can equipment fixed costs represented the added fixed costs of cooling milk with bulk tanks. Added fixed costs increased from $86 for the 100 gallon tank to $100 for the 200 gallon tank (Table V). For tanks larger than 200 gallons, the added fixed costs decreased until they were negative for the 1000 gallon tank. That is, the fixed cost for the 1000 gallon tank was less than for two 16 can coolers plus one 8 can cooler plus 80 cans.

Table V. Added Costs and Added Returns for Bulk Milk Cooling Over Can Milk Cooling; Oklahoma City Milkshed.

Tank Size (gallons)	Added Fixed Costs	Added Variable Costs		Total Added Costs	Added Returns	Returns Above Costs
		Repairs	Electricity			
		(dollars)				
100	86	12	— 3	95	313	218
150	98	14	— 5	107	470	363
200	100	14	— 6	108	626	518
250	90	12	— 8	94	783	689
300	97	15	—10	102	939	837
400	78	9	—13	74	1252	1178
500	61	2	—16	47	1565	1518
600	64	4	—19	49	1878	1829
800	43	— 5	—26	12	2504	2492
1000	—45	—27	—32	—104	3130	3234

SOURCE: Computed from budgeted data.

Added variable costs included only repair costs and electricity costs. Added repair costs were computed as the difference between total repair costs of the bulk tank units and the total repair costs of the can coolers. The difference ranged from a net addition of $12 for 100 gallon tanks down to a subtraction of $27 for 1000 gallon tanks per year.

Electricity costs were less rather than greater for the bulk tank.

*Can milk is usually picked up on an every day basis as compared with every-other-day basis with bulk tanks. A provision was made for the 10 percent seasonal factor but no allowance was made for holding one extra milking.

Over 50 percent of the producers said that the consumption of electricity decreased when they installed the bulk tank. On the basis of producer replies, it was assumed that the consumption of electricity would be 10 percent less with the bulk tank. This would be about 0.1 kilowatts or slightly less than 0.3 cents per 100 pounds of milk cooled. From these assumptions, the net reduction in added annual costs would range from $3 for the 100-gallon tank to $32 for the 1000-gallon tank.

Labor and supplies used in cleaning were assumed to be the same under the two systems. Although over 90 percent of the producers reported some savings in labor with the bulk tank, some of the saving was qualitative rather than quantitative. If savings are possible, the added costs in Table V are overstated. Savings reported by producers averaged 13 minutes per day. The decrease in cleaning time was about 10 minutes per day for producers in Groups A, B, and C; about 17 minutes per day for Group D producers; and about 20 minutes per day for Group E producers. At these levels, savings would range from two to six cents per 100 pounds of milk cooled.

Added Returns From the Bulk Tank

Most producers in the Oklahoma City milkshed realized additional returns when they installed the bulk tank. The principal sources were (1) premiums for bulk milk, (2) lower hauling costs, and (3) less milk loss from spillage. There was no conclusive evidence that changes in bacteria counts and butterfat tests resulted in additional returns.

Premiums for Bulk Milk: Premiums of 10 cents per 100 pounds for bulk milk were paid to producers at the time of the survey. For all producers the annual extra return averaged $257. This ranged from $100 per year for Group A producers to more than $500 per year for Group E producers.

Savings in Hauling Costs: Savings in hauling costs will vary among producers according to distance of their farms from Oklahoma City. Under present charges for bulk milk hauling, savings generally will be greatest for producers located at the periphery of the milkshed. There may be no savings for producers located close to Oklahoma City.

Forty-nine of the producers in the sample had lower hauling costs when they installed the bulk tank. Their costs for hauling milk in cans averaged 46 cents per 100 pounds. When they installed the bulk tank their costs averaged 30 cents, a saving of 16 cents per 100 pounds. Based on 1957 sales, annual savings averaged $411 per farm and ranged from

$161 for Group A farms to $822 for Group E farms.

Saving of Lost Milk: There is usually some loss of milk solids and butterfat when milk is sold in cans. Some is spilled and some sticks to the sides of the cans. This loss is avoided when milk is sold in bulk.

Research results from the Dairy Department of Oklahoma State University indicate a milk loss of 0.32 pounds for each 10 gallon can.* With a 1957 blend price of $4.56 per 100 pounds, this would be a loss of 1.4592 cents per can or about 1.7 cents per 100 pounds.

Total Added Returns: Total added returns for the sample producers averaged 27.7 cents per 100 pounds. This was composed of the 10 cent premium for bulk milk, the 16 cent reduction in hauling charges, and the 1.7 cent increase in returns from the avoidance of milk losses.

Annual added returns from the bulk tank were computed for 10 tank sizes. For each tank size, it was assumed that annual milk sales would be equivalent to 72 percent utilization of the tank (36 percent daily for 365 days). The 72 percent provided for a 10 percent seasonal increase for the peak production period and for holding a fifth milking. On this basis annual added returns ranged from $313 for the 100 gallon tank to $3,130 for the 1000 gallon tank.

Break-Even Volumes

If the costs of producing milk are equal with either the can or bulk system, the extra costs of the bulk system are the relevant costs for determining the break-even volumes. The added costs of converting to a bulk system, however, will not be the same for each individual producer. The lowest added costs would be those associated with the purchase of a *new tank unit* rather than the purchase of a *new can equipment unit.* The greatest added costs will be those associated with the purchase of a *new tank unit* rather than the use of a *serviceable but depreciated can unit.*

The costs per hundred weight for the alternative tank sizes are shown in Table VI. The assumed annual volumes of milk were based on 72 percent of tank capacity. For each 100 gallons of tank capacity the annual volume for every-other-day (E.O.D.) pick-up was approximately 113 thousand pounds. For example, the annual volume of milk for an 800 gallon tank would be approximately 904 thousand pounds.

*P. E. Johnson, H. C. Olson, and R. L. Von Gunten, **A Comparison of the Bulk and Can Systems for Handling Milk on Farms,** Agricultural Experiment Station Bulletin No. B-436 (Oklahoma State University, August, 1954), p. 13.

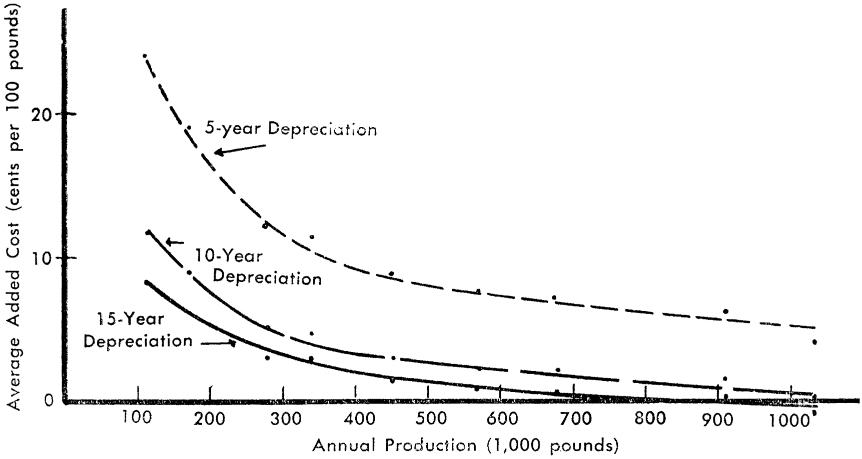

Fig. 2.—Average added cost of bulk tanks over average total can equipment cost, for alternative depreciation schedules; Oklahoma City milkshed.

With All New Equipment: The added costs of converting to a bulk tank when both bulk tank and can equipment are new are shown in Figure 2 for each of 10 tank sizes. Three separate estimates of costs are included. The first estimate is represented by the solid line and is based on costs associated with a 10 year life on the compressor and a 15 year life on the tank. The 10 cent bulk milk premium would more than cover these costs for any producer with milk sales of at least 100 thousand pounds per year. Producers with about 900 thousand pounds of milk sales or more per year could afford to install the bulk tank with no premium or savings in hauling cost if his only alternative is the installation of new can equipment.

The second estimate is represented by the dash line and is based on a 10 year life for both the tank and the compressor. The premium for bulk milk plus the savings from avoidance from milk losses would cover all costs for producers with 125 thousand pounds or more of milk sales per year. The break-even volume for the 10 cent premium only would be about 150 thousand pounds of milk per year.

The third estimate is represented by the dotted line and is based on a pay-out period of 5 years. With the average added returns of 27.7 cents for producers in the sample, producers with milk sales of 100 thousand pounds or more per year would pay for the conversion in 5 years or less. If there were no savings in hauling, the break-even volume for a 5 year pay-out would be about 300 thousand pounds per year. With only the 10 cent premium, producers would need a volume of

Table VI. Average Added Costs Over Can Equipment Costs, and Average Total Costs of Cooling Milk With Bulk Tanks Under Alternative Depreciation Schedules; Oklahoma City Milkshed.

Tank Size (gallons)	Average Added Costs: Above Total Can Equipment Costs (years depreciation)			Average Added Costs: Above Variable Can Equipment Costs (years depreciation)			Average Total Cost (years depreciation)		
	15	10	5	15	10	5	15	10	5
	(cents per 100 pounds)								
100	8	12	24	15	18	31	26	29	42
150	6	9	19	12	15	25	21	23	33
200	5	7	16	10	12	21	17	20	28
250	3	5	12	8	10	17	15	17	24
300	3	5	11	8	9	16	14	16	23
400	2	3	9	6	8	14	13	14	20
500	1	2	8	6	7	12	12	13	18
600	1	2	7	5	7	12	11	12	17
800	0	2	6	5	6	11	10	12	16
1000	– 1	0	4	4	5	9	9	10	14

SOURCE: Computed from budgeted data.

at least 375 thousand pounds per year for the 5 year pay-out.

With Old Equipment: The greatest added costs of converting to a bulk system would occur for those producers who had serviceable can equipment. If there is no appreciable investment, depreciation, interest, taxes, and insurance, these items may be neglected. Consequently, added costs were computed which included no fixed costs for the can equip-

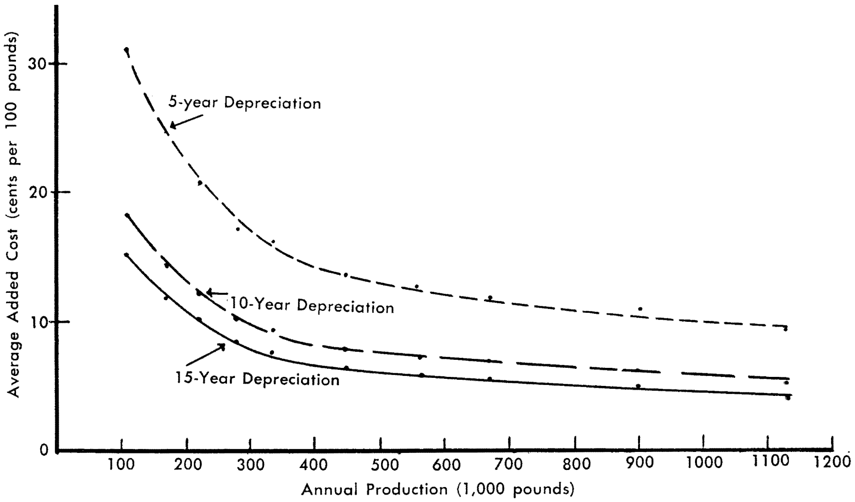

Fig. 3.—Average added cost of bulk tanks over average variable can equipment costs, for alternative depreciation schedules; Oklahoma City milkshed.

ment. Costs based on different pay-out periods for the tank under these conditions are shown in Figure 3.

Costs for all producers were less than average added revenues under the 15-year depreciation schedule for the tank and 10 years for the compressor. However, some savings in the hauling charge would be necessary to cover costs for producers with volumes of less than 175 thousand pounds per year.

Costs for all producers were also less than average added revenues under the 10 year depreciation schedule. The break-even volume was about 225 thousand pounds per year for producers who received only the 10 cent premium plus the savings from avoidance of milk losses.

Average added returns would cover added costs under a 5 year pay-out plan for producers with sales of more than 125 thousand pounds per year. However, only producers with volumes of at least 675 thousand pounds per year could make the bulk tank pay for itself in 5 years unless there was some saving in hauling charges.

Break-Even Volume to Cover All Cooling Costs

The average added returns were equal to or greater than the total cost of cooling milk with bulk tanks for most production levels under the 15 year depreciation schedule for the tank and 10 years for the compressor (Figure 4). However, some savings in hauling were necessary for the smaller volumes. With no savings in hauling cost, the break-even volume would be about 500 thousand pounds per year.

With a 10-year depreciation schedule the break-even volumes to cover all bulk tank cooling costs would be 125 thousand pounds per year with average savings in hauling and 900 thousand pounds per year with no savings in hauling.

A large number of producers could pay for all bulk tank cooling costs in 5 years with average added returns. The break-even volume would be about 225 thousand pounds per year. However, none of the producers could pay for all tank costs in 5 years without some savings in hauling costs.

Break-Even Volume for an Individual: The break-even volume for an individual producer will depend on the estimated added returns for his location and on the type of can equipment displaced.

The added returns can be obtained by adding any premium for

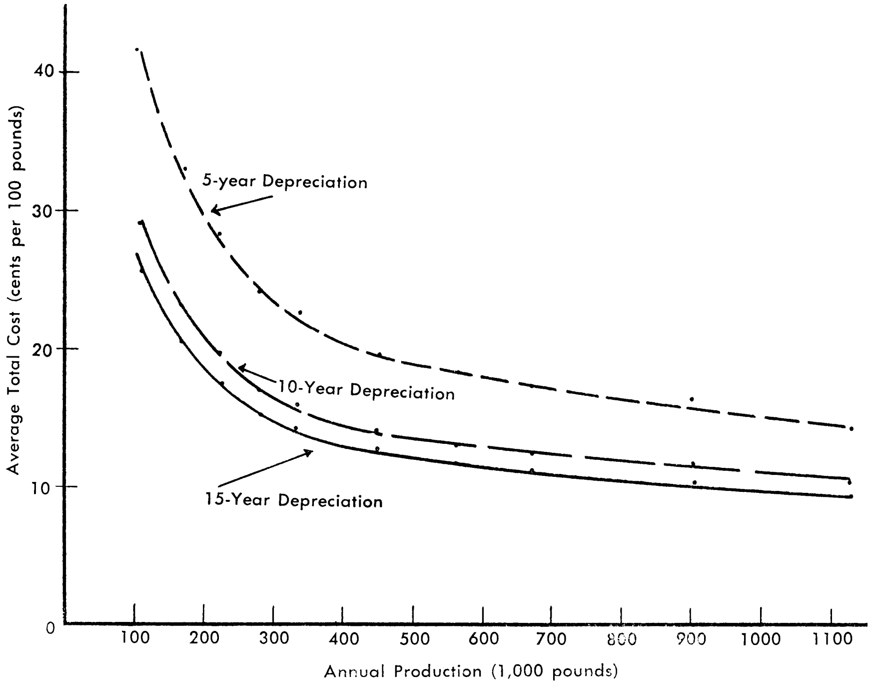

Fig. 4.—Average total cost of cooling milk with bulk tanks for alternative depreciation schedules; Oklahoma City milkshed.

bulk milk, about 1.7 cents per 100 pounds for avoidance of milk losses, and the difference between his present can milk hauling rate and the bulk milk hauling rate. Other returns may be added if they exist. All returns should be expressed as cents per 100 pounds.

If these returns exceed the average added costs for his volume in Figure 2 (for a pay-out period appropriate for him) then he can afford to install a bulk tank rather than buy new can equipment. If these returns exceed the average added costs for this volume in Figure 3, then he can afford to install a bulk tank even though he charges nothing for depreciation, interest on investment and taxes on this can equipment. If these returns exceed the average costs for this volume in Figure 4, then the added returns are covering all costs of cooling milk with the bulk tank.

SUMMARY

This study was concerned with determining the costs and returns of installing a bulk milk tank on Oklahoma dairy farms. It is based on information from a sample of 50 Grade A dairy producers in the Oklahoma City milkshed, varying in size from 78,816 to 840,916 pounds of milk produced per year.

Initial conversion costs of the sample farms required expenditures on the bulk tank, on improvements such as milkhouse alteration, additional wiring, a new hot water heater, and on road and lane surfacing. The cost of the bulk tank unit, the largest expenditure, varied directly with the size. The cost of the average size of bulk tank ranged from $1,963 for small-volume producers to $3,248 for large-volume producers. Improvement costs generally were from 3.0 to 4.5 percent of the cost of the bulk tank unit. Salvage values of the displaced can equipment averaged about 8.6 percent of the cash price of the tank or almost enough to cover the down payment on the tank.

The annual fixed cost of cooling milk with bulk tanks included depreciation, interest on investment, insurance, and taxes. These costs ranged from $161 for the 100 gallon tank to $495 for the 1000-gallon tank. Variable costs included electricity, repairs, and labor and supplies used in cleaning the tanks, and ranged from $131 for the 100 gallon tank to $543 for the 1000 gallon tank.

The total cost of cooling milk was about 26 cents per 100 pounds for the 100 gallon tank and decreased as the size of the tank increased until the cost reached nine cents per 100 pounds for the 1000-gallon tank. These costs assume a tank usage of 72 percent of capacity. Based on the size of tanks actually used by the sample producers, costs decreased about six percent for each 10 percent increase in size of tank. Large-volume producers had tank sizes which corresponded more closely with actual volumes of milk cooled than small-volume producers.

Added returns from the bulk tank averaged 27.7 cents per 100 pounds for the sample producers. This was composed of a 10 cent premium for bulk milk, a 16 cent decrease in hauling charges, and a 1.7 cent increase in returns from the avoidance of milk losses.

Added returns were greater than added costs for most of the producers sampled. In fact, the added returns were sufficient to pay for the tank in five years based on average total can costs. For large volume producers, the added returns from converting to a bulk tank would be sufficient to pay for the tank in five years even if fixed can cooling costs were ignored.