FARM BULK MILK HANDLING

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This article is based largely on a paper presented by the author to the Orange County, New York, milk sanitarians and guest farmers. The purpose of the task was to give a general picture of the bulk milk handling situation with emphasis on facts of interest to New York State producers.

The economic aspects as they affect the hauler, dealer and producers are briefly reviewed. Producers are informed and advised concerning some of the engineering aspects of bulk cooling. The effect on milk quality is discussed and the advantages and disadvantages of bulk tanks for the farmer are summarized.

The first calibrated farm bulk cooling tank was introduced by the Lucerne Milk Company, Oakland, California, in November, 1941. The first farm tank in New York State was installed on the Hedge Farm at Pine Plains in April of 1948 by Bryant and Chapman - R. G. Miller and Sons. The milk on this route went into Hartford, Connecticut.

The first every-other-day bulk pick-up system in New York State was started by Green's Dairy in Schenectady in May of 1952.

Today, there are at least 10,000 farm tanks in the United States and at least 400 in use in New York State.

TANK MANUFACTURERS

Surprisingly enough there are about 125 companies who are building tanks or plan to build tanks.

Below is a list of companies that I know have tanks on the market.

4. Damrow Brothers Company, 196-234 Western Avenue, Fond du Lac, Wisconsin.
10. C. E. Howard, Corporation, 9001 Rayo Avenue, South Gate, California.
16. Sunset Electric Company, 300 Westlake North, P. O. Box 3148, Seattle 14, Washington.
17. Tolan Machinery Company, Inc., Port Street, Port Newark, New Jersey.
18. Velco Manufacturing Company, 3470 Randolph Street, Huntington Park, California.

More new makes will be on the market soon.

Tanks manufactured by Numbers 3, 6, 13, and 19 are cooled by the ice-bank system. With Numbers 1, 11, and 18, chilled water or direct expansion cooling is optional. Manufacturer No. 9 sells three types—ice-bank, direct expansion, and semi-direct expansion. The remaining tanks are cooled by the direct expansion method.

ECONOMIC ASPECTS

Concerning the Hauler

A tank truck costs more than its counterpart for carrying cans but it can haul a greater payload, and in some cases, make more than one trip per day.

A report by Nelson shows considerable savings in hauling rates. Tank trucks in Oregon ranging in size from 1,200 gallons to 1,700 gallons have shown savings in transportation costs varying from 11 to 15 cents per hundredweight. The average distances these trucks traveled was 62.3 miles with an average of only 6.5 stops. Some of the organizations used 2,100-gallon and 2,500-gallon trucks traveling an average of 77 miles with stops numbering from 8 to 13. These routes reported a hauling rate reduction of from 18 to 20 cents per hundredweight.

However, as Nelson states early in his paper, each tank truck route has replaced four can routes in most areas of their state, resulting in more milk per load and more intensive use of equipment.

According to a Washington report, it costs about the same to operate a 1500-gallon tank truck...
as it does to operate a van-type truck designed to haul 1500 gallons in 40-quart cans.

In New York State some haulers have not been able to lower their hauling rates, probably because they have more stops than stated above, less intensive use of their equipment, and not a complete every-other-day farm pick-up schedule.

Again, with reference to a west coast study, Clarke reports that tank truck pick-up is more economical than the can method if for a 3000-gallon route at least 130 gallons can be picked up per collection, for a 2000-gallon route at least 120 gallons can be picked up per collection, and for a 1000-gallon route at least 100 gallons can be picked up per collection.

Concerning the Dealer

Obviously, the dealer can obtain his greatest savings only when he can completely eliminate the receiving of milk in cans. He may have some saving in cooling costs or other savings if tank pick-up eliminates over-time on the receiving deck or the necessity for expanding the receiving room.

The Oregon paper by Nelson states that plant savings can range from 2 cents per hundredweight when receiving 3000 cans per day to 4 cents per hundredweight when receiving about 600 cans per day if complete conversion to tank pick-up is made.

An article in the Milk Plant Monthly by Hall of Michigan gives the total costs of receiving and cooling milk in a very efficient one man operation as follows:

<table>
<thead>
<tr>
<th>Quantity of milk</th>
<th>Total receiving daily costs per cwt</th>
</tr>
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<tbody>
<tr>
<td>(pounds)</td>
<td>(cents)</td>
</tr>
<tr>
<td>20,000</td>
<td>7.4</td>
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<td>40,000</td>
<td>4.4</td>
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<tr>
<td>60,000</td>
<td>3.3</td>
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<tr>
<td>80,000</td>
<td>3.0</td>
</tr>
<tr>
<td>100,000</td>
<td>2.7</td>
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</tbody>
</table>

In the 1953 February issue of the Southern Dairy Products Journal, an article by A. A. McArthur states that savings from 8 to 20 cents per hundredweight are possible. The dealer or the producer will have some loss unless the tanks are properly calibrated. The farmer's milk is measured on a volume basis but the dealer must pay for it on a weight basis. Reports indicate that calibrations have been fairly accurate. Mr. P. C. Farrar of Hillcrest Dairy, Worcester, Massachusetts, has stated that it is unusual for their weights to be off more than 6 or 8 pounds per tanker. A dairy plant in one of the major New York State cities has had up to a 1.2 percent loss of milk on a tank truck shipment due to a difference between the milk receipts left the farmers and the actual pounds of milk weighed in at the plant, but this was an exceptionally high loss.

Some people have shown concern about the errors which may result when measuring milk with a stainless steel rod because of volume changes with a change in milk temperature or because of variations in weight with a change in fat test of the milk. These errors, however, are extremely small, less than the allowable error in the measuring rod as permitted by 3-A Standards for Bulk Cooling Tanks.

Concerning the Producer

In many cases the demand for farm tanks has stemmed straight from the producer, perhaps for such reasons as his desire to have the milk measured, sampled, judged, and purchased on the farm, to improve milk quality, and to increase his income.

A reasonable example of costs and savings for a 7- to 10-can producer is given in Mr. Fisher's talk referred to earlier in this paper.

He recommends a 150-gallon tank for this producer. If the tank is filled on an average to 65 percent of its capacity, it could be amortized over a five-year period at the cost of 14 cents per hundredweight. If this producer had a can cooler, amortization would cost him 6 cents per hundredweight, or an increase of 8 cents per hundredweight for the tank.

Fisher of General Ice Cream Corporation and officials of the Connecticut Milk Producers Association have estimated that Connecticut producers will save 4 cents per hundredweight in volume, 4 cents per hundredweight in fat and 2 cents per hundredweight can expense, or a total of 10 cents per hundredweight. This would more than make up for the 8 cents additional cost for the tank.

The bulletin by Nelson referred to earlier in this paper shows substantial savings for the Oregon producer with a tank as compared to one with a can cooler. The range was from $103 per year for the 10-cow herd to $1,681 per year for the 100-cow herd. These savings resulted from reduced labor and reduced handling rates. These Oregon farmers had to spend a significant amount of time handling, rinsing, and cleaning cans and cleaning a surface cooler. It took much more time than washing a tank every other day. New York

*Statement made by Mr. Farrar when serving on a bulk milk panel at the Milk Industry Foundation's 46th Annual Convention, Boston, Mass., October 23, 1953.
State producers, however, do not have to wash their milk cans nor do they have surface coolers to clean and as explained earlier many New York State truckers have not been able to cut their handling costs significantly.

Nevertheless, bulk tanks are feasible for many farmers in this state because of the savings listed below.

1. Savings in volume of milk may easily equal about 4 cents per hundredweight. At Cornell we have a loss of about 0.4 pound of milk per can of warm morning milk and about 0.6 pound per can of cold night milk. In our plant we have a slow, careful dumping operation. A commercial receiving operation may easily lose one pound per hundredweight because it is not economically feasible to dump cans as slowly and methodically as is done in our small plant.

2. Savings in fat may range from 0 to 5 cents per hundredweight. (Greater than 5 cents per cwt. savings have been reported). The difference of 0.2 pound between the 0.4 and 0.6 stated above represents cream which has stuck to the shoulders of a cold can. This cream, testing about 25 percent fat means a loss of .05 percent fat per can of cold milk. Commercial plants may average higher losses than this especially in winter. In many areas of New York State morning milk is not cooled so there would be no significant fat loss in these warm cans.

3. Savings by elimination of cans is often quoted as 2 cents per hundredweight.

4. Some producers have received 10 cents per hundredweight as a bonus or premium for their tank milk, especially from plants which have been able to switch to 100 percent bulk pick-up.

5. Some producers have had their hauling rates reduced.

Additional benefits that should not be overlooked by the farmer are: satisfaction of having milk measured, judged, and sampled on the farm; elimination of can handling; the pride of ownership of a stainless steel tank in place of the shabby can; less danger of rejections; and lower bacterial counts in properly handled milk.

ENGINEERING ASPECTS

All bulk tanks sold in this country today should meet the requirements of the 3-A Sanitary Standards for Holding and/or Cooling Tanks. These standards published in the 1953 July-August issue of the Journal of Milk and Food Technology are formulated by the International Association of Milk and Food Sanitarians, Inc., the United States Public Health Service, and the Dairy Industry Committee. They cover minimum standards for design, construction, and performance of farm bulk milk tanks.

Before buying a tank one should be sure it meets the 3-A Standards and the state and local health department requirements.

On February 1, 1954, the New York State and New York City Departments of Health published a list of manufacturers whose farm tanks were approved for use in this state.

The 3-A Standards require that the milk be cooled to 50° F within the first hour after the completion of milking and to 40° F within the second hour. New York State and New York City Health Departments require that the milk be cooled to 45° F within one hour after the completion of milking.

Most tanks are cooling much more rapidly than this, but some of the reports of extremely fast cooling rates are attributable to cooling only a very small quantity of milk in proportion to the maximum rated capacities of the tanks.

Tanks may be designed either to cool one-half their volumetric capacity of milk at one time for use on daily pick-up routes or to cool one-fourth their volumetric capacity of milk for use on every-other-day pick-up routes. A producer should not make the mistake of buying a tank designed solely for use on an every-other-day route and then use it to capacity as a daily pick-up tank. Under such a circumstance the tank simply could not cool rapidly enough.

There are two general types of tanks on the market today, the direct expansion tank and the ice-bank tank. Both can be designed to do an excellent job of cooling milk.

The direct expansion tanks in general require about 1 horsepower of compressor motor size for each 50 gallons of milk to be cooled at one milking. For example a 200-gallon tank from which the milk is to be picked up daily should have a 2-horsepower compressor motor, or a 1-horsepower compressor motor if every-other-day pick-up is anticipated.

In general, ice-bank coolers have compressor motors that are about one-third as large as those on direct expansion tanks, but these units run for a much longer time to store their refrigeration in the form of ice. This type of tank also has a water circulating pump with a 1/4 to 1/3 H.P. motor not found on direct expansion makes, but this cooler has a smaller power demand at any given time and also cannot freeze milk.

Direct expansion tanks will not freeze milk if properly designed and operated. They require slightly less power per given volume of milk cooled.

Each type has its own merits so before purchase of any tank the producer should carefully consider the advantages and disadvantages of both types in the light of his specific circumstances, keeping in mind the importance of good design, good construction, good performance and the need for satisfactory future service on the tank.

The refrigeration system on a bulk tank may have one of three types of condensers, air cooled, combination air-water cooled, or completely water cooled. The last two types are more efficient than the first.

For satisfactory performance of air cooled units, adequate ventilation is imperative. This subject is discussed in detail in Cornell Bulletin 899 entitled "Bulk Cooling and Storage of Milk on the Farm."

In winter the water connections to combination air-water condensing units should be disconnected and the unit carefully drained, or if not disconnected, protected from freezing. The straight water cooled units must be protected from freezing.

Proper wiring and correct overload protection for each motor is very important. This subject is also discussed in Bulletin 899.

Milk Quality

If milk is cooled slowly or not at all, poor, insanitary handling methods are easily revealed, but in the author's opinion this does not justify poor cooling of milk. The ideal is proper handling methods followed by very fast cooling. In bulk handling, one approaches the latter, and this fast cooling does
help to keep bacteria counts down. So, in general, it is not difficult for a producer to keep his bacteria count well below 50,000.

However, some farmers who produced high count milk in the past are still producing unacceptable milk after changing to a tank. One report of some tank milk produced last August showed a plate count of 180,000. This is much too high. Dirty milking equipment and improperly cleaned tanks especially in warm weather, or with cows with mastitis at certain stages, or improper operation of the tank may be the cause of these high counts.

Tanks should be thoroughly rinsed immediately after emptying and washed as soon as possible. In this state cold water under pressure and not less than 15 gallons of water at not less than 140°F must be available in the milkhouse at the time of washing the tank. (New York City Health Department requires hot water under pressure).

Milk low in bacteria count can still be of poor quality due to odors. It was mentioned earlier that truckers should first qualify as competent fieldmen. Truckers should not fail to smell each tank of milk. A driver may become careless in this respect because most of the tanks of cold milk will have very little odor. But occasionally an odor is so intense that it is obvious if any effort is made to detect it. It is not common, but tank loads of milk have been rejected for such odors as skunky, onion, garlic, silage, and sweet odor.

Another problem that should be mentioned in connection with bulk tanks in churning, or the appearance of tiny butter particles in the milk. This trouble was more common in some of the earlier tanks, especially those with high speed agitators. Recently the author examined the milk with a strainer dipper in 29 tanks in eastern New York. No evidence of churning was found in any of these tanks. There were some flakes in every single tank regardless of make or type but most of these so-called "flakes" were foam particles and a few, ice particles. When pressed between the fingers they reverted to ordinary milk. The author found some cream flakes in a few tanks. These cream flakes were greasy when rubbed between the fingers but they were not butter particles. This does not mean, however, that churning does not occur occasionally, for it can under such circumstances as: (1) abnormally slow cooling as caused by slippage of the compressor belt, loss of refrigerant, lack of cooling water in the condenser, or poor ventilation of its condenser; (2) agitator running at a high speed because it was accidentally left on manual control; or (3) addition of warm milk to an unagitated tank of milk which has formed a cream layer.

Churning is undesirable because it makes it very difficult to take a representative sample for the fat test and it causes a cream plug on the top of bottled milk and cream.

One more difficulty that may be found in some farm tanks is freezing of the milk. Freezing can occur in most direct expansion tanks under certain circumstances, such as: (1) if a small quantity of milk is poured into an excessively precooled empty tank; (2) if the agitator is left off while the condensing unit is running; (3) if the tank is accidentally left on manual control and the milk is cooled below its freezing point; (4) if the thermostatic control fails to shut off the compressor; or (5) if the thermostatic control is set too low.

Freezing may cause some destabilization of the milk and when thawed, flakes of curd and butter particles may appear. This is especially true if a high percentage of the milk is frozen.

SUMMARY

1. When properly established, the tank truck method of picking up milk is better and cheaper than the can method.
2. When the dealer completely eliminates can receiving he can realize a significant saving.
3. For the Producers:
   Advantages:
   (a) Satisfaction of having milk measured, judged and sampled on the farm.
   (b) A saving in milk volume of about 1 pound per hundredweight or 4 to 5 cents per hundredweight.
   (c) A saving in fat of 0 to about 5 cents per hundredweight.
   (d) Reported savings of 2 cents per hundredweight by elimination of cans.
   (e) Possibility of receiving a premium.
   (f) Possibility of reduction in hauling rates.
   (g) Possibility of saving in labor.
   (h) Elimination of can handling.
   (i) Better quality milk if properly handled.
   (j) Possibly more room in the milkhouse, especially for the larger producers.
   (k) Highly adaptable to pipe line milkers.

Disadvantages:
   (a) High initial outlay for tank.
   (b) Not as great a saving in dollars for most of the New York State producers as indicated by many reports.
   (c) Freezing in some tanks if improperly operated.
   (d) More difficult to cool milk in case of power outage.
   (e) May require:
        (1) New milkhouse or extensive modification.
        (2) Extensive rewiring.
        (3) Improvement of farm drive-way to handle tanker.
        (4) Installation of hot and cold water facilities in milkhouse.

REFERENCES


BEHAVIOR OF A HEAT RESISTANT FOOD SPOILAGE SPORE

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