FIELD PROBLEMS WITH BULK TANKS[1]

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Apparently, we are to admit that there are problems with bulk tanks. As one of the earliest manufacturers of bulk tanks for the Eastern market, I would not deny that there have been many problems, some of which may not have been entirely solved. Meetings like this, where such problems can be discussed, will do much to help the manufacturer, the farmer and the fieldmen to solve these problems by better understanding their cause and possible correction.

Any new development, particularly one as revolutionary and involving the use of a completely new and complicated piece of electrical refrigeration equipment built to Sanitary Standards for the handling of a highly perishable product will create many problems due to ignorance of those involved as to the proper design, construction, operation and maintenance of the equipment and the program for which the equipment is intended.

The automobile, which a couple of generations ago took over the transportation of our masses from the carriage and the stage coach, undoubtedly experienced the same growing pains. The missile program of our government and the contractors involved in the development of the missile, in spite of their tremendous financial and technical resources are, judging from what we read in our papers, having their troubles. Therefore, it is no disgrace to have problems.

May we briefly review a few of the outstanding examples of early trouble, some of which we are still living with because most of the tanks that have been manufactured since the inception of the program, covering a period of about ten years, at least in the East, are still being used on farms, and many of those original weaknesses are still bothering their users.

One of the most common problems has been caused by temperature controllers and thermometers. These instruments are the product of large, well known instrument manufacturers and were invariably recommended to farm bulk tank manufacturers by their makers, who adapted them from other industries. We very quickly learned that these instruments were not suited to farm tank use. The controller would many times shut off at too high or too low a temperature, permitting poor cooling or causing freezing.

Originally, some manufacturers of instruments recommended controllers without cross ambient protection. I am sure no such controllers are now being installed but even the best cross ambient protected instrument is affected by ambient temperatures. A change of 27°F in the ambient temperature will affect the most sensitive instruments by 1°F, so that cut off and cut on temperatures vary by 2° or 3°F because of this outside influence over which tank manufacturers have no control. Properly ventilated and heated milk houses reduce this problem.

Thermometers, too, have created quite a problem by not being as durable and accurate as would be desired. The 3-A Standards require a thermometer to be accurate within 2°F. This, added to the cross ambient variable mentioned above can give a reading variation of 4° or 5°F, depending on outside influences.

A controller should never be adjusted until a known accurate test thermometer has been used to check the temperature of the product. Too many times controllers have been unnecessarily adjusted.

Another cause of considerable instrument trouble has been the high humidity which, coupled with the acids and alkali from milk and detergents in the air, create a very corrosive condition under which these instruments are expected to operate and for which they at least originally were not designed. Some improvement has been made but more can be accomplished.

Another perplexing problem has been one of agitation. In the beginning agitator motors almost without exception seemed to leak grease from their gear case. This caused many service problems but fortunately the motor industry has developed several very satisfactory greaseless gearhead motors which apparently has entirely eliminated this original difficulty.

On some of the first tanks agitators were so designed that some gave excessive and others inadequate agitation to insure a correctly blended composite sample. These design weaknesses have been corrected so that today almost all tanks, when the agitator has been operated from 3 to 5 minutes, give an accurate butterfat sample, and the agitator, during the cooling cycle, will insure fast cooling without excessive agitation or air incorporation.

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Many complaints are due to external causes which cast suspicion on the tank, as an example, a farmer may be milking several low testing cows which have freshened or which he has purchased at about the same time he installed the tank. Changing feed or other environmental conditions can also affect butterfat tests. Other causes are water in the milk due to improper cleaning of the tank or milking machine pipeline, permitting water to remain in the system, or the deliberate addition of water.

Manufacturers do have frequent complaints of apparent butter balls on the surface of the milk after the agitator has been operated for sometime, but Cornell and other research stations have proved these to be an optical illusion. They are actually an air bubble with high fat milk forming the film from which the bubble is created. They occasionally found a deep yellow film on top of agitated milk but again the appearance was much worse than the fact, as almost without exception, when Babcock samples were taken from four corners and the center, the readings were found to be the same, within one to two tenths of a point.

When the tank is first being filled, some air incorporation is likely to occur as the milk comes up to the agitator, if the agitator has been put in operation at the beginning of the milking, which it must be, to realize the fastest possible cooling. However, no provable damage has ever resulted.

The covers on early model tanks often fitted so poorly that in tropical climates even frogs were able to get into the milk, and in many areas flies and other insects created a problem. Here again, manufacturers have recognized and corrected this original design weakness.

Some tanks were not properly engineered to insure the necessary rigidity of the milk lining to maintain calibration. These conditions, I believe, have been corrected and tanks today, because of their heavy steel frames, elliptical shape and other carefully designed and worked out improvements will without exception, when properly installed to maintain a level position, remain in accurate calibration.

Many tanks had a poor means to detect an out-of-level condition that might develop from a sagging or heaving milk house floor. These have been improved but there is still room for further improvement so that the fieldmen can quickly but certainly determine that the tank has been moved from its original calibration level either from natural or intentional causes.

One other condition that is not closely associated with the sanitary operation of the tank but certainly affects its appearance is the high humidity and the corrosiveness of milk acids and detergents on painted or plastic finished tanks. It has been found that it takes about 40% humidity to support rusting. We know that many milk houses approach 100% humidity as is indicated by the great amount of condensation found on the walls and equipment in the house. Proper ventilation would greatly relieve this situation and help to preserve not only the finish on the tank, but the agitator motor, temperature controller and in fact, the entire tank and its component parts, as well as other milk house equipment.

One of the greatest single causes of farm tank problems probably comes from tanks being used for much greater milk production than they were originally intended to handle, as for instance, tanks purchased for every-other-day pickup and equipped with every-other-day capacity compressors being used for every-day pickup and being loaded to the fullest capactiy of the tank each 24 hours rather than 48 hours.

We occasionally have complaints about bacterial count of the milk from a farm tank. We must remember that a farm bulk cooling tank can never improve the milk that has been placed in it. If the tank is properly operating, it will maintain good milk, better than any other method of cooling and storing the same quality milk. So, complaints about high bacterial counts in a farm tank should never be charged against the tank, if as I previously said, it is properly operating and of course has been properly cleaned. Here you fieldmen have a definite opportunity and responsibility. Most farm bulk cooling tanks today are manufactured to be readily and thoroughly cleaned, which is certainly the responsibility of the manufacturer. And, most reliable manufacturers provide cleaning instructions with every tank. However, these instructions need interpreting to the farmer and certain variable conditions such as the water available and the type of detergent that will work best under the conditions at hand, should be determined by the fieldman in cooperation with the farmer. Continued education and supervision to insure a sanitary tank to receive milk is the combined responsibility of the fieldman and the farmer, remembering at all times the milking equipment, the cleanliness of the cow's udder, the cow's health, the cleanliness of the milkers hands and clothing, the condition of the barn and many other influences can provide milk with either low or high bacteria count as it enters the tank. If it is low, it will be maintained at a relatively low count. If it is high, there is nothing the farm tank can do to correct the condition. It will, however, not increase as fast as it would under less ideal cooling and storing conditions.

Measuring has undoubtedly been one of the greatest deterrents to wider acceptance of farm bulk cooling tanks. I well remember when my parents sold cream to our local creamery by the inch, in other

words, the measuring stick was then the accepted method of determining the quantity of milk or cream being sold.

However, through many years of education, milk buyers and farmers have been taught to believe the only accurate method of determining the quantity of milk changing ownership is by weight. Ten years experience in the East and nearly 20 years on the West Coast has proven that we can accurately determine the quantity of milk by a measuring stick provided, and this is important, the tank is designed, built and installed to maintain its calibration and that the measuring stick is so made and mounted to the tank that it will always also absolutely maintain the relative position to the tank that it had at the time the original calibration was made. Experience has proven that the stick should be stored outside the tank at room temperature and dry to obtain the most accurate measurement. Of course, it is essential that the person making the measurement be conscientious and inherently honest. No device however complicated or expensive has yet been developed that will make a dishonest person honest.

There is available an electronic surface gauge or measuring device which will determine the depth of milk in the tank slightly more accurately than a calibrated metal measuring stick. However, it has other inherent weaknesses that evidently have prevented it from becoming popular. One manufacturer, a few years ago, attempted to popularize a scale mounted tank but because of the substantial extra cost of such a scale and the by then proven ability to accurately measure milk with a measuring stick, the sale of the scale never was successful.

Our entire Industry is hoping, and I for one, believe that some day we will have a metering device that will be satisfactory for the purpose of measuring milk accurately from the farm tank into the pickup truck tank. We know that extensive research and development is going on in this field. To my knowledge, one reported successful operation of such a meter is now being used on a route in Europe. There may be many others that I am not aware of.

I have previously outlined the responsibility of the fieldmen and his relationship to the farmer and the program of proper cleaning and sanitizing. There are other maintenance problems. For instance, it is not at all uncommon to have a farm tank develop an objectionable spot of rust on the interior of the milk lining. You must remember that stainless steel itself cannot rust. If the spot is small, it may be due to carbon steel that was imbedded in the stainless during fabrication and it must be removed to eliminate the re-occurrance of the objectionable condition.

More often rust comes from external causes such as rusty water pipes, pails or other contaminating conditions that permit rusty water to be used for cleaning the tank. The water that does not drain from the tank eventually evaporates, leaving rust deposited on the lowest point in the tank. Then the deposited rust builds up and to the inexperienced it would certainly look as though the stainless was rusting.

Both the imbedded steel and the deposited rust may be removed with a 4/0 sand paper used with a rubbing motion in the same direction as the grain of the stainless. If the external source of the rust has been eliminated it should not re-occur. The exterior of the tank, whether painted or stainless, must be kept clean in order to have good appearance in the milkhouse and to insure long life of the finish, particularly if it is a painted or plasticized finish.

Under the best maintained milk house conditions, painted tanks will need to be refinished frequently or whenever rust appears. This is not a difficult thing to do and it can be accomplished by the farmer if he will obtain some good automobile paint and apply it according to instructions, after thoroughly cleaning the metal to remove all rust, grease, moisture, etc. The bottom of the tank is important and many times neglected. It, too, should be kept clean and if carbon steel, painted.

Another problem that faced all farm tank manufacturers and their potential customers was an almost complete non-existence of trained sales, installation and service personnel in the rural areas to properly sell, install and maintain the necessary adjustments so that this new method of handling a delicate, perishable product can be sold, installed and maintained.

As is true in any such circumstance, manufacturers in desperation selected the best available people and did their very best to train and guide them in the job to be done. However, when it is remembered there are presently 32 manufacturers of farm bulk cooling tanks who have authorization to apply the 3-A Symbol, it is easy to understand how competitive the demand for even mediocre dealers is.

Unfortunately, many times in ignorance, such dealers, installers and service men and often manufacturers own representatives make statements about their own and competitors equipment that are so untrue that an atmosphere of great doubt is created. I recently talked with a successful and prosperous farmer who is going to buy a farm bulk cooling tank. He said to me that he was so confused by the many conflicting statements made by representatives of competing companies that he was literally unable to determine which tank he should purchase.

And, there has been, as we well know, great confusion among the ranks of our regulatory people as to the necessary finishes on the material, such as for instance, whether it should be a mirror finish, a No. 4 finish, stainless or painted exterior, the temperature to which the first milk should be cooled and the time that should be permitted to attain such temperature, the much discussed blend temperature, agitation, size of milkhouse, how much space should be provided at the back end, rear end, side and valve end of the tank, where and how many lights should be provided, where the drain should be, and on and on and on, certainly not a clear dictate to manufacturers or farmers as to type of equipment, its surroundings or operation.

Proper installation can substantially reduce the maintenance problem. Most smaller tanks, usually up to about 300 gallons, sometimes larger, have compressors mounted integrally with the tank and are of necessity located inside the milk house. The heat from these compressors, which is the heat that has been removed from the milk, serves to warm the milkhouse in the winter and if proper ventilation is provided, should substantially reduce the amount of humidity in the air and of course, create a more comfortable working condition while filling and cleaning the tank. For the same reason, this arrangement creates an excessively warm milk house in the summer. Good ventilation is essential, first to the satisfactory operation of the compressor and second for the comfort of people working in the milkhouse.

Larger tanks usually have remote compressors. Such compressors should be mounted close to the exterior wall of the milkhouse and should be enclosed in what is frequently called a "Dog House." This enclosure should be arranged so that a shutter or panel can be opened between the "Dog House" and the milkhouse to permit the entrance of warm air into the milkhouse for winter time operation, or so that by changing the panels or doors, the warm air can be directed to the outdoors during summer weather. This arrangement is preferable because it permits directing of the heat into the milkhouse for temperature and humidity control in cold weather and to the outside for more efficient operation and more pleasant working condition in hot weather. Such "Dog Houses" as well as milkhouses, when compressors are self-contained must be designed so there is adequate ventilation at all times as all of the heat removed from milk must be dissipated into the air surrounding the compressor through the condensor. The more efficient ventilation there is, the less time the compressor will need to run. It is necessary that the condensor or radiator like part of the compressor be kept clean of dust, chaff, and other materials that migh reduce the circulation of air.

The refrigeration tubing, connecting the compressor to the tank, particularly with remote installations, should be carefully installed to prevent damage from natural working conditions in the milkhouse. It can go down and under the floor or up and across the ceiling.

As a spokesman for the farm tank manufacturers, it is my desire to be impartial about the various types of tanks. However, while all types, direct expansion, ice bank, atmospheric, vacuum, manually cleaned or automatically cleaned will, if properly designed, manufactured, installed and operated, do a good job, there are certain inherent weaknesses and advantages to each. Farm bulk coolers are an adaption of refrigerated storage tanks used for many years in the receiving stations and processing plants. These storage tanks always have been and still are direct expansion tanks. Tests conducted by many recognized experiment stations have conclusviely proven that a direct expansion tank will use less electricity to cool 100 pounds of milk than an ice bank tank. On the other hand, direct expansion tanks require larger compressors running for much shorter times. The larger compressor in certain instances creates a problem for the power supplier, as rural lines are not always heavy enough to carry the additional load.

We are all familiar with the rusting milk can. Two of the things most desirable about direct expansion tanks are that they have entirely eliminated water as the cooling medium, which has caused milk cans and can coolers to rust, and also, have eliminated the potential danger of electrolysis because of the use of dissimilar metals, such as is common in water cooled tanks where stainless steel milk linings are mandatory and copper refrigeration tubing is used with stainless, copper or galvanized water tank liners.

One of the farm tank problems has been what to do when power fails. It is true with an ice bank tank there is some stored ice, however, milk cannot be cooled unless this ice is melted, which is accomplished by a circulating pump, which cannot be operated without electricity. This circulating pump is one additional mechanical part necessary on ice bank tanks. In addition two sets of controls are necessary, as one set is required to control the freezing of the ice and another set to control the melting of the ice to cool the milk. As was previously explained, controls are one of the most troublesome parts of tanks and two sets potentially double the control problem.

Direct expansion tanks, because of their heavier construction and larger compressors, are usually slightly more expensive to purchase. But the compressors because they run about one-third as long, should have much greater life expectancy.

There is in certain areas interest in vacuum tanks, one reason being the belief that they will improve the flavor and odor of the milk.

Work done by Dr. J. T. Lazar, Jr. and W. R. Bellamy, at Clemson College, shows that "Equipment—is available that will remove nearly all of the off-flavors caused by feeds and weeds." However, "*each* of these machines utilize the principle of boiling off volatile components in milk with the use of Vacuum." If milk is to be boiled by using the available vacuum (15″), the milk must first be heated to 179°F. at 0″ of vacuum and then be subjected to vacuum to lower the boiling point. Milk never is heated to this temperature in a farm bulk cooling tank!

Another contended advantage is that, because of the greater stored vacuum, the milking operation is more uniform and satisfactory. This, too, is questionable and I am not convinced that the farm tank is the proper storage for milking machine vacuum. It is true that this method of milking eliminates the need for a milking machine releaser but, because it eliminates the releaser, it requires the purchase of a pump for the circulation cleaning of the milking machine lines. This pump could just as well be used for releasing milk from vacuum into an atmospheric tank, therefore no less equipment is necessary to be purchased and cleaned.

Many times the milking operation is adversely affected by leaking gaskets, rotary seals and other components that make it impossible to maintain uniform, adequate vacuum for proper milking.

The other advantage claimed is that the tank can be circulation cleaned, which is true, if the cleaning device is properly designed and constructed for the job. On the other hand, it has been proven that a low open top tank can many times be thoroughly hand cleaned and sanitized in about the same length of time that is required to prepare the circulation cleaning equipment to operate, so that no savings result. And, in addition, more water, both hot and cold, and more detergent is required for circulation cleaning. And, at least one more mechanical, potential trouble making piece of equipment is added to our system with but questionable advantages.

A vacuum tank, because of its necessary cylindrical shape, is most difficult to clean manually should a producer not elect to purchase circulation cleaning equipment or should his equipment break down.

California has had farm tanks for about 20 years and the Los Angeles area has had a number of vacuum farm tanks, but to day only one such tank is operating under vacuum, according to the information recently compiled.

We, the producer, processor, fieldman and manufacturer have gone a long way in ten years in the development of the farm tank and the necessary program to go with it. Continued cooperation of all parties concerned will finish the job.