A manufacturer of farm milk cooling tanks will devote more time to the development of the agitator than any other part of these units due to the problems involved; the drive unit used, design of the agitator, shape and depth of the tank, rate of introduction of milk into tank, composition of milk, rate of cooling, and amounts of milk in the tank.

Fortunately, the people involved in 3A work (International Association of Milk and Food Sanitarians, The United States Public Health Service and The Dairy Industry Committee) are aware of these problems and have been quite thorough in the preparation of this section of the 3A Standard for Farm Milk Cooling and/or Holding Tanks. These Standards require that the agitation be sufficient to provide homogeneity after not more than five minutes of agitation. Homogeneity in this case means not more than 0.2% fat variation in samples taken from various depths and distances from the agitator. A tank manufactured by any one of the 32 manufacturers authorized to apply the 3A symbol will have to conform to the above requirement.

Every manufacturer has, at one time or another, received a complaint from a dairy farmer indicating that his butterfat test is lower than anticipated since he installed his tank. The fact that these complaints originate all over the country in all kinds of herds, makes it difficult for the manufacturer to determine the exact cause without investigation. He must find out if the dairyman is correctly operating the tank, if the milk is being agitated properly, if the dairy farmer is comparing the fat tests with those he received when he shipped in cans, or is comparing them with his herd average.

Early in the farm tank program it became apparent that dairy farmers converting from cans to tank during the winter months frequently gain in butterfat test. This is especially true when the can is transported long distances and sufficient time elapses for the cream to freeze in the neck of the can. Too often the frozen cream is left in the can and not transferred to the receiving tank. As a result, the test taken from the receiving tank is frequently many points below the actual test.

Many complaints of butterfat shrinkage have been traced back to over enthusiastic tank sales personnel having promised the farmer an increase in butterfat tests that never materialized. All manufacturers guarantee only that a more representative sample may be taken from the tank.

A farmer operating under a production testing program should, of necessity, have a D.H.I.A. supervisor capable of conducting a test that should theoretically produce a set of figures for butterfat test and total production that equal or closely parallel the test and weight taken from the tank by the plant tester, providing they are comparing data taken from the identical supply of milk. However, there are isolated cases where milk weights vary thousands of pounds per month and butterfat tests differ as much as 0.7%. Usually these variations occur where the dairy farmer is not interested in economical production, but rather in establishing a record for his herd. Too often D.H.I.A. day is a "special day" for this type of dairy farmer. The start of milking may be delayed an hour or more. (A delay of one hour means a 1/24 possible increase in production.) Milkers are left on longer than usual. Scales of questionable accuracy may be used for weighing. Feeding may be increased so that the second milking is a special one aimed at increased production.

In any case, one must ask, "Is the herd average comparable to the tank pay-off?" Perhaps the milk sold or consumed on the farm is selected from the best cow, or dipped from the tank without proper agitation. Who can say that a cow will produce butterfat at a uniform daily rate or that the quantity will not vary from day to day? Surely care of samples after collection, in transit, in storage, plus sound testing procedures are necessary to secure accurate data.

Data received recently from one D. H. I. A. tester indicated that butterfat-shrinkage is greater in tanks where the tank truck arrives late in the afternoon. The same report indicated that the hauler ran the agitators from 32 seconds to a maximum of 2 minutes prior to sampling. No explanation for the improper timing was made, yet the data was forwarded to the...
tank manufacturer in the nature of a complaint of butterfat-shrinkage. Perhaps tanks were only partially filled and the hauler reduced the time accordingly. *Partially filled tanks may be more difficult to agitate than a full tank because of the shape of the tank and reduced effectiveness of the impeller.* The five minute period of agitation prior to sampling should not be reduced.

Manufacturers have increased agitator impellor area and velocity to a critical point where further increases may cause excessive churning. Here it seems important to remind everyone that butterfat is measured in percentage. To reduce 2000 lbs. of 4% milk to 3.9% milk requires the removal of 2 lbs. of butterfat. The appearance of minute particles of churned fat in a tank, though undesirable, will not materially change the butterfat test and may not necessarily indicate improper agitation.

If stratification coupled with insufficient time for agitation prior to sampling is one of the causes of butterfat-shrinkage, then possibly the answer lies in using an interval timer. Timers automatically operate the mechanism to propel the agitators three minutes out of every hour. Timers can be manually set to five minutes to eliminate guess work in the length of time the agitator operates prior to milk sampling.

In addition to providing homogeneity the agitator must move milk over the evaporation area with sufficient velocity to eliminate freezing and promote proper heat transfer. Therefore, agitation is a necessary adjunct to the refrigeration system.

As freezing and churning are hazards to proper sampling the proper operation of the agitator is imperative.

Precooling of the empty tank in hot weather is recommended by most manufacturers. The condensing unit of a direct expansion tank should not be allowed to run continuously until the agitator thoroughly stirs the milk, unless the rate of introduction of the succeeding increments of milk into the tank is sufficient to prevent the freezing of the first milk entering the tank.

On subsequent milkings both the agitator and the refrigeration system should be placed in operation when warm milk is introduced.

**Summary**

1. Manufacturers of farm milk cooling tanks design agitators that will create homogeneity after five minutes of agitation.
2. Butterfat-shrinkage in bulk milk handling can occur because samples of improperly mixed milk are collected and/or milk is excessively agitated.
3. After a representative sample is obtained, it must be cared for in transit and in storage, and must be properly tested and recorded.
4. Comparative fat test data can be valid when tests are run on the identical milk supply.
5. Proper operation of the tank controls is a must in bulk milk handling.