Unit IV – Topic I

Receiving, handling and testing of milk – storage

Introduction

The handling of milk inside the plant is the key element in maintaining its quality. On arrival of milk is graded for acceptance/ ejection, weighed, sampled for testing, cooled and stored under refrigeration until next unit operation for preliminary processing in the dairy plant.

Milk Reception

Milk may be delivered to the dairy plant in cans or tankers (road or rail). The milk received in these systems has to be sampled, graded, emptied, measured (weight or volume) and bulked to provide continuous supply of milk to the pasteurizer.

In the absence of mechanical aids, the cans are off-loaded manually to the tipping point, where the lids/covers are removed and the milk inspected. They are then tipped manually and both cans and lids pass on to a can-washer via a 'Drip saver' or 'Drain rack'. Where a higher throughput is required, the procedure is mechanized and the cans are unloaded directly from the truck onto the conveyor (power-driven or by gravity roller) and the tipping, sampling and weight recording may be completely automatic.

The milk is tipped into the weigh tank/pan. Such weigh tank is suspended from a weighing machine, the dial displaying the weight. Two weigh tanks may be used for quick reception. The discharge valve has a large diameter to permit rapid emptying. The milk is discharged into a 'Dump tank' placed immediately below the weigh pan. From here milk may be pumped continuously to a raw milk storage tank, normally situated at a height to enable gravity flow to the pasteurizing plant.

The reception of milk from large rail or road tankers is primarily a matter of providing a covered area under which emptying and subsequent cleaning can take place. The tanker outlet must be connected to sanitary piping. The milk may be removed by a milk pump, placed at a level lower than the tanker, or a compressed air line may be connected to the top of the tanker and the milk forced out by pneumatic pressure. Cleaning and sanitization of the tanker should follow immediately after emptying is complete. The measurement of milk delivered by tankers is carried out using a weigh bridge or flow-meter.

If milk is received from chilling centers, it has already been graded, weighed, sampled and cooled. It may be weighed and sampled again, or the center's report may be used. The latter procedure applies especially to tanker deliveries.

Milk reception should be done in a planned manner to avoid delay in processing. If the milk is received continuously during the scheduled period, operations in the plant will not be interrupted and employees in the various sections will be fully occupied. The aim should be to complete milk reception within 3-4 hours, especially in tropical countries. Delay in processing may lead to

deterioration of milk awaiting dumping, increase labor costs and may increase the operating cost of the can-washer.

Market milk requires milk of a prime quality (from the standpoint of aesthetic quality, health, flavor, sanitation, keeping quality). The quality of the incoming milk greatly influences the quality of the processed milks (or manufactured products).

It is well known that the sanitary quality of milk on the RMRD depends on its background on the farm, viz. healthy cows, clean milk production, clean utensils, prompt cooling and refrigerated transport. However, there is a need for systematic and thorough inspection of all milk supplies every day by conscientious and experienced milk graders.

When milk is received at the dairy plant, it should be at 5°C or below. The milk should be clean, sweet, possessing pleasant flavor, free from off-flavors and reasonably free from extraneous material viz., antibiotics, pesticides and other chemicals or metals. Abnormal milk should not be accepted. Acid development is objectionable even from standpoint of heat stability.

Milk Reception Operations

The operation of receiving milk may be subdivided into Unloading, Weighing, Sampling, Grading and Testing.

1 Unloading

The truck carrying the filled cans is brought alongside the unloading platform. The milk cans are then unloaded manually. The milk cans are then assembled for grading in a definite order, according to each supplier, viz. the contractor or patron. If a milk tanker is used, it is first properly positioned so that pipe fitting connections can be made conveniently in the Tanker bay.

2 Grading

It is well known that the quality of the finished product depends on that of the raw material used. This refers to the classification of milk on the basis of its quality, for price-fixation. The milk grader is the key man for the proper selection of milk. The principle of grading is based on organoleptic (sensory) tests such as those for appearance, smell (odor), and taste, acidity sediment etc. are included under platform tests.

Note - The term 'Platform Tests' includes all tests which are performed to check the quality of the incoming milk, to decide regarding its acceptance/rejection. They are performed on each can/tanker of milk with the objective of detecting milk of inferior or doubtful quality, preventing it from being mixed with high grade milk.

The technique of grading milk is as follows:

1 Milk tanker (road/rail)

The grading has already been done at the milk collection-cum¬-chilling centre. As milk is chilled (< 5°C), it is not possible to detect off-odors. The appearance is noted, as testing of raw milk is usually avoided. After thoroughly mixing it for 5-10 min, a sample is taken for laboratory testing.

2 Milk can

The main tests applied to each can of milk consist of appearance, smell and temperature (touch); other tests such as taste (seldom carried out with raw milk) and sediment might be used to substantiate the initial findings. Tests involving time, laboratory facilities and special techniques are done by the quality control technician, for which a sufficiently large sample is taken.

Platform tests

1 Appearance

Observing each can of milk for any floating extraneous matter, off color, or partially churned milk. The milk should be normal in color, free from churned fat globules and reasonably free from any floating extraneous material.

2 Smell (Odour)

This furnishes an excellent indication of the organoleptic quality of milk that can be ascertained quickly (in seconds). In making the test, the cover of each can is removed, inverted and raised to the nose. The headspace in milk can is smelled. By replacing the lid and shaking the can vigorously, the test may be repeated. An experienced milk grader with a 'trained nose' decides the acceptance/rejection of the milk. The milk should be free from any off flavors.

3 Temperature

The temperature at which milk is delivered is often an indication of its quality. A daily check on the temperature of milk is helpful in keeping check on the quality of milk. With practice, the grader can tell with a high degree of accuracy whether the milk is sufficiently cold by touching the side of the can. A temperature of 5°C or below is satisfactory.

4 Sediment

The sediment test shows the visible foreign matter contained in the milk. It need not be made daily, but should be carried out often. For this purpose a reliable sediment tester (such as an off-the-bottom sediment tester) is used. Any method by which maximum sediment is obtained should be considered satisfactory. A low sediment is desirable. Sediment test is performed to judge the cleanliness of milk. There is no correlation between the amount of sediment and the bacteriological quality of milk. Measured quantity of milk is filtered or centrifuged and checked for sediment. A good quality milk gives no visible dirt whereas poor quality milk shows dark or blackish deposits on the filter pad. The milk is graded for its quality on the basis of BIS standards.

5 Acidity

'Natural' or 'apparent' acidity of milk is desirable which does not adversely affects its heat stability. However, 'developed acidity' (Natural + Developed = Titratable acidity) adversely affects the quality of milk which cannot be processed in pasteurizer.

6 Lactometer reading

The addition of water to milk results in lowering its density. Hence, this test is applied for detection of adulteration of milk with water. The reading for cow and buffalo milk should be about 28 to 30 and 30 to 32 respectively, when measured at 15.5°C.

Sampling

The importance of securing an accurate and representative sample of milk for chemical and bacteriological analysis cannot be over-emphasized. While strict precautions regarding sterility of the stirrer, sampler, container etc. are required for obtaining a bacteriological sample, dryness and cleanliness of the above equipment should be sufficient for a chemical sample. The first pre-requisite of sampling is thorough mixing of milk. This can be done with a plunger or stirrer (agitator), operated manually or mechanically for milk contained in cans or tankers, as the case maybe. With the former, a representative sample may be taken after dumping the milk in the weigh tank, whereby it gets mixed in so thoroughly that a representative sample may be taken without further mixing.

Samples may be: individual, composite (mixture of two or more individual lots of milk), drip (representing the entire day's supply), etc. Samplers may be dipper-tube or proportionate (also known as milk thief), automatic vacuum, drip etc.

The composite milk sample must not spoil by the time it is analyzed. This is accomplished by use of a preservative. It is wise to place the preservative in an empty bottle before milk is added. A wide mouthed glass bottle with a rubber stopper is suitable for keeping composite samples of milk or cream. The common preservatives used are as follows:

1 Mercuric chloride or corrosive sublimate

This is very poisonous. It may be added in the form of tablets, which are colored (usually bright red) to avoid the milk to be mistaken for food for consumption.

2 Formalin

This is a 40% solution of formaldehyde. Being liquid it is very convenient to handle. However, it interferes with the fat test.

3 Potassium dichromate

This is not as effective as the above two, but is easy to handle in dairy plants because it is available in tablet form.

Note - The composite samples should be stored in a cool place away from direct sunlight. Each bottle should be properly labeled.

5 Weighing

This is an essential step in accounting for milk receipts, disposal and making payments for milk. The milk from cans is dumped into the weigh tank, either manually or mechanically. The tank is mounted on scales and the scale dial set at zero when the tank is empty. Automatic printing of the weight is now becoming a practice.

The milk in tankers (road or rail) may be measured by volume by passing it through a flow meter, and its measurement converted into weight by multiplying volume with density (m = d x v). In case of road milk tankers weigh¬bridge can be used to determine its weight (weight of tanker when full – weight when empty). The characteristics of measuring by weight and by volume have been shown in table below:

Testing

Further testing is needed in case of 'doubtful quality' prior to its acceptance for processing. The Quality control laboratory of the dairy plant performs the requisite analyses. A record of the chemical and bacteriological quality of all accepted milk has to be maintained for making payments and for ISO records.

STORAGE OF MILK

Introduction

The first operation in a dairy plant is reception, chilling and storage of milk. Raw milk is pumped from the dump tank to the storage tank through a filter and chiller. The purpose of storage tank is to hold milk at low temperature so as to maintain continuity in milk processing operations and prevent any deterioration in quality during holding and processing period.

The milk may arrive at a chilling center or dairy plant in cans. After unloading the cans, milk is chilled and stored in storage tanks. Storage tanks are used to store raw or even pasteurized milk. Milk may be held in chilled condition (< 5°C) in the tank for up to 72 hours between reception and processing. Normally the milk storage capacity should be equivalent to one day's intake.

17.2 Objectives of Storage Tanks

- To maintain milk at a low temperature so as to prevent any deterioration in quality prior to processing/product manufacture.
- To facilitate bulking of raw milk supply, which will ensure uniform composition
- To allow for uninterrupted operation during processing and packaging
- To facilitate standardization of the milk

17.3 Storage Tank

Storage tanks enable milk to be stored for longer period of holding. They must be designed for easy cleaning and sanitization, preferably through CIP process. Storage tanks consist of a stainless steel inner shell, a layer of insulation, an outer jacket and necessary fittings for inspection control and cleaning. The tanks should be insulated or refrigerated so that they can maintain the required temperature throughout the holding period. Glass wool, Thermocol, Corkboard, Foam glass or Styrofoam can be used for insulation. Corkboard or foam glass is used in the lower portions of the tank where the insulations may carry a part of the load. Agitation must be adequate for homogeneous mixing, but gentle enough to prevent churning and incorporation of air. In many storage tanks, chilled water circulation system is provided to maintain the temperature of milk. All closed type of tanks must be equipped with a manhole round (diameter ~ 450 mm) or oval shaped to permit access to the interior for cleaning and inspection.

For foam-free entry of milk, a curved filling pipe, which guides the milk towards the wall is used. It is better to fill the tank from below, i.e., by the lowest outlet pipe. The storage tanks containing raw chilled milk or standardized pasteurized milk are usually located on the first floor. This allows feeding to the milk pasteurizers or even gravity filling of milk. Now-a-days, big sized silos, usually of > 1.0 lakh litres capacity are installed in the dairies on the ground floor only. They are very useful in storing skim milk for feeding to the powder plants. In the dairy industry, rectangular tanks are less preferred as compared to cylindrical tanks, because cleaning of sharp corners (in rectangular ones) is difficult. Secondly, the agitation effect does not reach the extreme corners of rectangular tanks.

17.4 Types of Storage Tank

Storage tanks can be classified on the basis of their shape and other features.

17.4.1 Insulated storage tanks

These tanks merely stores the milk at a temperature at which it is filled. In most cases, depending upon the quality of insulating material, there is tendency of rise in the temperature of milk with long storage. These tanks are made up of a stainless steel inner shell, a layer of insulation (thermocol and glass wool) and an outer jacket of stainless steel

or mild steel (Fig.17.1, 17.2)

17.4.2 Refrigerated tanks

It has built-in refrigerating facilities so that stored milk is chilled as and when required. This additional feature of maintaining the desired temperature is an added advantage in these tanks. In refrigerated tanks, the hollow space between the inner and outer shells is used for circulating the cooling medium (chilled water or brine solution).

17.4.3 Horizontal or vertical tanks

Horizontal tanks require more floor space than vertical ones, but need less headspace. For handling small volumes, horizontal tanks (5,000 to 15,000 litre capacity) may be used. Now-a-days, milk is stored in vertical storage tanks of one lakh litre capacity or more, commonly known as silos. These are vertical cylindrical tanks, installed outside the building. In these silos, milk feeding is from same discharge valve installed near the bottom