SNS COLLEGE OF TECHNOLOGY
(An Autonomous Institution)
Coimbatore.

Unit I – Topic 5

Standardization-cleaning and transport and storage tanks

STANDARDIZATION OF MILK

Introduction

Many dairy processes require standardization of the chemical composition of milk meant for market purpose or milk products manufacture. Standardizing milk might require control of only one component (usually fat) while allowing the others to vary or control two or more components simultaneously.

Standardization

It may be defined as the adjustment of one or more of the milk constituents to a nominated level. In market milk industry, this normally involves reducing the butterfat content by addition of skim milk or through the removal of cream.

Objectives

- To comply with the legal requirements for particular milk/dairy products.
- To provide the consumer with a uniform product.
- To ensure economics in production.

Addition of skim milk increases the volume of milk available for sale and removal of cream allows the production of other value added dairy products such as table cream, butter or other high fat products.

Methods of Standardization

There are three methods for standardization. These are batch, continuous and automatic standardization. They all involve the separation of whole milk into skim milk and cream and then proceeding for blending the required quantities only.

Batch standardization

It is a process most commonly used in the dairies. Raw milk is held in a silo and its fat content is evaluated. Some quantity of milk is removed and separated into skim milk and cream. The amount of skim milk or cream required is determined by the calculation (or from charts) and then added to the bulk milk under continuous agitation. The bulk milk is retested to check whether the fat content is as per the desired figure or not. If it is not, further adjustments are made until the batch is standardized correctly. The demerits of batch standardization are the time taken for agitation, testing and final mixing.

Continuous standardization

Continuous standardization employs an inline sampler in association with a testing device, which samples, measures and displays the fat content every 20 seconds. The operator observes the fat content displayed and adjusts the values to blend skim milk or cream into the milk line, before the sampling point, to alter the fat content to the required level.

Automatic standardization

It is an extension of the continuous process. The separator is replaced by a microprocessor/controller unit linked to the sampler/tester system. The microprocessor / controller unit has information about the desired fat content and flow rates of the whole and skim milk. It receives signals from the sampler/tester system and responds by opening or closing a valve, which regulates the amount of skim milk added to the whole milk. The merits of this automatic process are time and labour savings and ensure more accurate standardization than other methods. Standardization depends on correct sampling, accurate testing of fat content, efficient separation and the correct amount of skim milk or cream needed.

CLEANING OF MILK TANKS

ASPECTS OF CLEANING

The arrangements for cleaning equipment that comes in contact with products are an essential part of a food processing plant. It must be kept in mind that food manufacturers are always obliged to maintain high hygienic standards; this applies both to the equipment and, naturally, to the staff involved in production. This obligation can be considered under three headings:

1. Trade obligation
2. Moral obligation
3. Legal obligation

TRADE OBLIGATIONS

Good, wholesome, clean products that keep well and are free from health hazards are obviously good for trade; customers will buy the same product again. However, if a product is contaminated, does not keep well or is the subject of complaints to the authorities, the reverse is true, and the resulting publicity is very damaging.
The potential effects of poor cleaning, poor standards and poor quality must be kept in mind at all times.

MORAL OBLIGATION

Most of the customers who consume the products never see the factory or how the products are handled. They trust the company, rely on its reputation, and take it for granted that operations are carried out under the cleanest of conditions by well-trained staff who are continually aware and conscious of these factors

LEGAL OBLIGATION

The law attempts to protect the customer and purchaser in respect of health and quality. Failure to meet legal obligations, national or local, can result in very severe action, and prosecution proceedings can be very costly.

Prevention is better than cure, and companies are obliged to meet legal requirements and maintain high standards. Milk and milk products by their nature are ideal media for the growth of microorganisms, including many pathogens. As a result of this, there is more legislation concerning milk – its production, handling, processing, packaging, storage and distribution – than any other food product. Each country has its own national and perhaps local legislation standards.

CLEANING OBJECTIVES

Talking about cleaning results, the following terms are used to define the degree of cleanliness:

- Physical cleanliness – removal of all visible dirt from the surface
- Chemical cleanliness – removal not only of all visible dirt but also of microscopic residues that can be detected by taste or smell but are not visible to the naked eye
- Bacteriological cleanliness – attained by disinfection
- Sterile cleanliness – destruction of all microorganisms

It is important to note that equipment can be bacteriologically clean without necessarily being physically or chemically clean. However, it is easier to achieve bacteriological cleanliness as a matter of routine if the surfaces in question are first rendered at least physically clean.
In dairy cleaning operations, the objective is nearly always to achieve both chemical and bacteriological cleanliness. The equipment surfaces are therefore first thoroughly cleaned with chemical detergents and then disinfected.

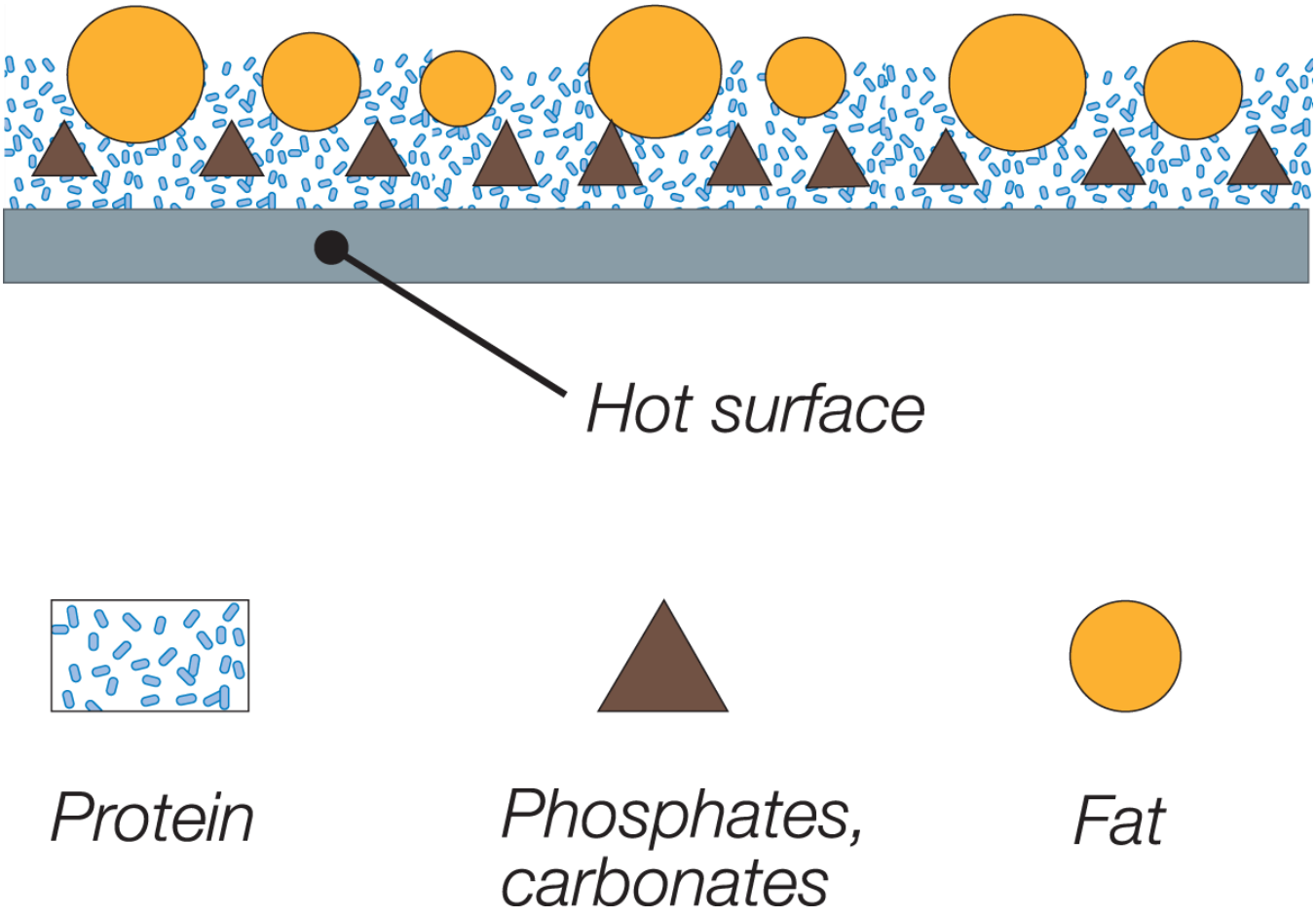
DIRT

It consists of deposits stuck to a surface and its composition, in this particular case, is

based on milk components that are utilized by bacteria 'hidden' in the dirt.

HEATED SURFACES

When milk is heated above 60 °C, *milk fouling* starts to form. This is a deposit of calcium (and magnesium) phosphates, proteins, fat, etc. You can easily see the result on heat exchanger plates after a long production run, in the heating section and the first part of the regenerative section to follow. The deposits stick tight to the surfaces, and after runs of more than eight hours, a change of colour from whitish to brownish can also be observed. Figure 21.1 shows an attempt to visualise the dirt on a heated surface.



COLD SURFACES

A film of milk adheres to the walls of pipelines, pumps, tanks, etc. ('cold' surfaces). When a system is emptied, cleaning should start as soon as possible, or otherwise this film will dry out and be harder to remove

CLEANING PROCEDURES

Cleaning of dairy equipment was formerly done (and still is in some places) by people armed with brushes and detergent solutions, who had to dismantle equipment and enter tanks to get to the surfaces. This was not only laborious but also ineffective; products

were often reinfected from imperfectly cleaned equipment.
Circulatory cleaning-in-place (CIP) systems adapted to the various parts of a processing plant have been developed to achieve good cleaning and sanitation results.
Cleaning operations must be performed strictly according to a carefully worked out procedure in order to attain the required degree of cleanliness. This means that the sequence must be exactly the same every time.

The cleaning cycle in a dairy comprises the following stages:

- Recovery of product residues by scraping, drainage and expulsion with water or compressed air
- Pre-rinsing with water to remove loose dirt
- Cleaning with detergent
- Rinsing with clean water
- Disinfection by heating or with chemical agents (optional); if this step is included, the cycle ends with a final rinse, if the water quality is good.

TRANSPORTATION OF MILK

Introduction

In rural India milk production is largely a subsidiary activity to agriculture in contrast to organized dairying in western countries. Small farmers and landless labourers usually maintain one to three milch animals. As a result, small quantities of milk are produced by each of the dairy farmers who are widely spread all over the country. This situation makes the task of milk collection and transportation complex. For efficient transportation, planning of routes by means of extensive survey is most important. In this connection, one must consider the availability of milk, road access to the milk collection points and their distance from the site of the dairy plant. The collected milk is generally filled in cans for transportation to the chilling center or directly to the milk plant. Milk must be brought to the chilling or dairy plant within three hours of milking.

Transportation of Milk

The milk should be transported to the dairies under chilled conditions (< 4°C) to prevent bacterial growth. In India, raw milk collected at various collection centers in the rural areas is dispatched to the dairy plant in two ways:

Transporting milk through cans

Suitable when milk volume handled is low.

Transporting milk through tankers (2000 to 10,000 liters of chilled milk)

This method is useful especially for transporting chilled milk from bulk milk coolers or chilling centers. Refrigerated/insulated tanker (Fig. 9.1) is important for transporting market milk, butter milk and other perishable dairy products.

Advantages of Tanker Over Cans

- quick mode of transportation
- low transport cost per liter
- better temperature control
- less risk of contamination
- time and labors savings
- overall savings in detergents

MILK STORAGE TANKS, SILOS, ROADS AND RAIL TANKERS

Introduction

Milk is stored in a great variety of storage tanks, first near to villages as Bulk milk cooling units, then transported by Road Tankers and then to Raw Milk Storage tanks in dairy plants. Further, it may be transported in Rail Tankers to long distances after processing, to large urban centers. Further, there may be requirement for processing operations like mixing, ripening, culturing, aging etc, which require further special features in storage tanks.

The requirement of modern quality standards, eliminate the use of open vessels. Further, the storage tanks are now made only of Stainless Steel, instead of Aluminum or other similar metals.

Milk Storage Tanks

They are usually cylindrical and mostly insulated. They may be horizontal or vertical types, depending on availability of flour space. For extremely large quantity of storage, Vertical Silo tanks are provided outside the Processing section, to avoid tall buildings to accommodate them.

Horizontal storage tanks / silos

The inner shell of storage tank is of Stainless Steel, and covered with suitable insulation, and then an outer shell, which may be Stainless Steel or Mild steel. Outer shell of mild

steel is used to reduce cost. The outer mild steel shell will be painted to prevent corrosion, which may be of two coats of antirust and two coats of enamel paint of suitable color , especially cream yellow.

The inner shell of storage tank should be smooth in surface finish, and should not have any sharp corners, to aid in proper cleaning. The edges must have a knuckle radius of at least 25 mm. Any welds present should be properly ground, so as to have smooth finish.

The shell will have drain from lowest point, preferably from the center of the bottom. If this is not possible, the bottom of the vessel should be sloped towards the outlet valve side of the bottom to ensure complete drainage. The slope is at least 1:12.5 towards the outlet.

The shell will have other openings like for Agitator, non-foaming type milk inlet, inlet for cleaning solutions through a spray device, air outlet etc. It will also have fittings for sight glass and light glass, for inspection of inside level measurement, to ensure proper cleaning etc. The glass has to be of non splinter type. The opposite end of sight glass will have the level marked by food grade paint, or buffing of the surface to indicate level markings and values marked adjacent to it. The tank is fabricated usually 15% over capacity than the nominal capacity of the tank. The technology of using load cells for remote sensing of measurement of level is also being introduced in most of the modern dairies, linked to automated operation. Inner shell will also be supported by four legs, through load distributer MS angles, to avoid change of shape or damage to inner shell. The load distributors also will have a lifting eye at top to lift the entire storage tank with cranes. The thickness of shell depends on the size of the tank, to withstand the weight. Usually it is 2 to 3 mm thick for horizontal tanks, and 4 to 5 mm for silos. The ends of tanks are usually dish shaped to give strength and it also gives a greater knuckle radius at the joint of dish end.

Insulation is using thermocol or PUF for lower temperatures. For higher temperature, glass wool or mineral wool is preferred. The thickness should be such that, the increase in temperature of fluid when filled should not rise more than 2 °C in 18 hours, under a test condition of 35 °C temperature difference between inside and outside. Average thickness of thermocol insulation provided is between 5 to 10 cm. There should be no hollow space in between the two sheets of SS and MS. In some of the designs however, this gap is provided with a breathing outlet at the bottom, so that the gap does not build up pressure when hot cleaning solutions are used.

The legs may be four or six in number, with adjustable ball feet. Threads of the ball feet are not exposed.

The milk inlet should be non foaming type at the top, with bent tube projecting towards inner wall. For Silos the inlet is also at the bottom, with a non-return valve. The milk outlet will be at the bottom, with a flange type valve fitting, usually with a two way valve. It is usually of 51 mm or 63.5 mm, to allow rapid unloading.

To keep the milk properly mixed, and avoid cream separation an agitator at slow speed is operated, which may be either horizontal, vertical, and in some cases, inclined too. Most commonly, the agitator is vertical, with one or two sets of blades, and is supported at the bottom by bush, so that there is no lateral oscillation. The agitators are connected to motor through reduction gear mechanism, which has oil as the lubricant. It has to be perfectly sealed to prevent oil leaking along with the agitator into the tank.

Tanks are also provided with other essential fittings like manhole, sampling cock, thermo-well, ladder in front to watch through sight glass, CIP pipe line connection with adequate support on top. The manhole is of swing-back type, which is oval in shape and can swing both horizontally and vertically, so that it can be positioned in place from

inside. There is a tightening arrangement to prevent leakage from manhole door, once the milk is filled. The sampling cock is positioned at a level such that sampling can be done even up to 5% of the capacity of the tank. It has spring loaded push type of lever, or a screw type of opening. Provision is also made of a Thermo-well, in which the sensing element of temperature indicator can be placed. It is an inclined SS tube, with lower end sealed, and positioned inclined to the inner shell, welded in that position. It is filled with oil or ceramic powder to have a better contact between the sensing element and the wall of thermo-well.

The air vent to the tank is provided to avoid build up of pressure during loading, and development of vacuum during unloading. It is provided with vermin proof cover to prevent dust and insects entering into the tank.

Vertical storage tanks / silos

The vertical storage tanks are mainly used, when the floor space is less, and the roof of processing hall is sufficiently high. Some of the high viscous products like cream or ghee are also preferably stored in this type of storage tanks.

Due to its shape, the manhole is at the top, and a ladder is provided for reaching on to the top. The top is also conical to prevent any accumulation of water or dust. The sight and light glass are also provided at the top. Due to its height, the agitator has to be long, and provided with more than two sets of blades for agitation. An internal ladder is provided to climb down for manual cleaning. Other fixtures like CIP cleaning attachment or spray ball, thermo well, sampling cock, lifting lugs or eye at the top, are provided as in horizontal storage tank. Both the inlet and outlet will be at the side at the bottom level of the tank. The slope is 1:10 towards the outlet so that there is free and complete drainage of liquid. The inner wall may be of Stainless steel sheet of 3mm thickness while outside can be 2 mm. Some of the floors have greater thickness of 5 mm. The tank is supported by four legs with SS ball feet and provision for height adjustment. Silos are vertical storage tanks of large capacity, usually more than 30,000 to even upto 1 lakh liters. The agitation is by compressed air in such case The compressed air is passed into it through a filter and a control valve. A pressure gauge is also provided to know the air pressure. The inlet and outlet are fitted to be operated from inside of the processing hall itself, through an opening called alcove. Inlet valve is provided with non-return valve. An overflow line extending to inside of the processing hall is also provided to know if the tank is full.

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