1. How milk collected from villages and received at chilling centers?

The society is formed at village level where the farmers can give the milk to the society. The milk is collected twice a day (morning and evening) from the farmers. The quantity of milk collected from the farmers is measured. A sample of milk is taken out for testing the quality of milk for its fat and solids- not – fat (SNF) content. The payment is made to the farmer based on the fat and SNF content of the milk that he/she has given to the society. Milk is collected from the societies and transported to the chilling center for chilling of milk.Generally farmers are paid once in 10 or 15 days for the milk that is given to the society during that period. The milk from societies will be transported to chilling centers and from there to the milk processing centers for further processing. The processing unit in the district (called milk union) will make payment to the society for the whole quantity received from the society. The society in turn makes payment to the individual farmers.

2. What are the platform tests conducted while receiving raw milk at the dairies?

The two main platform tests those are conducted at the platform of milk reception are organoleptic tests and chemical tests to check preservatives and additives. The organoleptic tests include checking the milk for presence of any visible extraneous materials present, smell and taste. The doubtful milk is then tested for heat stability test i.e., Clot-On-Boiling test, test for preservatives that could have been added such as sodium bicarbonate, hydrogen peroxide, etc. the milk is also tested for any additives such as sugar, starch, urea etc which increased the total solids in milk. The addition of preservatives and additives are not permitted to add in the milk.

3. What is pasteurization? Write different methods of pasteurization processes with temperature-time combinations

Pasteurization of milk is the process of heating every particle of milk to 71° C for 16 seconds or 63° C for 30 minutes in approves equipments so that the milk is made safe for consumption by eliminating the pathogenic bacteria. The milk is chilled immediately to 5° C after proper heat treatment. There are two methods of pasteurizations of milk. They are:

- 1. Batch type pasteurizer which is also called as Low Temperature Long Time (LTLT) pasteurization wherein the milk is heat treated to 63° C for 30 minutes and then immediately chilled to 5° C
- 2. Continuous type pasteurization which is also called as High Temperature Short Time (HTST) pasteurization wherein the milk is heated to 71° C for 16 seconds and then immediately chilled to 5° C

4. Explain in detail how milk is pasteurized in batch type pasteurizer

As the name indicates, in batch type pasteurization, the milk is heated or cooled in batches. The milk is taken in double jacketed vat and the milk is heated to $63 - 65^{\circ}$ C by circulating hot water in the jacket, and held at that temperature for 30 minutes. After holding to the desired time, the tap water is circulated in the gap between to jackets of the vat. Then chilled water at less than5°C is circulated to bring down the temperature of milk to 5°C. In some vats the heating and cooling of milk is done by using PHEs which is more efficient and energy efficient than circulating method. Care should be taken to avoid contamination of heat treated milk by raw water or any other source of contamination after pasteurization.

5. What is the basis for fixing temperature-time combination for pasteurization?

Pasteurization is a process of heating every particle of milk to a specific temperature for a specific period and immediately chilling to less than 5^{0} C so as to make the milk safe for consumption. The primary purpose of pasteurization is to kill all the microorganisms capable of causing diseases (pathogenic bacteria). The *mycobacterium tuberculosis* is taken as indicator pathogenic bacteria for checking the efficiency of the pasteurization since it is the most resistant pathogen that is likely to present in the raw milk. The time- temperature combination for pasteurization of milk is fixed on the destruction of *Mycobacterium tuberculosis* and *Coxillaburnetii*. These pathogenic bacteria are destroyed at temperature-combination of 60° C for 15 min or 70° C for 12 to 13 seconds. To make the destruction of these pathogens, the pasteurization temperatures and time of holding are fixed at slightly higher than the destruction temperature-time combination.

6. What is cream separation? What are the conditions to be considered for separating milk?

The separation of fat portion in the form of cream from the raw milk is called cream separation. In mechanical cream separator the lighter portion of milk fat (in the form of cream) is separated from heavier part of milk (called skim milk) by application of centrifugal force. The conditions for separating the cream from raw milk are:

The temperature of milk should be between 35 to 40° C

The flow of milk into the bowl should be uniform

The flow should be smooth and there should not be any vibration operation.

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The cream separator should be switched on atleast 4 to 5 minutes beforefeeding the milk into the bowl to attain the maximum

speed of bowlrotation

7. What is homogenization? What is the objective of homogenization?

Homogenization is the process of breaking up of the fat globules present in milk. The diameter of the fat globules in milk varies between 2 and 20 microns. These fat globules have the tendency of rising to the top of milk because of its lower density than skim milk. If the size of the fat globules is reducing to less than 2 microns, they lose the tendency to rise to the surface of milk. Hence by homogenization, the fat portion of milk is uniformly distributed in the milk. Therefore the flavour of milk can be improves. The milk also looks thicker. The milk fat easily digestible since the fat globule membrane is ruptured during homogenization and exposing the free fat to digestive enzymes.

8. Why milk is to be chilled to less than 5° C immediately it is received?

Milk is nutritious medium for all the living organisms including microbes. It contains all the nutrients such as fat, proteins, lactose and minerals dispersed in water. The conditions such as near neutral i.e. 6.6 to 6.8, presence of nutrients and ambient temperature makes the milk most suitable conditions for the microbes grow very luxuriantly. Due to its shortest generation time the microbes multiple very fast by consuming the lactose (carbohydrate of milk) and releases lactic acid into milk which makes the milk sour and unsuitable for heat treatment. By chilling the milk to less than 5^oC, the bacterial activity is reduced drastically and hence the quality of milk is retained at its original level for longer period.

9. Explain the working of a plate heat exchanger

Plate heat exchanger is an compact set of rectangular plates which are held tightly with suitable gaskets in between the plates. The plate heat exchangers are designed such that the milk or any less viscous fluid passes between the alternate plates. The heating or cooling medium flows in other alternate plates in opposite direction, so that heat exchange takes place the product and the heating/cooling medium. By the product comes out of the last plate it is heated /cooled to the temperature near to the heating/cooling medium. The main advantages of PHEs are: high energy efficient, occupies less space, compact and simple, easily cleanable by cleaning-in-place system, capacity can be increased by addition of plates, and hygiene and sanitary method of processing. The plates are corrugated to increase the surface area for heat exchanger and provide turbulent flow of the milk. The turbulent motion of milk helps in bringing every particle of milk to the surface so that they are instantly heated or chilled.

10. How the efficiency of pasteurization is checked?

To check the efficiency of desired heat treatment given to milk, the presence of enzyme alkaline phosphatase is tested. This enzyme gets inactivated at the temperature just above the pasteurization temperature. Hence, if the phosphatase test answers positive, it indicates that the milk has not attained the temperature required for destruction of this enzyme which in turn indicates the incomplete destruction of the pathogen and inefficient pasteurization. After pasteurization milk should be immediately chilled to less than 5° C.