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# UNIT 13 METHODS OF CLEANING & SANITIZATION

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## 13.0 OBJECTIVES

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After reading this unit we should be able to:

- <sup>2/21</sup> define clean surface, cleaning schedule and steps involved in it
- <sup>2/21</sup> enumerate methods of cleaning
- <sup>2/21</sup> indicate sanitization methods
- <sup>2/21</sup> assess the effectiveness of cleaning and sanitization by different methods.

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## 13.1 INTRODUCTION

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The equipment and containers are desired to be physically clean, dry, smooth surface and free from dirt and unsafe bacterial load to prevent occurrence of any sort of food and health hazard in milk and its products during handling and processing. Execution of cleaning and sanitization by using improper methods, material and frequency may result hazardous because of the presence of residual foreign matter, chemicals/ detergents, oil/grease and excessive microbial load in food. The particularity of selection of methods and chemicals depends upon the various considerations like effectiveness, cost, safety in handling, cleaning time, compactness, provision for dismantling and shape/size of equipment/container.

As a standard preparatory step, each and every equipments and container to be used in processing and handling operations need cleaning and sanitization before hand. This is also customary to follow the cleaning & sanitizing after flushing of emptied container/completed process. This reduces cleaning efforts as residues get loosened quickly.

**Food hygiene and safety** defined, as “all measures necessary to ensure the safety, soundness and wholesomeness of food at all stages from beginning to its final consumption.”

Safe Food may be defines as “a product, which is free of microbial, chemical or physical hazards”

Above definitions inter-relate food hygiene and safety aspects. The food safety is the legal, moral and economic responsibility of manufacturer. It gives a good business

by creating reliability and faith in the market. Effective cleaning and sanitization reduce the chances of physical, chemical and microbiological contamination and as such considered to be very essential preliminary process in the dairy plant.

**Check Your Progress 1**

1. Cleaning and sanitization are very basic requirements of dairy plant. Explain.

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## 13.2 CLEANING AND SANITIZATION

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**Definition:** Cleaning is the process in which unwanted matters including food poisoning and spoilage microorganisms are removed to prevent contamination of products. Sanitization reduces the microbial load of cleaned surface to a level, which is considered to be safe for handling and processing of dairy and food products. Cleaning without sanitization is meaningless. Both terms are complementary and supplementary to each other.

**Unwanted matter or soil:** It consists mainly of milk or milk products residues which may be some what altered by processing or by interaction with water, cleaning materials, dust and dirt.

**Milk stone:** It is the deposition of milk solids, water hardness compounds and washing solutions on the surface due to heating. It normally consists of precipitated, coagulated and heat dried milk proteins and insoluble calcium salts from water and detergent solutions.

### **i. Clean Surface**

Cleaning should result in a clean surface, which may be characterized by:

- <sup>2/21</sup> free from visible film or soil,
- <sup>2/21</sup> non-emittance of any objectionable odour,
- <sup>2/21</sup> non-greasy or rough feeling,
- <sup>2/21</sup> non-discolouration of a new white facial tissue wiped several times over the surface,
- <sup>2/21</sup> not showing any signs of excessive water break while water is draining it, and
- <sup>2/21</sup> not contaminating food products in contact with it.

### **ii. Cleaning Schedule**

For effective hygiene program, there should be properly planned cleaning schedule, which should include:

- <sup>2/21</sup> cleaning procedures that have been designed to meet the particular needs of the process and product concerned;
- <sup>2/21</sup> cleaning and disinfection of the equipment/tool used for cleaning;
- <sup>2/21</sup> allocate responsibility to a person(s) for cleaning tasks;
- <sup>2/21</sup> detail necessary safety precautions for the use of detergent and disinfectants; and
- <sup>2/21</sup> provision for adequate supervision by management to ensure compliance to procedures.

### iii. Standards and Steps

There are two standards of cleanliness used in the dairy industry:

- <sup>2/21</sup> **Visual cleanliness:** This refers to removal of gross debris (dirt, grime and surface residues) from a surface. Detergents and water are used for the cleaning.
- <sup>2/21</sup> **Microbial cleanliness:** This relates to microscopic cleaning to achieve a low bacterial count i.e. reduce bacteria to a safe level. Chemical sanitizers and/or very hot water/steam is used for this purpose.

There are basically four procedural steps in cleaning and sanitization:

- <sup>2/21</sup> Removal of gross debris by brushing, vacuuming, scraping of deposits or other methods whatever necessary, followed by the application of water.
- <sup>2/21</sup> The temperature of water used will depend upon the type of soil to be removed and surface to be cleaned.
- <sup>2/21</sup> Application of detergent solution to loose the soil and bacterial film and hold them there in solution or suspension.
- <sup>2/21</sup> Rinsing with water to remove loosened soil and residues of detergent.
- <sup>2/21</sup> Disinfection of the surface.

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## 13.3 CLEANING METHODS AND CONSIDERATIONS

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### i. Methods

The following methods may be employed for cleaning of dairy equipment and containers:

**Manual Cleaning:** It is the removal of soil by scrubbing manually with detergent solution followed by water rinsing.

**In-place cleaning:** In-place cleaning is most popularly known as C.I.P.( Cleaning-in-place).It is the cleaning of equipment including that of pipe lines, with water and detergent solution without dismantling. A minimum fluid velocity of 1.5 meter per second with turbulent flow is required for effective cleaning of pipelines. Wherever possible, parts of equipments which can't be satisfactorily cleaned by this method should be identified and should be dismantled and cleaned manually to prevent the possible build up of contaminants.

**Low pressure high volume spray:** In this method of cleaning, water and/or detergent solution is applied in large volume at pressures up to approximately 6.8 bar or Kg/sq.cm. (100 psi).

**High pressure low volume spray:** It is the application of water and/or detergent solution in low volume at high pressure, i.e. up to 68 bar or Kg/sq.cm (1,000 psi).

**Foam cleaning:** Detergent solution in the form of foam is applied and remained in contact for 15-20 minutes over the surface and then it is rinsed off with a water spray.

**Washing machines:** There are containers like milk cans, crates and bottles etc., which are commonly used, in the dairy industry. The large in number and smaller in sizes make manual cleaning of these items quite expensive, labour oriented, tiresome and involving huge manpower. These containers could be easily and effectively cleaned by special designed washing machines. The machine performs cleaning procedures as above with the addition of disinfection by hot water rinse at the completion of the cleaning cycle.

In dairy plants following type of washing machines are used:  
a) can washer, b) bottle washer, and c) crate washer

In all type of washing machines, the cleaning method incorporates rinsing, application of detergent, washing and rinsing with water followed by sterilization with steam/hot water or chemical sanitizers. The solutions are applied by soaking or jet arrangements.

**ii. Considerations for effective cleaning and sanitization**

Milk handling and processing equipments are normally fabricated from highly corrosion resistant materials like stainless steel to provide very good hygienic conditions. Cleaning and sanitization process, by the use of proper system, chemicals and cleaning parameters, should support this feature. In this context, some of the aspects are discussed below:

- a) Soap or detergent solutions of effective concentration remove soilings like grease and dirt due to their good wetting and penetrating capabilities and hold them in suspension. Thorough washing with a water rinse is followed by complete drying.
- b) Neutral or general purpose detergents of pH between 7 to 9 are useful for light to moderate heavy foaming type cleanings. These detergents foam well in water and are safe to use on most surfaces.
- c) Removal of tightly deposited milk solids/milk stone, atmospheric stains, oils/grease and other light discoloration is carried out with alkaline detergent solutions without using much manual scrubbing. Strong alkaline solutions may be useful in cleaning of heavy greased surfaces. Weak alkaline cleaning agents can be used on most surfaces, however care should be taken to ensure they do not damage the surface.
- d) Removal of water scale and milk stone is usually done by acid type detergent solutions, having pH less than 7. Acid detergents are used specially for the removal of mineral scale from metal surfaces of dishwashers and hot water runs.
- e) Abrasive cleaning processes use grains/granules, available in the form of a paste, cream or powder, to remove soiling from the hard surfaces. However, use of ordinary steel wool or brushes should be avoided to save surface from damage. As far as possible, spongy or soft fibrous materials like cloth pads should be used.
- f) For cleaning of newly installed equipment, soldering flux should be first neutralized with a 5-10% sodium carbonate solution or ammonia water and then, rinsed or washed and dried.
- g) Prolonged contact of sanitizers containing chlorine, iodine etc. should be avoided to prevent rusting of surfaces.
- h) Stain spots caused due to excessive heating should be removed by scouring with powder.

**Check Your Progress 2**

1. Name the various cleaning methods used in dairy plant.

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2. Define cleaning process.

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3. What are the significant physical attributes of an effective cleaning.

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4. Explain various consideration for cleaning and sanitization process.

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5. Discuss various factors that influence selection of detergent solutions for cleaning methods.

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### 13.4 SANITIZATION METHODS, FACTORS AND APPLICATIONS

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The aim of sanitization or disinfection in dairy plant is to reduce the number of living microorganisms to a level which is considered safe for dairy processing operation. Usually sanitization does not kill bacterial spores.

#### i. Methods

An effective disinfection/sanitization method requires thorough pre-cleaning. The following sanitization methods are generally used:

**Heating by Live steam or hot water:** The surface is heated by hot water or steam to inactivate the microorganisms. High temperature will denature protein residues and take them on the surface of equipment so, it is important to remove all debris by initial cleaning. Steam is found highly effective due to high penetration power to reach difficult surfaces. It also takes less time to heat the surface and easy to carry to various places like corners, end places (without use of pump). The high temperature helps in fast drying of equipment surface and achieving extra mileage for reducing water activity. This type of sanitization process requires proper time – temperature combination for better results. The steam is directly exposed to the cleaned surface, whereas hot water is filtered before spraying or circulated over the surface

**By applying chemical solutions:** This method is used where heat sanitizing is not practicable particularly to heat sensitive surfaces/processes. It has been also observed that continual use of a particular sanitizer may lead to the development of resistivity in microorganisms and therefore, it should be changed after some time. Following types of chemicals are used depending upon their suitability.

<sup>2/21</sup> Chlorine & chlorine based products: These are generally used in the form of liquid hypochlorite.

<sup>2/21</sup> Iodophors

<sup>2/21</sup> Quaternary Ammonium Compound

<sup>2/21</sup> Amphoteric Surfactants

**Application of radiation like Ultra Violet rays:** This type of application is getting attention day by day for disinfection of packing machine and materials, air required in the processing for ice-creams manufacture and drying products like peda, kalakand, milk cake etc.

**ii. Sanitization Effectiveness Factors**

Following factors need to be considered while using a sanitizer:

<sup>2/21</sup> The concentration of the chemical sanitizer.

<sup>2/21</sup> The temperature.

<sup>2/21</sup> The contact time required to reduce bacteria to a safe level. The time of surface exposure to disinfectant solution – general wet exposure time of no less than 10 minutes.

<sup>2/21</sup> Condition of surface as sanitizers work best on soil free surfaces.

<sup>2/21</sup> Extent of pre-cleaning. Pre-cleaning removes soil which harbours and protects microbes. Once this protection is removed, microbes are more vulnerable to chemical sanitizers which can kill or inactivate microbes.

**iii. Sanitizer Application**

Application of sanitizers depends upon the method of sanitization and characteristics of sanitizers are discussed below:

<sup>2/21</sup> Flooding: Surfaces requiring sanitization are flooded with sanitizer solutions through circulating solution or dipping the container/machine parts in to the sanitizer solution of desired concentration for desired contact time.

<sup>2/21</sup> Fogging: Fogging of suitable chemicals is done over the place requiring sanitization to inactivate the microorganisms.

<sup>2/21</sup> Spraying: Sanitizer solutions of desired concentration are sprayed over the surface by means of sprayer jets.

<sup>2/21</sup> Effectively exposing the surfaces to the live steam through suitably designed nozzles for killing the microorganisms.

<sup>2/21</sup> Use of radiation for inactivation of microbes. The use of radiation waves placed suitably creates sanitization effect in the close vicinity.

**Check Your Progress 3**

1. Define sanitization process. Why cleaning is required before sanitization?

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2. What are the main considerations for using sanitizers?

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### 13.5 IMPORTANT INSTRUCTIONS FOR USE OF DETERGENTS AND SANITIZERS

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**Use of “Material Safety Data Sheet (MSDS)”:** Every detergent and sanitizer has its specific handling requirement, depending upon their reactive nature to users, handling equipment and surrounding atmosphere. In order to prevent harmful effect and inconveniences, one should read carefully and go with safety instructions about the chemicals and its necessary application techniques. Most preferably, these MSDS should be displayed near the place of use and storage.

**Selection of effective chemicals:** The washing machines are designed by keeping certain types of detergent/sanitizer characteristics in mind and hence, manufacture’s recommendations must be looked into while selecting the detergent & sanitizers.

**Safe storage:** Following attention is required for warehousing the chemicals to be used for cleaning and sanitizing.

- 221 Proper labelling of containers of detergents and sanitizers
- 221 Specifically earmarked space at safe distance from processing areas to prevent cross-contamination of milk and milk products.
- 221 Availability of proper chemical handling means like hand gloves, safety shoes etc. in the storage vicinity.
- 221 Adequate training to personnel handling these chemicals.
- 221 The containers of these chemicals should be placed over pallets of suitable materials like plastic.
- 221 Enough lights should be provided in the storage area.
- 221 Proper display of precautions in handling.

#### Check Your Progress 4

1. What precautions are required while using detergent and sanitizers?  
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### 13.6 ASSESSMENT OF EFFECTIVENESS OF CLEANING AND SANITIZATION

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**Methods of assessment:** The presence of foreign matters on the surface can be detected by either of the following methods:

**Visual inspection:** In large tanks/silo proper light arrangement is made to inspect cleanliness status. Remote places could be inspected by focussing powerful light over the surface.

**Touching:** Touching the cleaned surface with clean & sanitized fingers shall help in knowing the presence of physical/chemical matters. Detergent residue gives whitish appearance over the fingers, whereas presence of milk fat gives oily impression.

**Drop test:** When clean water is dropped over the inclined/vertical surface, it gives specific flow pattern depending upon the extent of cleanliness. Excessive water-liner breaks could be observed on improperly cleaned surface.



**pH test:** The most of detergents are alkaline and their presence after rinsing could be detected by checking the pH of the surface. More than 7pH will indicate presence of traces of detergents.

**Indicator test:** The presence of detergent could also be noticed by applying phenolphthalein indicator over the cleaned/rinsed surface. The trace of detergent will change the colour of the indicator into pink.  
The sanitary conditions of the cleaned and sanitized surfaces are assessed by the following methods.

**Rinse method:** The sterilized surfaces are rinsed with distilled water. The result is presented to know the microbial load as colony per litre of rinse. From the rinse collected, a sample of known quantity is tested for counting the colony and the count is multiplied with the either factors of the rinse quantity. Rinse quantity has two factors, one is the sample quantity and other is the quotient of rinse quantity and sample quantity.

Norms for assessing the effectiveness:

<b>Bacterial count, colonies per litre</b>	<b>Effectiveness status</b>
Less than 1000 colony per liter	Satisfactory
1000 to 5000	Fairly satisfactory
More than 5000	Unsatisfactory

**Swab method:** The sanitized surface is wiped with a clean and sanitized cotton and rinsed with the distilled water of known volume. A representative area is properly wiped and rinse is prepared, which is tested for determining microbial load in terms of colonies present in the sample. Actual quantity present in the known rinse will be calculated to find out colony per 900 sq.cm area.

Norms for assessing the effectiveness:

<b>Colony per 900 sq. cm. area</b>	<b>Effectiveness status</b>
Less than 5000	Satisfactory
5000 to 25000	Fairly satisfactory
More than 25000	Unsatisfactory

Always neutralize the effect of chlorine in the sample of rinse water by adding 0.05% of sodium thiosulphate to avoid any lethal effects on the viable microorganism. When quaternary ammonium compounds are used as sanitizing chemicals may be neutralized by adding 0.4% lecithin and 1% Tween 20.

Adenosine-triphosphate (ATP) tests provide an indication of viable micro-organism within few seconds and assess the effectiveness of sanitization. This test is useful in correcting the cleaning/sanitizing process well before the commencement of production.

**Check Your Progress 5**

1. How would you ensure effectiveness of cleaning and sanitization processes?

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## 13.7 LET US SUM UP

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Adequate maintenance of the process equipment, utensils and other physical facilities is required for effective milk handling, processing and packing operations in a dairy plant. The size and shape of these processing facilities vary greatly and thus require suitable system of cleaning and sanitation. All careful considerations shall be looked into to achieve effective clean surface without much of the operational problems and financial burden.

Small vessels, containers and pieces of pipes, valves, joints and gaskets are cleaned manually with the help of detergent solution and soft brush. Small containers of large numbers are economically and efficiently cleaned and sanitized by specially designed washing machines such as can washers, crate washers; whereas large size vessel/ tank/silo, pipe lines and other compact equipments like milk chiller, pasteurizer, evaporator etc. are cleaned by cleaning-in-place (CIP) method.

Load and nature of operations, instructions of equipment manufacture, quality of water and availability of time and temperature are very important in selection of chemicals and suitable methods of cleaning and sanitization.

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## 13.8 KEY WORDS

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<b>Adequate</b>	:	Sufficient to accomplish the intended purpose
<b>Cleaning</b>	:	Removal of soil, food residues, dirt, grease or other objectionable materials
<b>Container</b>	:	An item for containing something i.e., box, can, jar, vessel etc.
<b>Contamination</b>	:	Occurrence of any objectionable matter including micro-organisms in the product
<b>Dairy</b>	:	A commercial establishment that processes and distributes milk and milk products.
<b>Detergents</b>	:	Chemicals used for cleaning purpose.
<b>Disinfection</b>	:	Reduction of number of microorganisms to a safe level.
<b>Equipment</b>	:	Machinery used for processing operations.
<b>Food Hygiene</b>	:	All measures necessary to ensure the safety, soundness and wholesomeness of food.
<b>Hygienic</b>	:	Promoting health, sanitary
<b>Sanitizers</b>	:	Chemicals/materials used for the purpose of disinfection.
<b>Washers</b>	:	Machines/equipment used for cleaning/washing the containers.
<b>Rinse</b>	:	To wash with clean water
<b>Swab</b>	:	To mop the surface

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## 13.9 SOME USEFUL BOOKS

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BIS, New Delhi 11002. IS 2491:(1998), Food Hygiene – Hazard Analysis and Critical Control point (HACCP) – system and guidelines for its application

BIS, New Delhi 11002. IS 15000:(1998), Food Hygiene – General principles - Code of practice (second Revision),

Newcomer, J.L., (1981) Preventive maintenance manual for dairy industry, Venus Trading Company, P.O.Box 17, Anand 388 001, Gujrat, India.

De, Sukumar (1980), Outlines of dairy technology. Oxford University Press, Delhi.

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## 13.10 ANSWERS TO CHECK YOUR PROGRESS

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**Your answer should include the following points:**

### Check Your Progress 1

- 1) i. Hygienically handling of milk & milk products.
- ii. Prevent contamination.

### Check Your Progress 2

- 1) i. Manual cleaning, mechanical cleaning and cleaning-in-place
- 2) i. Cleaning is the process in which unwanted matter that may contain food poisoning and spoilage microorganisms is removed to prevent contamination of products.
- 3) i. Free from visible film or soil,  
ii. Non-emittance of any objectionable odour,  
iii. Non-greasy or rough feeling,  
iv. Non-discolouration of a new white facial tissue wiped several times over the surface,  
v. Not showing any signs of excessive water break while water is draining from it: and  
vi. Not contaminating food products in contact with it
- 4) i. Alkaline: weak and strong detergents  
ii. Acidic detergent  
iii. Neutral pH type detergent
- 5) i. Neutral detergents are general purpose detergents with pH reading between 7 to 9 and useful for light to moderate heavy cleaning tasks. These foam well in water and safe for use on the most of the surface.

### Check Your Progress 3

- 1) i. Surfaces of equipment contain presence of bacteria. To destroy the load of this microorganism below to a safe level, sanitization is done through application of chemical known as sanitizer, which have bactericidal properties. Since microorganism present in the soiling can not be killed by the sanitizers, therefore the removal of the layer of soil is essential for an effective sanitization.
- 2) i. Sanitizers used in dairy industry are: Chlorine water, iodophors, quarternary ammonium compound, amphoteric surfactants, steam and hot water.

### Check Your Progress 4

- 1) i. Use of "Material Safety Data Sheet"  
ii. Selection of effective chemicals  
iii. Proper storage

### Check Your Progress 5

- 1) i. By conducting assessment test for checking physical and microbial conditions. Popular microbial tests are rinse test, swab test, ATP tests.