



Cleaning Of Dairy Equipment

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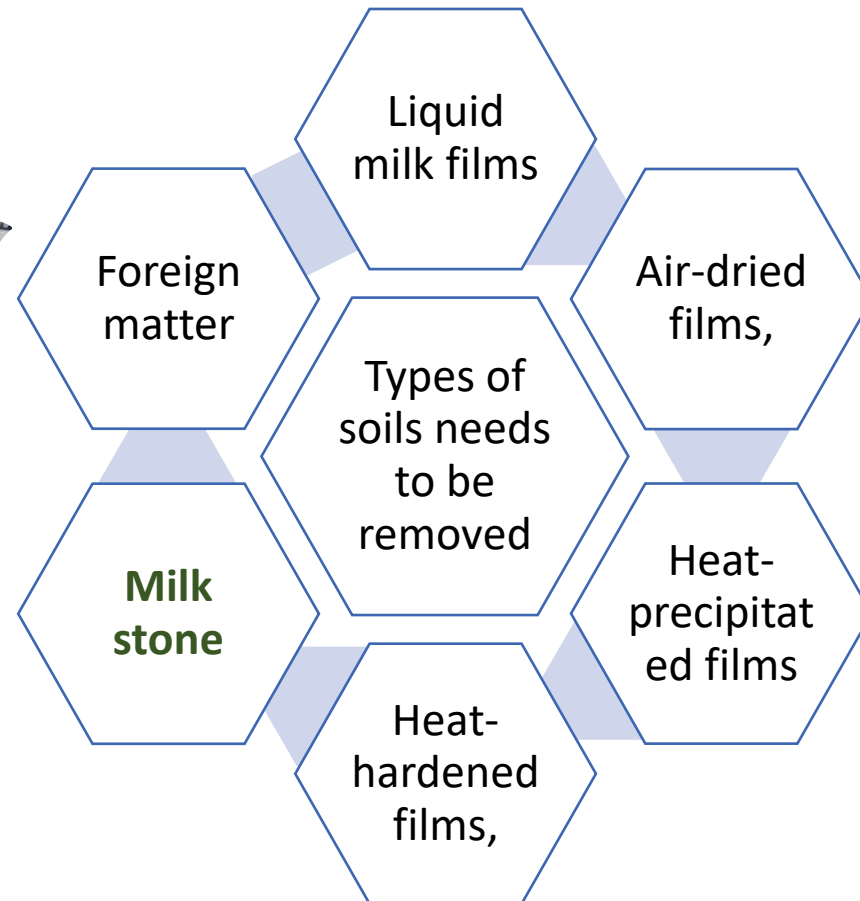
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1. Introduction

- A **systematic process** of removing dirt and food particles from a surface, including equipment and utensils used in the food and dairy sectors, among other things.
- **Cleaning and sanitation** is complementary to each other and meaningless without each other.
- Equipment and containers to be clean, dry, smooth, and free from dirt and dangerous bacterial load using various cleaning methods.
- Followed by cleaning, sanitation needs to be done, to reduce microbial load on the cleaned surface up to an acceptable level.



1.1 Types of food soil



Milk stone : Deposition of milk solid, water hardness and washing solutions due to heating effect.

1.2 Benefits of Cleaning Dairy Equipments

- **Clean equipment in food/dairy Processing plants is crucial for:**
 - Maintaining high **hygienic standards**,
 - **prevent contamination** of food resulting safe produce
 - **preventing health risks** during the handling and processing of milk and,
 - Maintain brand reputation due to less recall, consistent product quality

1.3 Objectives of cleanliness:-

- **Physical cleanliness** – Removal of visible dirt from the surface.
- **Chemical cleanliness** – Removal of microscopic residues that aren't visible to the naked eye.
- **Bacteriological cleanliness** – Removal of bacteria using disinfection.
- **Sterile cleanliness** – Destruction of all microorganisms.



1.4 General Guidelines of Cleaning:-

- Equipment and containers must undergo effective cleaning and sanitization before each use.
- Milk storage tanks should be cleaned at least **every 72 hours** to prevent microbial contamination.
- Aseptic packaging systems, including dairy equipment and packages, should be cleaned and sterilized before every final heat process to ensure product safety.
- Cleaning log records should be maintained for manual and CIP operations for validation by plant QC and regulatory agencies.
- Milk tank trucks should be labelled or tagged for sanitization purposes and only taken out at designated receiving stations or facilities.
- Regular cleaning equipment inspection and maintenance should be practiced to ensure optimal performance and effectiveness. Worn-out brushes, nozzles, and other components are promptly replaced to prevent equipment malfunction.

1.5 Regulatory Standards for Cleaning

General IS Standards for Cleaning

- Selection of detergent should be done according to
 - type of soil to be removed
 - quality of available water
 - material of equipment, and
 - method of cleaning.
- Standard cleaning procedure should be used for cleaning of certain equipment.
- On average basis, **15 g** of the cleaning agent's mixture for cleaning a utensil of 10L capacity is recommended to be used.
- Before being used, the cleaned utensils must be sterilized with either by rinsing using hot water or a chlorine solution.
- For tanker, hot detergent solution of **3 % NaOH at 60 -70°C** should be used. For aluminium tanker, sodium metasilicate recommended to be used with NaOH with lower alkalinity.

2. Cleaning & Sanitizing Materials

- a) **Water:** Used for pre-rinsing, rinsing, hot water rinsing & sterilization, cleaning solution preparation or steam production for sterilization
- High-quality potable water free from contaminants to ensure effective cleaning and sanitizing.
- b) **Steam:** Used to heat cleaning solution or direct steam sterilization
- removes grease, oil, and stubborn soils from through its high heat and pressure.
 - Has sanitizing properties, as the high temperatures associated with steam can kill bacteria, molds, and yeast.

2. Cleaning & Sanitizing Materials (Cont.)

Cleaning agents: Substances used for actual cleaning purposes to remove dirt/dust, soil, foul odors, and clutter on surfaces. Various class of cleaning agents are:

- i. **Detergent:** Including Soap, alkaline detergents. Ex: sodium hydroxide or caustic soda (NaOH); sodium bicarbonate, (NaHCO_3); sodium carbonate or soda ash (Na_2CO_3); sodium sesquicarbonate ($\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{H}_2\text{O}$), and trisodium phosphate ($\text{Na}_3\text{PO}_4 \cdot 12\text{H}_2\text{O}$) etc.
- ii. **Acids:** Weak solutions of about 0.1 % or slightly more. Ex: phosphoric and nitric acids
- iii. **Other chemicals:** Surface active agents (sodium alkyl sulphates and quaternary ammonium compounds), Chelating agents, Emulsifiers, Abrasives, Inhibitors, etc.

2. Cleaning & Sanitizing Materials (Cont.)

iv) Sanitizing agents: Substances used to reduce number of bacteria on a product contact surface up to a safe level (~ 99.999% reduction). Such as chlorine, iodine, acid sanitizers, quaternary ammonium, and peroxyacetic acid (PPA) etc.



3. Types of Cleaning method

1. Manual cleaning

- Removal of soil by scrubbing manually with detergent solution followed by water rinsing.
- Involves disassembling the equipment for cleaning and sanitizing each part.
- Time consuming and labour-intensive method.



2. Cleaning-out-Place (COP)

- Involves partially disassembling and cleaning in specialized COP pressure tanks
- Done at designated cleaning station or area for cleaning using mechanical cleaning equipment.
- Easier to control the environment and use specialized cleaning agents, but it is time-consuming and labour-intensive.

3. Cleaning-In-Place (CIP)

- Cleaning of equipment including pipelines, with water and detergent solution without dismantling.
- A minimum fluid velocity of 1.5 ms^{-1} with turbulent flow is required to effectively clean pipelines.
- Most effective method, highly efficient.



3.1 Other Ways Of Cleaning

A. Low-pressure high-volume spray

- Water and/or detergent solution is applied in large volume
- Done at low pressure of 6.8 bar or 100 psi.

B. High-pressure low-volume spray

- Water and/or detergent solution in low volume
- Done at high pressure of 68 bar or 1000 psi.

C. Foam cleaning

- Detergent solution in the form of foam
- Retained for 15-20 minutes over the surface before rinsing.

D. Washing machines

- Using water and/or detergent, & disinfection by hot water rinse.
- For milk cans, crates and bottles etc.
- large in number and smaller in sizes make manual cleaning
- Quite expensive, labour oriented, tiresome and involving huge manpower

4. Clean-in-place (CIP)

Actions recommended for a clean in place (CIP) operation:

1. Items like fill tubes, manhole gaskets, plug valves, etc. that need to be manually cleaned should be removed.
2. Incorporating physical breaks between product-containing tanks and circuits.
3. Pre-rinse or flush using cold water $\leq 25^{\circ}\text{C}$ and discard pre-rinse water, until it appear clear.
4. To eliminate the residues from the circuit, run a powerful detergent solution over it for the required amount of time.
5. Rinsing with clean water
6. Acid treatment (whenever required or once in 24 Hours) followed by another rinse.
7. Sanitize immediately before use.

4.1 Types of CIP Cleaning

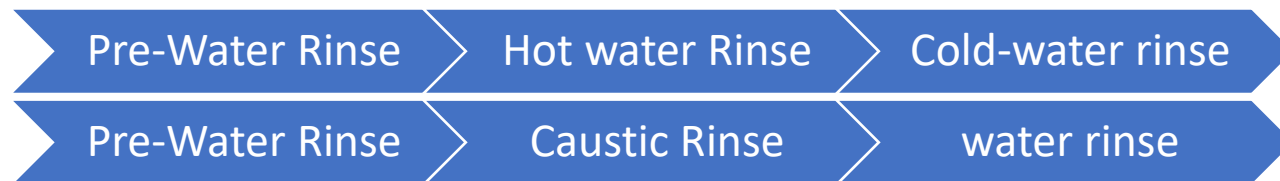
There are two types of CIP cleaning system

- **De-Centralized CIP:**

- ✓ Single use system used for small units close to the equipment
- ✓ Ex- heating equipment- pasteurizer, Cold milk equipment

- **Centralized CIP:**

- ✓ Re – Use CIP system for inline system where cleaning solution is supplied from cleaning solution storage tank.
- ✓ Based on status of equipment, following cleaning stages are used:
 1. 3 stage cleaning (using various combinations, usually with hot water)



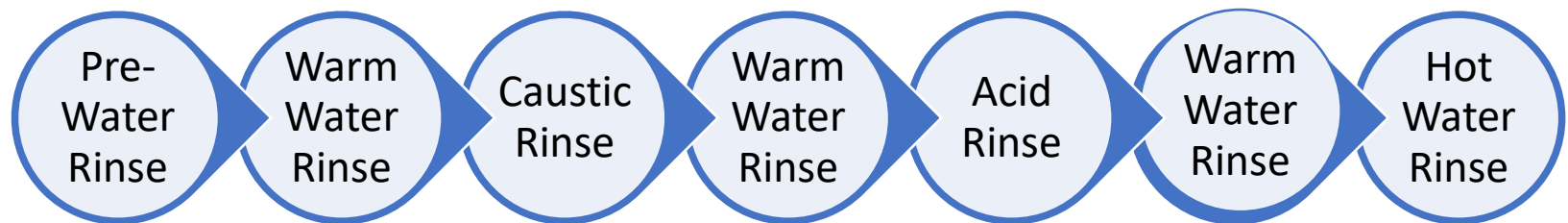
2. 5 stage cleaning



3. 7 stage cleaning

7 Stage Cleaning: Steps of CIP (Cleaning Cycle)

- **Step 0:** Recovery of dairy residue
- **Step 1:** Cleaning using cold water until drain water appears clean. (Pre-rinse)
- **Step 2:** Cleaning with warm water (50-60°C for 10 min.)
- **Step 3:** Cleaning using alkaline detergents/ caustic solution (0.5 -1.5% conc.) at 75-80°C for 30 min.
- **Step 4:** Warm water (50°C) rinse for 5-8 min
- **Step 5:** Cleaning using acid solution (generally nitric acid with 0.5 to 1% conc.) at 75°C for 20 min
- **Step 6:** Warm water (50°C) rinse for 5-8 min
- **Step 7:** Thermal disinfection (90-95°C) and cooling for 10 min or chemical disinfection with a suitable sanitizer



4.1 (a) Cleaning of cold milk equipment

- **Cleaning media**

- Alkaline cleaning media 0.1-0.2% concentration
- Surface active and anti – foaming agents are added (up to 0.08%)
- Liquid chlorine sanitizing agent is also added up to 50 to 100 ppm

- **Stages of cleaning:** After each processing 3 step cleaning and one 5 step cleaning within 24 hours using cleaning media.



4.1 (b) Cleaning of hot milk equipment

- **Cleaning media**
 - Detergent @0.1-0.2% concentration
 - Surface active, emulsifying agent and anti – foaming agents @0.08% conc.
 - Acid cleaning media: 0.5-1.0% conc.
 - Liquid chlorine sanitizing agent 50 to 100 ppm conc.
- **Stages of cleaning:** After each processing 3 or 5 step cleaning and one 7 step cleaning within 24 hours using cleaning medium.



Step 0: Recovery of product residue

- Recovery of product residue prior to cleaning is essential as it
 - minimizes product loss to drain.
 - Increases the efficiency of the cleaning
 - prevents pipe and drain choking
- Done using
 1. scraping the equipment surface
 2. forcing product out with the help of water
 3. blowing and flushing out with water.



Step 1: Pre-rinsing with water

- Carried out immediately after production.
- Should be done till clear water obtained from the system, as any residue leads to extra effort on detergent cleaning.
- Temperature of pre-rinsed water: $\leq 25^{\circ}\text{C}$



Step 2: Rinsing with warm water

- To remove solidified fat.
- Further, reduces effort on detergent cleaning.
- Condition: @ $\leq 55^{\circ}\text{C}$ for 10min (for effective flushing of milk fat without coagulation of milk protein.)

Step 3: Cleaning with Detergents

- The selection of detergents is depending on the -
 - Types and properties of soils that are needs to be removed
 - Cleaning procedure and
 - Water characteristics and detergents cost
- Ex: NaOH, NaHCO₃, Na₂CO₃, Na₃PO₄ ·12H₂O, non-foaming surfactant etc.

Step 4: Rinsing with warm water

- Rinsing is essential to remove traces of detergents from the inline piping or equipment, as it may contaminate the product.
- Done using warm water at 50°C for 5-8 min.

Step 5: Cleaning with Acid solution

- Acid treatment is generally done to remove milk stone formed on the surface of dairy equipments due to heating effect on milk residue.
- In addition, it also neutralizes detergents residue and tend to protect against corrosion.
- A dilute to mild acid solution is used with conc. of 0.5- 1%.
- Ex. Phosphoric acid, nitric acid, etc.



Step 6: Rinsing with warm water

- Rinsing effectively removes acid residue present on the surface of dairy equipments.
- Done similarly as step 4, using warm water at 50°C for 5-8 min.

Step 7: Final rinsing with Hot water

- It ensure no leftover material or chemical residue presence in dairy plant's equipment and aid in an efficient cleaning for the next pre-rinse.
- Type of water used: Clean potable water, De-Ionized water, or RO water
- Condition: 90-95°C for 5 to 20 min.
- At final stage, air should blow to remove moisture.

Step 7(a): Sanitizer Rinsing

Done using liquid chlorine as a sanitizing agent with conc. of 50 to 100 ppm followed by cold water rinse and blow drying.

5. Reference

1. Cleaning of dairy equipment | dairy processing handbook (tetrapak.Com)
2. Cleaning and sanitation of milk plant.Pdf (ndvsu.Org)
3. Eec-13 block-1 (egyankosh.Ac.In)

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