

Cleaning and Sanitizing Milking Equipment

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All milking equipment, lines, and utensil surfaces that come into contact with milk or dirt or manure must be thoroughly cleaned and sanitized before the next milking. Bulk milk tanks also must be cleaned after each milk pickup, and sanitized before the next milking. The purpose of cleaning is to remove milk soils, organic and mineral solids that form on equipment surfaces after the milk is removed. The purpose of sanitizing is to kill residual microorganisms present on these surfaces immediately prior to milking. Inadequate or improper cleaning or sanitizing or both allows bacteria to remain on equipment surfaces and to grow and multiply. This results in elevated bacteria counts in milk.

Types of Soils

Organic soils consist of the major organic constituents of milk: fats, proteins, and sugars. It is important to remove these soils from surfaces as quickly as possible after milking because their adhesion to surfaces increases with time, dryness of the soils, and heating. After they dry and harden, they form a deposit that is difficult to remove.

Mineral soils, or inorganic salts of various minerals (usually calcium, magnesium, or iron) in milk or water, are precipitated by alkaline conditions or heat. Cleaning agents can actually enhance precipitation of these salts if they are not compatible with water hardness conditions or are used in concentrations or at temperatures contrary to manufacturer's recommendations. Precipitated minerals on surfaces of milking or milk storage equipment can combine with organic soils to form a deposit called milkstone.

Cleaning Agents

Effective cleaning of milking equipment begins with analysis of the water supply for mineral content or hardness and choosing a cleaning compound that is compatible with the water. When the water hardness exceeds 10 grains per gallon, it may be necessary to increase detergent concentration. In very hard water (30 grains per gallon or more), a water softener should be used. The bicarbonates, sulfates, and chlorides of calcium or magnesium present in hard water can neutralize detergents, decrease rinsability, create films on equipment, and cause problems with water heaters. The compatible cleaners would then be used according to manufacturer's directions in relation to amount and concentration of cleaner, temperature of the cleaning solution, and contact time of the cleaning solution and the surface to be cleaned. In other words, read the label! Measure the correct amount of water to be used in the cleaning cycle.

Usually an alkaline or chlorinated cleaner (alkaline cleaner with added chlorine) followed by an acid cleaner is used. Alkaline cleaners usually contain basic alkalis, phosphates, wetting agents, and chelating agents. They dissolve milk fats, proteins, and carbohydrates, and loosen and suspend other soil particles so that they can be removed by mechanical action, i.e. by brushing or by circulation cleaning. The chlorine aids removal of protein deposits and prevents the formation of film. They are not sanitizing agents! Acid cleaners remove or prevent accumulated mineral deposits or milkstone buildup. Rinse the pipeline with an acid rinse (e.g., 1 oz. acid per 5 gallons of water) immediately after the detergent solution is rinsed from the system. Bulk tanks can be rinsed with acidified water after the detergent solution is rinsed off by installing a spray unit to the water line that automatically adds the proper concentration of milkstone remover.

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Sanitizing Milking Equipment

Cleaning reduces bacterial numbers on surfaces but does not eliminate all types of bacteria. The sanitizing of surfaces within 30 minutes of the next milking destroys nearly all lingering organisms if: (1) the sanitizing solution used is of proper strength, and (2) a thorough cleaning precedes the sanitizing. Improper cleaning results in residual soils that can protect bacteria from the sanitizing action. Some sanitizing compounds lose strength with time in storage (chlorine compounds) or increasing pH (chlorine and iodine compounds). Some are unstable at temperatures above 120°F (iodine compounds), while others are not compatible with hard water (quaternary ammonium compounds).

Cleaning Procedures

Equipment and bulk tank cleaning procedures should be posted on the milk-house wall and rigidly followed. An example of equipment cleaning procedures is presented in Table 1. The precise course of action, compounds used, and water temperatures will vary. In general, equipment should be rinsed with lukewarm 100 to 110°F water immediately after milking to prevent drying of milk solids on surfaces. Water that is too hot can cause denaturation of proteins and a protein film on surfaces, while water that is too cold can cause fat crystallization and the formation of a greasy film on surfaces.

Washing and rinsing should follow. Wash water should remain above 120°F. Start with water at 170°F. In clean-in-place (CIP) systems, velocity and air in the system are also essential. A minimum velocity of 5 ft/sec is necessary to ensure effective cleaning action. Introducing air into the system provides slugging or turbulence and increases scouring action. The wash cycle should take 6-10 minutes. With longer times, the water becomes too cold. The concentration depends upon water hardness and iron content.

Acid rinse. Rinse the line with acidified water (pH 3.0-4.0) to remove all traces of cleaning solution (2-3 minutes minimum contact time). This should be done after every milking. It helps prevent mineral deposits and the lower pH is bacteriostatic.

All equipment and utensils should be stored in a manner that permits water to drain and equipment to air dry. In CIP systems, a drain should be located at the lowest point in the system.

Teat cup liners and other rubber parts that come into contact with milk must also be thoroughly cleaned after each milking and sanitized before the next milking.

Liners and other rubber parts should be replaced when they have been used for the recommended number of milkings (e.g., 1200) or when they become soft, cracked or rough, or have holes. Pores and cracks in rubber parts protect soil and microorganisms from effects of cleaning and sanitizing.

Bulk Milk Tanks

Bulk tanks also must be properly cleaned and sanitized, or psychrophilic bacteria (microorganisms capable of rapid growth at temperatures of 35 to 50°F) multiply rapidly. Tanks are cleaned by using essentially the same procedures as recommended for milking equipment. The milk hauler is normally responsible for rinsing the tank immediately after the milk is removed. Rinse water temperature should be 90-120°F. Following this, the tank must be washed, rinsed, and sanitized. Allow the mechanical cleaning device to operate until clean (6-10 min.). Cleaning solution temperature should remain above 120°F during the wash cycle and that means starting with hot water (170°F). Rinse the tank completely with tepid water, finishing the rinse with acidified solution as it neutralizes and removes detergent residues and removes inorganic soils. Tank covers and gaskets should be disassembled and the calibration rod removed for manual cleaning. The outlet connection and outlet valve must be cleaned manually. The tank exterior should be washed. Sanitizing should occur just before the next milking. Allow the sanitizer to drain from the outlet to prevent sanitizer residues in milk. Tanks may be cleaned manually or with CIP or mechanical systems.

CIP Equipment

The development of automatic (CIP) milking and bulk tank systems have been great time-savers for dairy farmers. However, these systems must be properly maintained. Many problems will occur if these systems are not checked regularly, at least twice-a-year.

Improper or careless cleaning and sanitizing of equipment and tanks is a major cause of inferior milk quality. It need not be if cleaning water and cleaning compounds are compatible and a precise procedure is formulated and followed.

Safety Precautions

1. Cleaning and sanitizing chemicals should be stored in a locked room inaccessible to children and unauthorized personnel. The storage room should be on cooler side and should be lighted so labels can be read. Storage drum openings should be kept tight to prevent dissipation of ingredients into the air,

including teat dips and sprays. Chemicals should have spill containment. Material safety data sheets should be kept on file

2. Detergent-acid resistant gloves, proper safety eye protection or a face shield when mixing chemicals, and protective footwear to prevent slips should always be worn.
3. All cleaning and sanitizing chemicals must be labeled properly; The label and other manufacturer's directions should be read; Chemicals should be mixed in an open, ventilated area.
4. Use extreme caution when mixing or handling caustics or acids; Slowly add chemicals to water, especially caustics—never add water to chemicals and never add to hot water.
5. Never mix chlorine compounds with other detergents or acids as it may produce deadly chlorine gas.
6. A cleaning program or directions should be posted for each piece of milk-handling equipment. Pipelines, bulk tanks, and equipment that are cleaned manually should have directions posted which cover rinsing, washing, and sanitizing. Directions in each cleaning program must be specific as to temperature, gallons of water used in each cycle, and amounts in ounces of each chemical.
7. Never climb into a closed container such as a bulk tank (single manhole tanks in particular) because of lack of oxygen. Chemical vapors inhaled can burn sensitive tissues in your eyes, mucous membranes in your nose and sinus cavities, and lungs.
8. Include 911 and phone number of area poison control center and local hospitals near telephones.
9. Have an eye wash station located near mixing areas. Any chemical in the eyes should be flushed with water immediately for 15 minutes, followed by a doctor's examination.
10. Any chemical detergent contacting the skin should be flushed immediately with water for 15 minutes. Remove any clothing that has been contaminated by chemical detergent and flush affected area. Obtain medical assistance at once.
11. Empty containers must be thoroughly rinsed and disposed of according to local environmental regulations.

References:

Dairy Practices Council. 1995. DPC #4 Guidelines for installation, cleaning, and sanitizing of large parlor milking systems, Keyport, NJ.

Dersam, P. You can avoid dairy chemical accidents. Pages 674-5 in October 10, 1999 issue, Hoard's Dairyman.

Table 1. Example of Cleaning Procedures for Milking Equipment

1. Pre-rinse
Rinse all equipment and utensils and flush pipeline with lukewarm (100-110°F) water immediately after use. This also applies to bulk tanks. Water temperature should not exceed 120°F.
Disassemble all parts that must be hand-washed.

 2. Wash
Mix chlorinated alkaline cleaning solution as determined by manufacturer's recommendations and water quality tests.
___ gallons hot water (160-170°F)
___ ounces alkaline cleaner
For hand washing:
 Soak all parts at 120-135 F for at least 5 minutes.
 Brush all parts thoroughly.
 Drain.
For pipelines and bulk tanks:
 Circulate cleaning solution for 6-10 min.
The wash solution temperature should be above 120°F at the end of the cycle. Start with water at 170°F. Run air through for 2-3 min.
Brush all parts not designed for cleaning by circulation solution including Outside of tank and outlet valve.
Drain.

 3. Rinse
Rinse the detergent solution with tap water before adding the acid rinse.
Rinse tank thoroughly (inside and outside).
Rinse tank outlet valve.

 4. Acid-rinse
Rinse pipeline and bulk tank with lukewarm or cold acidified water.
___ gallons clean water
___ ounces acid cleaner
Do not recirculate rinse solution.
Circulate 2-3 minutes and drain. Repeat running air through for 2-3 min.
Visually inspect line, receiver jar, etc., for proper cleaning.
- Immediately before milking:
1. Sanitize
Flush pipeline and bulk tank with sanitizer immediately before milking, using:
___ gallons clean water
___ ounces sanitizer
Circulate 2-3 minutes and drain.
Sanitize hand-washed parts.
Let drain.