DAIRY OPERATORS GUIDE TO MILKING MACHINE CLEANING AND SANITATION

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The decision to produce quality milk rests primarily with the dairy producer. The efforts of service personnel and consultants will not be effective without this intention and commitment on the part of the producer. The motivated dairy producer needs competent support service to achieve her/his goal. This paper will present tools that the dairy producer can use to ensure that the milking and milk handling equipment is not the cause of high bacteria counts in milk. The role of the various service providers in this process is also indicated.

START WITH PARLOR PLANNING

Many of the worst problems with milking machine cleaning and milking performance are the result of installing a milking machine in a building not designed for it. Some fundamental design concepts that will make for a trouble free system include:

Keep It Compact: Every extra foot of pipe and hose adds complication for control of the system for both milking and cleaning. When considering options for parlor layout prioritize those designs that minimize milkline, wash line and airline lengths. This can be accomplished by keeping the receiver, wash sink and bulk tank or tanker port as close together as possible. The receiver should not be placed in a location that will interfere with movement of the operators during milking. The wash sink is generally located near the bulk tank inlet to facilitate piping to switch from the milking to cleaning configurations. The length of piping from the milk room to the parlor should be kept to a minimum to reduce cleaning water volume, heat loss during cleaning and difficulties controlling circulation.

Keep It Simple: Extra equipment such as milk meters and back flush systems require additional up-front cost as well as ongoing costs for maintenance and cleaning. Additional components also make control of milking and cleaning performance more difficult. Consider if there will be sufficient cash flow to keep equipment maintained. Consider the value of each piece of additional equipment and how data will be used.

Keep It Safe: The chemicals used for cleaning and sanitation can cause damage to skin and are very dangerous if ingested. They are also corrosive to equipment. These chemicals should be stored in a secured area away from places where they can come into contact with people and equipment.

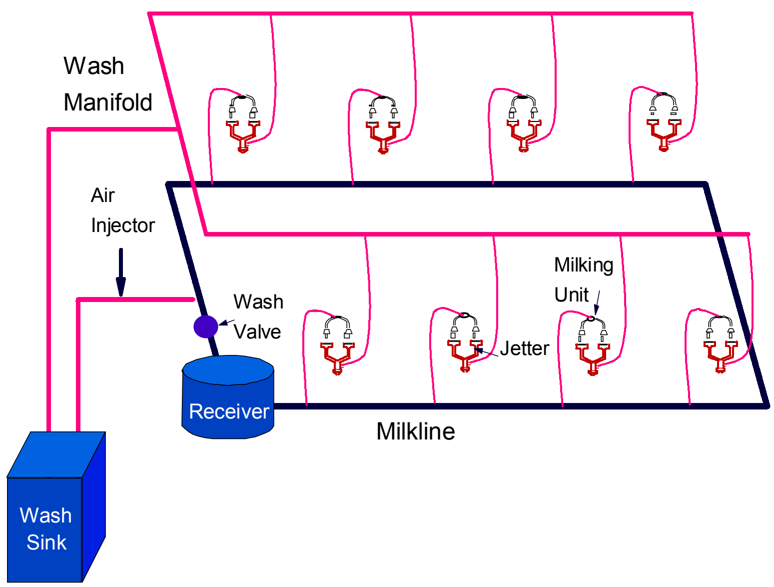
Remember Drainage: Milking parlors generate lots of wastewater. Make sure that all floors are sloped to a drain to keep floors free of puddles, mess and ice. The drainage system will be much more effective and efficient if the parlor platform, parlor pit and holding area all slope in the same direction.

EQUIPMENT INSTALLATION AND COMMISSIONING

Before any new milking machine is used, it should be thoroughly tested for both milking and cleaning performance. This is the responsibility of the milking machine supplier. The milking machine dealer should provide the dairy operator with instructions for operation of the milking machine in both the milking and cleaning mode. The results of a commission test should also be presented documenting that the milking machine is functional and with measurements of:

- Vacuum level at the regulator or vacuum gauge
- Milking vacuum level (average vacuum in the claw at peak milk flow)
- Pulsator rate and ratio with a commissioning check of each pulsator
- Effective and Manual Reserve airflow
- Air injector timing
- Water flow rate thorough each milking unit during the wash cycle.
- Recommended cycles for cleaning
- Recommended chemical concentrations for each cycle

As milking machines become more complex the task of assuring adequate mechanical cleaning action in all parts of the milking machine becomes increasingly complex. Although system designs vary considerably, typical features of milking parlor CIP systems are shown in Figure 1. Cleaning solutions are transported from the wash vat through the sanitary parts of the system and back to the wash vat during the CIP process. Two-phase flow patterns are determined by the diameter of system components and water and air flow rates. Internal diameters range from 10 mm in short milk tubes to 98 mm or more in milklines and in excess of 150 mm in milk meters and recorder jars. Flow velocities and flow patterns therefore vary greatly in the different parts of the system. Air-injection is normally used to produce slug flow in milklines. The objectives and optimal control strategies for air and water admission to milking units and other components differ from those for the pipeline. Milking units are either flooded or alternately flooded and emptied. Large components such as some milk meters and recorder jars are generally cleaned with a spray or sheet of water over the interior surfaces.



In milking parlors, milking units are commonly attached to wash assemblies (jetters) fed from a wash manifold. This water-draw pipe network and jetters make up the wash manifold. Cycled air-injection may enter through the wash manifold, the milkline or both. Air and water are separated at the receiver jar. The air travels to the distribution tank and is removed from the system by the vacuum pump. Water is returned to the wash vat by the milk pump through the milk transfer line.

Great variation in water flow between milking units can occur in milking parlors when no attempt is made to adjust the flow. The system vacuum, line diameter and length, and the lift from the wash sink determine the flow capacity of the wash manifold. Excessive flow through the first several units can drain the wash manifold resulting in little or no flow through units at the end of the line.

Milk pump capacity is often the limiting factor in CIP systems. The distribution of water flow between units should be as uniform as possible to make the most efficient use of water and air when cleaning milking equipment and to avoid exceeding the capacity of the milk pump. Field studies have indicated that 3 L/min is sufficient to clean most milking units. While many units will clean at flow rates below this value, the risk of cleaning failure appears to be increased. Systems with milk meters or weigh jars require 4.5 to 6 L/min for effective cleaning.

Assuring that the mechanical cleaning action is adequate typically requires very little added cost but relies on the skill of the equipment installer. This requires testing and adjustment of the water flow to each milking unit and milk meter as well as precise control of air injection. Look for some documentation that the installer has performed these tasks.

With proper system design and control strategies, the vacuum pump capacity required for cleaning most milking machines is less than the minimum recommended for milking. Additional vacuum pump capacity may be required on large systems using cycled air injection to multiple locations. All pipelines, hoses and components must also be installed so that they will drain by gravity between cleaning cycles. Drainage is an important aspect of cleaning, because any standing water in the system increases the risk of bacterial growth between milkings and mixing of different cleaning chemicals during cleaning.

Some milking machine dealerships also supply cleaning chemicals or another supplier may supply them. It is the responsibility of the chemical supplier to prescribe the amount of chemical and temperature to be used for each cycle based on the water volume and results of water quality tests. The chemical consultant should be trained and equipped to perform water quality tests, measure water temperatures and volumes and determine if the appropriate chemicals are being used. Label directions are good as a first estimate for the amount of chemicals required but confirmation tests should be done of pH, alkalinity and chlorine contents using the recommended chemical concentrations and water available on the farm.

As a dairy operator motivated to produce quality milk, you should make it clear to the milking machine installer and chemical supplier that you expect commission tests to be done and expect to see these reports. A good way to determine the quality of a milking machine dealership is to visit other installations that they have done and determine if these items have been tended to.

STANDARD OPERATING PROCEDURES

As with milking there should be clearly defined operating procedures for milking machine sanitation and all new staff should be trained. This task falls in the lap of the dairy producer, although there are now some service providers who can be hired to oversee the development of operating procedures and training of milking staff. These operating procedures should include instructions of how to prepare the milking machine for cleaning and sanitation including putting milking units in jetters, operation of any manually controlled valves, pipes and switches, chemical handling (including checks for empty chemical barrels) and washing of external surfaces of milking machine, milking parlor and milk room. Even in the most modern milking machine there are still components that must be disassembled and cleaned by hand. Make sure the staff knows which components need to be manually cleaned and that the proper chemicals are used for this task.

MONITORING CLEANING PERFORMANCE

The single most powerful tool for producing quality milk is routine monitoring of the types of bacteria in the bulk tank. This task can be performed done by the motivated diary operator or by one of the farm service providers. The two main sources of bacteria in raw milk are organisms transported from the environment into the milking machine and mastitis organisms from within the udder. Bacteria deposited in milk handling equipment will multiply and become a major source of contamination if this equipment is not cleaned and sanitized properly. Some form of testing for bacterial contamination is done periodically on all farms to assure compliance with national, state, and local requirements.

Tests routinely performed by the milk plant assess the bacterial quality of raw milk is the standard plate count (SPC) or Plate Loop Count (PLC) and more recently the Bactoscan. These are broad-spectrum tests indicate the number of bacteria present in the milk, but do not identify the types of organisms present and have little diagnostic value in determining the cause of bacterial contamination. Additional testing is required for diagnostic purposes.

A quantitative bulk tank culture is commonly used to diagnose mastitis problems and the cause of High Somatic Cell Counts. Information from the quantitative bulk tank culture can also be used to diagnosis the cause of high bacteria counts. High bacteria counts may result when certain types of mastitis organisms such as *strep ag* or *step uberis* are present in the herd. The number of *streps* from the quantitative bulk tank culture can be used to estimate the contribution of these organisms to the Total Bacteria count or SPC. A major source of coliform bacteria in bulk tank milk is transportation of soil from the teats and udders into the milking machine. The Coliform count thus provides an indication of both the effectiveness of cow preparation procedures during milking and the cleanliness of the cows' environment. Coliform counts between 100/ml and 1000/ml are generally an indication of poor milking hygiene. Coliforms will also incubate in residual films left on milk contact surfaces. Coliform counts in excess of 1000 suggest incubation in milk handling equipment. A Coliform count less than 100/ml of milk is considered acceptable for raw milk for pasteurization. In states where raw milk may be sold to consumers, Coliform count must be less than 10/ml. Coliform counts less than 10/ml indicate excellence in both pre-milking hygiene and equipment sanitation.

Another bulk milk test that provides diagnostic value is Lab Pasteurized Count (LPC) or thermoduric count. Most milk testing labs will do this test if asked but it is not routinely performed in most parts of the country. The LPC test is performed in the same way as the SPC except that the milk sample is pasteurized at 63 C for 30 minutes before plating and incubation. This procedure kills the usual mastitis-causing bacteria (including coliforms) leaving only those organisms from the environment that can survive elevated temperatures. These types of organisms will grow and multiply in the milk handling equipment if cleaning and sanitation procedures are inadequate. Poor milking hygiene results in an elevation of both Coliform and SPC with a near normal LPC if the milking machine is clean. When milking equipment is not cleaned effectively, both Coliform and LPC will be elevated due to coliforms growing in soil films in the milking machine. Incubation of the milk films in the milking system will elevate

SPC, Coliform, and LPC. The LPC should be below 100/ml to 200/ml if equipment cleaning and sanitation are good. A LPC below 10/ ml indicates excellent equipment hygiene.

When the routine bulk tank testing indicates that a problem exists, more detailed tests can be performed to further isolate the source of the problem and recommend the most effective methods to solve it. Strategic sampling of milk in different locations will determine if the location of a cleaning failure and/or incubation problem is: in the milking units, milkline and receiver, in the milk transfer line (including filters and pre-coolers), or in the bulk tank Strategic sampling of milk at different times during the milking process will determine if incubation in the milk handling system is a major source of contamination.

OBSERVING CLEANING ROUTINES

If bulk tank cultures indicate a potential cleaning problem, begin troubleshooting with the simplest things first. You have to take apart many complicated electronic devices only to find out that the batteries were dead to learn this lesson. Observe one complete cleaning routine and verify which cycles are used and the chemical concentrations and water temperature of each. Newer automatic washers can record whether cleaning cycles actually occurred and the temperature of each cycle. Typical sources of problems are: empty chemical barrels, broken water heaters or mixing valves, broken or uncharged water softener, valves not properly actuating, etc. If this observation and correction of obvious errors does not solve the problem consult your milking equipment service and/or chemical supplier for more detailed analysis.

EXAMINATION OF RESIDUAL FILMS

Cleaning failures usually result in a visual buildup or residual film on some part of the milk harvesting or storage equipment. Some of these films have a characteristic appearance, which can help determine the cause of the cleaning failure. There are two broad categories of residual films: Organic films such as fat and protein, and inorganic films such as hard water minerals, iron, and silica. Discoloration may also occur due to corrosion and/or pitting of surfaces. Protein films can appear as a brownish slime (applesauce) when wet. Mineral films usually have a rough porous texture and are invisible when wet. Organic films are generally alkaline soluble whereas inorganic films are generally acid soluble. Protein films are soluble in chlorine. Films can be diagnosed by scrubbing a small area with concentrated acid and/or detergent solutions.

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