

# Cleaning the Milking Machine

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An efficient wash up routine will remove milk residues and bacteria from the plant. This will maintain milk quality, improve the appearance of the parlour and prolong the life of milking equipment. If problems occur with the wash-up routine, then milk films will build up in the plant. These films provide nutrients for bacteria which can then multiply and increase the TBC or Bactoscan.

The milking system is cleaned by the physical action of cleaning solutions assisted by temperature and chemicals. No matter what system is used, the machine will not be cleaned unless wash up solutions come into contact with all soiled parts of the plant.

The following will be required irrespective of the type of milking system;

- Supply of potable water (water free from faecal contamination),
- Efficient water heater,
- Thermometer,
- Chemicals
- Protective clothing.

British Standards require a minimum of 18 litres (4 gallons) of boiler capacity per milking unit irrespective of the method of cleaning used. The milking system is designed to produce minimal turbulence during milking because excess turbulence may lead to 'buttering' of milk. However, during the wash up routine maximum turbulence is required to make sure that all internal surfaces of the plant are cleaned. Some plants are fitted with air injectors that admit "slugs" of air to increase the turbulence by bubbling and swirling water all around the pipes. Air injectors are of increasing importance in large bore systems so that the entire surface of each line can be physically cleaned.

It is essential that all dairy chemicals are stored safely and used correctly. Protective clothing (goggles, gloves and aprons) should be worn to avoid accidental injury. Chemicals should not be stored in the same room as the bulk tank to avoid any risk of milk taint.

Two forms of cleaning are used, Circulation Cleaning and Acid Boiling Wash (ABW). Circulation cleaning is the most common method of cleaning in the United Kingdom.

## **CIRCULATION CLEANING**

This form of cleaning is divided into three cycles;

- rinse                      removes milk residues after milking
- wash                        removes any remaining soil
- disinfectant              kills bacteria remaining in the cleaned plant.

The milking system should be cleaned immediately after milking while the plant is warm and before milk deposits start to form on pipes. Disconnect the milk pipe from the bulk tank. When milking is completed. Any milk in the receiver vessel and the milk pump is drained. The external surfaces of clusters and milking units are rinsed clean and the plant set up for the wash-up routine. This consists primarily of attaching jettors to the clusters and then transferring vacuum to the wash lines so that wash solutions are drawn into the wash lines, through the cluster and back to the dairy. Figure 2 shows the route of wash solutions.

### **Rinse Cycle**

Warm water at 38-43°C should be rinsed through the milking system and run to waste immediately after milking. This will remove the majority of any residual milk left in the plant. Most dairy farmers, however, use a cold rinse. Under no circumstances should cold water be used as it will congeal butterfat onto glass and stainless steel fittings and cool down the plant before the hot wash. Energy in the form of hot water will then be required to heat up the pipes before the hot wash. In addition, minerals and sugars in milk are more easily dissolved in warm water.

After the rinse cycle, the wash line valves should be shut off to prevent large volumes of air being sucked into the system. This air may cool down the plant before the hot wash. It may be advisable to insulate the milk and wash lines. This is essential where any of these pipes are exposed to the outside environment. Not only will it prevent excessive cooling during the wash up cycle, but it will also prevent milk freezing during winter milking. The rinse cycle should remove between 90 and 95% of all milk residue in the system and all the milk sugars. The remaining residues are removed during the wash cycle by chemical action.

### **Wash Cycle**

In circulation cleaning, the wash cycle relies on an alkaline detergent solution to remove butterfat. Chlorine is normally incorporated into the detergent to remove protein, but in this form has no disinfectant property. Wash up solutions are very sensitive to temperature. In general their cleaning power doubles for each 10°C increase up to a maximum of 71°C. Once they exceed this temperature they tend to become unstable,

vapourise and hence become less effective. There are a few detergent solutions designed to be circulated in cold water to clean the plant.

An adequate supply of hot water must be available. Maintaining the correct temperature of water in the boiler is essential. It is also important that the boiler has a large bore tap so that the wash trough can be filled rapidly without heat loss.

The water temperature should be checked regularly against the boiler gauge to ensure that the thermostat and heater element are functioning correctly. Sometimes the boiler gauge becomes faulty or the heating element becomes caked with mineral deposit. This is especially common in hard water areas. The best way to check on boiler efficiency is to fill a trough with hot water and measure the temperature in the filled trough. This is the temperature that counts.

Detergents solutions must be used at the correct concentration and so the volume of wash water must be known. Hot water is run into the plant and as it travels around it heats up the pipes and vessels. Only then should the correct amount of detergent solution be mixed into the circulating hot water. If the detergent solution is too weak it will be ineffective. If the solution is too strong then it will be wasteful and may even corrode the stainless steel or rubberware in the plant.

If the rinse cycle has not been effective a large amount of milk residue may be left in the system. This milk will inactivate some of the detergent which will decrease the efficacy of the wash up routine. Ideally a thermometer should be fitted to the return wash pipe to check that solutions are being circulated at the correct temperature in accordance with the manufacturers recommendations.

If solutions are circulated for long periods of time, the temperature drops and then protein may be deposited back onto the pipes. Milkers have been known to let the hot wash cycle run while they go and have breakfast!

The essential components of the wash cycle are:

- Temperature,
- Volume of solution,
- Concentration of chemical,
- Circulation time,
- Scrubbing and swirling action,

## **Disinfection Cycle**

At the end of the circulation wash, the milking plant should be clean and free from any milk soil. A disinfectant rinse will reduce the number of bacteria in the plant and help maintain milk quality. Sodium hypochlorite is the most commonly used disinfectant at a strength of 50 ppm. This disinfectant solution may be circulated and then dumped to

waste at the end of the wash-up routine. Alternatively it may be left in the plant until the next milking when it will then have to be drained from the plant before milking can take place.

### **A typical circulation wash-up routine is as follows;**

- Hose off all external surfaces (ideally with warm water) and remove the milk pipe from the bulk tank, set up the plant for cleaning,
- Run warm water at 38-43°C through the system and run to waste until the water appears clear,
- Circulate hot water around the plant and after the first circuit mix in the detergent,
- Circulate the hot detergent solution between 60 and 70°C for five to eight minutes, or in accordance with the manufacturers recommendation,
- Run this detergent solution to waste,
- Circulate disinfectant solution,
- Allow solutions to drain from the plant.

### **Common problems associated with circulation cleaning**

- Rinsing the plant with cold water after milking will cool down the warm plant and congeal butterfat. The hot wash solutions will then have to heat up the plant from cold, and the detergents will have to remove the butterfat deposits,
- Water is not hot enough - this will make the detergent solutions less effective as they are temperature sensitive. This may be due to small boiler capacity, hot water used for other purposes such as feeding calves etc.
- Inadequate volumes of wash water may not come into contact with all internal surfaces. This may result in some areas of the system not being cleaned, especially the top part of the milk lines,
- Incorrect strength of detergents used. Too little is ineffective while too much is costly and corrosive,
- If there is insufficient turbulence or flow of wash solutions, the cleaning maybe ineffective as shown on the liner in Plate \*\*. This build up of soil occurred on all the liners in this plant due to inadequate flow of wash solutions due to narrow bore wash and milk lines,
- Wash cycle continued in excess of the recommended time. The solutions will have cooled down and may re deposit material back onto the internal surfaces. Cooling may also occur if the water supply to the plate or tube cooler has not been turned off or if wash lines are not lagged and exposed.
- The milker should not clean the outside of the recorder jars with cold water during the rinse or wash cycle as this will cool down the temperature of the jars and also the circulating solutions.
- Blocked wash-up jettors may result in one liner or a complete milking unit not being washed. The effect will depend on where the jettor is blocked,

- Faulty air injectors will not create the physical turbulence that is needed to clean large bore lines.
- Deposits frequently build-up in dead-end areas as they are difficult to clean, as shown in Figure \*\*.
- Some farmers store the hot wash solution from the morning milking and run it through the plant after the evening milking. This practice is not recommended as the cleaning power of this cold solution is poor and it is also likely to contain some milk soil.
- If you examine the internal surfaces of some rubber components in the plant and a black deposit marks your finger, as shown in Plate \*\* this indicates rubber damage caused by too high a level of hypochlorite. The same effect may be seen in the black colour of the disinfection rinse as shown in Plate \*\*. Remember that chlorine compounds reduce the life of all rubberware and liners.

### **ACIDIFIED BOILING WATER CLEANING (ABW)**

ABW relies entirely on heat for disinfection. 18 litres (4 gallons) of boiling water over 96°C are needed for each milking unit. This water is run directly from the boiler around the plant to waste. It takes the same path as for circulation cleaning the only difference being that the solutions are run around the plant to waste. All parts of the plant to cleaned must reach and maintain a temperature of 77°C for at least two minutes. Dilute nitric or sulphanic acid is run in with the boiling water in the first two minutes to prevent deposits building up on any of the surfaces. The cleaning cycle lasts between five and six minutes.

The plant must be capable of withstanding high temperatures and acids. There should be no dead ends and the plant should be as compact as possible to avoid excessive heat loss. This form of cleaning is not very popular as problems occur if the water temperature or volume is too low. ABW does save on dairy detergents and is a faster form of cleaning compared to circulation cleaning.

### **BULK TANKS**

The bulk tank must be cleaned every time that milk is emptied. Most tanks are now cleaned by automatic washers that rely on chemicals and jetters to complete the process. All internal parts of the plant that can come into contact with milk must be cleaned and disinfected. It is essential that the milker checks that this process has been carried out before milking.

While automatic washers do a good job, there is the risk that because it is automatic, things can go wrong. The milker rarely looks inside the tank to check on cleanliness.

Occasionally problems do occur such as when a wash jetter becomes blocked and so part of the tank will not be cleaned, as shown in Plate \*\*. This will result in a build up of milk film on which psychotrophic bacteria can multiply and this will result in increased TBCs .

### **IF A WASH-UP PROBLEM IS SUSPECTED**

The efficiency of the wash-up routine can be evaluated through bacteriology of bulk milk measuring the number of Thermoduric bacteria. A Thermoduric Count (TD) or Laboratory Pasteurised Count (LPC) over 500 cfu/ml indicates a wash-up problem. If a wash-up problem is suspected, the cause must be identified. Much can be gained by manually inspecting the system after the wash-up routine. Removing pipe ends and examining internal surfaces with a torch. Look inside the following areas for any evidence of milk film or soil build-up;

- ACR flow sensors - a common site for soil build up,
- liners,
- long milk lines (especially the top of the line),
- bungs and valves at the base of jars,
- Receiver vessel,
- dead-end areas.
- bulk tank.

Once a problem has been identified it is necessary to find out why it has occurred. The only way to investigate is to attend the wash-up routine and check the following;

- Current wash up routine
- Water temperature of the boiler,
- Boiler capacity - is there 18 litres capacity per unit available for washing,
- Volume and concentration of the wash-up solutions,
- Circulation time
- Is the entire plant being cleaned - check each milking unit,
- Are chemicals being used in accordance with the manufacturers recommendations,
- Are there any blocked wash jetters,
- Are the air injectors functioning,

In summary, the wash-up routine is a vital part of clean milk production. A good wash-up routine will help to maintain the life of the milking equipment while protecting milk quality through low TBCs.

## **PROBLEM HERD**

A client who had installed a new milking machine was experiencing problems with his TBCs and submitted a sample of bulk milk for bulk sample analysis. The results are listed below;

<b>Test</b>	<b>Result</b>	<b>Target</b>
TBC	41,000	< 10,000
Coli Count	20	< 25
LPC	2,780	< 500

The bulk sample shows a low level of environmental contamination (Coli Count) but a high level of thermodurics (LPC) which indicates a problem with the wash-up routine. A visit was arranged to coincide with the wash-up routine following morning milking. The farm visit revealed the following;

The boiler capacity was 144 litres for 16 milking units, equivalent to 9 litres per unit. The minimum figure is 18 litres. Immediately after milking the plant was rinsed through with cold water to waste thereby cooling down the plant and congealing butterfat. Water out of the boiler was 64 C but the guage read 90 C. The temperature in the trough beofre circulation was 61 C, after the first cycle it was 35 C and at after 5 minutes was 33 C. Due to the design of the plant, wash solutions travelled through 81 meters of unlagged pipes before returning to the wash troughs. The correct amount of detergent was used for the amount of hot water but no allowance was made for the hardness of the water. The hot wash was circulated for 15 minutes folowed by a hypochlorite rinse.

### **Action required;**

- Boiler capacity to be increased by a minimum of 144 litres
- Rise the plant with warm water after milking
- Service the boiler and fix the thermostat
- Lag the wash lines
- Increase detergent usage by 50% to compensate for the hard water
- Hot wash cycle to circulate for a maximum of 8 minutes

Reluctantly, the owner installed a new boiler and lagged the wash lines. He followed the recommendations made and another bulk sample was collected and the thermoduric count was down to 150 cfu/ml. Result, a happy client impressed by the use of bulk tank bacteriology and way the problem was investigated with a successful conclusion.