SECTION IV: PROPER MAINTENANCE AND USE OF MILKING EQUIPMENT

TABLE OF CONTENTS

1. PARLOURS

Parlours are effective milking management systems on many dairy sheep operations. The ability to milk a number of ewes at one time allows for effective milking times, which is extremely beneficial for time management on-farm, and can also be economically efficient, as a milker's time can be reduced in the parlour. In addition, with a parlour system, the animals are standing at a platform which is elevated from where the milkers stand, which avoids bending to apply milking machines.

Fig. 1. Double-sided low-line parlour, milk from behind

Although these are very beneficial systems, it is important to understand the differences between parlours, how to manage each type properly, as well as how to manage ewes through these systems, from pre-milking to post-milking.

1.1 TYPES OF PARLOURS

Although there are many similarities between parlour types, each system has to be handled in a specific way to ensure that all ewes are being handled properly, and that the upmost care is taken to ensure optimal udder health.

1.1.1 MILKING FROM BEHIND

Parlours in which the ewes are milked from behind are called parallel parlours and are the most common type seen. A group of ewes go through a side of the parlour at one time, and are all milked at the same time, and released from the parlour at the same time. Parlours may be single-sided or double-sided (Fig. 1). With the latter, when one side of parlour is milking, the other side is being prepped for milking, which increases parlour efficiency.

Fig. 2. Entering parlour. Milk from behind

When entering a parallel parlour, ewes walk straight into the parlour, and then when they reach their designated milking stall, they turn 90°, so they are standing away from the milker pit at a perpendicular angle (Fig. 2). These parlours allow for easy access to teats, as the ewe's legs do not block the udder and teats.

One downside to parallel parlours is that the group must all be finished before leaving and allowing the next group to enter. This means that the speed is as slow as the slowest milking ewe in the group.

1.1.2 MILKING FROM THE SIDE

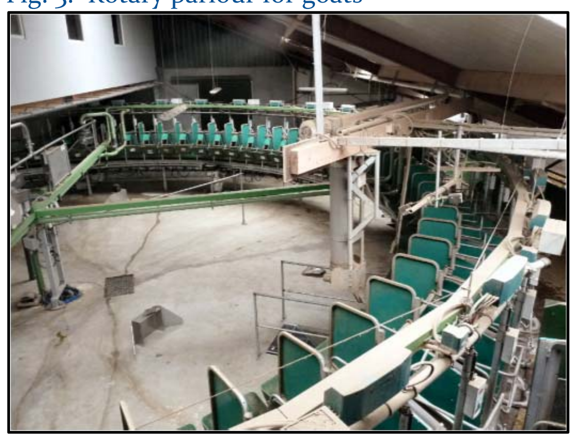
Parlour systems that allow milking from the side are called herringbone parlours and are not commonly used when milking sheep. They are essentially the same style of parlour as parallel parlours, except for the stall positions when being milked. The ewes enter the parlour, and they stop at stalls that are angled slightly outward from the parlour, with the ewes' head being farther away from the milking pit then their hind ends. This positioning allows for faster entry into the milking parlour, which can decrease overall milking time. However, fewer ewes can be milking in the same space.

There are a few issues to consider when milking in a herringbone parlour. The first is the possibility of being kicked by the ewes during milking, as both milking prep and attachment of the milking unit have to be done around the back legs. When milking, it is also important to ensure that the teats are being stripped and wiped on the teat farthest from the milker pit first, following by the teat closest to the milking pit, and that the milker unit is placed on the teat closest to the milking pit first, followed by the teat farthest from the milking pit. By milking in this manner, it decreases the risk of contaminating teats when reaching over to wipe, or attach the milking unit, which in turn decreases the risk of transmitting pathogens to the teats.

1.1.3 ROTARY

Rotary parlours have become increasingly popular in the dairy industry, as these systems maximize milking efficiency on-farm. Ewes enter the parlour one animal at a time. Rotary parlours are circular, and rotate slowly, to allow for ewes to walk into their respective stalls. The parlour rotates them around to be prepped, milked and post-dipped, finishing with exiting the parlour. Ewes may face head-in or head-out.

Fig. 3. Rotary parlour for goats



Milkers prep the animals at the beginning of the parlour rotation, apply the milker unit, and then the ewes are milked for the majority of the parlour rotation. Once the parlour has almost finished its rotation, the milker unit is released; the ewe is post-dipped, and ready to exit the parlour.

These systems should be used with automatic take-offs to assure over-milking does not occur; this is because rotation time, i.e. milking time is set by the speed of the rotation of the parlour.

Fig. 4. Pre-milking pen

1.2 PRE-MILKING PENS

Before being milked, ewes are brought into a pre-milking pen, or holding area that is close to the parlour (Fig. 4). Generally, ewes from a whole pen are brought into the holding area at one time, so they can stay segregated into their respective groups. Ewes then enter the parlour from this area.

1.3 BRINGING THE EWES INTO THE PARLOUR

Fig. 5. Ewes exiting from the front

Ewes are brought into the parlour from their pre-milking pens (Fig. 2). After the ewes exit the parlour (Fig. 5), an entrance gate will be opened to allow a new group of ewes to enter the parlour side. Animals walk directly into the parlour, and after all stalls are filled, the entrance gate will be closed again, and milking procedures will commence.

For the majority of the time, ewes will walk directly into the parlour without issue, however with younger or problem ewes, a producer may need to help guide them to the parlour. This can be done manually, by walking behind the ewes, directing them into the parlour, or automatically with a crowd gate, which pushes the group towards the parlour. It is important that this be done by moving quietly and not shouting or using physical force. Any nervousness will inhibit milk let-down and reduce milk production (see Section I.1.2.2).

1.3.1 HEAD RESTRAINTS

Fig. 6. Head gates. Ewes can't back out

When sheep enter the parlour and go into their individual milking stanchions, there are two options for the head: the head is not restrained, or their head goes through a headlock system, so they are only allowed minimal movement during milking. A locking headgate prevents ewes from moving excessively during milking and encroaching on other animals.

1.3.2 FEEDING CONCENTRATE IN THE PARLOUR

Mangers are often placed on the other side of the headlocks to offer a concentrate feed during milking. While this occupies the ewes, assures that each ewe has access to grain - and may help to bring nervous animals into the head gate readily, there are risks with this type of feeding that should be appreciated.

Fig. 7. Ewes eating concentrate in parlour

DISADVANTAGES

Eating grain either twice or once per day (depending on how often the ewe is milked) is not good for rumen health. The rumen microflora should be fed concentrate, e.g. grain throughout the day – balanced with forages, minerals and vitamins to keep optimal rumen health (see Section I.2.4). Feeding the grain ration this infrequently may cause ruminal acidosis (also called grain overload when severe, or sub-acute ruminal acidosis when milder) and can cause the ewes to go off-feed, develop laminitis from the toxins released from the rumen, and the milk to absorb bad flavours. Some producers also report decreased cud chewing and sometimes cud dropping because of the digestive upset caused by this type of feeding.

Additionally, relying on milking time to feed concentrate, may mean that some ewes do not get enough and others too much. With the former, this can lower milk production and may harm reproductive performance if the ewes are too thin. With the latter, the ewes will get fat – and this is a waste of money. The best way to feed concentrate is in a balanced ration as a total mixed ration (Section I.2.4) and to not feed it in the parlour. Importantly, the dairy cattle industry has abandoned this practice now and cows will still readily come in to be milked.

1.4 TYPES OF MILKING SYSTEMS

1.4.1 PIPELINE

An overview of the components of a pipeline parlour system is provided in Fig. 8. In new parlours, pipelines are generally installed as a low-line system (Fig. 9- right), which runs below the milking units. This system provides a consistent downwards flow of milk to the line, which allows for stable vacuum. There is an option of having the pipeline above the ewes, called a high-line system (Fig. 9 - middle), which helps to keep the line away from the animals, and potential damage. Ideally, the highline will be no more than 1.8 m (6 ft) above when the milker stands in the parlour.

Pipelines should be sloped (a minimum of 1%) towards the receiver to help with the flow of milk, and be properly sized so the milk flows through the pipe without blockages and also ensure that the slugging action during the wash cycle provides enough volume and force to adequately clean all interior surfaces of the pipeline and system.

Fig. 8. Adapted from Dairy Practices Council publication DP 70

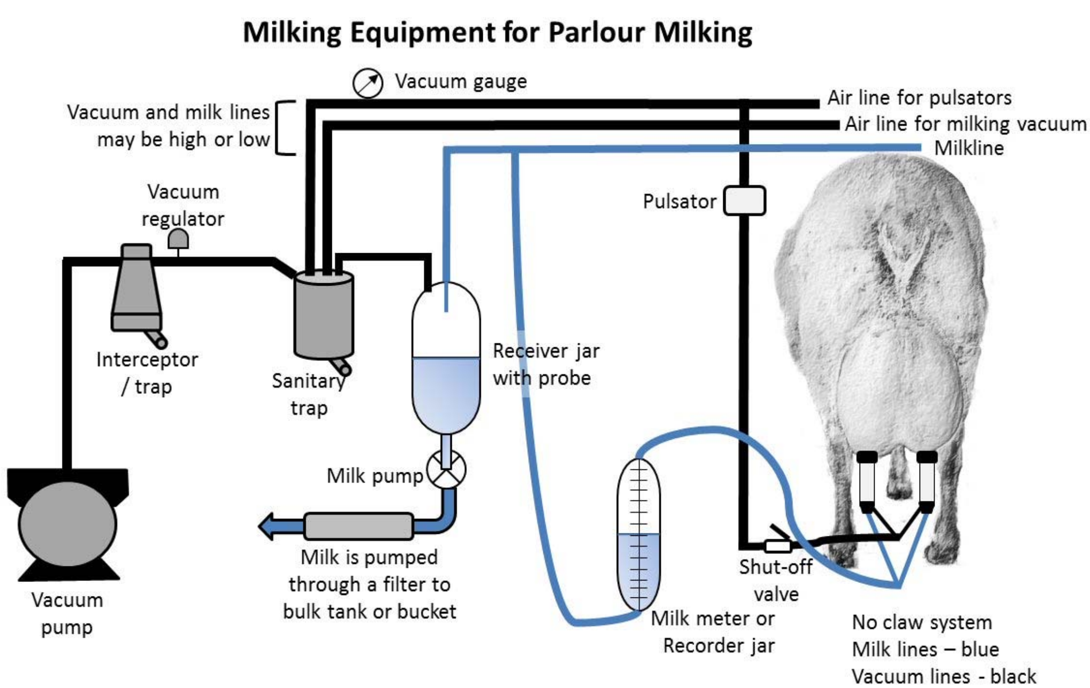
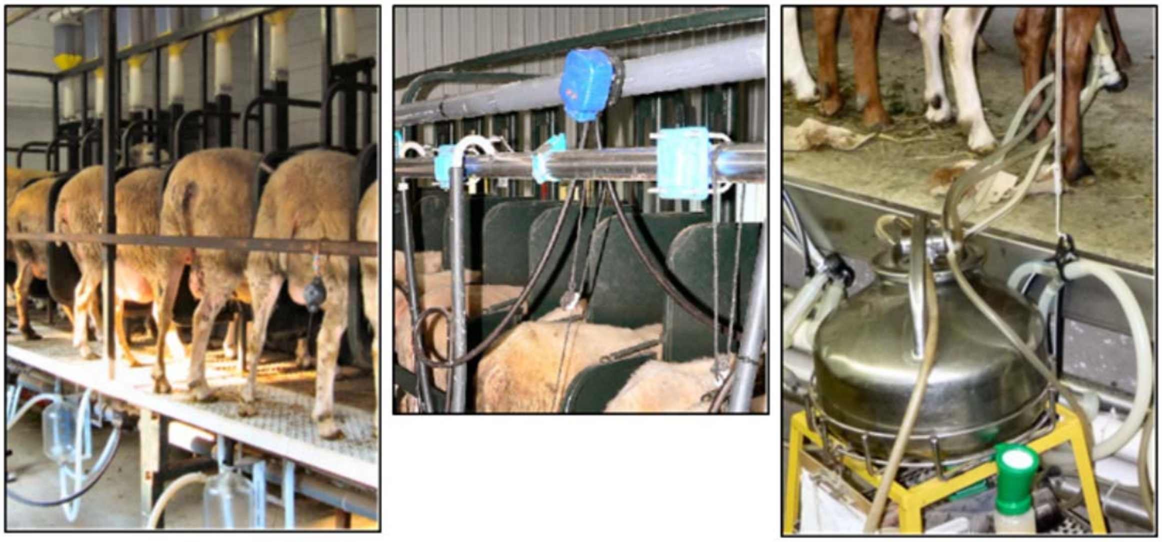
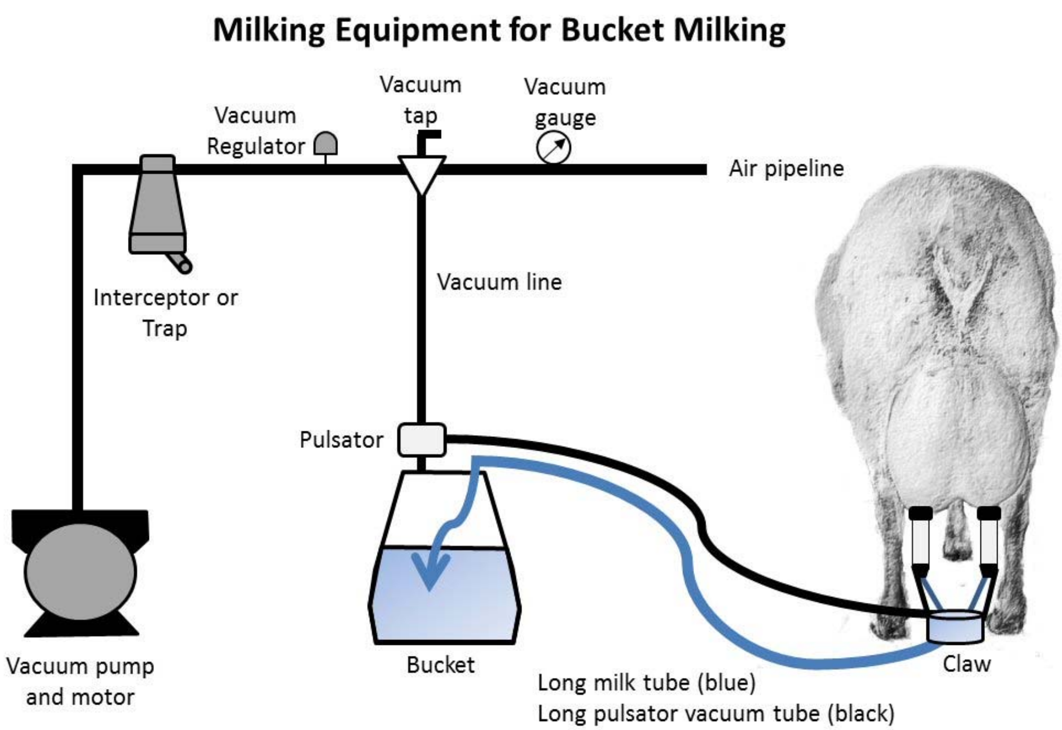


Fig. 9. Left - lowline; Middle - highline; Right - bucket milking system



1.4.2 BUCKET

Fig. 10. Adapted from Dairy Practices Council publication DP 70



A bucket system is commonly used with smaller dairies. It is also used to milk animals whose milk needs to be kept out of the tank (e.g. treated ewes, ewes with mastitis, fresh ewes) (Fig. 9- right). The milk storage unit is a sealed sanitary bucket so that vacuum can be used to pull the milk from the teats and hoses into the bucket (Fig. 10).

1.4.3 HANDMILKING

In this system, each ewe is milked into a pail with the milker sitting on a stool or raised platform beside or behind the ewe (Fig. 11- left). Ewes may be milked from the back or side. It is laborious but requires much lower financial input. Hand-milking of sheep and goats is common in Ontario.

1.5 RELEASING THE SHEEP

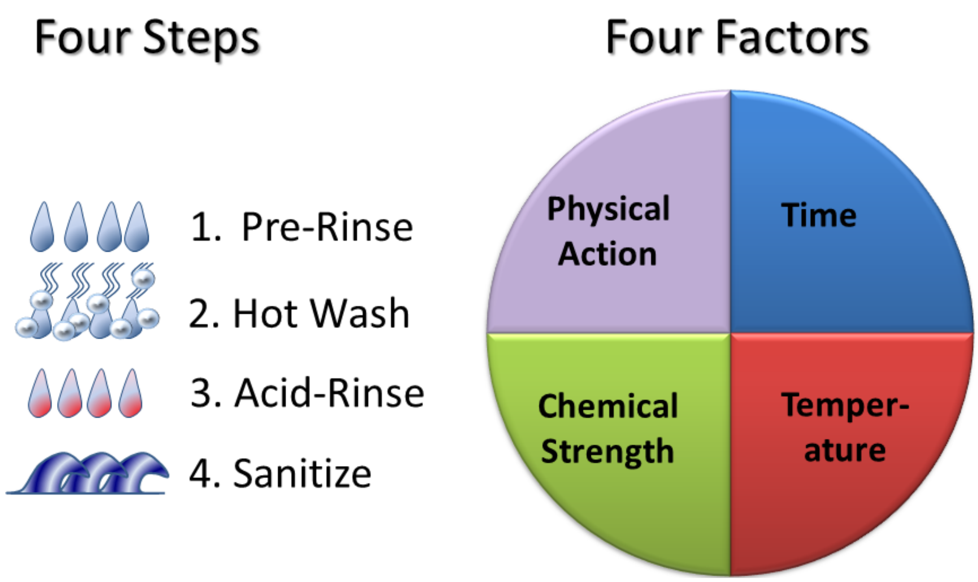
At the end of milking, sheep can exit the parlour in a variety of ways. In a parallel parlour, a rapid exit is a common system, where the front gate rises after milking, and all animals exit the parlour at the same time down the return lane to their housing pens (Fig. 11 - right). This exit system can also be done in batch or gang exits, where only a portion of animals are released at each time. This type of system tends not to use headgates. Exiting can also be done with the ewes backing up once released from the head gates. The head gate release is usually at one end of the parlour and all ewes are released at once. In a herringbone parlour, ewes exit the parlour in a single file and travel down the return lane back to their holding areas.

Fig. 11. Left – hand-milking; Right - hydraulic gate for releasing ewes from parlour

2. THE BASICS OF CLEANING MILKING EQUIPMENT

In order to provide high quality milk to the market place, a pipeline milking system must clean up perfectly after each milking. The four basics of cleaning are **Time**, **Temperature**, **Chemical Concentration** and **Physical Action**. These factors are important in each cycle of a clean in place (CIP) system (Fig. 12).

Fig. 12. **SANITATION 4X4.** The key steps and factors involved in the cleaning process for hand-milking, bucket-milking or pipeline milking are basically the same.



2.1 STEP 1 – RINSING MILKING EQUIPMENT SURFACES

Milking equipment should be rinsed and washed immediately after milking to avoid milk residues from drying on equipment. If not cleaned promptly, these residues will be very difficult to remove later.

2.1.1 PURPOSE

This step removes 90-95% of milk solids. The high solids content of sheep milk make this step particularly important. It also removes residual milk and dirt and serves to warm up the milk line for Step 2.

2.1.2 TEMPERATURE RANGE

Water temperature should start at 43 °C to 49 °C (110 °F to 120 °F). If water temperature becomes too cool, i.e. drops below 38 °C (100 °F) milk fat will solidify back onto the milk line. The temperature can also be too hot. A rinse temperature above 60 °C (140 °F) may bake on milk protein.

2.1.3 MANAGEMENT TIPS

The first rinse should be an open cycle and not recirculate, i.e. open to the drain so only fresh water is used (Fig. 13). Otherwise a milk film may be redeposited in the system. Use of a pre rinse divert valve will eliminate recirculation of milk soil and reduce the load that must be removed during wash cycle.

Fig. 13. First rinse should be discarded
Source: http://www.progressivedairy.com/

To reduce the amount of milk in waste disposal systems, some producers save the first-rinse water-milk mixture and feed it to livestock. Note, it is not suitable to feed this water-milk mixture as a substitute for milk or milk replacer to nursing-age animals as the milk doesn't contain enough nutrients.

2.2 STEP 2 – HOT CHLORINATED ALKALINE DETERGENT WASH

2.2.1 PURPOSE

This cycle removes fat, protein and other organic materials including large number of bacteria.

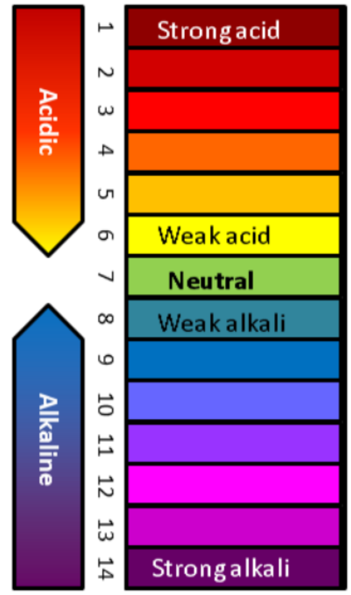
WHY HOT WATER?

Dairy detergents require hot water to work effectively.

WHY A HIGH PH?

The alkali in the cleaner reacts with milk fat breaking it down and suspending it in the cleaning solution. The chlorine chemical breaks up the milk proteins which are then also suspended in the wash solution. See Fig. 14 for range of pH numbers.

Fig. 14. pH scale.



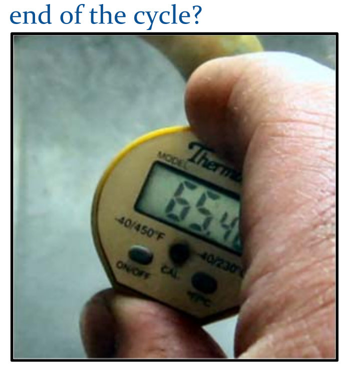
WHY DAIRY DETERGENTS?

Dairy detergents contain sequestering agents or chelating agents which tie up hard water minerals such as calcium and magnesium. Chelating agents prevent minerals from precipitating out of solution and forming films on the milk contact surfaces (milk stone). Dairy detergents also contain surfactants which decrease the surface tension of the solution and assist in penetrating the milk soils. Use only approved dairy cleaners. Non-dairy cleaners are less effective and over time will lead to the development of films and residues, which leads to high bacterial counts in the milk.

2.2.2 TEMPERATURE RANGE

Start temperature should be 74 °C (165 °F). Water temperature at the end of the cycle must be **absolutely no less than 49 °C (120 °F)** (Fig. 15). Circulation time is usually 6 – 10 min. Adequate end temperature is more important than precise wash solution contact time.

Fig. 15. Hot enough at the end of the cycle?



2.2.3 MANAGEMENT TIPS

WATER QUALITY

The wash solution is mostly water - 99% or higher. The amount of detergent used depends on volume of water and water hardness. Hard water can reduce the effectiveness of dairy cleaning products. A water softener is recommended for hardness over 20 grains.

Most labels will specify amounts to use per quantity of water, according grains of water hardness. Your chemical supplier should provide a wash procedure chart, which reflects the types and amounts of cleaners required for each cycle. Follow the recommendations!

Fig. 16. Hot water tank in good repair

ALKALINITY OF THE CLEANING SOLUTION

The pH of the caustic cleaning solution should be between 12 and 13 (Fig. 14). Handle using gloves and goggles to reduce risk from splashing. The active alkalinity needs to be in the 600 - 900 ppm range, in the higher range for bulk tank and milk meter cleaning.

INVESTIGATE WATER TEMPERATURE IF CLEANING AND BACTERIAL PROBLEMS

The water heater needs to be adequately sized for your requirements. The actual amount of hot water available from a tank is about 70% of its capacity. So a 40 gallon tank only provides (40 X 0.7) 28 gallons of hot water!

Using hot water for other uses e.g. mixing milk replacer, can reduce the availability of hot water for pipeline washing. Recovery rates will vary depending on your specific heater. The time between a pipeline wash and a bulk tank wash needs to be long enough to allow the water heater to recover.

Water heater problems can go undetected for a long time if you do not monitor wash temperatures. Calcium and magnesium salts can accumulate in water heaters and reduce heating capacity to below adequate. A burnt out bottom element is a frequent problem. Buildup of mineral in water pipes and screens can restrict the flow of water to the wash control box causing improper temperatures at the wash sink.

Fig. 17. Maintain water level

Unplanned admissions of air into the milking system cools wash water very rapidly and may cause poor slugging. Maintain water level in wash sink so that suction lines never draw air (Fig. 17). The pipeline must be free of air leaks at joints and milk inlets.

PHYSICAL ACTION / SLUGGING OF CLEANING SOLUTION

Most modern pipeline systems rely on slugs of cleaning solution to provide scrubbing action. If your system has an air injector, proper adjustment is essential.

Keep filters clean; a blocked air injector results in a poor slug. The air injector open time determines slug travel distance. The open time should be just long enough to cause the slug to travel to the receiver jar before it breaks up. The air injector closed time determines the amount of water drawn in and initial slug length.

Fig. 18. Receiver jar wash-up

- Slug volume should be about 1/3rd the volume of the receiver.
- Slug velocity needs to be 7-10 m/sec (23 to 33 ft per sec).
- Minimum of 15 slugs per wash.

The following indicates there may be an issue with air injector location or timing:

- The water level in the receiver does not change during the cleaning cycle
- The milk pump never shuts off during the cleaning cycle
- The system "traps out" (the ball valve in the sanitary trap shuts off system vacuum during one or more wash cycles)
- A large volume of water drains from the distribution tank when the vacuum pump is shut off after cleaning
- Air is drawn into the system at the wash sink.

Douglas J. Reinemann Trouble Shooting High Bacteria Counts in Farm Milk 1997

Fig. 19. Manually clean bulk tank

Automatic wash bulk tanks are more difficult to clean because the spray may only hit a small surface area. Cleaning is achieved by a sheeting action. The entire surface of the tank needs contact with the cleaning chemicals. You may need to manually clean your tank to be sure all surfaces are adequately scrubbed (Fig. 19).

DRAINAGE IS IMPORTANT

Wash temperatures as well as chemical concentrations can be adversely affected by residual water from previous cycles. All secondary drains, especially from the receiver must be large enough to drain completely before the next cycle. All milk lines and wash lines need adequate and continuous slope to allow for complete drainage between cycles. Inadequate drainage in the system results in mixing / neutralizing of cleaning chemicals. This can affect solution temperatures and strength. Poorly drained equipment allows bacteria growth between milkings.

2.3 STEP 3 - ACID RINSE

2.3.1 PURPOSE

This cycle removes detergent residues, neutralizes alkali residues and prevents mineral deposits. The acid rinse leaves the pipeline with an acid pH, (pH 4.0 or less, see Fig. 14) which suppresses bacteria growth. An acid rinse also increases the life of inflations and gaskets. If an acid rinse is not completed rubber ware starts to ink quickly indicating that the rubber is deteriorating and not doing its job of providing a water-tight seal.

2.3.2 TEMPERATURE RANGE

Water temperature is not critical in this cycle but should comply with label recommendation as posted on wash chart.

2.3.3 MANAGEMENT TIPS

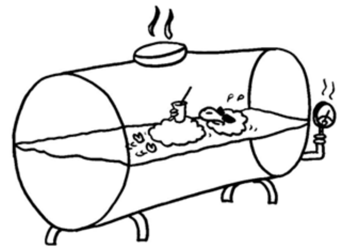
The acid rinse pH should be between 2.5 and 3.5. Handle using gloves and goggles to prevent injry from splashing. **NEVER mix an acid detergent with a chlorine-based product.** This produces a highly lethal chlorine gas which, when enhaled can destroy the lungs of animals and people, in a very short period of time.

2.4 STEP 4 – SANITIZE

2.4.1 PURPOSE

This cycle is completed to eliminate bacteria that may grow on equipment surfaces between milkings even when well cleaned and acid rinsed.

2.4.2 TEMPERATURE RANGE



Use warm water 43 °C – 60 °C (110 °F – 140 °F)

2.4.3 MANAGEMENT TIPS

Use a solution containing 100-200 ppm chlorine. The sanitize cycle should be completed just prior to milking – no more than 30 min prior to milking and should circulate for 3 to 4 min. It should be run before installation of an inline milk filter.

2.4.4 TYPES OF SANITIZERS

CHLORINE

Chlorine is the most popular dairy sanitizer. It has activity at low temperatures, is relatively inexpensive, and leaves minimal residue or film. It is a broad spectrum bacteriocidal chemical (kills many forms of bacteria). It is minimally affected by hard water but is corrosive if present in too high concentration. Chlorine is minimally affected by hard water. A maximum of 200 ppm chlorine should be used just prior to milking.

The major disadvantage to chlorine is corrosiveness (especially at high temperatures). Avoid using hot water in the sanitize cycle, cold or tepid is acceptable. The activity of chlorine is reduced by organic load and by alkaline pH. Chlorine sanitizers must not be mixed with acid cleaners because at low pH deadly chlorine gas can be formed.

IODINE

Iodine also has broad spectrum microbial activity. Iodine sanitizers mixed with a surfactant are termed iodophores. Organic matter has less effect on iodophores than on chlorine. Iodophores have more residual activity than chorine. A concentration of 12.5 to 25 ppm is recommended for iodophore sanitizers.

The major disadvantage is that iodine can cause staining, particularly on plastics. Iodine vaporizes at temperatures above 120ºF / 49ºC. Loss of activity occurs at a high pH.

PEROXYACETIC ACID

Peroxyacetic acid (PAA) is stable at use strengths of 100 to 200 ppm. These sanitizers are non-corrosive and tolerate hard water. PAA solutions have been shown to be useful in removing biofilms – important when troubleshooting high bacterial counts in the milk. PPA solutions have a pungent odour.

2.5 CLEANING MILK CONTAINERS

2.5.1 CLEANING THE BULK TANK

Bulk tank cleaning involves the same cycles and temperatures as pipeline cleaning. Often bulk tanks are a more difficult vessel to clean than a pipeline. Achieving a 120 °F / 49 °C end temperature of the hot wash can be challenging. Automatic bulk tank washers deliver a spray of cleaning solution which sheets over the surface. There is much less shear force or physical action as compared to pipeline slugging. The spray-ball or jet tube must deliver cleaning solutions to all interior parts of the bulk tank. Watch for plugged spray heads and incomplete drainage between cycles.

Listed below are areas where cleaning problems frequently occur in bulk tanks.

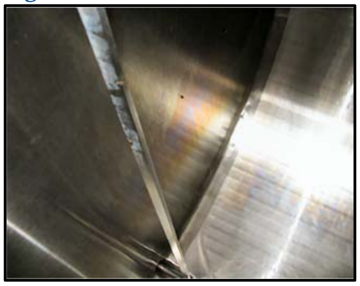
- Outlet and valve
- Plug and plunger rod
- Under the bridge and lid
- Dipstick and dipstick socket
- The corners of a square tank
- Agitator paddles

2.5.2 CLEANING MILK CONTAINERS USED FOR FREEZING MILK

Fig. 20. Buckets for milk need to be cleaned between uses

The cleaning procedure is labour intensive: first warm rinse, followed by brush cleaning each bucket with a hot chlorinated alkaline dairy detergent. Then rinse with dairy acid. Let thoroughly dry before stacking or nesting together. If they are stacked wet, molds and bacteria may grow causing later milk contamination and off-flavours. The lids and pails should be stored on the farm where they don't get dirty or dusty. Check with the processor to determine cleaning procedures at the plant. Ideally the processor will thoroughly clean and sanitize the pail and lid with chlorine after removing the milk.

Fig. 21. Protein film in tank



2.6 RESIDUAL FILMS ON MILKING EQUIPMENT

Cleaning failures usually result in a visual buildup or residual film in some part of the milking equipment. Films can often be diagnosed by scrubbing a small area with concentrated acid or detergent solutions. There are two categories of residual films:

2.6.1 ORGANIC FILMS

Organic films are usually composed of fat or protein. Protein films can appear as a blue rainbow colour (Fig. 21) or a brownish slime (applesauce). Beads of water hanging on the top side of the pipeline or receiver jar may indicate a fat film. Fat films are alkaline soluble. Protein films are soluble in chlorine.

BIOFILMS

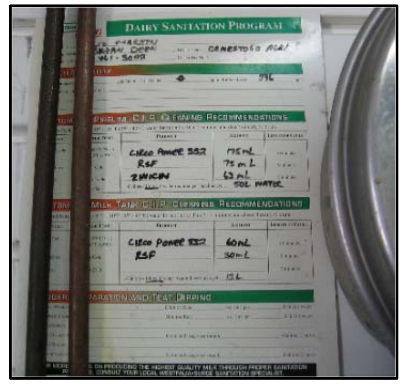
Fig. 22. Mineral deposit

Microbiological films, a type of organic film, can form under certain conditions. These films are called biofilms and can be very difficult to remove. Often there is no obvious residue but the stainless lacks the sheen of a clean surface and may appear a dull grey colour. A group of bacteria known as pseudomonads are often linked to biofilms. These biofilms shed billions of bacteria and cause a significant increase in standard plate counts (see Section V.3). Cleaners and sanitizers with strong oxidizing properties have proven to be effective in biofilm removal. Peroxyacetic acid sanitizers are effective in biofilm removal.

2.6.2 INORGANIC FILMS

Inorganic films are typically hard water minerals such as calcium, magnesium and iron (Fig. 22). Mineral films have a rough porous texture and are invisible when wet. Inorganic films are usually acid soluble.

Fig. 23. Posted cleaning instructions



2.7 TROUBLESHOOTING CLEANING

If a cleaning problem is suspected, begin troubleshooting the simplest things first. Observe one complete cleaning cycle (pipeline and bulk tank). Make sure that the manufacturer's cleaning instructions are being properly followed (Fig. 23). Note times and temperatures of each cycle. Verify amounts of cleaners used (Fig. 24 - left) and if possible chemical concentration (e.g. pH, Fig. 14).

A hand held thermometer is essential (Fig. 24 - right). A visual inspection of the milk contact surfaces requires a strong flashlight (Fig. 24 - right). This is particularly important for bulk tank examination. Mineral deposits and biofilms are difficult to detect when stainless steel is wet. Allow surfaces to dry prior to visual inspection. For more information, see Section V.3.5.

Fig. 24. Left - verify cleaners used correctly; Middle - pH paper to check acidity / alkalinity; Right - thermometer and strong flashlight

EXAMPLES OF PROBLEMS EASILY DETECTED

- Low end temperature of wash water
- Improper temperature at beginning, middle of cycle
- Wash draw line in the sink is sucking air
- The system "traps out" or sanitary trap floods causing shut-down of the wash system
- The hot wash circulates only once and then drains
- The sink drain is leaking and losing cleaner down the drain
- Poor washing action is one or more claws or hoses due to a plugged jetter
- Incomplete drainage from pipes etc. between the cycles

2.8 PLANNING A PARLOUR FOR CLEANING

2.8.1 KEEP IT COMPACT

Parlour design should minimize milkline, wash-line and airline lengths. Every extra foot of pipeline adds complication for cleaning. The length of pipeline from the milk-house to the parlour needs to be minimized. This will reduce heat loss during cleaning and reduce water volume requirements.

Fig. 25. Milk meters need extra cleaning

2.8.2 KEEP IT SIMPLE

Additional components such as milk meters can be difficult to clean. If you use these components as a management tool, be prepared to do some extra cleaning!

3. SET-UP AND INSPECTION OF MILKING EQUIPMENT

Having a standardized inspection of milking equipment on a regular basis is important to make sure that the system is functioning properly. For an excellent overview of the components of a milking machine system, visit the FAO website[1]. Proper inspection should be done by an equipment dealer representative on an annual basis, and if particular issues arise. On a daily basis, the system should be looked over by producers to see detrimental fluctuations which could influence it's efficiency.

3.1 PROPER SET-UP OF MILKING EQUIPMENT FOR DAIRY SHEEP

Sheep are different from cows in that they have lower milk production, higher fat levels, smaller teat orifices and larger cisterns as a proportion of daily milk production. For all of these reasons, set-up of equipment may be different that the dairy cow. The following recommendations come from the International Dairy Federation (IDF)[2] and the Dairy Practices Council ® (USA) (DPC)[3].

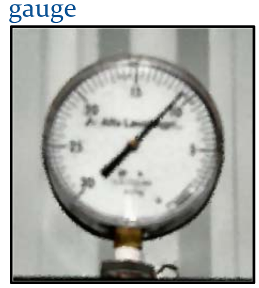
3.1.1 VACUUM

VACUUM LEVEL

The recommended claw vacuum at peak flow is 9.5 to 11.5 in of mercury (inches Hg) or 32.5 to 39 kilopascals (kPa). Usually to achieve this, the system is set-up as indicated below:

- High Line = 12.5-13.5 " Hg; 42-46 kPa
- Low Line = 10.5-12 " Hg; 36-41 kPa
- Mid Line = 11.5-13 " Hg; 39-44 kPa

Fig. 26. Vacuum gauge



[1] FAO United Nations http://www.fao.org/docrep/004/t0218e/t0218e02.htm
[2] International Dairy Federation http://www.fil-idf.org/Public/ColumnsPage.php?ID=23077
[3] Dairy Practices Council http://www.dairypc.org/

Higher values may lead to teat-end damage and slower milking. Lower values may lead to units dropping off during milking.

VACUUM LINES

The materials used for the vacuum lines should be able to withstand vacuum levels of 85 kPa (25" Hg). For the main vacuum line length and diameter recommendations, consult the "Dairy Practices Council® Guideline for the Design, Installation and Cleaning of Small Ruminant Milking Systems" (DPC 70, 2000).

VACUUM PUMP

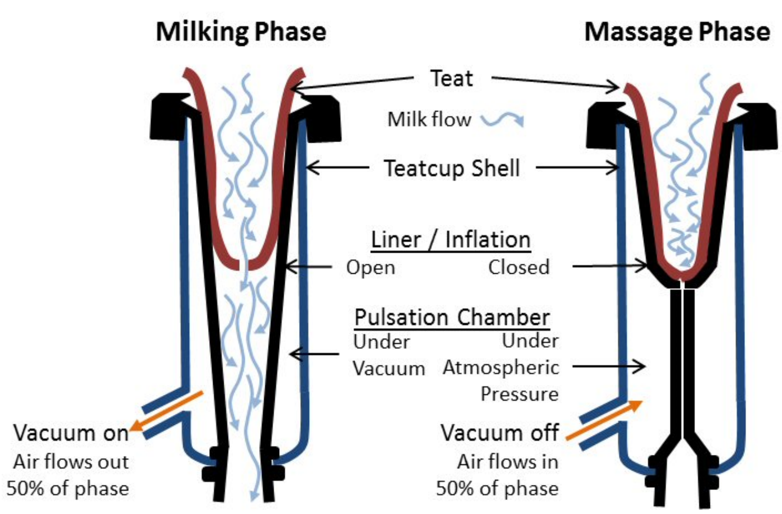
Vacuum pumps need to be located close to the parlour but in a clean and dry location, free of dust and extremes of heat and cold. The document DPC 70, 2000 – provides recommendations of the air flow requirements needed for milking and washing – both for bucket systems and pipeline systems. It also provides recommendations on changes needed if the farm is located above 300 m (1000 ft) sea level, as more vacuum is required to compensate for the thinner air.

VACUUM RESERVE

Sufficient vacuum reserve is necessary to prevent liner slips and squawks, drop-off of inflations and drop in vacuum resulting in fluctuations and milk impacts. Information that is used to calculate this amount includes: type of milking system (pipeline versus bucket); number of units; whether conventional clusters or those with automatic teat cup valves; and whether an automatic shut-off valve is used with the cluster. Elevation is also important as more reserve is needed at higher elevations above 300 m (1000 ft) sea level. Tables are available in the IDF Bulletin 370 (2002) so that a specific recommendation can be made for your facility.

3.1.2 PULSATIONS

Fig. 27. Action of the teat cup during machine milking



The pulsations allow for vacuum changes in the teat liner / inflation to gently squeeze the teat sphincter to open and shut, allowing for removal of milk (Fig. 27). During the milking phase, the vacuum removes the air from the pulsation chamber – the space between the liner and the shell of the teat cup. This forces the teat sphincter open and allows milk to be pulled from the teat. When the vacuum is shut off, air enters the pulsation chamber, collapsing the liner and allowing the teat sphincter to close. Milk does not flow and the teat relaxes. Changes from the milking phase to the massage phase must be rapid to allow blood to flow back into the teat during the massage phase.

PULSATION RATE

For dairy sheep, the recommended rate is 90 to 180 cycles / min, with 120 cycles being most commonly recommended. There must be adequate rest time between each cycle to allow for blood flow back into the teat. If not, then teat damage may occur. For this reason, adapted pulsators designed for use in dairy cows should not be used as the change from open to closed and open again may not be fast enough given how rapid the pulsations are.

Fig. 28. Pulsation rate and ratio

PULSATOR RATIO

Pulsator ratios are usually between 50% and 60%, similar to dairy cattle, with 50% most commonly recommended. The pulsator ratios should not vary between units by more than 5%.

PULSATION LINES

The vacuum line to the pulsators should be 2 in (48 mm) in diameter. If using more than 36 milking units, the diameter should be 3 in (73 mm). The slope should be 0.4% (4 mm per metre of line length) to the vacuum distribution tank.

3.1.3 MILKLINES

SLOPE OF THE MILKLINE

Milklines should have a continuous and even fall towards the receiver jar, with a minimum of 10 mm (1 cm) of drop for every metre of pipe. This translates into a minimum decline of 0.5%. For example, if the distance from the furthest sheep being milked to the receiver jar is 20 metres (66 ft), then the minimum drop must be 10 cm (~ 3”).

COMPOSITION OF THE MILKLINE

The inside of the milkline should be as smooth as a Number 4 mill finish in stainless steel sheet. It needs to be free of any marring of the inside surface, e.g. pitting, cracks, crevices. All welds of joints, ferrules and gaskets should also be smooth with no pits. There should be inspection ports to allow for visual inspection of the inside of the milkline.

FLOW OF MILK THROUGH THE MILKLINE

The flow of milk inside the milkline should be at a level of less than 50%, i.e. there should be more air above the level of milk than milk below. This is called "stratified flow" (Fig. 29). Slugs of milk flowing through the milkline, where the level of milk fills the milkline, will cause a drop in vacuum (usually greater than 2 kPa) and result in longer milking times, and more liner slips.

Flow rates of milk will vary between breeds of sheep and perhaps between stage of lactation. The following milk flow rates have been suggested by the IDF:

- Low milk flow animals = a maximum of 0.8 L of milk/ min
- Medium milk flow animals = a maximum of 1.3 L of milk / min
- High milk flow animals = a maximum of 2.7 L of milk / min

Fig. 29. Milk flow through line

If flooding occurs during peak milk times (e.g. when ewes are in early lactation), you may need to decrease the number of units on at any one time to prevent "seasonal" flooding.

Based on research, sheep tend to either milk-out quickly (75 to 100 sec), or slowly (125 to 200 sec), with most milking out in less than 2 min (120 sec). High milk flow animals tend to milk out more quickly than low milk flow animals.

Milk flow rates and volumes will vary by number of units being used and type of animal being milked (flow rate and length of time for milk-out). Udder stimulation and subsequent milk-let down will also impact milk flow.

To calculate the minimum diameter of the milkline needed to keep a stratified milk flow, consult the IDF Bulletin 370 (2002), using information on expected maximum milk flow, number of units, type of milk-line (dead-end versus looped) and slope.

3.1.4 MILKING CLUSTER

CLAW

Milking clusters may or may not use a claw. The claw of the cluster should be large enough so no flooding occurs during maximum milk-out. If flooding occurs, milk may move from one teat cup to the other and transfer mastitis bacteria to the other gland.

Fig. 30. Claw size large enough?

INFLATIONS

The size of the inflation opening should be adequate for the teat size of the sheep. Recommendations on inflation maintenance are provided in Section IV.3.2.1.

AIR VENTS

The milking cluster requires air vents so that the milklines do not become flooded. The air vents are located either in or near the claw or in the tube close to the teat cup inflation. They should be as small as needed to allow milk to move without flooding.

Fig. 31. Shut-off valve

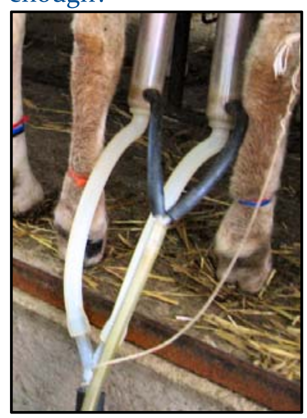
SHUT-OFF VALVE

There should be a shut-off valve installed to break the vacuum between the milk line and the inflation. This should be used every time a milking unit is removed. Automatic shut-off valves are recommended but must be properly calibrated so that sheep are not over or under-milked.

MILK HOSES FROM TEAT CUP TO MILKLINE

If no claw, the milk hoses from each teat cup to the bucket or milkline should extend long enough (1 m) to prevent milk flow back to the other gland. However, they should not be longer than 3 m (9 ft). They should enter the pipeline perpendicular and at the top half of the line.

Fig. 32. Milk hoses long enough?



3.1.5 RECEIVER TO MILK TANK

RECEIVER

The receiver jar should be located in the milk-room or parlour. From the receiver jar, one line goes from the top of the jar to the trap - preventing milk or cleaning solution from entering the vacuum distribution tank. Another line goes to the bulk tank. A probe within the jar when triggered by the rising milk level will start the milk pump to move the milk from the jar to the bulk tank. Flooring should be impervious, washable and with an adequate and well-maintained drain. Souring milk will also cause bad odours which may be absorbed by the saleable milk.

MILK FILTERS

All milk (whether going through a pipeline or strainer) must be filtered prior to storage. Use only filters designed for use with milk and replace after each milking. Milk filters (in-line and strainer-type) should be replaced before or after each cleaning as determined by milking equipment manufacturer's recommendations. The filter will screen out debris and sediment (such as straw and large dirt particles) and some mastitic milk (i.e. clots). Checking the filter for signs of mastitis and other debris can help you to identify problems (e.g. adequate udder preparation (Fig. 34). The filter is not a replacement for proper udder and teat preparation (see Section III.1.1). Filters should also be used for hand-milking before the milk enters the bulk tank or bucket for storage (Fig. 35).

Fig. 33. Receiver jar with milk pump and trap

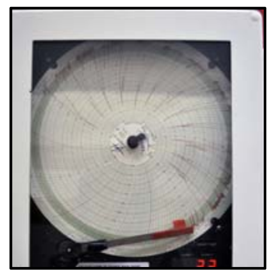
Fig. 34. Cleanliness of milk filter reflects udder preparation and health. Left – filter containing feed material and manure. Right –little dirt indicating good udder prep in this flock.

Fig. 35. Milk poured through strainer fitted with filter. System used with hand-milking.

3.2 MAINTENANCE OF EQUIPMENT

It is important to monitor milking equipment on a regular basis to determine if maintenance needs to be performed. Daily monitoring of the bulk tank temperature to identify inconsistencies is important to the maintenance of milk quality (Fig. 36). Weekly monitoring of pre-rinse or wash water, as well as inspection of problem areas in the milking equipment should be done to monitor build-ups, cracks and leaks. If there are any issues at these weekly inspections, maintenance should be done by producers, or by equipment dealers as soon as possible after the problem is detected.

Fig. 36. Monitor temp of bulk tank



The system should have a thorough evaluation completed by an equipment dealer annually to make sure the equipment is functioning properly. In addition, oil for the vacuum pump should be monitored and changed when needed. The vacuum pump, as well as the valves and screens need to be cleaned twice a year. Inflations should be changed as required, as set by the equipment dealer, or if there is a leak.

3.2.1 REPLACE MILK INFLATIONS (LINERS)

Milk inflations need to be replaced when worn. Rough inking and porous inflations can harbour bacteria and negatively impact milk quality. Worn inflations can harm teat end health predisposing ewes to mastitis. Breakdown of silicon will allow milk fat and solids to migrate into shells (the outer portion of the teat cup). Bacteria can also increase risk of mastitis.

GUIDELINE FOR REPLACEMENT

This can be calculated based on the rating of the inflations and how often they are used.

Fig. 37. Worn inflation

1. Number of milkings / day for each unit = (# milking sheep / # of milking units) X 2
2. Number of days to change inflations = # of milkings/day (#1)

E.g.
200 ewes milking in a 24 unit parlour, being milked twice day = (200/24) X 2 approximately 17.
If using silicone inflations with a rating of 6500 milkings, then inflations should be changed every (6500/17) = 390 days. If using rubber inflations, the rating is much lower, i.e. ~ 1500 milkings or as per the equipment dealer.

Sometimes the inflations need to be replaced more often than manufacturer's recommendations. Things that can influence this:

- If > 60 cycles/min is used as is the case with sheep, where 120 to 150 is most commonly used, they may wear faster.
- If the ratio of washings to milking is higher (e.g. smaller dairy with same number of units used), the inflations may also wear out with fewer milkings.
- Excessive chlorine use.

3.2.2 MONITOR AND REPLACE RUBBER WARE

Fig. 38. Inking from rubber breakdown

As with milk inflations, rubber ware breaks down with time, use, exposure to heat, cold and chemicals. Worn parts can harbour bacteria and leak milk. Rubber, which is breaking down, leaves a black residue called "inking" on surfaces. This is a sign that the rubber part needs replacement.

GUIDELINES FOR REPLACEMENT

- Replace silicone milk hoses every 2 years
- Replace plastic milk hoses every year
- Replace black gaskets every year
- Replace silicone gaskets every year
- Follow guidelines of dealer unless worn rubber indicates more frequent replacement is needed

Fig. 39. Check sanitary trap for cleanliness

3.2.3 CHECK FOR RESIDUES AND WEAR ON EQUIPMENT

- Manually cleaning of the jetter cups will increase their life expectancy
- Check the milk wash plug for inking. Check it also for cleanliness. If a short plug is used for milking, make sure it is manually cleaned after each milking.
- If a jet tube tank washer is used, check the outlet valve and clean routinely. Keep the tip of the jet tube up off the floor to keep cleaner. Check for wear on the impeller – remove to inspect.
- Inspect the washer pump hose for debris. The spray ball may plug with debris – a cap may reduce this.
- Periodically inspect and clean shut-off valves.

Fig. 40. Check tank for milk residues

Fig. 41. Milk tank equipment needs to be inspected and cleaned after every pick-up

3.2.4 BULK TANK MAINTENANCE

VISUALLY INSPECT THE TANK AFTER WASHING

Open the hatch after washing and let the surfaces dry before inspecting (Fig. 40). Wet stainless steel will appear clean. Water beading may indicate a fat film. A blue rainbow haze may indicate a protein film. A greyish film (lack of shininess to surface) may indicate a biofilm, which is essentially a layer of bacteria growing on the metal surface of your tank and lines – very important if a problem with high bacterial counts exists!

INSPECT TANK HATCH AND OUTLET VALVES

Residues can build up around the tank hatch. The lid gasket, breather and exterior need frequent inspection and cleaning. The tank outlet valve should be cleaned every milk collection / tank wash day (Fig 41).

3.2.5 WASH CONTROL BOX MAINTENANCE

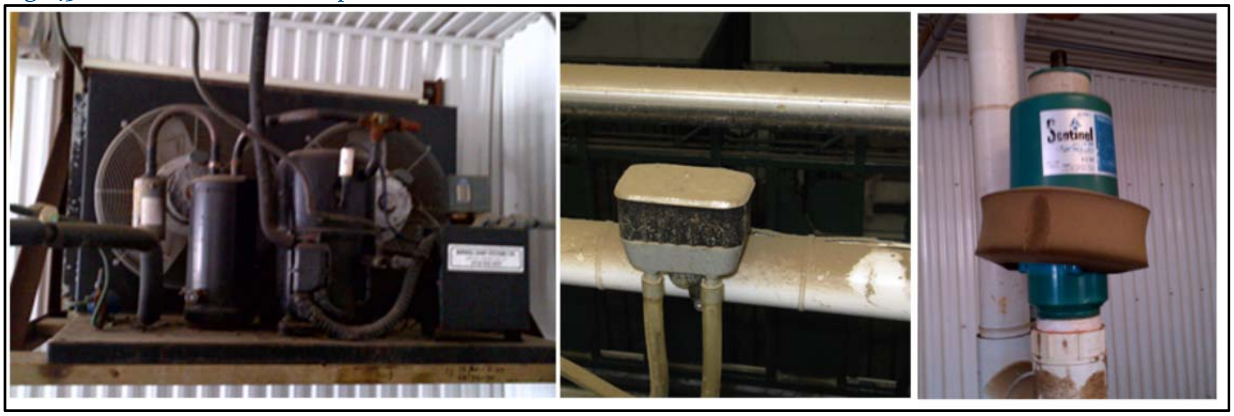
Fig. 42. Wash control box in good repair

Check and clean the screens on the hot and cold inlet hoses. If the water is hard, calcium deposits can build up. Repair any leaks at the chemical dispensing jars promptly. Leaks will result in a loss of the cleaning chemicals.

3.2.6 CLEAN DUST AND DIRT FROM EQUIPMENT AND HOUSING

Equipment, particularly those with electronic components (e.g. pulsators, vacuum regulator pumps, air injectors, heaters), should be kept dust-free to assure proper operation. It is very important to keep the radiator of the condenser unit free of dust and dirt (Fig. 43) to ensure effective and efficient milk cooling. Parlours can be a dirty place which means that regular cleaning is necessary to keep things working right. Use of screens on the windows, regular fly control in the parlour and milk house, air filters on intake fans will all help – but attention and care to keeping delicate equipment clean must be done.

Fig. 43. Dust and dirt can impair function



FLY CONTROL

Flies are attracted to organic material and carry many bacteria. The parlour should be kept free of manure, urine, spilled milk and residual feed. It should be designed so it can be frequently cleaned. Areas in the milk house which may attract flies include the garbage (e.g. soiled milk filters), drain areas, dirty buckets, etc. Keep all areas clean and sanitized and remove garbage frequently. Keep flies out by having intact screens on all windows and doors. Fly bait – approved for use in livestock premises, can be used if fly build-up becomes a problem. Keep window sills free of debris and moisture. Floors should be kept swept and clean, particularly around drains which should also be cleaned frequently. Other fly sources to consider include manure storage facilities and dead-stock composting areas. Locate those away from the milking area and milk house. Don't give the flies a reason to be attracted.

3.2.7 WASH SINK

Keep non-essential items out of the sink (e.g. milk bottles and nipples). Ideally, a cover should be in place over the sink. This will help to maintain water temperatures as well as keep debris out.

A coarse screen should be put on the end of the suck pipe to prevent debris from being sucked up. This debris can accumulate in the wash line and restrict flow to the jetters. For systems that are Clean In Place (CIP), the suck pipe should not draw air during the cleaning cycles. Corrective actions should include consulting with your equipment dealer. Make sure drain stay clear and clean as well to allow for dirty water to get away quickly.

Fig. 44. Covered wash sink helps maintain temperature of wash water