Dairy Sanitation Practices

Cooperative Extension South Dakota State University

Follow this and additional works at: https://openprairie.sdstate.edu/extension_fact

Recommended Citation
https://openprairie.sdstate.edu/extension_fact/1162

This Fact Sheet is brought to you for free and open access by the SDSU Extension at Open PRAIRIE: Open Public Research Access Institutional Repository and Information Exchange. It has been accepted for inclusion in SDSU Extension Fact Sheets by an authorized administrator of Open PRAIRIE: Open Public Research Access Institutional Repository and Information Exchange. For more information, please contact michael.biondo@sdstate.edu.
Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

For current policies and practices, contact SDSU Extension
Website: extension.sdstate.edu
Phone: 605-688-4792
Email: sdsu.extension@sdstate.edu

SDSU Extension is an equal opportunity provider and employer in accordance with the nondiscrimination policies of South Dakota State University, the South Dakota Board of Regents and the United States Department of Agriculture.
DAIRY SANITATION PRACTICES

COOPERATIVE EXTENSION SERVICE
SOUTH DAKOTA STATE UNIVERSITY
U. S. DEPARTMENT OF AGRICULTURE
BACTERIA AND MILK

Bacteria involved in milk production present a perplexing problem to many dairymen. The cow, being a ruminant animal, depends on millions of bacteria in her rumen to digest her food in order to make milk. However, other types of bacteria cause diseases and still others, when present in the milk, result in poor keeping qualities and off-flavored products.

Three main factors affecting the growth or reproduction of bacteria are food, temperature and water. Food requirements are similar to those of humans in that bacteria require proteins, vitamins, carbohydrates, minerals and water. The most favorable temperature for bacteria growth is from 70 degrees to 100 degrees. However, some can grow at temperatures below freezing and others grow well at temperatures over 115 degrees. When favorable conditions of food and temperature do not exist, the bacteria may become dormant or go into “hibernation” until the conditions become more favorable. In general, the lower the temperature, the slower the growth. This is the reason why fast cooling of milk is necessary immediately after it is removed from the cow. This slows down the growth, but it does not destroy the bacteria.

Bacteria are destroyed most effectively by heat or chemicals referred to as bactericides. The properties of milk are such that it is impractical to destroy bacteria in the milk with high heat temperatures at the farm. The heat method is used at processing plants where large volumes of milk are treated in a single operation. It is illegal for either the producer or processor to adulterate milk with chemical bactericides to destroy bacteria. Consequently, the practical approach for the dairy producer is to use methods as sanitary as possible to keep bacteria out of the milk and cool milk at temperatures below 40 degrees F. as rapidly as possible (within 1 to 2 hours). “Clean and Cold” are the two key words.

Milk has been called the food most nearly perfect for humans—as well as for bacteria. Food requirements for bacteria are all in milk. The differences of high and low bacteria counts among dairy producers often lies in the differences in cleanliness of equipment and quickness of cooling. Bacteria cannot move by themselves—they must be transported. General methods of transportation are found above listed in the “primary sources.”

Dirty milking equipment generally has deposits of milk stone, dried milk, fat deposits or manure. The material provides food for the bacteria and they multiply rapidly. In addition, dirty equipment often comes in direct contact with the milk or induces infection in the udder of the cow. Unsanitary milking procedures may also spread bacteria from cow to cow. This happens from contaminated hands of the milker and use of dirty wash rags or sponges.

Bacteria reproduce by a process called fission. As the bacteria grow, a cross-wall develops and the organism divides or splits into two plants. This process can occur every 15 minutes under favorable conditions. Consequently, milk containing only 100 bacteria per milliliter (ml) (very satisfactory quality), can have over a million bacteria per ml in less than five hours if conditions are right. This would become highly unsatisfactory milk.
In order for a dairyman to keep disease problems, such as mastitis, at a minimum and also to market a high quality product, he need not be a bacteriologist. He must, however, produce the milk as cleanly as possible and cool it as quickly as possible. He must also recognize that when bacteria problems do arise in a particular area that the organisms were transported there. The method of transportation must then be eliminated either through the dairyman's own efforts and experiences or with the help of a qualified sanitary.

**WATER AND DAIRY SANITATION**

Water is the foundation of the entire dairy farm cleaning and sanitation program. Tap water or warm water is used to rinse visible soil from milking equipment and for washing udders. Dairy cleaners are mixed with water to remove soils from dairy equipment and the cow's udder. Sanitizers are added to rinse water to sanitize equipment.

Water for the dairy farm is usually ground or well water. Wells may be “shallow” (8 to 50 feet) or “deep” (50 to more than 300 feet). Ground water may be from the surface, stored on top of the ground in farm ponds or lakes, or it may come from springs.

Well water originally comes from the ground surface. The water travels through the ground downward to the water table which may be deep or shallow. This process is called **percolation**. As the water percolates through the soil to the water table it absorbs from the soil. It may also become contaminated with bacteria. There is generally more of a contamination or purity problem with surface water than with deep well water because the percolating process helps remove the impurities.

Water from deep wells, however, may contain higher proportions of mineral salts because the water must travel farther through the soil. The percolation process will not filter out these mineral salts.

Poor taste, odor, and color make water undesirable. These occur most often in surface or very shallow well water and result from dissolved organic matter, waste products and dissolved organic gases. Hydrogen sulfide may be found in either deep or shallow wells. Water containing hydrogen sulfide is characterized by “rotten egg” smell and will cause copper fittings to turn black. Aeration, lime softening and carbon filtering are effective means of removing undesirable odors and flavors from water. Water is seldom found in its pure chemical form, H₂O. Impurities can seriously affect the properties of water, hence its cleaning ability and compatibility with cleaning compounds.

Mineral salts or water hardness is the most common water problem in South Dakota. The two most common salts which cause water hardness are calcium and magnesium. The degree of hardness in water is measured in terms of parts per million (p.p.m.) or grains. A grain of hardness is equal to 17.5 p.p.m. There are several guides for the classification of water hardness but the guide used in this publication is that established by the S. D. Station Biochemistry Department of the Agricultural Experiment Station which has been adapted for South Dakota water conditions. This guide is as follows:

<table>
<thead>
<tr>
<th></th>
<th>Parts per Million</th>
<th>Grains per Gallon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft</td>
<td>0-53</td>
<td>0-3</td>
</tr>
<tr>
<td>Average Hardness</td>
<td>53-437</td>
<td>3-25</td>
</tr>
<tr>
<td>Above Average</td>
<td>437-875</td>
<td>25-50</td>
</tr>
<tr>
<td>Very Hard</td>
<td>over 875</td>
<td>over 50</td>
</tr>
</tbody>
</table>

Other guides classify water as being hard at 10 grains and soft at from 0-10 grains.

The control of hard water is extremely important for cleaning dairy equipment. Heat and alkali cleaners will cause the salts to precipitate and leave an insoluble white deposit on equipment which is difficult to remove. Bacteria can grow in this deposit. This deposit will also build up in the interior of water pipes and water heaters. A 1/16-inch scale of precipitate on the interior of a water heater will reduce the efficiency of the heater by 15%. A 1/8-inch scale may reduce the efficiency by 50%, thereby increasing gas or electric bills.

A minimum of hard water salts may be held in suspension by certain types of dairy cleaners. The chemicals added to the cleaners combine with the hard water salts and hold them in the solution. These types of cleaners are very effective for “softer” water. However, as the hardness increases, the amount of cleaner required to hold the hard water salts in suspension increases proportionately.

When water hardness increases to over 10 grains per gallon it is often more economical to install a water conditioner because it may not be possible or economically practical to remove the salts with a dairy cleaner and do an effective job of cleaning. Water conditioners soften the water by exchanging the calcium and magnesium ions for sodium as the water passes through the softening device. This is an effective and economical means of conditioning water, particularly when water contains over 15 grains hardness. As the hard water passes through the conditioning system the Zeolite material becomes “loaded” with...
calcium and magnesium and it must be “reactivated” periodically. This can be done by passing a solution of sodium chloride (rock salt) through the conditioner and back wash with water. This may be done manually or automatically.

Iron and manganese oxides in the water supply can be a special problem. They are undesirable because they produce reddish-brown stains on equipment and fixtures. There are two forms of iron in water. Iron in suspension will cause freshly drawn samples to turn a reddish color after standing for a short time. This is brought about by the absorption of oxygen in the water causing the formation of ferric iron oxide. The problem may be eliminated by filtration with a high capacity water conditioner when iron content is less than 3.0 p.p.m. Special green sand iron filters must be used for water containing over 3.0 p.p.m.

Iron in solution is the other type of iron in water. It will not produce a reddish color in a fresh sample but may leave deposits on equipment. Iron in solution may be handled by ion-exchange in the resin bed of a regular water conditioner. When determining the size of a water conditioner needed, iron content should be considered as 4 grains hardness/p.p.m. As little as 0.3 p.p.m. of iron will cause noticeable stains and is considered objectionable.

Bacteria can be a serious problem in shallow well or surface water systems. The primary sources of pollution are septic tanks and their drainage fields and barn yard drainage.

Bacterial contamination of water supplies may be eliminated by boiling the water, but the most practical method for larger water supplies is chlorination. It is not possible to specify exact amounts of chlorine to be added to a water system to effectively kill the bacteria. This is because of widely varying conditions in regard to the number of bacteria, the amount of other foreign material, and amount of water. The reaction or killing time is in proportion to the amount of chlorine added to the system in proportion to the amount of water being treated. The most effective kill method is to add high amounts of chlorine to water as it enters a small storage tank. This will assure a complete kill in a short period of time, however, it will leave a chlorine taste in the water which may be objectionable. This may be eliminated by installing an activated carbon filter to the system.

CLEANING DAIRY EQUIPMENT

An essential phase of a successful dairy operation in regard to mastitis control and marketing a quality product is cleaning the equipment. Clean equipment has soil removed and is free from bacteria. Soil is defined as material such as dirt, milk deposits, residues or anything which must be removed from a surface in the cleaning operation. The need for the removal of soil from equipment is essential because soil accumulations provide excellent accommodations or environment for bacteria growth. It is the bacteria, not the soil, which can spread disease (masitis), cause off-flavors in milk, and lower keeping qualities of the product.

The dairyman must be concerned about three types of soils. These are alkali soluble soils, acid soluble soils and water soluble soils. The main alkali soluble soil is milk fat. Most commercial alkali cleaners also contain chlorine, which is efficient for removal of milk protein. In these chlorinated-alkaline cleaners the alkali removes the fat from equipment by dissolving and emulsifying it and the chlorine penetrates and loosens the protein soil deposits.

Acid soluble soils include minerals derived from milk as well as some of the calcium and magnesium salts from hard water. The acid dissolves the mineral from the equipment surfaces. Acid cleaners should never be mixed with alkali or chlorine cleaners because they neutralize each other and become ineffective.
Three cleaning additives are generally added to commercial chlorinated alkaline cleaners. These are *sequestering agents*, *wetting agents*, and *dispersion agents*.

*Sequestering agents* are in effect chemical “water conditioners” because they have the ability to combine with hard water salts and hold them in suspension. Suspension refers to action which holds insoluble particles in solution, thereby preventing the settling of solids which might form deposits. It also makes it easy to flush the insoluble particles from the equipment. *Wetting agents* lower the surface tension of water, making water “wetter,” thus greatly increasing the ability of water to contact all surfaces. *Dispersion agents* break up aggregates or large clumps of soil into individual particles. These many small particles are then more easily suspended and flushed off equipment.

Water soluble soils are the milk sugars and just plain dirt. They are dissolved by water and may be partially rinsed off with the fresh milk immediately after milking. Rinsing in plain water, however, will not remove all of the fresh milk. Rinsing fresh milk from milking equipment should never be considered an adequate cleaning job.

**Cleaning Procedures:**

Cleaning procedures may be classified as *routine* and *special*. Routine procedures are those which are carried out on a daily basis as recommended.

Special cleaning procedures are those which must be done when routine cleaning procedures are not practiced, resulting in heavy build-up of soil accumulations. Special cleaning procedures are more expensive because they require additional amounts of chemicals and more work or time. Conditions requiring special cleaning procedures are also responsible for higher bacteria counts, “short-time blue tests” and are related to mastitis problems.

The effectiveness or relationship to the amount of time spent in routine cleaning over special cleaning is dependent upon several variables which include: contact time between soiled surface and cleaner solution, type of cleaner, concentration of cleaner, temperature of the cleaner solution, and physical action such as turbulence of cleaning solution or mechanical brushing (elbow-grease).

The following is a description of recommended routine cleaning procedures:

1. Immediately following milking flush with clean, warm (100 to 110 degrees F.) water.

This will remove residual milk before it can dry onto the equipment. When the water temperature is above 95 degrees F. the milkfat will become liquid and much of it can be rinsed away. However, rinse water which is hotter than 115° will denature proteins in the residual milk and cause them to stick on metal surfaces. A common practice for “rinsing” bucket type milkers is to evacuate the air from the bucket and place the teat cups in a pail of water. The water is then drawn from the pail into the milker bucket and “sloshed” around. More often than not this practice is repeated with the same rinse water with two or more buckets. This is definitely **not** recommended because the temperature range, 100 to 110 degrees F. is too specific. The water cools too fast and rinsing process becomes inefficient. Consequently, the second or third “sloshing” may leave more residue in the bucket than it contained originally. Bucket milkers should be partially disassembled and thoroughly rinsed with a continuous flow of clean water.

2. Wash with hot water (as hot as the hands can stand) and an alkaline-chlorine base cleaner.

The amount of cleaner to be used **should not** necessarily be based on the directions on the package. The amount to use should depend on the following factors:

a. Water hardness.

b. Iron content of the water.

c. Acidity or alkalinity level of the cleaning solutions.

The cleaning solution should have an alkaline pH value of 10.5 to 11.

Factors 1 and 2 may vary significantly from one farm to another and may well vary from season to season on the same farm. This is why it is extremely important that any suppliers of dairy cleaners be in a position to test the water and develop a cleaning program compatible to the water on the farm.

Equipment which is to be brush cleaned should be completely dismantled before placing it in the cleaning solution. This allows for a more complete contact of the equipment with the washing solution and complete brushing. Each piece of equipment should be thoroughly soaked and thoroughly brushed.

3. Rinse with warm (100 to 110 degree) water containing about one ounce of acid cleaner to every five gallons of water, immediately after washing.

Hot water will promote drying of equipment when it is removed from the solution. The addition of the acid to the rinse water on a daily basis will
usually take the place of alternate cleaning. In addi­
tion, the acid will break down chlorine which is
 corrosive to metal and eliminate water spotting or
filing if the water is not over 10 grains hardness.

The acid dissolves the hardness minerals but this
“dissolving process” is limited to the hardness of the
water. Water containing more than 10 grains hard­
ness will require excessive amounts of acid and will
be ineffective with extremely hard water. An addi­
tional problem related to hard water is that when
water containing more than 15 grains hardness is
heated over 115 degrees the minerals will be de­
posited on equipment surface. They can only be re­
moved with an acid rinse.

4. Drain all lines and invert all items until the next
milking.

Water allowed to stand in lines or on equipment
may collect dust, form water “spots” or provide
favorable environment for bacteria growth.

5. Sanitize just prior to next milking.

Bacteria may accumulate on the equipment be­
tween milkings. Chlorine or iodinated sanitizer sol­
utions are very effective sanitizers. The amounts to
use should follow the manufacturer’s or service­
man’s recommendations. The sanitizer should not
be rinsed from the equipment before using, but the
lines and other equipment should be drained. The
milk contact surfaces should not be handled after
sanitization.

Care of Inflations

Inflations should be cleaned as described in the
routine cleaning section. In addition, use the follow­
ing recommendations. There should be two sets of in­
fations for each milker unit and each set should be
alternated weekly. The set not in use should be cared
for as follows:

1. Boil in 5% lye solution (one 13 ounce can of lye to
2 gallons of water) for 30 minutes. This removes
butter fat and protein accumulations.

2. Rinse in plain water.

3. Scrub in an acid solution (1 ounce per gallon of
hot water) to remove milk stone.

4. Rinse in plain water or acidified rinse (1 ounce to 5
gallons of water).

5. Store dry (in the box they came in for one week at
a cool temperature). This restores the “life” of the
rubber.

Inflations cared for by this procedure will normally
last about 1,500 milkings. However, spongy, cracked,
or blistered inflations should be discarded at any time.

Special Cleaning Procedures

Special cleaning procedures are required when ac­
cumulated deposits are allowed to build up. These
usually result from inefficient cleaning, hard water,
too low or too high water temperature or improper
use of cleaners.

The removal of accumulated deposits requires the
complete dismantling of all equipment. Soak the dis­
mantled equipment in a concentrated acid cleaner (1
part acid to 4 parts water at 145 degrees F.) for 10 to 15
minutes. Then hand-brush thoroughly. This will re­
move milkstone and other accumulations. Rinse the
equipment in an acidified rinse as described in the
routine cleaning procedure. Drain all lines or hoses
and invert all items to store dry.

Cleaning in Place. Cleaning in place (CIP) offers
considerable labor saving and is considered more ef­
ficient than hand cleaning when the equipment is in­
stalled and operated correctly. CIP cleaning com­
pounds are generally more highly concentrated than
those used in hand cleaning operations because they
are not handled. In addition, CIP cleaning compounds
contain very little or no wetting agents in order to
minimize foaming.

It is essential that the water be tested for hardness
in a CIP unit because the concentration of the cleaner
is very important and the ratio of water to cleaner
must be known. It is not possible to list general clean­
er recommendations here because of wide variances
and the specific needs. The manufacturer’s direction
should be followed. These directions should specify
the quantity of cleaner, the amount of water circu­
lation time and solution temperature.

The general procedure is as follows:

1. Rinse all equipment with 100 to 110 degrees F.
water immediately after use. Do not recirculate; rinse until the water runs clear at the outlet end.

2. Disassemble all parts which will not clean by circu­
lation.

3. Prepare a solution of 140 to 160 degree F. water and
the recommended amount of a circulation cleaner. Select the cleaner in accordance with water hard­
ness and other conditions.
4. Circulate the cleaner for 10 to 20 minutes, brushing all surfaces not cleaned by the solution. The temperature of the wash solution should be above 100 degrees F. at the end of the cycle.

5. Rinse with clear water (use an acidified rinse in hard water supplies). Drain or air dry. It is desirable to dry plastic tubing with forced hot air.

6. Circulate a non-foaming sanitizer prior to milking. Follow the manufacturer's directions to obtain the correct solution strength.

Immediate rinsing after use is the key to easy cleaning.

Preparation of the wash solution whether by hand or automatic timers and dispensers is very important. The end-point temperature should never be less than 100 degrees F.