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DEPARTMENTS OF DAIRY HUSBANDRY AND BACTERIOLOGY

CLEANING AND STERILIZING DAIRY FARM UTENSILS¹

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INTRODUCTION

In the production of clean milk and cream it is very important to use only equipment which has been thoroughly cleaned and properly sterilized. Further, this equipment should be subsequently handled so as to prevent contamination from the surroundings and inhibit the growth of surviving organisms.

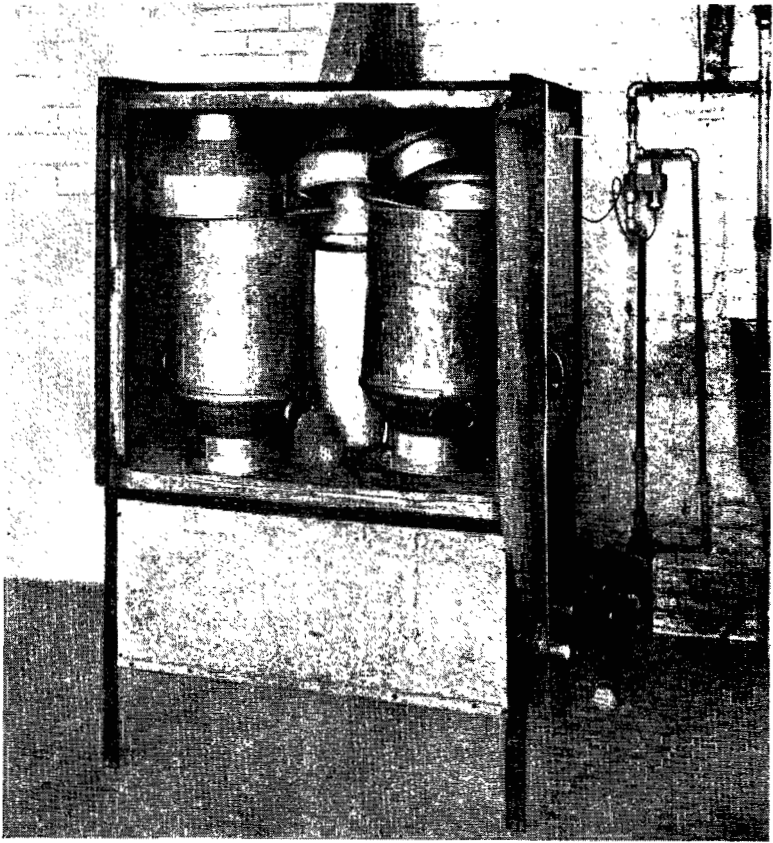
After use the surfaces of dairy utensils are usually coated with a moist film of milk. Irregularities in the surface, crevices in seams, and unevenly soldered joints are points for the deposition of milk solids. The milk fat tends to prevent the removal of this material by forming a greasy film which is resistant to cold water.

There are several fundamental points in the cleaning and sterilizing of dairy utensils which may well be considered in the discussion on the treatment of milk cans and pails. Although these points apply more or less generally to the cleaning and sterilizing of all dairy utensils, certain pieces of equipment require special treatment and will be discussed under separate headings.

1. Contribution No. 93 from the Department of Dairy Husbandry and No. 157 from the Department of Bacteriology.

MILK CANS AND PAILS CLEANING

Immediately after use the utensils should be rinsed with cold water to remove as much of the milk as possible, then brushed with hot water containing a washing powder. Soap should not be used because of the tendency to leave a film on the surface of the vessel. The washing powder aids in dissolving the milk solids while the hot water not only melts the fat but hastens the action of the washing powder. In this way the greasy, water-resistant film is removed and the other milk solids are more easily washed from the surface. The washing powder should then be rinsed from the vessel with clean hot water.



Courtesy N. Y. State Agr. Expt. Sta. (Geneva).

FIG. 1.—Gas-heated dry-air sterilizer with an automatic oven control.

STERILIZING

Sterilization may be carried out by the use of hot water, steam, dry heat, chemicals, or a combination of these.

Hot Water.—Boiling water is effective as a sterilizing agent, only when the utensil may be submerged for several minutes in water that is boiling vigorously. The common practice of scalding utensils by pouring a small amount of hot water over the surface is a very inadequate method of sterilization.

Steam.—The most effective method of sterilizing dairy equipment is by exposing the utensil to live steam in a closed cabinet for 10 to 15 minutes. Steam jets commonly employed in dairy plants for sterilizing cans, pails, etc., are frequently ineffectual because of the short periods of exposure. When the vessel is exposed to a jet of steam for less than one minute, as is very frequently the case, little destruction of bacteria can be expected. The principal advantage of the use of a steam jet is that the utensil is heated so that subsequently it will become thoroughly dry.

Dry Heat.—A recent development is the use of so-called “dry heat” for sterilizing milk utensils. The method of treatment is to transfer the utensils directly from the wash vat into a specially designed cabinet (fig. 1) which is heated with electricity or some efficient type of burner.

This method when properly used is very efficient. It has the additional advantage that the utensils are absolutely dry at the completion of the sterilizing process. Complete information concerning the use of so-called “dry heat” in sterilizing dairy utensils is contained in a recent bulletin from the New York State Agricultural Experiment Station.²

Chemicals.—Chemical sterilizers when employed in sufficient concentration provide an excellent means of destroying bacteria on milk utensils. The chemical disinfectants most commonly used are those containing chlorine. The principal criticism of this class of disinfectants lies in the fact that the dairyman usually has no facilities for determining the strength of the solutions employed. In the appendix of this circular a method is described for detecting impotent chlorine solutions.

The most effective method of using a chlorine sterilizing agent is to immerse the utensil for a period of not less than one minute in a solution containing a minimum of 100 parts per million of available chlorine. The chemical sterilizing solution should be applied just before the utensil is used. This eliminates the possibility of corrosive action and tends to destroy bacteria which may have developed during storage.

If chemical sterilizers are employed immediately after washing, the utensil should be thoroughly rinsed with sufficient hot water to remove the chemical and to heat the utensil so that it will become thoroughly dry.

² Dahlberg, A. C., and Marquardt, J. C. Sterilization of dairy utensils with dry heat. N. Y. State Agr. Expt. Sta. (Geneva) Bul. 612:1-16. 1932.

STORING

The vessel should be kept dry during the period between washing and subsequent use. This is a very important point in reducing the contamination of milk from utensils. Bacteria require moisture for growth and hence cannot multiply on a dry surface. Since a few organisms survive the usual cleaning and sterilizing process, these few may multiply to many millions if a small amount of moisture is available. A poorly-cleaned milk can which is perfectly dry is usually in better condition after 24 hours than a well-cleaned can which contains some moisture. Regardless of the method of cleaning and sterilizing, it is very important that no moisture be left in the vessel.

The utensils should be protected from contamination. Dust, flies, etc., frequently introduce undesirable and perhaps dangerous types of contamination. A suitable rack in the milk house affords an ideal place for storing milk utensils.

MILKING MACHINES

The use of a milking machine reduces to a minimum the contamination from the barn air, the flanks of the cow, and the manure. However, the difficulties encountered in effective cleaning and sterilizing, particularly of the rubber parts, frequently result in higher bacterial counts in machine-drawn than in hand-drawn milk.

CLEANING

Any effective method of cleaning milking machines depends on systematically following a definite procedure immediately after each milking. The importance of promptness cannot be overemphasized. If milk is allowed to dry on the surfaces of the rubber tubes and inflations, it encourages the growth of enormous numbers of bacteria, which can be removed only by taking the machine apart and subjecting it to a thorough brushing and cleaning.

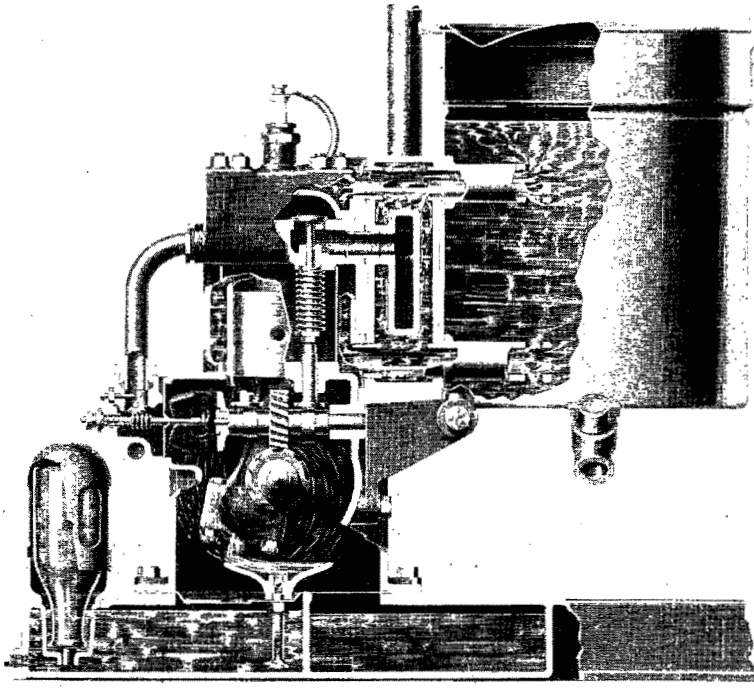
Cold-water Rinse.—One of the most important steps in cleaning a milking machine is to draw not less than 3 gallons of clean, cold water through each unit immediately after milking. The water should be flushed through by alternately submerging and removing the teat cups into and out of the water. This cold-water rinse will remove most of the milk from the rubber parts and mechanically wash out a majority of the bacteria present.

It should be emphasized that the cold-water rinse must precede the use of hot water, otherwise the solids in the milk may be cooked on the rubber surfaces.

Hot-water Rinse.—Hot water aids in the removal of butterfat adhering to the rubber parts and destroys many of the remaining bacteria. Experiments at the Kansas Agricultural Experiment Station indicate that not less than a gallon of water at a minimum temperature of 165° F., must be drawn through each unit. This means that the water must be not less than this temperature after it has passed through the machine. It is advisable to begin this operation

with an abundant supply of water at or near the boiling point. In drawing the hot water through the milking machine the teat cups should not be removed from the water, as the air drawn in tends to cool the rubber surfaces and reduces the effectiveness of the treatment.

Water-heating Equipment.— The problem of providing an adequate supply of hot water confronts every dairyman. Water heaters are available which use electricity, compressed natural gas, natural gas, gasoline, or kerosene as the source of heat. Where natural gas



Courtesy De Laval Separator Company.

FIG. 2.—Gas engine with water heater and cooling unit combined. Note that the watercooling unit of the engine has been enlarged to hold from 3 to 5 gallons of water. This amount of water is sufficient for the needs of the average dairyman in washing his milking machine.

is available it is usually an economical and desirable source of heat in that it is practically free from fumes and odors. A study at the Idaho Agricultural Experiment Station³ showed the cost of heating water with compressed natural gas to be less than one third the cost of electricity. Gasoline heaters are available which are efficient,

3. Theophilus, D. R., and Atkeson, F. W. Sterilizing dairy utensils on the farm. Idaho Agr. Expt. Sta. Bul. 133:1-28. 1931.

economical, and are largely free from the fumes and odors usually associated with kerosene heaters. Where a gas engine is used to operate the milking machine, some type of water heater attached to the engine can be used to good advantage. (Fig. 2.)

Weekly Cleaning.—Once each week the milking machine should be taken apart and the rubber parts which come in contact with the milk thoroughly cleaned. This removes the milk solids that may have been deposited on the rubber and prevents the inflations from sticking to the teat cups. All rubber parts should be renewed as

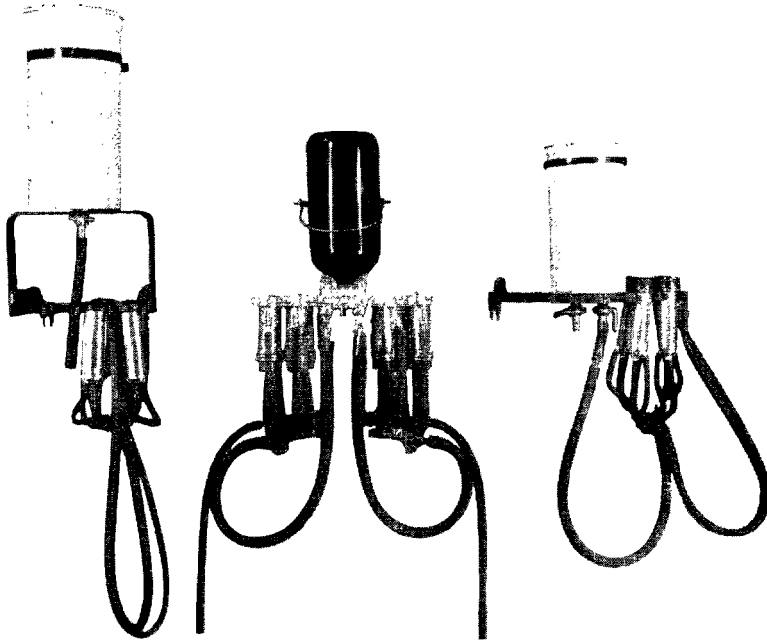


FIG. 3.—Representative types of commercial solution racks.

soon as there is any evidence of checking or cracking, as it is then impossible to keep them in a sanitary condition.

The practice of keeping two sets of teat cup inflations, which can be interchanged weekly, is to be recommended. The life of the rubber is prolonged and the inflations hold their shape better and work more efficiently than those inflations which are used continuously.

STERILIZING

After the teat cups and rubber parts have been washed as described above it is very essential that they be adequately sterilized. It is equally important that they be stored in a condition which will discourage the growth of bacteria until the next milking.

Hot Water.—An effective method of sterilizing milking machines is to submerge the teat cups in a large volume (10 to 15 gal-

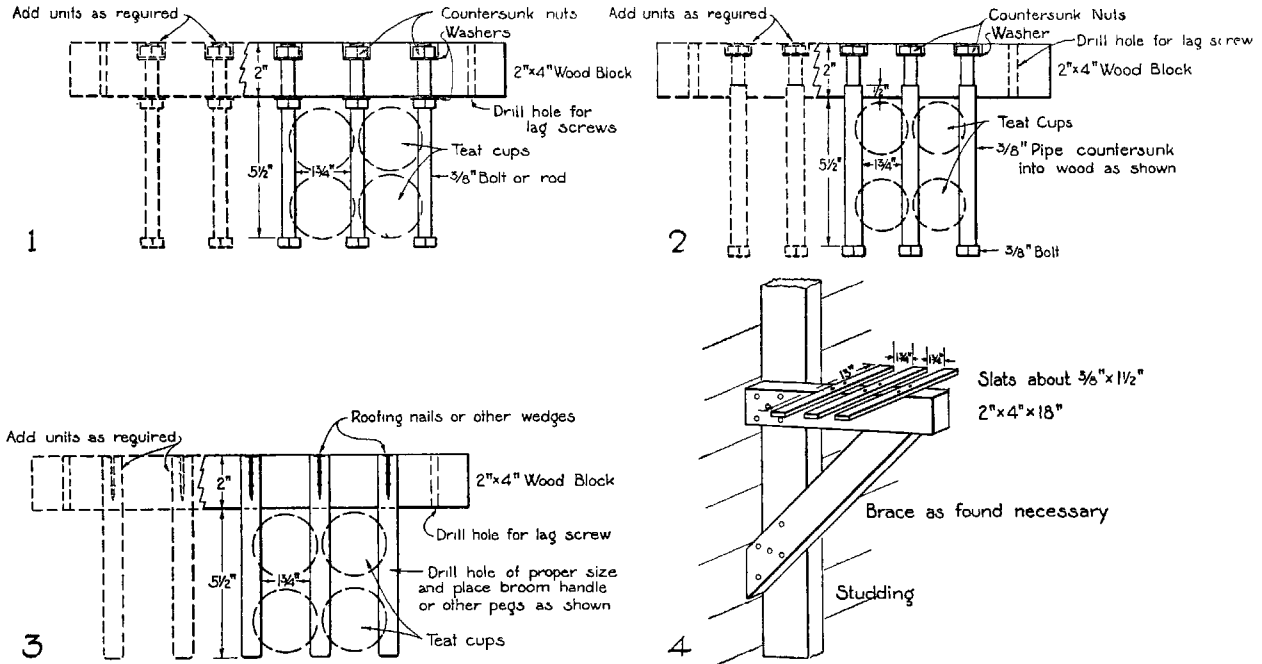


FIG. 4.—Representative types of easily constructed, inexpensive, home-made milking machine teat-cup racks. Rack No. 1 is constructed with properly-spaced 3/8-inch bolts inserted into a 2" x 4" wood block. Rack No. 2 is similar to No. 1, except that the bolts in No. 2 are encased in pieces of gas pipe. No. 3 is constructed from pieces of broom handles or other pegs inserted and fastened to a block of wood. No. 4 consists simply of properly-spaced slats nailed across a wooden block.

lons) of water at a temperature of 160° F. Care should be taken to fill the tubes completely with water and thus prevent the formation of air pockets. Allow the parts to remain submerged in the water until the next milking. Obviously the use of this method is limited to those farms with adequate facilities for heating a large volume of water.

Advantages of Solution Rack.—The equipment most commonly employed in the sterilization of milking machines is either a solution rack (fig. 3) or a crock in which the teat cups and rubber tubes may be submerged in the disinfectant solution. While a survey showed that a majority of Dairy Herd Improvement Associa-

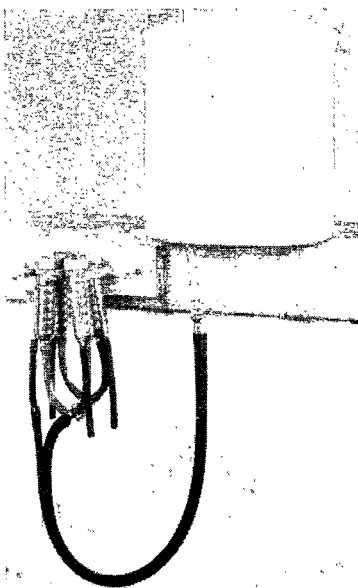


FIG. 5.—Home-made solution rack using an earthenware crock.

tion members in Kansas were using the latter method, experiments recently conducted at the Kansas Agricultural Experiment Station have indicated a marked superiority of the solution rack over the immersion method of disinfecting milking machines.

A considerable saving can be effected through the use of the solution rack, especially when chlorine disinfectants are used. The solution rack requires only approximately one eighth as much sodium hypochlorite as the crock or immersion method.

When lye solution is used, the solution rack requires less than one third as much as the immersion method. The stability of a lye solution, together with its low initial cost, makes its use relatively inexpensive, whether the solution rack or immersion method is used.

Most milking-machine companies manufacture a solution rack

suitable for use in disinfecting their type of milking machine. (Fig. 3.) Plans for several simple racks are also shown in figure 4.⁴ Figure 5 illustrates a home-made solution rack in use.

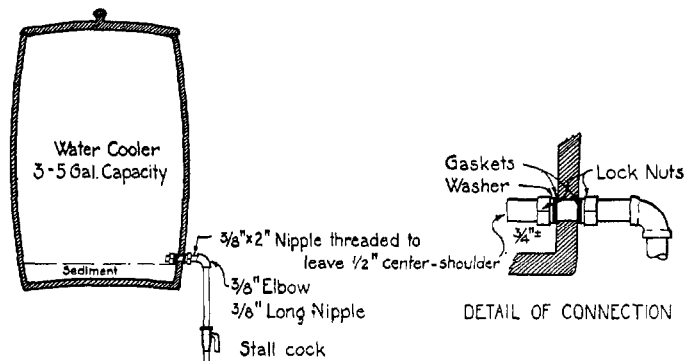


FIG. 6.—An earthenware water cooler that may conveniently be converted into a container for the disinfectant solution.

An earthenware water cooler such as is shown in figure 6 makes a very satisfactory and inexpensive container for the disinfectant solution. If a chlorine disinfectant is used, not more than a week's

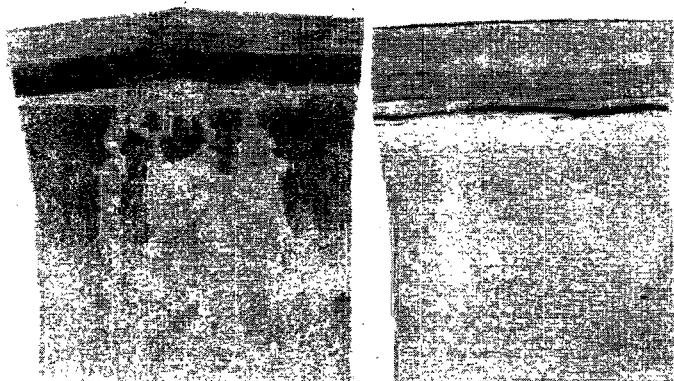


FIG. 7.—Portions of used rubber teat-cup inflations. The one on the left was used with chlorine disinfectant. The one on the right was used with lye disinfectant.

supply of the disinfectant solution should be prepared at one time, since chlorine disinfectants lose their strength upon standing.

From the standpoint of cleanliness, convenience of handling, cost, and particularly as a means of maintaining the strength of disin-

4. The authors wish to acknowledge the assistance of Prof. Walter G. Ward, extension architect, who designed and prepared the drawings for the solution racks shown in figures 4 and 6.

fectant solutions, the solution rack has marked advantages over the old-style immersion or crock method of disinfecting milking machines, regardless of the kind of disinfecting agent used.

Chemicals.— In recent years lye solution has been used as a sterilizing agent for milking machines with excellent results. Lye is very effective in destroying germs where prolonged contact is possible. Lye solutions retain their strength, have no detrimental effect on the rubber, and do not produce a granular deposit as observed with chlorine disinfectants. (Fig. 7.)

In using lye solution as a disinfecting agent for milking machines, attach the teat cups and rubber tubes to a solution rack containing 0.5 percent lye. (See Appendix for preparation of lye solution.)

Although chlorine compounds make excellent disinfecting agents for most dairy utensils, certain disadvantages are encountered in their use with milking machines. An important objection to the use of chlorine solutions is that they cause the formation of a fine granular deposit on the inner surface of the rubber tubes and inflations, especially where hard rubber is used. This not only results in deterioration of the rubber, but the rough surface affords a lodging place for milk solids and interferes with effective cleaning. (Fig. 7.)

As previously mentioned, one of the chief criticisms of the use of chlorine disinfectants is that the dairyman usually does not have the means for determining the strength of the solutions employed. Hence, he may unknowingly employ a solution which is of no value as a disinfectant.

If rubber tubes which previously have been treated with chlorine are sterilized in a lye solution it will be noticed that the solution which drains from the teat cups and tubes is badly discolored. The lye solution dissolves the granular deposit formed on the rubber parts by the chlorine and leaves them in a cleaner and more sanitary condition.

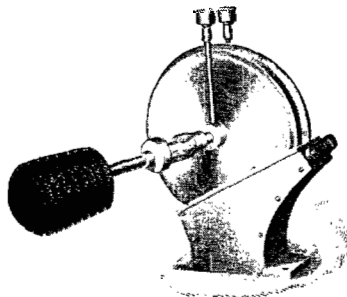
Limitations in the Use of Lye Solution.— Although lye has certain advantages over chlorine disinfectants for the sterilization of milking machines, this does not mean that it can replace chlorine compounds in the disinfection of other dairy utensils. On the contrary, experimental evidence indicates that when the time of contact with the surface to be disinfected is short, lye is not so effective as a chlorine solution in destroying bacteria. Furthermore, the continued use of a 0.5 percent lye solution will corrode the tinned surfaces of dairy utensils. The effect of immersing separator discs in a 0.5 percent lye solution for different periods of time is shown in figure 8. The tinning on a milk pail is affected in a similar manner when immersed in a 0.5 percent lye solution. Since lye solutions readily attack aluminum, they should not be used in sterilizing the milking machine pails. Fortunately the metal surrounding the teat cups of most milking machines is not noticeably affected by dilute lye solution. Lye has been used successfully over a period of two years at the college dairy barn for sterilizing teat cups and rubber tubing with no evidence of deterioration of the metal claw, or the metal surrounding the teat, cups.



FIG. 8.—A series of discs showing the effects of a 0.5 percent lye solution on the tinning of cream separator discs. No. 1, check; discs Nos. 2, 3, 4, and 5 have been immersed in a 0.5 percent lye solution for 6, 10, 13, and 15 hours, respectively.

MILK BOTTLES CLEANING

The problem of effectively cleaning and treating milk bottles to destroy bacteria constantly confronts the dairyman who is retailing milk. The minimum facilities which should be provided for this purpose include a three-compartment wash vat, a motor-driven or steam turbine bottle brush (fig. 9.) and an adequate supply of hot water.



Courtesy Creamery Package Manufacturing Company.

FIG. 9.—A steam turbine bottle brush washer.

In the first compartment of the wash vat, the bottles should be brushed in warm water containing an alkali washing compound. In the second compartment the bottles should be rinsed with clean hot water, and in the third compartment they should be treated with a chlorine disinfectant solution.

STERILIZING

Improperly sterilized milk bottles are important agencies in the spreading of contagious diseases. When one considers the possibility that milk may be delivered in bottles which, on the previous

day, may have been in a home where sickness prevailed, the importance of effective sterilization is emphasized.

Chemicals.— After the bottles have been thoroughly washed and rinsed they should be immersed for not less than one minute in a chlorine disinfectant solution containing not less than 200 parts per million available chlorine. The bottles should then be inverted in the cases and stored where they are protected from dust and flies.

Steam.— A more effective, though more expensive, method of sterilizing milk bottles is to subject them to live steam in a closed cabinet (fig. 10) for a period of 20 to 30 minutes. If the cabinet is large enough to accommodate all of the bottles required, they may be left in it until used.



Courtesy Cherry-Burrell Corporation.

FIG. 10.—Steam cabinet for sterilizing milk bottles.

CREAM SEPARATORS

CLEANING

The cream separator, unless thoroughly washed and sterilized, is an important source of bacterial contamination of the cream. The slime which accumulates in the separator bowl is an excellent medium for the growth of bacteria. These bacteria are washed out and contaminate the cream at the following separation. Even though the separator is washed immediately after use, it still may add large numbers of bacteria to the cream if the parts are not effectively sterilized. The care given the separator is an important

factor in the keeping quality of cream. The production of sweet cream of high quality demands that the separator be washed and the parts sterilized each time after use. As with other metal utensils the parts should be rinsed thoroughly with cold water, then scrubbed with hot water containing a washing powder, followed by a rinse in hot water.

When sour cream is sold it is a common practice not to take the separator apart after it has been used for separating the evening milk. Although this practice results in highly contaminated cream from the following separation, the extent of contamination can be greatly reduced by rinsing the separator with approximately a gallon of water immediately after separating the evening milk, then with at least 3 quarts of chlorine solution (containing at least 100 parts per million available chlorine) just before separating the morning milk. After the chlorine solution has gone through the machine it is advisable to rinse the machine with about 2 quarts of water. It should be understood that the use of a chlorine disinfectant solution in this way is by no means a substitute for the complete washing and sterilizing of the separator parts regularly each day.

Lye solutions have been found unsatisfactory for rinsing the separator not only because of the corrosive action on the metal (fig. 8), but also because the time of contact is too short for a disinfectant which acts slowly.

STERILIZING

After the separator parts have been thoroughly washed, dried, and properly stored, it is very essential that they be effectively sterilized before use.

Chemicals.— One of two methods may be used for the chemical sterilization of cream separators. The most practical method on the average farm is to run not less than 3 quarts of chlorine solution (100 parts per million of available chlorine) through the assembled machine just before use. It is advisable to rinse the machine with about 2 quarts of clean water following the chlorine treatment.

Separator parts may also be sterilized by submerging them in a chlorine solution (100 parts per million of available chlorine) for not less than one minute before assembling the machine. If the chlorine treatment is employed immediately after washing, it is important that the parts be subsequently submerged in hot water (preferably boiling) for a few minutes. This not only removes the chlorine and prevents corrosion but leaves the parts in a dry condition.

Hot Water.— Another effective method of sterilizing separator parts is to submerge them in water that is kept vigorously boiling for 10 minutes. They should then be removed from the water, allowed to become thoroughly dry, and stored in a place protected from dust and flies.

APPENDIX

DIRECTIONS FOR MAKING 0.5 PERCENT LYE SOLUTION

1. Dissolve the contents of a 13-ounce can of lye in one gallon of water. The lye should contain at least 94 percent sodium hydroxide (see label on can). This is called the stock solution.

2. Add 7 ounces of the stock solution (slightly less than one half pint) to one gallon of water. This gives approximately a 0.5 percent solution.

Due to the fact that considerable heat will be generated in dissolving the lye, it should be prepared in some nonbreakable container such as a wooden bucket or an enamel-lined basin. In no case should the lye be dissolved in a tinned or galvanized iron container. After cooling, the concentrated lye should be transferred to a glass or earthenware jug and kept tightly stoppered. A precipitate usually forms when lye is added to hard water. If allowed to settle and the clear solution on top used, the precipitate is not objectionable. Comparatively clear solutions are formed when soft water is used.⁵

DIRECTIONS FOR MAKING STOCK CHLORINE SOLUTION

Chloride-of-Lime Method

1. Dissolve the contents of a 12-ounce can of fresh chloride of lime (bleaching powder) in 2 gallons of water, using an earthenware vessel. Stir vigorously several times during the first 3 to 6 hours, then allow the solution to stand undisturbed overnight.

2. Siphon the clear supernatant liquid into one-gallon jugs. A funnel, fitted with a filter pad of absorbent cotton, should be placed in the mouth of the jug to keep out all solid particles of the sediment. Place tightly fitting stoppers in the jugs and store in a cool place. If clear-glass vessels are used they should be placed in the dark. Effective filtering of the solution and the use of tightly fitting stoppers greatly enhance the keeping quality of the stock solution.

This stock solution contains calcium hypochlorite as the germicide. Its strength is dependent upon the available chlorine content of the chloride of lime. Since the small 12-ounce packages obtainable in drug stores are frequently low in available chlorine, because of prolonged storage, it is not advisable to use this method of preparing a disinfectant unless facilities are available for testing the final product. However, this method has the advantage of simplicity and affords a very convenient means of preparing a small amount of disinfectant at a cost of about 25 cents per gallon. If the bleaching powder contains the maximum amount of available chlorine (about 35 percent) very satisfactory results may be obtained. The use of this method is recommended only where small quantities of chlorine solution are used.⁶

5. Lye is recommended only for the disinfection of the rubber parts of milking machines. It is not recommended for the disinfection of metal utensils because of its corrosive action.

6. A detailed description of chlorine disinfectants and methods of their preparation is given in Circular 169 of this station, "The Preparation, Testing, and Use of Chlorine Disinfectants."

DETECTING IMPOTENT CHLORINE SOLUTIONS

Intelligent use of chlorine disinfectants demands that they be tested at frequent intervals to insure the use of effective solutions. Although it is desirable to know the actual strength of the solutions, it is absolutely essential to know that the chlorine disinfectant is not impotent. On small dairy farms where it is not feasible to employ a test for determining the parts per million available chlorine, it is possible to avoid the use of impotent solutions by the following simple procedure: To approximately $\frac{1}{4}$ pint of disinfectant rinse water in use add a few crystals of potassium iodide and shake until uniformly colored. (The number of crystals which can be conveniently picked up between the thumb and index finger is an adequate amount. Potassium iodide may be procured at any drug store.) A solution which has lost its disinfecting properties will have a very light straw color approximating that of very weak tea. If the color is comparable to that of strong tea, ample chlorine is still available. Stronger solutions have a brownish color which approaches that of weak coffee.

With a little experience one can soon learn to determine the approximate strength of chlorine solutions by the color reaction with potassium iodide. The test should be made before and after the use of each batch of chlorine rinse water to insure effective disinfection.