Cleaning and Sterilizing Short-Time Pasteurizers

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IT is to be expected that the cleaning of a high-temperature short-time pasteurizing unit is a more difficult problem than cleaning a storage tank, a weigh tank, or a similar piece of dairy equipment. There are two obvious reasons for this: we are heating the milk to a higher-than-normal temperature and we are handling tremendous quantities of milk in the heating and cooling stage over a comparatively small area of equipment. The development of such new equipment as short-time pasteurizers invariably creates new problems in cleaning and sterilizing. Fortunately, the manufacturers of sanitation supplies have kept pace with the manufacturers of dairy equipment. A need was created for a foolproof method involving a minimum of labor and material to insure proper cleaning and sterilizing of the plate-type units. Before discussing this method further, however, it would be well to briefly consider the factors which contribute to the formation and structure of the deposit encountered on such pasteurizers. We can conveniently divide these into chemical factors and mechanical or physical factors.

CHEMICAL FACTORS

Because of the difficulties experienced in investigating the type of deposit actually encountered under plant conditions, our Research Laboratories designed and built equipment to duplicate reasonably well the plate-type short-time pasteurizer. This equipment was so constructed that a deposit would be formed on stainless steel tubes which were then removed from the experimental unit and available for further study. Samples of the deposit were scraped from the tubing and subjected to an accurate chemical analysis. It was possible to make preliminary cleaning tests with such scrapings, or the tube could be replaced in the unit and treated by a cleaning procedure comparable to that actually employed in the plant. Also, the unit could be operated at the start by a process comparable to the holding method of milk so a direct comparison of the deposit could be made. By further modifications, the effect of water hardness, rinsing, composition of the milk, various cleaning and sterilizing compounds, as well as milkstone removers were thus determined with reasonable accuracy under laboratory conditions. This made it possible later to transfer the work to actual operating conditions in the plant to prove or disprove any ideas obtained from the laboratory investigation.

In these preliminary investigations, it was found that the type of deposit present on the short-time pasteurizer was quite different in composition from that encountered when the milk was pasteurized by the holding method. In the batch or holding method, the deposit consisted of organic and inorganic substances held together and to the equipment by the adhesive characteristics of the casein in the milk. Removal of the casein binder would thus bring about a disintegration of the entire deposit so that mild brushing would effectively remove the entire contamination. Where the equipment had been previously handled with ordinary cleaning compounds, particularly in

hard water, the deposit would usually contain a higher-than-normal mineral content. A deposit of this sort would respond more readily to treatment with the proper type acid-base milkstone remover.

In the short-time pasteurizer, the normal type of deposit would consist of organic and inorganic substances but comprised mainly of casein salts which were produced undoubtedly by chemical reaction between the casein and minerals in the milk. Calcium caseinate would predominate; in fact, formed a substantial part of the deposit. Calcium caseinate is not readily soluble in most alkaline solutions and particularly so in those which could be economically and efficiently applied to the equipment under practical operating conditions. When treated with ordinary acid products alone, effective removal was not accomplished because, while the acid solutions would break up the casein salts, it would generally form from it a free casein deposit which was not particularly affected by the acid treatment alone.

Further tests and studies, later confirmed by actual plant runs, resulted in the development of a double operation which is now almost universally accepted as the proper treatment to bring about perfect cleaning of plate-type short-time pasteurizing units. The initial treatment consists in the application of the proper temperature, concentration, and time of contact, and a special milkstone remover which, while acidic in nature, contains adequate wetting properties, solvent characteristics, and ingredients to insure ready contact, penetration, and solution of the deposit. This prior treatment decomposes the calcium caseinate and other complex, organic salts, leaving it in such a condition as to permit practically complete removal by the subsequent or second treatment. The second treatment is the application of an alkaline type milkstone remover which not only contains necessary water-softening powers but further possesses unique wetting action, peptizing, emulsifying, and deflocculating characteristics. Properly applied, with the right compounds, this double treatment results in a surface which is so free of any deposit that subsequent brushing is seldom necessary and then serves more as a check during the inspection of the plates.

That the dual application saves both time and labor can be well demonstrated by use of the products in a single treatment and subsequent examination of the surface. Where the acid-type milkstone remover is used by itself, the organic contamination can be removed by brushing. This brushing operation, however, is not only difficult but very time-consuming, and because of the large number of plants involved, quite impractical—today more than ever before. Application of the special alkaline milkstone remover by itself brings about an action on the organic matter but leaves an objectionable film or deposit which defies any normal brushing operation. Harsh abrasives, scrapers, and mechanical treatment of that sort are generally necessary where only an alkaline milkstone remover is used. The same unit treated the following day by the double method gives results which are well nigh perfect.

PHYSICAL FACTORS

The physical factors which play a part in the type of deposit formed can sometimes be controlled and sometimes not. For example, the final temperature to which the milk is heated. It has been mentioned previously that milk heated to 165° F. produces a different type of deposit than when milk is heated in the same plate unit to 144° F. The rate of heating is likewise a factor. Slowly heated to 163° F., a different type of deposit is produced than when the milk is rapidly heated to 163° F. The actual area of surface in contact with the milk during heating and cooling is another factor. In plate-type units the ratio of surface area to gallons of milk differs greatly

from the ratio of surface to milk in the holding method. A tremendous volume of milk handled in a limited area of equipment in a plate-type unit not only creates a greater amount of deposit at the end of each day's run but the deposit itself will frequently be stratified —will consist of several layers of varying composition.

The rate of flow of milk through the unit affects the type and amount of contamination produced. A relatively slow rate of flow gives a heavier deposit which is more uniform in composition over the entire surface of the plates. As the rate of flow increases, less total deposits results but a heavier deposit will generally form on the sides and corners of the plate where the resistance to the flow is greater. There is a tendency for the deposit to be mechanically pushed away or eliminated from those places where the flow is fast and later deposited in those places where the friction is greater and the flow of milk has slowed down.

CLEANING PROCEDURE

These and many other factors have been carefully studied, first in the laboratory experimental unit and then when promising results were indicated, actually carried out in the plant where the short-time unit is operated. This two-fold investigation has resulted in the development of a cleaning procedure that has given eminently satisfactory results in hundreds of plate-type pasteurizing units in all types of hard-water conditions. The important steps in this cleaning procedure may be conveniently summarized as follows:

1. Immediately after handling the milk, disconnect the flow diversion valve and shut off the hot water pump.

2. Circulate cold water through the unit by filling the surge tank with water from the hose and keeping the surge tank overflowing with the cold water. Allow the water to run onto the floor as it comes from the unit. Continue this procedure until the rinse water is free of any traces of milk and the entire unit is cooled down to room temperature.

3. Shut off the flow of cold water to the surge tank and heat the water in the tank to 135–150° F. with a steam hose. Arrange the equipment so that the solution from the unit, which formerly drained to the floor, is circulated back to the surge tank.

4. Add the special acid-base milkstone remover at a concentration of from one pint to one quart to each 40 gallons of water used. The strength to use will depend upon the condition of the plates, the amount of milk handled, and other factors. Enough of the special milkstone remover is used to give the proper concentration to the water contained in the surge tank, as well as that contained in the unit between the plates and in the various connected pipes and pumps.

5. Circulate the milkstone removing solution through the equipment for from 30 minutes to 1 hour. The solution should be maintained at the initial temperature by hot water in the plates. However, at the start the steam hose should be used to bring the solution up to the proper temperature rather than heating it through the deposit on the plates. The use of an ordinary centrifugal-type pump is highly recommended for circulating the cleaning solution. The precision-type milk pump usually employed for handling the milk is lubricated by the fatty matter in the milk and might be damaged through lack of lubrication in the milkstone removing solution.

6. After the milkstone removing solution has been circulated for the proper length of time, overflow the water in the surge or balance tank with hot water from a hose. This will remove the scum and accumulated contamination from the surface of the solution. After the surface contamination has floated off the solution, the outlet pipe from the unit should be removed so that the warm rinse water will be pumped from the balance tank through

the plates and onto the floor. This rinsing should continue for 10 to 15 minutes.

7. Turn off the hot water hose and replace the outlet pipe to the balance tank so that the solution can again be circulated. Add the special alkaline-type milkstone remover to the tank, using 2 pounds for each 40 gallons of water. This solution is heated with a steam hose to 135–145° F.

8. The special alkaline-type solution is circulated through the unit for from 30 minutes to 1 hour. The temperature is maintained at 135–145° F.

9. Force the alkaline solution from the unit by placing cold water in the balance tank and removing the outlet pipe from the unit. Continue circulating fresh cold water through the unit until the plates are cooled down to at least room temperature.

10. Dismantle the pipe lines and open the unit for inspection. A mild solution of alkaline cleaner is prepared in a bucket. The plates are brushed with this solution where necessary. Proper operation of the treatment with proper selection of the products used will produce results so that at best only very light brushing is required, and in most cases a rinse with a hose will remove the last traces of the softened contamination.

11. Rinse the plates thoroughly with warm water. The unit is then reassembled, ready for the sterilizing treatment the following morning.

Where conditions permit, it is of definite advantage to circulate the acid-type solution through the water side of the plates in both the heating and final cooling sections. This treatment will prevent the build-up of even a slight amount of rust film or water scale which naturally interferes with the efficient transfer of heat or refrigeration. With some units a by-pass arrangement is available which makes it possible conveniently to circulate the solution in this way. With other units, special hook-ups are necessary.

If the cooling section of the unit is operated with brine instead of cold water, the brine should always be drained before circulating the hot cleaning solutions. Brine is generally quite corrosive to stainless steel even at low temperatures. If left between the plates during the treatment with the hot milkstone removers, the corrosive action is increased many times and severe difficulties are apt to be encountered. Drain the brine from the unit, rinse it with fresh water where possible, and then circulate the special milkstone removing solutions through the brine section.

STERILIZING PLATE-TYPE UNITS

The sterilizing of short-time pasteurizing units does not differ greatly from the sterilization of other types of dairy equipment. It is very important that the equipment be thoroughly cleaned before we can expect effective sterilization. This holds regardless of whether the equipment under consideration is a vat, a cooler, a pipe line, or a plate-type pasteurizer. The use of chlorine is generally recommended for sterilizing this equipment and is readily applicable in plate-type units as well. A solution of 100 ppm. available chlorine, or whatever strength is required by local health department regulations, is readily circulated through the unit. A sufficient quantity of the sterilizing solution is prepared so that five minutes contact time, the normal recommendation of most health departments, will result.

The temperature at which the chlorine sterilizing solution is used brings in one precaution as compared with sterilizing a weigh tank or vat. With chlorine sterilizers of the quick-acting type, the solution is generally used at room temperature as it is practically as effective in a cold solution. With the short-time pasteurizer, however, the temperature of the chlorine solution must be maintained at the same temperature which is used in handling the milk. This permits the flow diversion valve to remain open so that the solu-

tion will flow through the unit, as will occur when handling milk. If the chlorine solution is used at a low temperature, the flow diversion plate-type valve would cut in, causing the solution to be by-passed back to the balance tank and thereby keep it from flowing through to the cooling section of the unit.

Because of the high temperature necessary with the chlorine sterilizing solution, it is important that one be selected which is not only stable at the temperature used but which is also completely non-corrosive to stainless steel and other metals involved in the equipment at the temperature and concentration employed.

PIN POINT BACTERIA

The plate-type pasteurizer, like any other piece of dairy equipment, may be a source of contamination unless properly cleaned and sterilized. This is particularly true in the case of thermoduric or heat-resisting organisms. While it is possible to destroy such organisms with steam or hot water methods of sterilization, such treatment frequently involves many practical operating difficulties. Steam and hot water leave much to be desired when used for sterilizing plate-type pasteurizers. One common fault in the use of hot water for sterilizing, for example, is the failure to maintain the water hot enough to destroy bacteria throughout the entire unit. While it is a simple matter to use the heating section of the plate unit to heat the sterilizing water up to 165 or 175° F., many operators fail to take into consideration the fact that this is the temperature of the water only at the heating end of the unit. Temperatures will be considerably lower in the other sections just as the temperature of the milk is lower when it is handled in these sections. It is generally recognized that it is necessary and important to sterilize preheating, regenerative, and cooling sections of the plate-type unit as well as the heating section. When the chlorine method of sterilizing the unit is employed, it is only necessary to have the temperature of the chlorine solution up to 161° to 165° F. at the flow diversion valve.

Another perhaps more important matter to consider is the resistance of thermoduric organisms to destruction by heat alone. Tests now being conducted at various Agricultural Experiment Stations and not yet published have shown that a temperature of 170° F. in contact for one hour will not destroy certain resistant types of thermoduric organisms. Treatment of the same strain, however, with chlorine at the normally recommended concentration and time of contact brought about complete destruction. Further, the organisms used in these studies show a tendency to develop immunity to treatment by heat. Evidence so far available indicates quite conclusively on the other hand that no such immunity is developed towards chlorine.

The cleaning and sterilizing of electric-type units has also been carefully studied. With these special units it has been shown that the type of deposit produced is generally of such a character that circulation of a solution of the special acid-base milkstone remover will properly take care of conditions without the use of the alkaline milkstone remover. With the special acid milkstone remover, which is extensively used in many plants, a concentration of one-half pint to nine gallons of water gives a solution of the proper electrical characteristics. Nine gallons of the solution are sufficient to accomplish circulation through the unit. The sterilizing solution prepared from the special non-corrosive, stable, quick-acting chlorine sterilizer is made up at the rate of 6 ounces to 9 gallons of water. This solution also has the necessary electrical characteristics to bring about effective results in the electric pasteurizer. It also, of course, has proper germicidal strength to destroy bacteria.