THE DAIRY PRACTICES COUNCIL®

GUIDELINES FOR
CLEANING AND SANITIZING IN
FLUID MILK PROCESSING PLANTS

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ABSTRACT

The guideline represents an effort to present pertinent current information on the cleaning and sanitizing of fluid milk processing equipment. The introduction presents a general discussion on the nature of soils, water quality, and types of cleaners. Various cleaning methods are discussed and detailed cleaning instructions are given for specific types of equipment. Types of sanitizers and methods of sanitization are covered in detail. Also discussed are: 1) evaluation of cleaning, 2) good housekeeping practices, and 3) personal hygiene.

PREFACE

This publication embodies an endeavor commenced back in 1979 by personnel in industry, regulatory, and cooperative extension to provide a practical, current guideline directed to cleaning and sanitizing in fluid milk processing plants. Many dedicated people have contributed to this effort over the years. This revision was prepared under the leadership of Mr. J. F. Mauck, Alpha Chemical Services, Inc., and assisted by Dr. R. A. Holley, Canada Dept. of Agriculture, and Mr. J. Jakubowski, Lacto Milk Products Corp.

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GUIDELINES FOR CLEANING AND SANITIZING IN FLUID MILK PROCESSING PLANTS

INTRODUCTION

Purpose

This set of guidelines represents an effort to bring together some of the latest information available on the cleaning and sanitizing of fluid milk processing equipment. Significant strides have been made in recent years by dairy equipment engineers in the design and construction of equipment. Suppliers have improved the formulation of cleaning and sanitizing agents, and processors have improved processing and cleaning and sanitizing methods. These advances, when monitored by an effective quality assurance program, have resulted in improved quality and keeping characteristics of products in the hands of the consumer.

To maintain good product shelf life, it is essential to keep up-to-date on cleaning and sanitizing practices and to properly apply them to plant operations. This guideline has been developed to present a comprehensive review on the subject of cleaning and sanitizing in fluid milk processing plants. It is hoped that this guideline will aid milk plant managers, supervisors and employees in the execution of their responsibilities. Also, it should be of help to the sanitarian or the student who may be concerned with the technology of milk plant sanitation.

The primary purpose of cleaning dairy equipment after each use is to remove all residues. Residues will provide harborage for bacterial growth that affect dairy product quality and shelf life and have a potential to cause disease. Secondarily, excessive soil buildup will be detrimental to those processes where heat transfer is involved.

In the past, products used in cleaning have been condemned for such negative effects as the production of foam in streams and the possible eutrophication of certain bodies of water. Recent advances in detergent technology have eliminated the former problem and are effective in helping control the latter. Nevertheless, plant efficiency and the need for sanitary, high quality milk products mandate the wise use of various chemicals for equipment cleaning.

Nature of Soils

The majority of soil residues on dairy equipment consist of milk constituents. Water can contribute varying amounts of soil residue, based on its quality, and additional sources of contamination can be detergent and sanitizer residues or dust and dirt from the environment.

Milk residues are primarily organic and consist chiefly of milk sugar, protein and milkfat. The inorganic residues are the various salts contained in milk.

Milk sugars are readily removable, even with rinse water, and do not present any difficulty in equipment cleaning. Fats are easier to remove above their melting point of approximately 90°F (32.2°C). Proteins can cause residues which are difficult to remove particularly if they become cooked-on or denatured as happens in processing operations employing considerable heat, such as pasteurizing. The inorganic residues combined with certain amounts of fats and proteins can dry on or cook on and, combined with constituents of water, form a residue known as <u>milkstone</u>.

Water Quality

The USPHS, in its Grade "A" Pasteurized Milk Ordinance, requires that water for milk plant purposes be of a safe and sanitary (potable) quality. This includes water used for cleaning and sanitizing of equipment, etc. Water supplies must be certified as bacteriologically safe (less than 2.2 coliform organisms/100 ml or its membrane equivalent, < 1 per 100 ml) when first installed, following repairs to the system and semiannually on routine basis. Some of the common characteristics that relate to water quality are taste, odor, color, bacteria, dissolved and suspended solids, hardness, and iron.

Steps must be taken to correct any condition that adversely affects the operation of the plant. Chlorination, ozonation, or ultraviolet light sterilization can be helpful to improve bacteriological quality. Gravel, sand and activated carbon filters can remedy excess suspended matter or organic materials that cause taste, color, or odor. Special chemical filters or addition of polyphosphates can either remove iron or prevent "red iron" deposits on water contact surfaces.

Water hardness also affects water quality. Hardness is classified as either temporary or permanent. Temporary hardness is caused by calcium or magnesium bicarbonate and can be precipitated by heat or by many alkaline materials. Permanent hardness is mainly caused by calcium and magnesium chlorides and sulfates. It is precipitated by most alkaline materials but not by heat.

The U.S. Geological Survey water hardness classification is as follows:

	Parts per Million	Grains per Gallon
Soft	0 - 60	0 - 3.5
Moderately Hard	60 - 120	3.5 - 7.0
Hard	120 - 180	7.0 - 10.5
Very Hard	Over 180	Over 10.5

Soft and moderately hard water can easily be used for cleaning purposes by proper selection of detergents or by periodic acid washes or rinses. Hard or very hard water may need conditioning by ion exchange. Softening the entire water supply of a plant is costly and is impractical unless the water is very hard. Water softening can pay for itself very quickly in special cases. For example, water of almost any hardness used with conveyor lubricants should be softened. Water over 100-ppm hardness should definitely be softened. This will permit either greater dilution of the lubricant or the use of less costly lubricants. A second example is the softening of boiler or cooling tower feed waters; this can be beneficial in reducing maintenance and chemical costs.

Water conditioning is a specialized area. Consult experts in the field when considering or installing any treatment.

Detergent Terminology

Principle terms that are associated with detergents and cleaning compounds are:

Emulsification - the spontaneous dispersion of certain solid substances (i.e., fats and soils) when brought in contact with water.

Peptize - is the mechanical action combined with a surfactant causing two immiscible liquids to form a stabilized colloid.

pH - this is the term used to indicate the intensity of the acidity or alkalinity of a solution. The pH scale ranges from 0 to 14. Solutions of pH 7 are neutral; less than pH 7 are acid and more than pH 7 are alkaline.

Saponification - combining an alkali with the fatty acid of oils and fats to produce soap.

Sequestering and Chelating - tying up hard water constituents into stable and soluble compounds to prevent precipitation.

Wetting - lowering the surface tension of a cleaner to permit it to break the bond between the soil and the surface to which it adheres.

Types and Properties of Cleaning Compounds

Cleaning compounds found in milk plants may be neutral, alkaline or acid. Different types of cleaners are necessary because of different types of soils and methods of cleaner application.

A good cleaning compound should have as many of the following properties as possible:

1. Economy of use
2. Water softening properties
3. Low toxicity
4. Low corrosiveness
5. Quick and complete solubility
6. Stability in storage
7. Ease of handling and use
8. Free rinsing

Cleaning compounds usually contain several chemicals that can be categorized among the following groups:

Alkalies

Alkaline cleaners are those that have a pH higher than 7. They are commonly used in the dairy industry because they saponify fat, that is, they convert the fat to soap so it can be removed with water.

These are usually considered to consist of sodium hydroxide (caustic soda) potassium hydroxide (caustic potash), sodium carbonate (soda ash), and sodium silicates. Trisodium phosphate (TSP) is also placed into the alkali group because of its reaction with water to yield hydroxide ions.

Both caustic soda and potassium hydroxide are strong alkali bases and both can cause corrosion and tissue damage.

Soda ash is an inexpensive source of alkali. It is mild and lends itself to incorporation into manual equipment cleaners. It will precipitate hard water salts and has to be used judiciously in hard water areas or be blended with ingredients which will effectively soften water.

Sodium silicates are good soil suspending agents with an additional property of inhibiting corrosion of soft metals such as aluminum.

Trisodium phosphate has good emulsifying powers and softens water by precipitating the hardness.

Polyphosphates

These are often referred to as complex phosphates. They are excellent emulsifiers and soil dispersing agents and additionally prevent scale buildup by tying up hard water constituents. The primary complex phosphates are sodium tripolyphosphate and sodium hexametaphosphate.

Organic Chelating Agents

These are ingredients blended into detergents to control hard water and scale deposition. Salts of ethylenediaminetetraacetic acid and of certain organic acids such as gluconic acid are the most often used.

Chlorine Compounds

Various sources of available chlorine are very often added to alkaline cleaners. These enable the cleaner to solubilize protein residues by peptizing the protein and to promote rinsing of the equipment, leaving it more free from water spots.

Wetting Agents

These are the "synthetic detergents" that promote soil removal and are most often blended into acid or alkaline cleaning compounds. Wetting agents are the primary active ingredient in neutral cleaners. They work by permitting the cleaning solution to penetrate soils. Additionally, they emulsify fats, disperse and suspend soils, and promote rinsing of the cleaning solution. Many are high foamers, but some have the ability to defoam and are used in circulation cleaning.

Most wetting agents are now biodegradable, which means that they will be broken down in effluent treatment systems and will not create subsequent foam in streams.

Acids

Acid cleaners have a pH of lower than 7. These cleaning compounds are principally used to eliminate or prevent milkstone and to descale equipment. Acid cleaners are also used in one step of the cleaning cycles for high temperature heat exchangers. Inorganic or organic acids and salts are used with a wetting agent and are often included in the formulation.

Phosphoric acid is the most commonly used inorganic acid because it is effective, relatively safe, and less corrosive than other mineral (inorganic) acids. Hydrochloric acid is sometimes used for removing heavy scale, but it is very corrosive and must be used carefully. Nitric acid, often with phosphoric, has been used to clean HTST pasteurizers. Organic acids such as citric and hydroxyacetic acids, are milder and less corrosive than the mineral acids, but their widespread use has been limited by their high use costs.

Factors Influencing Cleaner Efficiency

It is important to select the proper cleaner for a specific job and to use it properly. The nature of soils and of the cleaning compound itself will dictate the temperatures, concentration and contact time for the cleaning. Overuse of a cleaner is not only expensive but can adversely affect rinsing and leave residues on equipment. Suppliers of cleaning chemicals should be consulted for advice on control and use of cleaning solutions incorporating their products.

METHODS OF CLEANING

Purpose and Principles

The purpose and need for thorough cleaning have been set forth previously in this guideline. The methods to accomplish those requirements vary greatly and are listed below.

All methods, however, if they are to be successful, require that certain rules and procedures be followed. It is a long established and well-known fact that pre-rinsing equipment after use with warm, clean water (approximately 110°F (43.3°C) to remove as much of the free soil as possible prevents residues from adhering to equipment, thus minimizing films and/or milkstone formation. Drain periods must be adequate to permit complete drainage of milk and detergent solutions.
Cleaning action must be long enough and at the proper temperature and detergent concentration to loosen and break up the remaining soil so it can be removed by physical and chemical action.

The post-rinse must be sufficient to carry away the loosened soil and detergent solution, leaving the equipment in a thoroughly clean condition without any trace of soil or detergent. It is advisable to acidify the post-rinse whenever possible. This prevents the accumulation of any alkaline residual from the detergent or minerals from the rinse water. It further leaves the surfaces at a slightly acidic pH which improves the bactericidal action of many chemical sanitizers to be used just before start-up of the equipment for the next day's operation.

In summary, the rules that must be adhered to are 1) sufficient time, temperature, detergent composition and concentration, and physical action must be provided to clean the equipment; and, 2) the step-by-step procedure of rinse, wash, rinse, must be practiced in all methods of cleaning.

Manual Cleaning

This process requires the disassembly of equipment after rinsing so that all product contact surfaces can be manually brush washed to remove product residue.

Piping systems must be taken down and placed in pipe wash tanks containing detergent solution and must be brushed either by hand or with a power-driven brush. All pumps, valves, caps, tees, ells, ferrule unions, etc., must also be brush washed. All gaskets must be removed and inspected on a daily basis. Gaskets should be replaced as necessary.

Vats, tanks, tank trucks and other vessels must also be thoroughly brush washed with the proper detergent solution. The following items cannot be cleaned properly unless they are removed and disassembled!

1. Volume gauge line
2. Tank fill gooseneck
3. Vent cap and screen
4. Manhole door gasket
5. Sample valve in-door
6. Siphon breakers

Manually washed fillers require hand brush washing of the bowl, the product supply line, ell, and bushing. All valves must be completely removed and disassembled so that all surfaces of all valve parts can be carefully and thoroughly cleaned. The vacuum supply line must also be thoroughly cleaned. In short, manual simply means hand brush washing of equipment.

Since manual washing is done with a brush, it is of utmost importance that proper brushes be utilized. A proper brush is one that has a block constructed of durable material that will be resistant to heat and chemicals and also be moisture proof. Also, the fill, or bristles, of the brush should be of nylon material. It is important that the fill does not act as a wick maintaining moisture within itself that would tend to hold dirt and encourage the growth of bacteria and fungi. Rather, the brushes should be quick to dry.

Blends of various types and sizes of nylon bristles within a brush provide excellent water retention. If a nylon brush contains only one size and shape of bristle, water immediately escapes from the brush and does not provide good cleaning action. The brush that is constructed of various sizes, diameters and shapes of bristles will retain cleaning solution within it much like a sponge. This "sponge action", therefore, makes it possible to carry the cleaning solution to the surface to be cleaned. Its performance in this respect equals or surpasses that of a natural fiber bristle. Moreover, the use of a nylon or plastic block and nylon bristle provides a brush that retains its shape, has much wear resistance, and will normally outlast four or five cheaper brushes constructed of wood blocks and natural fiber bristles. At the same time, it will provide a sanitation tool that does not serve as a harbor for microorganisms. Therefore, it is the recommendation of this guideline that the term "proper brushes" indicates nylon fill with a plastic or nylon block construction.

Cleaned-Out-Of-Place (COP)

COP means specifically "cleaned-out-of-place" and requires the disassembly of equipment after rinsing so that all parts and short pipe sections can be placed in a recirculation tank for chemical and physical action cleaning.

This procedure is based on the use of a rectangular recirculation tank equipped with an integrally mounted high volume recirculating pump, the combination generally being referred to as a "parts washer". The design of such equipment varies with the application. They range from tanks of approximately five feet in length equipped with jets in the side for washing filler parts, centrifugal machine parts, etc., to tanks of approximately the same dimensions as standard pipe wash tanks. The latter tanks are equipped with pump suction and discharge connections at opposite ends to induce a longitudinal flow through the tank for cleaning "take down" piping of appreciable length. In some instances, a single tank is designed to permit both end-to-end recirculation or the more violent "rolling" action caused by side-mounted jets, with the choice being determined by the use of a three-way valve in the recirculating pump discharge line.

A temperature recording chart and an automatic temperature controlling steam valve are a must for every COP system, as it is extremely important to maintain sufficient cleaning temperature at all times and to have a clear and concise record of that temperature. This equipment allows elevated temperatures and increased concentrations of CIP-type detergents to provide more effective cleaning of complicated equipment parts than can be accomplished by manual cleaning.

Cleaned-In-Place (CIP)

CIP (cleaned-in-place) systems are now present to some extent in practically every milk processing plant. Cleaning in place refers specifically to the cleaning and sanitizing of dairy processing equipment and piping in its assembled condition by recirculation of the necessary rinse, detergent and sanitizing solutions under the appropriate conditions of time, temperature detergency and physical action. Recirculation is a necessary condition for COP.

CIP cleaning can be accomplished as simply as hooking up a “pump and a pot” to a pipeline loop and utilizing the physical action plus heat and detergency to clean that line, all of which can be manually controlled. CIP cycles are based on controlling functions (pumps, valves, etc.) in a repeatable pattern each time the cycle is activated. Automated systems of various degrees of sophistication can be provided, the ultimate is a completely automated or programmed push button system.

Systems in use include mechanical/relay logic controllers with adjustable cam timers (one cam unit for each program), and drum timers (limited to 3 or 4 programs per drum). Other controllers used are punched card programmers, time discs and run-out timers (in series).

More recently, solid state programmable controllers, such as time count modules, microprocessors, and computers, have been applied to CIP systems. These controllers provide the same repeatable pattern of functions as the mechanical controllers do, but with the additional advantages of 1) no step or time limit restrictions for any step in the program, and 2) extended service and reliability (no moving parts).

There are also differences in solid state controllers, just as there are differences in mechanical controllers. Those microprocessors that are dedicated to CIP control are generally insensitive to ambient temperature and humidity conditions and need no battery back-up to retain program information in the event of power loss. These conditions do exist in dairy plants and are important considerations when selecting solid state controllers.

Recording charts that give a permanent record of the time and temperature of each cycle of the CIP cleaning system must be a part of every installation. In addition, it is a great advantage also to have the pressure of the CIP pump recorded so that physical action and hydraulic performance of the pump can be monitored at all times. Some CIP systems utilize a dual action recorder for this purpose. Having a permanent record of time, temperature and physical action is of great advantage in monitoring and determining performance of the total CIP systems.

Because CIP eliminates the manual physical action of the brush from the cleaning process and replaces it with chemical and hydraulic physical action, it is important that plant personnel, preferably quality control people, monitor the chemical levels and concentration of the wash solution on a daily basis. Most detergent manufacturers supply test kits, making it possible to titrate alkalinity and chlorine levels and concentrations in the alkaline wash solution, as well as pH of acid washes and acidified rinses. Because of the importance of proper levels of detergency to accomplish and attain absolutely clean equipment, the controlling of detergent solutions cannot be overemphasized.

Circulation of Pipeline Circuits

Layouts for CIP lines for processing operations require attention to numerous details such as:

1. Location and utilization of every pipe for both cleaning and processing functions.
2. Permanent installation of the greatest possible amount of pipe.
3. Elimination of all unnecessary bypass and return connections.
4. Provisions to enable all processing to be completed without piping changes yet permit quick conversion to the cleaning circuit.

This type of planning demands considerable thought but pays off in reduced product loss, improved sanitation, and savings in man-hours of cleanup and processing labor.

The materials and connections for CIP piping must be given very careful thought. Welded stainless steel lines are undoubtedly the best, for there are no joints and no gaskets to form possible sources of contamination. Second best is to use fittings that are of CIP clamp-type design. Thirdly, where standard bevel seat fittings are a necessity, special gaskets that are suitable for being cleaned in place must be used.

It is most important that all lines in any recirculation cleaning system be properly fitted, properly pitched, and rigidly supported, with special attention to the latter, since proper support alone can assure maintenance of proper fit and pitch. Gaskets and joints that are protected from stress will be long-lived and trouble-free. Most plants should inspect gaskets every four to six weeks and replace gaskets as indicated necessary.

Spray Devices

Spray devices have been developed for application in cleaning various types of processing or storage vessels and tank trucks. These units are normally constructed of stainless steel, with interior and exterior surfaces polished to standards normally required for product contact surfaces (3A). They are self-cleaning and self-draining and have been universally accepted for installation in the product zone of storage and processing vessels.

The permanently installed spray unit has become the most popular spray cleaning fixture. Such a unit has no moving parts and its performance is not affected greatly by minor variations in supply pressure. Furthermore, once an installation is made which produces the desired results, it will continue to do so as long as the proper cleaning program is followed.

As with pipeline circulation, spray cleaning operations may be conducted with various degrees of complexity and automation. The very minimum system necessary to provide satisfactory operation and achieve good cleaning results must include a recirculating unit consisting of a pump, tank, a three-way valve, and a steam injection mixer in order to control and maintain wash solution temperature. The ultimate in total plant CIP systems is the installation and use of the completely automatic CIP systems. Automation cleaning refers to the application of automatic controls to the recirculation cleaning process. This provides fully automatic control of all process variables including time, temperature, and detergency for conducting highly repetitive cleaning tasks such as washing tankers, plant processing and storage vessels, and product piping circuits. Highly specialized system engineering also assures exceptionally fine control of physical action through system design, pump application, etc.

High Pressure-Low Volume

This method of cleaning utilizes a high pressure pump that provides up to 700 psi through a cleaning wand and nozzle specially designed to control the volume of solution supplied for cleaning application. This volume can vary, but the most effective and economical application is between two and three gallons per minute. This high pressure solution provides a very effective cutting action to remove soil buildup from equipment. It is an excellent tool to clean hard-to-get-at places, such as the underside of equipment beneath the filler turntables, conveyor systems, the outside surfaces of equipment, walls and floors. It is impractical for use in cleaning pipelines or large storage equipment. It definitely has a place in the overall sanitation program in a dairy plant and can further be used with proper selection of detergents for truck washing.

Because the areas normally cleaned by high pressure-low volume methods vary so greatly in the soils encountered, the types of metal involved, etc., it becomes necessary to use great care in the selection of the detergent used in these systems. Consideration must be given to detergent selection in order to get the best cleaning action on the specific soil to be removed and at the same time provide protection to soft metals. Therefore, one cannot overemphasize the need to consult your detergent supplier and follow his recommendations for selection and concentration of detergents. The optimum temperature for most high pressure-low volume cleaning is in the 140°-150°F (60°-65.5°C) range. This wash solution temperature should never exceed 160°F (71.1°C). Sometimes, depending upon circumstances, it may be necessary to utilize a much lower temperature, in which case effective cleaning can be accomplished by utilization of the proper detergent at the recommended concentrations. As in all types of cleaning, the rinse-wash-rinse procedure must be followed.

EQUIPMENT CLEANING[1]

Receiving Equipment

Weigh and Dump Vats

Disconnect dump vat from piping. Rinse weigh vat with warm water with valve open[2]. Remove screen, covers, and dump valve from weigh vat and rinse all removed parts. Thoroughly dissolve a manual cleaner in water (minimum temperature of 150°F (65.6°C) in a plastic or rubber bucket. Remove cover from dump vat and rinse all surfaces of cover and vat using the solution from the bucket. Use a suitable set of brushes that will reach the various surfaces. Separate brushes of appropriate size and shape are needed to properly contact each unique area such as the tubular shape of the dump valve guide, the outlet of the vat, and the large flat surfaces. Scrub all surfaces and parts. High-pressure washing devices may be used on larger surfaces. (See High Pressure-Low Volume, page 10). Immediately after scrubbing, rinse well. Drain and reassemble. Do not sanitize until just prior to use. Color coded brushes are available to assist in assuring that brushes are only used in the Receiving Department. For example, red is typically used for receiving; white for pasteurized, etc.

Milk Flow Meters

Unless the manufacturer's instructions provide for CIP of the meter with rotors in place, assume that rotors must be removed. Rotors are usually made from hollow stainless steel or compressed carbon and must be handled very carefully. Remove from meter, rinse, and hand-wash as specified in section above. The air eliminator device should be disassembled for manual cleaning. The body of the meter may be disassembled and hand cleaned, or it may be reassembled without the rotor and CIP cleaned with the lines. (See In-Line Samplers, following.)

In-Line Samplers

In-line samplers, by design, constitute a dead end and must be disassembled daily. They may be partially cleaned in place by removing the sample container and circulating a cleaning solution through the sampler and lines while pulsing the sampling valve at the same frequency during CIP as is used for product sampling. Following CIP, disassemble the sampling valve and inspect the parts for cleanliness, giving attention to the "O" ring and the groove it rides in, and also the threads engaging the sample bottle. Surfaces needing scrubbing should receive it. Check rubber parts for deterioration or shrinkage and replace as needed. Hand scrub and sanitize the sample bottle.

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[1] Six charts on pages 42-46 give specific times, temperatures, and concentrations for cleaning all equipment.

[2] To reduce pollution, all rinsings containing milk residues should be utilized or disposed of in a manner that will keep the milk solids out of the plant drains consistent with state and local ordinances. Re-use of rinsings in food products is not endorsed. This recommendation applies throughout this guideline wherever the rinsing of equipment is mentioned.

Blow dry the sample bottle with sanitary compressed air if it is to be replaced just after sanitizing, or drain and air dry. Drain and air dry is preferable.

Can Washers

Operate can washers with a nonfoaming, can washing detergent solution of 0.15% to 0.3% alkalinity at 145°F (62.8°C).

Milk cans will usually clean at 0.15% to 0.25% alkalinity, while mix, cream, and chocolate milk cans may need 0.3% alkalinity. A meter-controlled proportioner is effective for maintaining solution strength on large can washing operations. Dispenser cans wash best with a wash jet hose connected to each dispenser ferrule nipple on cans in the washer; otherwise, use a small brush inside each can ferrule.

An acid detergent (phosphoric acid) may be substituted two consecutive days per week to prevent milkstone and mineral deposits. Use at 0.2% to 0.5% acidity (pH 2.4-3.0) at 145°F (62.8°C). Rinse and wash jets should be checked periodically during operation and be cleaned as needed. They should be removed for cleaning at the end of a day's operation. Screens should be removed and the tank drained and cleaned daily. The final rinse temperature should be 180°F-190°F (82.2°-87.8°C) to provide for quick drying.

Lines

Manual cleaning of milk pipelines involves clearing of product, pre-rinsing, disassembly, rinsing, scrubbing, and post-rinsing. Clearing lines may be done with compressed air or by pumping and draining. Pre-rinse with a small amount of water. In clearing and pre-rinsing, it is advantageous to retain the mixtures for disposal in such a way as to prevent a high solids content going to the plant waste disposal. Disassemble lines and rinse thoroughly. Using a suitable general cleaner solution, hand scrub with nylon bristle brush on a handle or wire long enough to extend clear through the longest pipe section.

A motor driven pipe brush mounted on a pipe wash vat is an effective device for scrubbing. Multi-use rubber or plastic joint gaskets may be scrubbed with an 1/8" thick pad of nylon sponge. Rinsing of manually cleaned lines should be done immediately after washing so that the detergent film does not dry on the surface. Pipe sections which are dented do not clean effectively with hand scrubbing and should be replaced.

CIP cleaning of lines requires clearing of product. Pre-rinsing, circulation cleaning, and post-rinsing require a velocity of five feet per second. Clearing of product may be done with compressed air fittings controlled by the CIP programmer. Air inlets into product lines must always have check valves to prevent any liquid from getting into air lines. Without compressed air, clear lines by pumping with a small amount of water and retain for disposal as mentioned above. Air-actuated product valves in the line circuit should pulse to half closed and return about every 20 seconds during circulation. final drainage of the system should be complete. CIP type product valves should be disassembled for inspection of rubber plungers and "0" rings at least monthly. Replace parts as needed to prevent failure and product loss.

Dead-end fittings in lines such as thermometer probe tees, plug valves, or butterfly valves are not fully cleanable with CIP. They should be removed after the clearing of the lines, cleaned manually, and replaced for CIP. A COP tank may be used for such parts.

Pumps

Some centrifugal product pumps are self-draining and may be effectively CIP cleaned without disassembly. These include two-speed pumps which become CIP circulation pumps when run at the higher speed.

Most product pumps are not capable of producing the five feet per second velocity recommended for CIP. Therefore, they should be cleaned manually by the procedures recommended for lines. An alternative is to remove the impellers, rinse the housing and seals while open, and reassemble without the impellers for CIP cleaning and post-rinsing with the line circuit. Disassembly after CIP should involve inspection of the cleanliness and condition of the housing seals and back plate seals on the shaft prior to reassembly with the impellers. A COP tank may be used for pump parts.

Storage Tanks

The USPHS Pasteurized Milk Ordinance, as well as some state regulations, require that storage tanks which are used for storage for more than 24 hours be cleaned at least every 72 hours and that a record of tank cleaning times be maintained. When storage tanks are CIP cleaned, a seven-day recorder is required showing temperature of milk storage and cleaning.

Horizontal Tanks

Manual cleaning of tanks is effective when all surfaces can be reached by brushing. This involves clearing of product, disassembly of fittings, pre-rinsing, cleaning, post-rinsing, and assembly. Tanks should be cleared of product by rinsing as soon as possible after they are empty. Remove inlet fittings, vent, agitator, door gasket, sampling valve, outlet valve, and level gauge devices or sight glass. Outlet of tank should be disconnected from any lines in use prior to any rinsing. Pre-rinse all parts removed and all other milk contact surfaces of the tank.

Parts may be soaked in a manual detergent solution. Use a completely dissolved solution of general cleaner prepared in a plastic or rubber pail. Place pail and long handled brush inside tank with outside protected light shining through port. The brush should have stiff, straight, nylon bristles standing in the same direction as the handle so that operator can apply pressure overhead and elsewhere. Working from the back of the tank toward the outlet, scrub all of the interior in a progressive pattern so that no surface is missed. High-pressure scrubbing devices may also be used inside tanks. Use a properly shaped brush to scrub inlet ports, vent ports, sight ports, agitator bushing, sampling valve port, and outlet. Scrub both sides of the door from outside of the tank. Immediately rinse the entire interior of tank. Wash the outside of the tank as needed and then rinse. Manual scrubbing of tank parts should be accomplished as described above for manual cleaning of lines or a COP tank may be used to clean separate tank parts. The parts must be placed securely in a special stainless steel basket so that they will not be damaged by abrasion from other surfaces due to the turbulence in the COP tank. Parts must be rinsed before reassembly in tank. Apply sanitary lubricant to the agitator bushing and the plug of the outlet valve without contaminating the lubricant or the surfaces. Sanitize the tank just before use.

CIP cleaning of horizontal tanks requires one or more spray balls or spray heads which are designed and positioned for the specific shape and dimensions of the tank. Disconnect the tank outlet from any product lines which are in use. Clearing product from the tank should be the same as for manual cleaning. Disassembly of the tank parts is the same as for manual cleaning with the following exceptions. The outlet valve is left in place if it is the CIP type. Plug valves must be removed, manually cleaned, and replaced in the open position for CIP. The solid door of the tank should be left unclamped to provide venting. This venting of the tank is essential to prevent collapse of the tank liner due to rapid pressure changes.

Pre-rinsing, cleaning, and post-rinsing are best controlled by a programmable controller. Pre-rinse water should be the same as for manual rinsing. CIP cleaning solutions should be nonfoaming. Post-rinsing is the same as in CIP post-rinsing of lines. Allow sufficient time to flush out all detergent solution. Spray devices must be disassembled often enough to remove any particles of gaskets or other debris that would detract from the spray pattern. This problem can be minimized by maintaining a fine screen in the discharge side of the CIP pump which should be cleaned at least monthly. Internal gauge tubes may be cleaned by CIP in position by using a hose fitted to the outer connection of the tube and pumping detergent solution piped from the main CIP supply line. The gauge tube should be fitted with a permanently installed restriction at the bottom. Tank parts that are removed should be cleaned manually or by COP as outlined above. Reassemble the tank. Do not sanitize until just before use.

Silo Tanks

Because of their height, silos must be cleaned by CIP methods. These tanks come equipped with solution distributing devices. Silo doors must be replaced with vented doors or held open by a positive device while cleaning. This device is usually a projecting stainless steel rod welded to the vertical jumper pipe which connects to both the vent line and the CIP distributor supply line. The silo outlet must be disconnected from product piping and connected to the CIP return line. Some silos are agitated by compressed air so that the only fittings to be removed for separate cleaning are the sampling valve and the door gasket or the entire door.

Proper programming of the CIP controller for silo cleaning requires considerable experience on the part of the technician. Pre-rinsing is accomplished by intermittent controlled bursts rather than continuous flow. This tends to move the milk foam through the outlet rather than letting it float on the surface of the "pond" of rinse water at the bottom of the silo. The outlet valves are usually air actuated and pulse to half closed about every 20 seconds as programmed. These valves must be disassembled at least monthly or more frequently as recommended by the manufacturer, for inspection of "0" rings and plunger. When plug valves are used, they must be removed for manual cleaning prior to CIP and replaced for the programmed cleaning cycles.

Cooling Equipment

Plate Coolers

Clear the product from the cooler with compressed air, or by pumping a small amount of water and retaining the mixture for disposal as recommended above. Close the inlet valve on the coolant supply and leave the return line valve open so that the expended coolant may return to its supply. Pre-rinse with water of the same temperature and flow as required for lines. The cleaning cycle requirements are the same as for lines, and coolers may be cleaned in the same circuit. However, a larger capacity CIP pump will be required to overcome the additional pressure drop across the cooler. Post-rinsing is the same as for milk lines. The plate cooler should have the plates opened periodically for inspection of gaskets and cleanliness. At this time, remove any debris which may have accumulated inside. Occasional circulation or scrubbing of the coolant sides of the plates will increase the efficiency of heat transfer.

Tubular Coolers

The same procedures of clearing product, pre-rinsing, circulation, and post-rinsing apply to the tubular cooler as to the plate cooler. In order to drain the coolant from a tube cooler, an air relief valve is often needed at the upper end of the unit to permit drainage back to the supply. Tube section gaskets should be inspected periodically. Occasional circulation of a detergent solution through the coolant section of the tubes is beneficial for better heat transfer.

Centrifugal Equipment

Separators and Clarifiers

The standard separator and clarifier (nondesludging) must be disassembled for cleaning. They should be cleared of product while still running by pumping a limited amount of water through them. Pre-rinsing is accomplished by pumping warm water through the unit until clear. Turn the power supply to OFF and carefully apply the bowl brake. Considerable time is required to bring the bowl to a full stop, but safety demands that a full stop be achieved before any attempt is made to loosen any parts. Disassemble the unit from the top down until the stack of discs is reached. On the larger machines, a hand-operated hoist is provided to lift the heavier parts. The stack of discs, when removed, should be rinsed keeping the discs in the same order. On certain models, the inlet fittings at the bottom of the unit should be removed and placed with the other parts. All parts should be rinsed thoroughly. The discs are best cleaned on a special rack placed on a COP tank. Other parts are placed in a suitable stainless steel basket in the COP tank. The bowl bottom should be removed and the drive shaft bearing immediately covered with the water shield provided. With a rubber or plastic bowl scraper, remove the sludge from the bowl into a bucket for disposal with solid wastes in a sanitary manner. Manually clean the bowl as described for weigh vats or use a high-pressure washer device or, if possible, put in COP tank. Nonstainless steel bowls and covers should be dried after post rinsing to prevent rusting. The spindle tube in the machine frame must be brushed manually with the proper brush and manual detergent, then rinsed with water or acidified water.
The inside frame around the bowl should be cleaned without getting liquid on the drive shaft bearings. All parts should be post-rinsed as recommended for lines, drained and reassembled. For efficiency of separation, the rubber seals on the bowl-cover spindle should be replaced before any air leakage can occur

around them as this affects the cream screw settings. Be sure the bowl locking bolts are removed from the bowl slots after reassembly so that no damage will occur to the motor when restarting the machine.

Desludging Clarifiers

These clarifiers are made to be CIP cleaned. Since they periodically discharge the sludge from the bowl during operation, they do not have a packed residue to be removed. While the clarifier is running, it is pre-rinsed with water until the discharge is clear. It continues to run and is connected to the CIP supply. The special water hose on the unit is connected to the designated fitting at the milk inlet and water flow started. The desludging cycle should be actuated at least twice during circulation. Hand brush the vent tube and exterior of the sludge pot. This may be done during circulation. Post-rinsing should follow the same procedures as pre-rinsing. Some desludging clarifiers are placed in the HTST system and CIP cleaned with that system, in which case the recommendations applied to HTST solutions are sufficient for clarifier cleaning. Disassembly of a desludging clarifier is required every six months for maintenance of gaskets and seals.

HIGH-TEMPERATURE SHORT TIME (HTST) PASTEURIZERS

General Information

When setting up the cleaning procedures for a high-temperature short-time pasteurizer, the following information must be obtained:

1. Flow rate of unit in pounds or gallons per hour.

2. Hours of operation and type product or products that are pasteurized.

3. Number of times unit is shut down for change of products and if water is recirculated during this period.

4. Any abnormalities that may occur during the processing period.

5. Condition of plate gaskets and plates.

In addition, the following factors must be considered:

1. Cleaning pump should be sized to deliver 1 1/2 times the flow rate of product.

2. If plates are backed off to allow for expansion during the cleaning cycle, extreme caution should be exercised to avoid excessive leaking.

3. Unit should never be operated with heat medium ON unless plates have either product or cleaning solution in them.

4. Air leaks will cause excessive build-up and burn-on of soil.

5. Warped plates, bad plate gaskets, or bad port gaskets any place in the system will cause air leaks and excessive build-up and burn-on.

6. If, when inspecting the HTST plates after cleaning, one finds small areas of soil at the top of the plates, this is an indication that cleaning solution has not contacted these areas. To eliminate this problem, reduce the discharge line to 1/2" less than the size of the pump discharge line. This will, in effect, cause a back pressure and force solution into the troublesome areas at the top of the plates. Very thorough pre-rinsing is important to remove all possible milk residues.

Standard Method of Cleaning

The following are standard recommendations for cleaning a fluid milk HTST pasteurizer:

1. Immediately after pasteurizing run ends, follow milk through the system with water. After discharge is clear, shut down unit and turn off cooling water. Add one pound of general cleaner, pump into system, and proceed with step 2.

2. Remove piston from non-CIP type flow-diversion valve and cap divert port. Make connections for circulation cleaning of HTST.

3. Fill surge tank with clean water; pre-rinse entire unit until discharge to drain is clear and free of milk solids[1].

4. With system full of clean water and circulating tank half full, add enough of the recommended acid detergent to provide a pH of 2.5 to 2.7. Start circulation pump. Set control panel thermostat to maintain a temperature of 175°F (79.4°C) and circulate acid solution for 30 minutes.

   Note: After acid solution has reached desired temperature, back off HTST plates to allow for metal expansion.

5. Turn discharge line to floor drain; add fresh water and rinse until discharge water is clear and free of acid cleaning solution. Then turn discharge line back into the surge tank[2].

6. Pre-mix the required amount of a well-balanced heavy duty alkaline circulation cleaner in a pail with cold water to provide a concentration of 0.7 to 1.0% causticity in the cleaning solution. Add the pre-dissolved cleaner directly into the surge tank. Check the HTST cleaning solution after five minutes of circulation.

7. Circulate this alkaline cleaning solution for 30 to 45 minutes, maintaining temperature at 175°F (79.4°C).

8. Turn heat OFF. With discharge line open to floor drain, add fresh water and rinse until discharge is clear and free of cleaning solution.

9. With system full of clean water and circulating tank half full, add a nonfoaming acid detergent to provide a pH of 4.5 to 5.0 in the cold water in the system. Circulate for 10 minutes, drain completely; open and inspect periodically.

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[1] In some plants where the product mix includes heavy amounts of cream running through the HTST, it may be advantageous and even necessary to provide a 0.5% causticity pre-flush circulated at 160°F (71.1°C) for 10 minutes to saponify and remove some of the heavy fat and solids residues that will be present. At the end of the 10 minute pre-flush, turn the discharge line to the drain or retain for disposal. Add fresh water and rinse until the discharge is clear and free of cleaning solution. At this point, continue with step 4.

[2] Substantial savings in water, sewerage, steam, and time (labor) can be realized by the elimination of step 5 and the utilization of the over-ride method of cleaning. In this method, the necessary heavy duty alkaline cleaner is added directly into the acid cleaning solution in the surge tank. Therefore, once the proper quantity of water is in the system, it is used for both the acid and alkaline cleaning cycle. This is a savings not only of water but also on the load on the disposal plant. BTU savings are realized in that only one volume of water is heated for the entire cleaning cycle. The time necessary to accomplish that rinsing step is also saved. NOTE: Do not use over-ride method if chlorinated caustic is used as chlorine gas will be generated from the acid.

Note: While acidified rinse is circulating in step 9, brush wash frame and outside of unit by dipping brush in this acid solution. Also brush-wash entire flow-diversion valve assembly.

Alkali First Method of Cleaning

The following are recommendations for cleaning a fluid milk HTST pasteurizer using the alkali first method:

1. Immediately after pasteurizing run ends, follow milk through system with water. After discharge is clear[1], shut down unit and turn off cooling water. Add one pound of general cleaner, pump into system, and proceed with step 2.

2. Remove piston from non-CIP type flow-diversion valve and cap divert port. Make connections for circulation cleaning of HTST.

3. Fill surge tank with clean water; pre-rinse entire unit until discharge to drain is clear and free of milk solids.

4. With system full of clean water and circulating tank half full, add enough of the recommended heavy duty alkaline detergent to provide a concentration of .7 to 1.0% causticity. Start the circulating pump. Set control panel thermostat to maintain a temperature of 175°F (79.4°C) and circulate alkaline solution for 30-45 minutes.

5. Note: After alkaline solution has reached desired temperature, back off HTST plates to allow for metal expansion.

6. fresh water and rinse until the discharge water is clear and free of alkaline cleaning solution and the pH is 7 or the same as the pH of the water supply. Then turn the discharge line back into the surge tank.

7. With the system full of clean water and the circulating tank half full, add enough of the recommended acid detergent to provide a pH of 2.5 to 2.7.

8. Circulate this acid cleaning solution for 30 minutes, maintaining temperature at 175°F (79.4°C).

9. Turn heat OFF. With discharge line open to floor drain, add fresh water and rinse until discharge is clear and free of cleaning solution and the entire unit is cool to the touch.

[1] See footnote 2 on page 11.

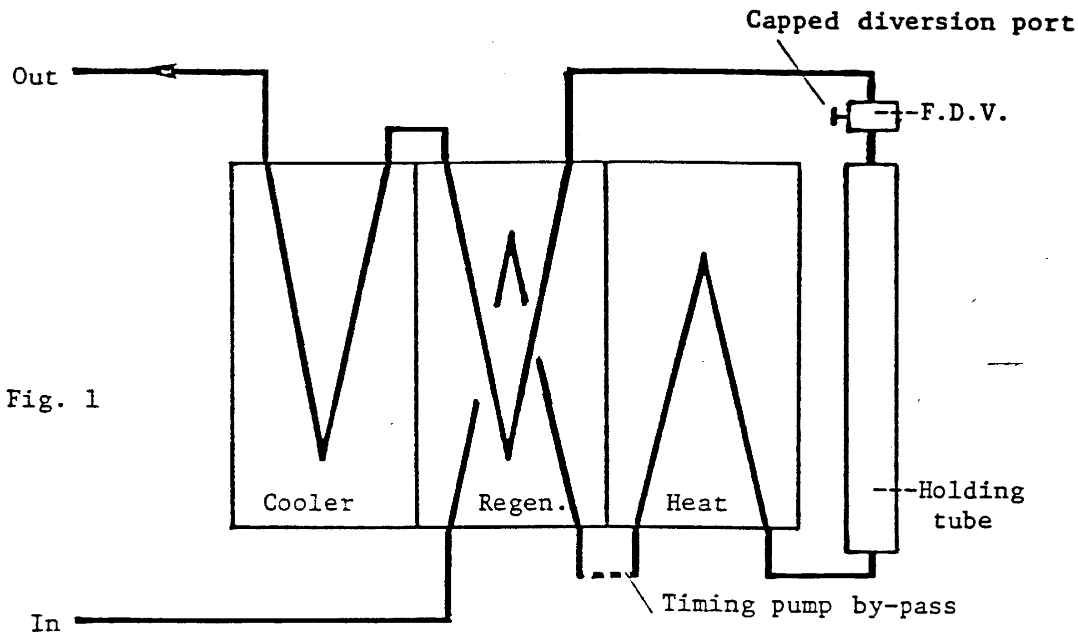


Fig. 1

STANDARD CLEANING FLOW (FOLLOWS PRODUCT FLOW)

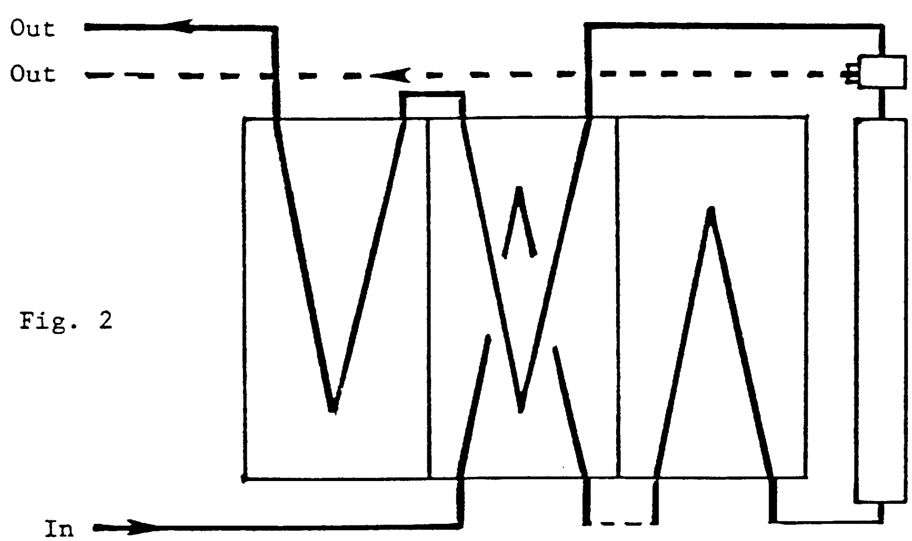
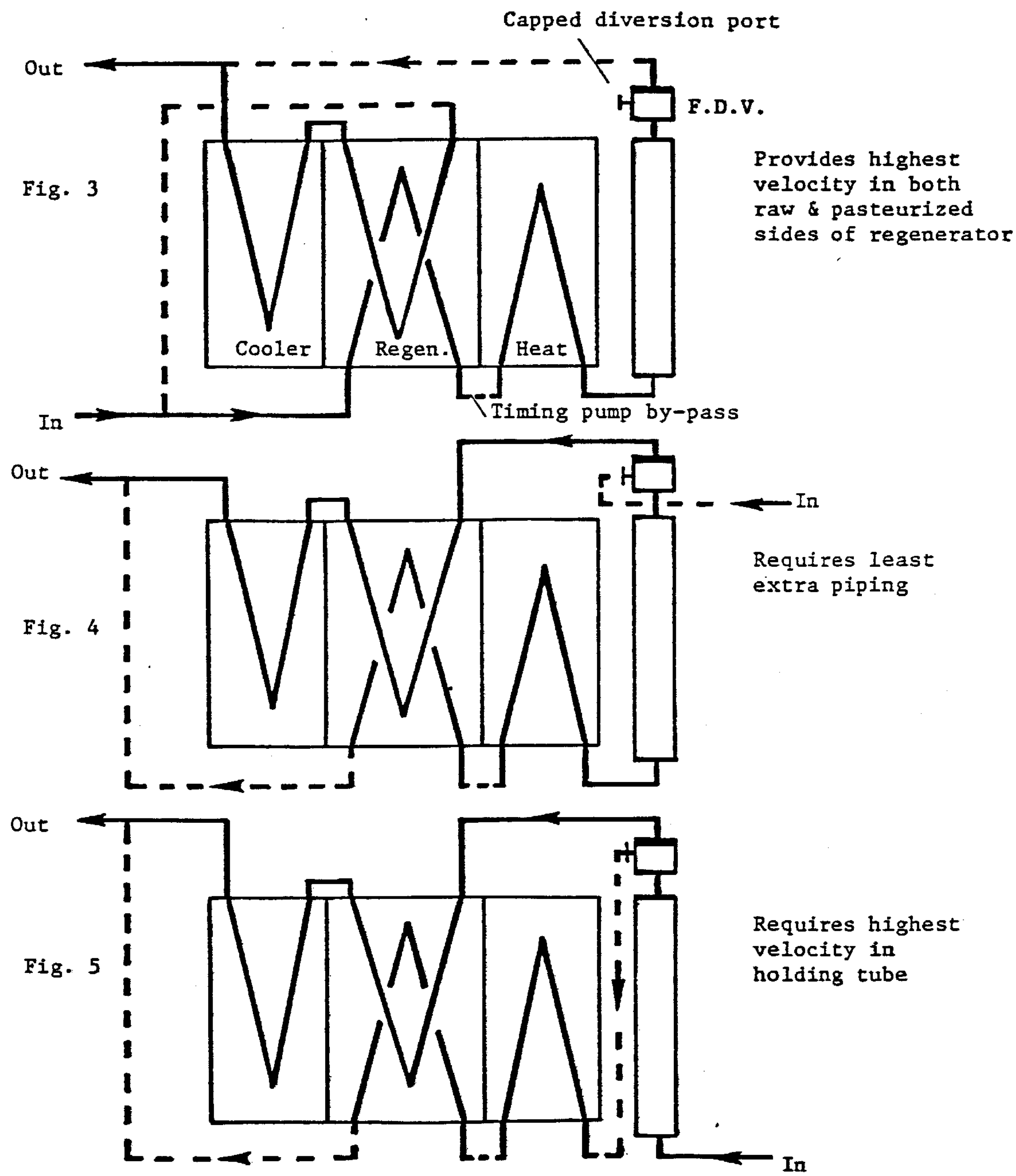


Fig. 2

INCREASED CLEANING FLOW THROUGH RAW REGENERATOR, HEATER, AND HOLDING TUBE (MAINTAINS FLOW THROUGH PASTEURIZER SIDE OF REGENERATOR AND COOLER) (DIVERT LINES LEFT IN PLACE WITH A 3/4"-1" ORIFICE INSTALLED)



INCREASED CLEANING FLOW

Courtesy of
Klenzade Products
Economics Laboratory, Inc.

Flow Rates (Velocity) and Pressure Losses

Due to the configuration of some HTST units, an extreme pressure loss and lack of flow rate is inherent regardless of the size of hp rating of the pump that is used. This has a definite detrimental effect on the cleaning process. Usually this condition exists in small capacity HTST units. Larger units, because of their processing capacity, also have the capacity for sufficient cleaning flow rates. Where this condition does exist, however, a simple method of reducing the pressure loss and increasing the flow rate is available.

This method is called "split flow". Actual piping changes can be suggested by your equipment supplier and in some cases by your detergent supplier.

Several "split-flow" arrangements are included in this guideline. See fig. 1-5, pp 17 and 18.

Ultra-Pasteurizers

Ultra-pasteurization is defined as heating to 280°F (138°C) or above for at least 2.0 seconds. Ultra-pasteurization systems can be cleaned by following a good HTST cleaning program. Most of these systems have greater flow rates than HTST units. This is necessary for processing, as well as for the cleaning process. Only in a very few cases has it been found necessary to alter the standard procedure for HTST cleaning in order to get effective cleaning of the higher heat shorter time units. The only variations are to increase the concentration of the alkali cleaning solution, or to use a caustic pre-flush at about 0.05% causticity. It may be necessary to increase the concentrations of the alkali to 3.0%-3.5% and increase the circulation time. The addition of a chelating agent and low foaming wetting agent to the caustic wash solution is beneficial to remove the heat denatured soils.

Therefore, following the standard HTST procedure usually will provide excellent cleaning results. If is does not, consult with your cleaning supplier who can make the proper recommendations to solve the problem.

Flavor Treatment Units

Usually these units are cleaned with the HTST units. Installations vary, however, and proper cleaning methods should be determined for each individual installation. In all instances, a cleaning pump of proper size is very important. The amount of cleaners used will depend on the size of the various units; this applies to all of these units.

The cleaning procedure, if independent of HTST unit, is as follows:

1. After complete hookup has been made, flush with clean water until discharge runs clear[1].

2. Add enough water to fill system and half fill circulating tank.

3. To this, add enough acid detergent to provide a pH of 2.5 to 2.7 and circulate for 30 minutes at 175°-180°F (79.4°-82.2°C). Then add heavy duty alkaline cleaner to provide 0.7% to 1.0% causticity and circulate for 30-40 minutes at 175°-180°F (79.4°-82.2°C).

4. Turn discharge to drain and rinse with clear water. Then circulate an acidified rinse at pH 5 for five minutes. Open and inspect.

[1] See footnote 2 on page 11.

HOMOGENIZERS

Manual Washing Procedure

1. Immediately after day's run has been completed, flush with warm water until discharge runs clear.

2. Dismantle and place all parts into wash vat.

3. Brush wash thoroughly each individual part. Place on parts rack and rinse.

4. Dissolve a general cleaner in a pail of warm water and wash the entire head of the homogenizer using proper hand brushes and making sure all ports and valve seats are thoroughly cleaned.

5. Immediately after washing, rinse thoroughly.

Circulation Method With HTST, HHST and Ultra-Pasteurization Units

1. Leave homogenizer in circuit with high-temperature short-time pasteurizing unit for rinsing with homogenizer pressure OFF.

2. Turn off homogenizer after rinsing but leave in circuit with HTST pasteurizer.

3. During the last ten minutes of cleaning with the acid detergent in the HTST pasteurizing unit, turn on homogenizer and allow acid detergent to circulate through homogenizer.

4. Rinse in circuit with HTST pasteurizing unit until all traces of acid are gone. If the over-ride method is used and step 4 is eliminated, allow the homogenizer to run through the first ten minutes of the alkaline cycle.

5. During the first ten minutes of cleaning with the alkaline detergent in the HTST pasteurizing unit, leave homogenizer turned ON and allow alkaline detergent to circulate through homogenizer. After ten minutes, turn homogenizer OFF.

6. Turn homogenizer ON at start of alkaline rinse cycle. Allow homogenizer to run through the entire rinsing operation and the acidified rinse of the system.

7. Homogenizers should be set up for CIP with a by-pass around the homogenizer to insure sufficient flow through the plates, holding tube and related piping. To insure proper cleaning of pulsation dampeners and standpipes, they should be included in the by-pass.

PASTEURIZED STORAGE TANKS

Cleaning of storage tanks has been discussed. The instructions found there also apply to pasteurized storage tanks which should be washed each processing day. However, it is recommended that a chlorinated alkaline detergent be used for manual washing of pasteurized storage tanks. The CIP method of cleaning pasteurized tanks operates and is programmed basically the same as for raw tanks. The variations here would require a slightly higher chlorinated alkaline detergent concentration and the boosting of the temperature to 145°F (62.8°C).

VAT PROCESSORS

Manual Brush Wash

1. Pre-Rinse. Immediately after emptying each vat, with outlet valve open to drain[1], flush inside and outside of vat with water using vat brush to loosen milk deposits. While rinsing, cool vat by circulating cool water through the jacket. Remove air space heater parts, defoamer parts, and removable agitator parts for washing separately in parts wash tank.

2. Wash. Close outlet valve. Dissolve a chlorinated alkaline detergent in a pail of water. Use a rubber or plastic pail. Apply solution to all interior and exterior areas of the vat with an appropriate brush. Thoroughly brush wash all surfaces. Give special attention to inlets, thermometers, non-removable agitators, under bridge, covers, and milk or cream line deposits. Disassemble outlet valve and brush wash.

3. Post-rinse. Thoroughly rinse vat and all associated parts with cold water.

4. Acidified Rinse. Follow with an acidified rinse using a nonfoaming acid. (In manual, cleaning a foaming acid is recommended.)

CIP of Vat Processors

Processing vats can be classified as vats that are used for pasteurization or as supply storage for by-products. Many of these vats are steam jacketed.

From experience, it has been determined that it is more desirable to clean vats which are used as pasteurizing vessels by the over-ride method. This technique has resulted in clean vats used for refrigerated storage.

It is also true that the circulation cleaning time at cleaning temperature is greater for cleaning vats used to pasteurize by-products than is necessary for cleaning vats used for refrigerated storage.

The programmed automatic CIP system supplies burst-rinses for pre-rinsing loose product from the vat. At this point, the acid wash cycle continues for 6 or 7 minutes at temperature, after which a heavy duty alkaline detergent is metered directly into the circulating cleaning solution. The alkaline wash cycle continues 10 to 12 additional minutes, and the original temperature is maintained.

Immediately following the wash, post-rinse utilizing rinse-bursts. Finally, apply an acidified rinse to the vat and recirculate for approximately three minutes.

Where manual CIP procedures are used and an automatic system is not tied into the vats, the same procedure as above should be followed. However, all functions need to be manually controlled.

Lines, Valves, Pumps and Samplers

See section entitled Receiving Equipment for information on cleaning of lines, valves, pumps, and samplers. The same basic procedures apply.

The only exception is that on CIP of pasteurized line circuits, temperatures should be raised and maintained to 160°-175°F (71.1°-79.4°C). The alkalinity concentration should be 0.20 to 0.25% with chlorine levels at 50 to 70 ppm.

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[1] See footnote 2 on page 11.

The time and temperature will depend upon the number of line circuits within the valve nest arrangement. As an example, if the valve nest was divided into four circuits during the cleaning, then 10 minutes would be allowed per circuit which would be 40 minutes wash time at temperature.

FILLERS

Glass or Molded Plastic Fillers

The procedure for cleaning filler bowl and filler parts is as follows:

1. Flush milk lines and filler with lukewarm water immediately after use, working filler valves until discharge runs clear[1].

2. Disassemble filler. Remove valves, vacuum tubes, and rubber seals. Rinse with warm water; place in basket.

3. Carefully place parts in baskets.

4. Place baskets in COP tank.

5. Operate tank at 145°-150°F (62.8°-65.6°C) for 30 minutes.

6. While parts are being circulation cleaned, prepare a chlorinated alkaline-type cleaning solution at 125°F (51.7°C) in a plastic or rubber pail. Place pail in bowl and thoroughly brush-wash bowl inside and outside. Carefully brush-wash valve ports with a good bottle-type brush.

7. Wash outside surfaces of bowl and cover.

8. Rinse thoroughly; then assemble filler.

9. Apply acidified rinse to all inside and outside surfaces.

Paper Fillers

Manual Cleaning of Paper Carton Filling Equipment.

CAUTION: Never clean machine with power ON.

1. Immediately after production has been completed, close off product supply to filler bowl.

2. Drain product from filler bowl into a suitable sanitary container and store in a refrigerated area. When rinsing filler, control the water pressure to prevent excessive splashing which would cause serious electrical and mechanical problems.

3. Rinse COP tank thoroughly with water (tank valve open). Close tank valve and fill COP tank with clean water; to this add a good chlorinated alkaline CIP type detergent (0.4% alkalinity) which will also provide 50 to 60 ppm of chlorine. Heat to and maintain 150°-155°F (65.6°-68.9°C).

4. Carefully disassemble floats, valves, pistons, links, slides, springs, cylinders, etc., and carefully place in stainless steel baskets to be immersed into the cleaning solution of the COP tank. Defoamers, folding shoes, etc., should also be put into the COP tank.

[1] See footnote 2 on page 11.

5. Parts should remain in COP tank for 20 minutes. While parts are being circulation cleaned, the rest of the filler can be brush-washed.

6. Add five ounces of a good chlorinated general cleaner to a pail containing three gallons of 125°F (51.7°C) water. Using a nylon bristle brush or plastic sponge (NEVER use steel wool or metal sponges), wash mandrels, mandrel hub, pressure pad, sealing unit, breaker, area that contacts carton tops in sealer, dater assembly, container chains, and entire machine frame.

7. Rinse with warm water, being careful not to splash water into electrical contacts of machine bearings.

   NOTE: COP of all removable product and carton contact surfaces is preferred; however, these parts can be hand cleaned if a thorough job is always done by the operator.

8. Rinse immediately with copious amounts of cold water followed by acidified water to remove all alkaline residuals. After cleaning, apply a thin film of FDA approved sterile lubricant to close tolerance moving parts and "O" rings as they are being reassembled.

   Note: Use of chlorinated cleaners may cause staining of aluminum components on newer models of paper carton fillers.

CIP of Paper Fillers

Many of the newer models of high speed paper filling equipment can be cleaned-in-place. However, with the various manufacturers and many models involved, each of different construction and having different features, it is necessary to follow cleaning procedures designed specifically for the individual piece of equipment being cleaned.

Therefore, it is recommended that consultation with the manufacturer and actual on-the-spot supervision and instruction from the cleaner supplier be followed to achieve proper cleaning results for each type and model of equipment.

In general, however, efficient cleaning of the filler bowl and fill valve can be accomplished by using a chlorinated alkaline detergent containing a small amount of a foaming surfactant to provide a slight foam level. Circulate this solution for 40 minutes at approximately 150°F (65.6°C). It is important that the filler bowl be full and overflowing through the vent tubes and that every cylinder is draining properly.

After the alkaline wash, the bowl and valves should be rinsed thoroughly with warm water. Then, fill the bowl with cold, acidified water and run the machine until all filler valves are activated and then drain.

Note: NEVER run the machine with hot, acid water.

On a regular basis, cylinders must be removed and "O" rings replaced.

During the circulation of the bowl and valve assemblies, clean the rest of the filler, making sure to clean all areas. This can be done either with the hand brush method or by high-pressure, low-volume cleaning method.

All removable parts can best be cleaned in a COP tank. However, hand washing of these parts can be done if particular care is taken to make certain that they are properly cleaned.

Note: See note under Manual Cleaning, No. 8 above.

Dispenser Cans

Dispenser can filling equipment must be rinsed very thoroughly immediately after use and then be completely disassembled for placement into a COP tank for the best cleaning results. However, hand brush washing can be used as long as extreme care is taken to thoroughly clean all parts. The defoam pipe is of such length that unless it is placed in a COP tank with end to end recirculation, the use of a long handled pipe wash brush is necessary to clean the inside of it. Upon removal from the COP tank, all parts should be thoroughly rinsed with a final acidified rinse.

The filling equipment should be reassembled just before use, being careful to thoroughly sanitize while reassembling and then once again after it has been completely reassembled and before starting the next production run.

Some of the newer, higher volume fillers, designed basically for "bag and box type" containers, are designed to be at least partially CIP cleaned. Where this fits into the scheme of cleaning in a specific plant, it works well. However, this equipment is readily cleaned by disassembling and placing in a COP tank as described above.

Plastic Film Type Fillers

This procedure refers specifically to the Pitcher-Pak filler.

1. Disconnect the filler supply line from the filler supply tank outlet valve and rinse the tank thoroughly. When the tank is free of residual milk soil, reconnect the filler supply line to the tank outlet valve and add enough tepid water to completely and thoroughly rinse the supply line and the entire filler bowl and valve assembly.

2. Attach the CIP return line to the vent fitting on the cover of the filler bowl and position this return line to the floor or drain.

3. Position the filler bowl float in the "down" or "open" position.

4. Using a good brush, thoroughly clean all dead end fittings on the filler bowl from a pail of general cleaner solution.

5. Close the filler valve but allow the plastic film to remain in the filling position.

6. Start the filler supply pump and rinse until rinse water from the return line is clear and free of visual milk soil.

7. Open the filler valve and rinse until the discharge is clear.

8. With entire piping system filled and enough 140°F (60.0°C) water in the pasteurize supply tank to provide constant circulation, add enough chlorinated alkaline CIP-type cleaner to provide 0.4% alkalinity. Position the return line to return to the supply tank. Circulate this 140°F (60.0°C) cleaning solution through the pump, lines, and filler bowl for 10 to 12 minutes. Float must be in "down" position throughout.

9. Approximately 2 minutes after start of circulation, open the filler valve until the rinse water trapped there is replaced by 140°F (60.0°C) cleaning solution. Then, close the jaws on the plastic film (without heat on the sealing units) to form a plastic film reservoir and fill that reservoir to a level that covers at least 8 to 10 inches of the exterior of the valve assembly. Close the valve until end of the 10 to 12 minute wash time.

10. Open the filler valve. Allow all CIP wash solution to be discharged to drain through filler valve.

11. Follow wash solution with cold rinse water. Position the return line to the drain. Close the filler valve until discharge from the return line is cold and the discharge is free of alkalinity. Then open the filler valve and discharge the remaining rinse water to the drain.

12. Add enough cold water to the supply tank to provide constant circulation. Add a nonfoaming acid detergent to provide a pH of 5.0.

13. Re-position the return line back to the supply tank. Start the pump and circulate for 5 minutes. Then open the filler valve to discharge to the drain, closing and opening jaws several times to fill plastic reservoir to a level to cover the exterior surfaces of the filler valve.

The short section of plastic film used for the cleaning cycle must be advanced out of the machine and discarded.

At least once each week the filler must be dismantled to inspect and assure that all areas of the bowl, including the gaskets, seals, float, top cover, etc. are clean.

Aseptic Fillers

Most models of aseptic filling equipment are intended to be CIP cleaned. However, with the various manufacturers and many models involved, each of different construction and having different features, it is necessary to follow cleaning procedures designed specifically for the individual piece of equipment being cleaned.

Some models have parts and components constructed of "soft metals", which require that the detergents selected are safe to use on these metals. Some have areas that require special attention, ranging from daily to weekly. Others have components that must be replaced on a daily schedule, others once a week.

The most sophisticated have built-in, automatic cleaning and/or sanitizing systems. Some, because of construction and included specific components (i.e., steam-lock valves) need special procedures that must be followed explicitly and without deviation. All of this equipment requires special daily attention to mandrels and heaters where carbon deposits are formed. Approved solvent-detergents should be used for carbon removal on a daily schedule.

Some manufacturers recommend weekly disassembly for inspection, and parts (gaskets, seals, bellows, etc.) replacement. On those days, COP and manual cleaning procedures should be followed. There are models that combine the Ultra Pasteurization equipment and the aseptic filler in the same CIP circuit. These require specific procedures as relates to time, temperature, concentration, and types of detergents used. The procedures are substantially different than those for cleaning only the filler.

Therefore, it is recommended that consultation with the manufacturer and on-site supervision and instruction from the cleaner supplier be followed to achieve proper cleaning results for each type and model of equipment.

General Procedures For Aseptic Equipment

1. Rinse the entire system with cool water until discharge runs clear.

2. Filler Only: Circulate a CIP type liquid chlorinated alkaline detergent (0.4% alkalinity) which will also provide 60 to 90 ppm (minimum) chlorine, with a defoaming or very low foaming wetting agent at 140°-160°F (60.0°-71.1°C) for 30 minutes.

   Filler Plus Ultra Pasteurizer: Circulate high alkaline detergent solution (1.0-1.5% alkalinity) containing chelate and defoaming or very low foaming wetting agent at 175°-190°F (79.4°-87.8°C) for 30 minutes.

Note: Over-ride or conventional method can be used. Circulate acid detergent solution (.75-1.0%) containing defoaming or very low foaming wetting agent at 140°-160°F (60.0°-71.1°C) (depending on model and type) for 30 minutes.

3. Rinse with sufficient cool water until the discharge runs clear and the pH of the discharge is equal to the pH of the incoming water.

4. Manually clean the exterior of the filler, and all parts not CIP cleaned. COP cleaning is recommended whenever possible. (Carefully select detergent for soft metal protection).

5. Circulate a cool acidified rinse at pH 4.0 to 5.0 for 2-5 minutes. (Acid or acid-sanitizer must be an approved product for that purpose).
6. Check all CIP spray devices on a weekly basis to determine if they are plugged.

Sanitizing of product contact surface is not sufficient. Hot water/steam sterilization must be practiced.

STERILE ACID FLUSH

The use of the "sterile acid flush" is a method of cleaning during a product "run" which does not "break sterility" or totally clean. It just flushes the equipment to increase efficiency and allows completion of a product run without complete clean-up and re-sterilization. This procedure of about 10-20 minutes can save 3-4 hours. Caution is required when adding the acid detergent. If you slug the acid detergent into the balance tank, the cleaning process could be so fast the tubing could become jammed with released product. The normal discharge will be a dark carmel color and rinsing must be adequate to remove all traces of flushing and return the rinse pH to 7.0.

There are two reasons why acid rather than caustic should be used. The first is answered in the above due to causing a jam-up. Second, caustic exposed to a temperature of 215°F (102°C) and above is extremely dangerous and also could cause more mineral fall-out than beneficial clean-up.

Other Considerations:

1. Positive air pressure must be maintained in filling chamber.

2. Positive air should be passed through an absolute filtration system.

3. In certain processes, using an air conditioner to cool and dehumidify this air would be desirable.

4. Proper brush washing of all external parts of the filler, chain and related supports is very important.

MULTI-USE CONTAINER WASHERS

Glass Bottle Washers

Maintenance and Operation of Soaker Type Bottle Washers

In considering the operation and maintenance of soaker bottle washers, one must always think of this as a two-part job. The first is the original charge of caustic to the soak tank, and the second is daily maintenance or upkeep. It is necessary to add caustic to any bottle washer daily no matter how small the number of bottles washed. This should be done following a test to determine the alkalinity of the washing solution expressed as percent NaOH (available alkalinity). Concentrations to maintain recommended strengths of causticity vary from state to state. Obviously, the soaker solution must be maintained at a minimum strength to comply with each state's recommendations. The recommended causticity of the soaker solution is 2.4-3.0% caustic.

Frequency of Changing Solution

No definite recommendations can be given as to how long a caustic solution shall be maintained. Varying conditions, such as the amount of soil on the milk bottles, must be taken into consideration. The condition of the caustic solution itself is the best determining factor. This should remain bright and clear-looking and should not have visible sludge or filth. Most important of all, the condition of the bottles is an excellent indication. If they come out of the caustic bath with hardened visible dirt, the caustic solution needs to be changed.

Daily Upkeep

As the bottles are washed each day, some portion of the caustic compound is consumed in saponifying the fat and washing the bottles. Moreover, the bottles themselves carry away a certain amount of the caustic solution which is later flushed from the bottle by the various rinsing positions. Also the rate at which the caustic is used is greatly increased in any machine which has visible lime. The lime on moving parts acts as a sponge soaking up the caustic and carrying it away where it is later rinsed off and wasted. Therefore, caustic solutions must be made up daily to the required strength. In the case of very large operations, it may be necessary to add the caustic two or more times each day.

Generally speaking, it is safe to calculate roughly that approximately one pound of caustic will be consumed for each 1,000 quart size bottles washed. This, of course, will vary greatly with the cleanliness of the machine. The amount of soil on the bottles, the hardness of the water, and other factors have some bearing, but this figure can at least be used as a guide or starting point.

Special Treatments for Hard Water Conditions

Bottle washing is especially sensitive to the difficulties arising from hard water supplies. As has been previously discussed, the minerals precipitate out not only on the machine but on the bottles themselves, which then dry with a dull appearance and very often with a visible greyish film. This condition is both unsanitary and unsightly. Methods of treating this hardness vary considerably and are discussed briefly below.

Proprietary Compounds

Many companies prepare proprietary compounds containing caustic soda chemically blended with special types of phosphates. These latter ingredients help to soften the water and assist in suspension of the lime and mineral hardness. They are, normally, fairly effective in water up to 7 or 8 grains of hardness. Some companies also have special compounds which contain the polyphosphates and sometimes wetting agents and chelating agents. The best of these will normally be effective in water of up to approximately 15 grains per gallon hardness.

Additives

These compounds are essentially polyphosphates or chelating agents and in some cases wetting agents are added. They are specifically designed to be used either with caustic soda in its natural form or with any of the various proprietary compounds discussed above. This is perhaps the most satisfactory method of handling very hard waters as the amount of compound may be directly proportioned to the mineral hardness present. Any buildup of lime on the machine or any visible residue on the bottles is an indication that insufficient amounts are being used and charges must be corrected.

Temperatures

Temperatures are very important in the successful bottle washing operation. Since we are dealing with multi-tank equipment and with material that is susceptible to breakage due to extreme temperature change or shock, it is important that varying temperatures be arranged to eliminate the shock and also make it possible to reach the maximum temperature in the soak tank as recommended by individual states.

These recommendations vary from 120°-165°F (48.7°-73.9°C). It is recommended that temperatures be lowered no more than 40°F (4.4°C) from one tank to the next, until reaching the final temperature of the fresh water rinse, which should be approximately 60°F (15.6°C).

It must be remembered not only that the temperature must be maintained at the most efficient degree for cleaning but that sudden and abrupt changes must be eliminated in order to prevent breakage of glass.

The final fresh water rinse to all bottles should be also a sanitizing solution. Chemical sanitizers utilizing either chlorine or iodophors do an excellent job of destroying any microorganisms in the water supply itself and will also assure that any microorganisms still present on the bottle itself will be eliminated.

It is recommended that the level of chemical sanitizing for this final fresh water sanitizing rinse be 50 ppm chlorine or 10 ppm iodophor. It should be pointed out that although either of these halogens is very effective at these levels in destroying microorganisms, the chlorine product does present the possibility of corrosion to the mild steel construction of the bottle washer itself. Therefore, the use of the iodophor is more desirable. Chlorine is also corrosive to proportioning devices and therefore accurate, reliable proportioning devices are not as readily available for chlorine as for iodophors.

Washing Multi-Use Plastic Bottles

Returnable plastic milk bottles have become more popular during recent years. Basically, they are cleaned in a manner similar to glass bottles, in that they are washed in a soaker-type bottle washer just before filling.

Essentially, all steps for washing glass bottles (as described in the previous section) apply to returnable plastic bottles. However, there are some distinct differences of material construction that cause plastic containers to be much more difficult to clean and therefore definite changes in bottle washing procedures must be adhered to.

First of all, the surface of plastic is more porous than is glass. Therefore, certain soils and mold growth may adhere to the more porous surface and make cleaning much more difficult. Secondly, the solubility properties of plastic tend to provide an affinity for adsorption or assimilation of certain volatile chemical substances. Therefore, plastic containers that have been misused for the storage or volatile hydrocarbons (petroleum or petroleum derivatives) cannot be satisfactorily reused for the packaging of milk products. A special device is required to be installed between the filler and the bottle washer that will detect many volatile contaminants and destroy bottles that may have traces of these materials adsorbed to the internal plastic surface.

The typical soil residues encountered in returnable milk bottles can be successfully cleaned from these plastic surfaces by elevating the soak tank temperature to 160°F (71.1°C)[1] and having a minimum soak time of five minutes.

In order to be assured of continuous use and successful washing of the polycarbonate resin (clear Lexan) plastic bottle, it is necessary to use a special non-caustic form of detergent as opposed to a standard caustic bottle washing compound for glass and polyethylene plastic bottles. A final sanitizer rinse is essential for polycarbonate plastic bottle washing.

<u>Dispenser Can Washer</u>

General Conditions

Only cans that are in good condition should be used. The can washer should be carefully examined regularly to be certain that it is in excellent condition. Pump seals must be maintained to assure good operating pressure to the spray nozzles. Every spray and jet should be tested to see that it operates properly

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[1] Experience on the West Coast has been that if a temperature in excess of 160°F (71.1°C) is employed, substantial shrinkage of container volume occurs.

and that a sufficient volume is discharged from it including those directed at the can lid and the hose for cleaning the dispenser can nipple. Also, temperature control devices must be maintained so that their operation is exact and temperatures of the wash tank and final rinse tank are maintained at the desired settings. The correct air volume and drying temperature must be maintained, so that the can is removed from the can washer in a dry condition.

Overflow

Proper overflow in the wash tank is very important and should be carefully checked and controlled. The overflow from the wash tank should be between 1 and 1 1/2 pints per can washed. More than this is not necessary for proper cleaning and exhausts the cleaning material too rapidly. Less than this is not sufficient to provide proper skimming action to maintain clean water in the wash compartment.

Skimming

A foam cap of at least one half inch should be maintained on the wash tank at all times when under agitation to facilitate this skimming and allow removal of the gross soil held in the foam cap. The location of the overflow pipe to facilitate skimming is important.

Temperatures

The pre-rinse section should carry a temperature of 90°-100°F (32.2°-37.8°C). The wash tank should be maintained at 150°-160°F (65.6°-71.1°C). Post-rinse following the wash should be 180°-190°F (82.2°-87.8°C).

Detergent Concentrations

Selection of a well-formulated and balanced detergent for dispenser can washing is very important. The wash tank concentration should be maintained at 0.40% alkalinity.

Hand feeding of detergent to the wash tank is not good enough. Today there are available very sophisticated solid state electronic control devices that will automatically maintain the desired concentration in the wash tank so that the last can washed gets the same treatment as the first can washed. The electronic controlled devices will insure proper detergent concentration throughout the washing period and therefore improve the probability of all cans being clean.

Daily Cleanup of the Can Washer

When all of the cans have been washed, tie the pump wash and pump rinse valves open to permit the cleaning solution to come in contact with all surfaces. Let run for 10 minutes, shut off the pumps and drain the tanks. Open all doors and using a hot water hose, completely rinse down all interior surfaces of the can washer. With the doors open, permit complete drying until the next use. This method will keep the can washer clean and extend its life.

Plastic Dispenser Containers

Proper cleaning of these containers requires all of the general conditions and considerations that are outlined above for Dispenser Can Washing.

However, in addition, it must be remembered that these containers are constructed of high density polyethylene plastic which presents an altogether different and more difficult cleaning task. Water tends to bead on the plastic rather than sheet as it will from other materials. Therefore, good cleaning action is inhibited. Also, there seems to be a static bond that causes soil to tightly adhere to the plastic material. Normally, the soil is easy to remove with some friction like that provided by a brush. But where this is not available, the answer lies in the utilization of a detergent compound that is especially formulated with defoamers and surfactants that provide maximum soil penetration and free rinsing. When this type product is used, it normally is necessary to elevate the wash tank temperature to 160°F (71.1°C) to properly activate the formulations of these products. Care must be taken in selection of these specialized detergents to be certain that they first of all, do the job of soil removal, and secondly, are mild enough so as not to affect silk screen printing on these containers.

Case Washing

General Considerations

As with any other type of mechanical washer, good cleaning results will be attained only if the washer itself is in excellent condition. This means that pumps must be maintained and seals checked to make sure they are not leaking so that proper pressure will be maintained. All jets and sprays should be checked regularly to be certain that they are open and operating properly, and temperature controls must also be maintained to assure optimum operating temperatures in the wash tank.

The use of solid state electronic controllers is important here, also, to maintain proper concentrations at all times in the wash solution. For wire cases or cases constructed of a combination of wood and wire, a concentration of 0.25% alkalinity of a suitable nonfoaming mechanical cleaning detergent will do a good cleaning job.

Plastic Cases

With the increased usage of high density polyethylene plastic for cases, an altogether different and more difficult cleaning task is presented. Therefore, careful selection of specialized detergents for the washing of this type of case is essential. (See discussion under Plastic Dispenser Containers, preceding.) At the end of each day's run, drain the solution tank or tanks. Remove the screens and then flush and brush wash the case washer. Plastic cases are difficult to wash, in large measure, because the standard industry machine is marginally capable of cleaning them even when they are well maintained and the wash temperature is held at 160°F (71.1°C). Proper, frequent and conscientious maintenance is needed here or cases will just become wet. Still holding original soils, these cases then carry all manner of filth into the filling room and are a perfect vehicle for Listeria. This is a real risk to public health and therefore every effort should be made to ensure cases are properly cleaned before being reused.

EVALUATION OF CLEANING

Introduction

Dairy plant management must assume responsibility for cleaning and sanitizing programs to assure that products are safe and wholesome. Cleaning personnel are usually employees with the least experience. Therefore, personnel involved in cleaning equipment which contacts dairy products must be well trained. In addition, they must be supervised by an experienced foreman.

Visual Inspection

Milk contact surfaces which are the most difficult to clean in systems should be checked visually. These include pumps, return lines, valves, and vertical discharge pipes. They provide an indication of the cleanliness of the entire system.

When possible, disassembly of parts in a system should be done after surfaces are dry. If there are any unclean surfaces, they should be pointed out to processing or cleaning personnel. At least monthly, checks should be made of critical areas and written reports made and posted. The psychological effect on personnel who know they are being checked can be very valuable.

A black light can also be used to check in areas which are difficult to clean. This is the most applicable to large surface areas such as storage and transport tanks.

The color of deposits usually provides some indication as to the composition of the film and the cause. A dullness or white deposit on stainless steel usually indicates hard water or alkaline deposit. A bluish or rainbow hue is frequently an indication of a protein film. They may become thicker and appear more like a layer of applesauce.

Bacteriological Evaluation

The ideal locations to obtain samples for bacteriological analysis are at natural breaks in the system. Such areas are storage tanks, balance tanks, filler bowls, and filled product containers. Sampling valves and rubber sampling plugs provide another area of possible contamination.

Rinse counts, contact plates, and swab tests may be used for determining cleanliness of milk contact surfaces. In most cases, they are not necessary to determine the source of the problem.

Samples taken from various locations in processing systems will usually indicate the area of contamination. They may be plated immediately or held for five to seven days at 45°F (7.2°C). Results of holding quality tests should indicate potential shelf life. Flavor evaluation should not be ignored, especially of samples held for shelf life tests. "Lacks freshness", putrid, and spoiled tastes usually indicate bacterial contamination after pasteurization.

Levels of bacterial contamination in freshly pasteurized milk (plated and incubated at 90°F (32.2°C) for 48 hours) should contain <500 organisms per ml, ideally less than 300 per ml. Unfortunately, the time delay required to complete the test limits the usefulness of the results. This is also true of rinse counts, contact plates and equipment swabs done in a conventional fashion. Newer swab tests based on luciferin/luciferase/ATP technology promise faster results but do not readily detect less than 1,000 organisms per sample without enrichment. Malthus impedance detection equipment is designed to be compatible with swab analysis and will provide fast results if surfaces are heavily contaminated.

The Virginia Polytechnic Institute (VPI) pre-incubation (PI) method for prediction of pasteurized milk shelf life should also be used as a means for evaluating bacteriological loading. The VPI PI test provides information on the keeping quality of freshly pasteurized milk within 66 hours following acquisition of the sample. The test predicts 14 day shelf life better than most other methods, including the conventional Moseley holding quality test which takes 7-9 days to complete. Correlations with shelf life for VPI PI and Moseley are 0.89 and 0.75, respectively.

Flavor evaluations should not be ignored and is probably the most valuable test for evaluating the ability of product to reach coded shelf life when tested at code plus 4 days (hold at 45°F (7.2°C).

Note: VPI PI = sample of milk incubated 18 hours at 70°F (21.1°C), then followed by a 1/1,000 dilution plated conventionally or on Petrifilm and incubated 48 hours at 70°F (21.1°C). Samples having <1,000 organisms per ml will exceed 14 days shelf life. Samples having >200,000 organisms per ml will have a shelf life of <10 days at 45°F (7.2°C).

SANITATION

Sanitation vs. Sterilization

The cleaning of equipment is intended to remove all food residues and foreign matter from contact surfaces, but this sanitation step does not guarantee a sanitary surface at the time of the next use. For this purpose, an efficient bactericidal treatment is necessary. Sanitation, rather than sterilization (a more rigorous and difficult procedure), is the objective of the bactericidal treatment.

The USPHS Grade "A" Pasteurized Milk Ordinance has offered this definition: "Sanitization is the application of any effective method or substance to a clean surface for the destruction of pathogens, and of other organisms as far as is practicable. Such treatment shall not adversely affect the equipment, the milk or milk product or the health of consumers, and shall be acceptable to the health authority."

By contrast, sterilization is a treatment or process which destroys all microorganisms including spores and requires much higher temperatures than is generally feasible in fluid milk bottling plants. For example, 250°F (121°C) for not less than 15 minutes is the required treatment to sterilize laboratory glass and metal equipment. Consequently, sanitizing is the common plant practice rather than sterilization.

For the successful use of any sanitizing agent, the equipment surfaces to be sanitized must be absolutely free of organic matter (fat, protein, and/or milkstone films). It is impossible to properly sanitize equipment with chemicals unless it has been cleaned and is void of any spots of milk residues. When inadequate hot water is used, the heat may bake on the soil and yet be insufficient to penetrate through the soil to kill all the bacteria, especially spore-formers. Hence, the next milk to flow over the surface will be contaminated. Proper heat treatment, however, has the advantage of deep penetration into equipment joints and all surfaces, killing bacteria in areas where chemicals may fail to penetrate. When chemical sanitizers are used on an unclean surface, they are effective only on organisms at the surface of the soil. Also, to be most effective, sanitation processes should be employed just prior to use of the equipment, so that surviving organisms will not have time to multiply and recontaminate surfaces.

Requirements for Sanitizers

- Dairy Sanitizers should be:
- Non-Toxic
- Quick acting
- Relatively non-corrosive
- Easily and quickly applied
- Relatively inexpensive
- Acceptable to USPHS/FDA and the Environmental Protection Agency (EPA)

General Considerations

Numerous sanitizers are available for use. Plant operators must be aware of and consider the following before purchase and use of any sanitizer:

1. It must be a product that is registered and approved by the EPA and be acceptable to the USPHS/FDA.
2. It must be capable of performing the function for which it is intended.
3. Complete instructions for proper handling and use should be readily available for supervisors and employees. Proper test kits should also be readily available.
4. Product should be stored in original containers with proper labels of identification.
5. Cleaners and sanitizers should not be stored in same area with food ingredients, e.g. nonfat dry milk, stabilizers, etc.
6. The possibility of any detrimental effect of the sanitizer on the waste disposal system should be considered.

Types of Sanitization

Heat

Hot Water. Hot water sanitization is an excellent method for sanitizing either pasteurized or raw product contact surfaces. Totally enclosed, confined areas are easiest to sanitize with hot water, but even pasteurized surge tanks can be sanitized with hot water by spray ball or other distributing devices. Many milk plants confronted with a difficult coliform contamination problem have found it helpful to resort to heat and the heat transmission property of metal equipment to assure complete sanitization.

Steam. Steam is not recommended for sanitizing because, as commonly used, it causes 1) heat stresses which may crack soldered seams and welds, especially in stainless steel equipment, 2) waste of heat by loss of steam to the atmosphere, 3) leaky valves and rapid deterioration of rubber hoses, 4) noise, and 5) destruction of paint on walls and equipment.

Chemical

Hypochlorites. The most common type of chlorine sanitizers used in the dairy industry are hypochlorites. They are economical and effective for plant use. Sodium or calcium hypochlorites at varying strengths may be purchased in either granular or liquid form. Sodium hypochlorite is also available with onsite generators, using common salt, water and electricity. The lower pH of onsite generated hypochlorite offers equivalent bacterial kill at lower concentrations. Chlorine in the undiluted form can be hazardous and corrosive. Care should be taken to prepare proper strengths and to prevent personal injury and damage to equipment.

Elemental Chlorine. Chlorine is also available as a gas in cylinders.

Organic Chlorine Compounds. These compounds such as Chloramine-T are significantly affected by pH. Chloramine-T is much slower acting than the inorganic chlorine sanitizers. It is generally not recommended for use in fluid milk processing plants.

Iodophors. In this product, iodine has been combined with non-ionic wetting agents and acidified for stability. Iodophors are generally less corrosive at proper use concentrations than chlorine sanitizers. After proper cleaning of aseptic fillers, sanitizing of the filling chamber is accomplished effectively subsequent to hot water/steam sterilization.

Mixed Halogens. Sanitary agents containing both chlorine and bromine are also available. The synergetic action of the two halogens permits a lower use level than those required with regular chemical chlorine sanitizers.

Quaternary Ammonium Compounds. These are commonly called "quats". They are non-corrosive to dairy equipment and their germicidal activity is less affected by the presence of organic matter than other sanitizers. The bactericidal effectiveness of quaternary ammonium compounds is influenced by the hardness of the water. The label should indicate the upper limit of water hardness in which the quaternary sanitizer is effective. This is required by USPHS/FDA. They are also less effective against certain spoilage (gram negative) bacteria, although recent data indicates that acidified quaternary compounds may offer substantial protection against Listeria.

Acid Sanitizers. Acid sanitizers are a mixture of acids and wetting agents. Their germicidal properties are based upon the lower pH and the activity of the wetting agents at this low pH. They are generally slower acting than hypochlorite sanitizers.

Mixtures of peracetic acid and hydrogen peroxide have been shown to have excellent oxidizing properties and to be effective against a broad range of bacteria. These are highly corrosive and should be used with caution.

Application

Heat

Hot Water. Hot water should be employed at a temperature of not less than 170°F (76.7°C) as determined at the discharge point for at least five minutes.

Steam. Steam may be employed in closed systems when the temperature of the drainage at the outlet is not less that 200°F (93.3°C) for at least five minutes. The use of steam is to be discouraged and is not recommended (see **Steam**, preceding column).

Chemical

Chemical sanitizing may be accomplished by the proper use of the following types of bactericidal agents:

Chlorine. Hypochlorite compounds should be applied in accordance with the following minimum standards at a reaction not higher than pH 8.5.

Method of Application	Temperature Range °F	Temperature Range °C	Minimum Available Chlorine ppm	Minimum Time Exposure min.	Minimum Residual Chlorine min.
Circulation	75-90	24-32	100	2	50
Spraying	75-90	24-32	250	2	50
Fogging	-------	-------	400	2	50
Immersion	75-90	24-32	100	2	50
Bottle rinse	-------	-------	50	--	----

When lower temperatures are used with hypochlorite sanitizers, the contact time or strength should be increased. For each 18°F (10°C) drop in temperature, the strength of solution or contact time should be doubled.

Iodophors. The following table gives minimum standards for sanitizing with iodine compounds.

Method of Application	Temperature Range °F	°C	Minimum Available Iodine ppm	Minimum Time Exposure min.	Minimum Residual Iodine min.
Circulation	50-70	10-21	12	2	2
Spraying	50-70	10-21	12	2	5
Fogging	-------	-------	25	2	5
Immersion	50-70	10-21	12	2	5
Bottle rinse	-------	-------	5	--	----

Iodophors as Used with Aseptic Fillers

1. The entire filler room should be fogged for a minimum of 5 minutes at 40 ppm of iodophor. A spray station set at 12.5 - 25 ppm iodophor should be used for floors, walls, and exterior of the fillers including the undercarriage.

2. Sanitizing of the filling chamber when the chamber is open is done effectively with 20-40 ppm of iodophor.

3. Mandrel feed slides and mandrels should be fogged periodically with iodophor.

4. Hands of operator must be dipped in iodophor solution prior to touching any part of the filling process.

5. Boxes of cartons should be fogged with iodophor prior to breaking box seal.

6. All equipment, disposal bins, etc. which enter the filling room must be sanitized with iodophor.

7. Any disposal bins or equipment entering filling rooms must be sanitized. Boots should be sprayed outside room before entering room.

Fogging Precaution. Fogging is not effective with compounds containing foaming type wetting agents.

Emergency Precautions. Occasional equipment repairs and changes must be made which may lead to contamination of product contact surfaces and the products themselves. It is very important to sanitize the product contact surfaces, especially when pasteurized or ready-to-eat foods are involved. Product should be moved from the pump, filler, or system, and repasteurized. Product contact surfaces should be washed with an alkaline cleaner if dirt or grease is present. Surfaces should always be sanitized with an iodine sanitizer at 25 ppm or chlorine at 200 ppm. The easiest way is to use a dispenser attached to a spray hose.

Acid Sanitizers. The strength of acid sanitizers is commonly determined with a test kit which uses phenophathalein and NaOH to measure relative acidity. The acceptable strength of the solution is expressed in ppm. This is a measure of the acidity of the sanitizer solution which relates to the concentration of the anionic surfactants in the acid sanitizing solution. Acid anionic surfactant combinations destroy bacteria by a general denaturization of cell protein, inactivation of enzymes necessary for cell metabolism and disruption of the cell membrane (wall).

Nonacceptable Types -

Phenols and bis-phenols. Phenol and phenolic compounds have long been known for their antibactericidal action. The halogenated bis-phenols are more active than the mono-phenols from which they are derived, e.g. hexachlorophene. Phenol or phenol derivatives in general are not acceptable types for use in milk or food processing plants.

Heavy Metals. Some heavy metals such as mercury and silver have germicidal action on bacteria. Heavy metal salts of mercury (Hg), silver (Ag), lead (Pb), zinc (Zn), copper (Cu), and chromium (Cr), are not acceptable types for use in milk or food processing plants.

Strength of Sanitizer Solutions. The manufacturers' recommendations regarding concentration generally provide a 50% margin of safety. Sanitizing solutions should be checked on a routine basis and replaced when the strength becomes too weak. Test kits are provided by manufacturers for the purpose. For some sanitizers, color and odor of the solution will provide some indication of strength. Iodophor solutions are the color of weak tea at normal strength and colorless when all strength is gone. Increasing the strength of a solution beyond the recommendation of the manufacturer should be avoided as this often results in less effective solutions. In the case of chlorine sanitizers, potential corrosiveness and damage to rubber parts increases materially.

Records

The FDA requires that:

1. Plants using chemical sanitizing methods shall possess appropriate testing equipment. Daily records of sanitizer residuals shall be kept on file for six months.

2. Plants using hot water for sanitizing shall use an approved thermometer to check the water temperature.

3. On systems other than CIP, recording charts showing the time and temperature of each sanitizing shall be provided and the charts kept on file for six months.

Special Applications

Ultraviolet

Practical applications of ultraviolet (UV) radiation have been used with success in the milk and food industry for the reduction of bacteria, fungi, and viruses. Areas which have found UV as a useful tool are:

1. Air intakes for laboratory, culture transfer, and culture products processing areas.

2. Air spaces in liquid sugar tanks.
3. Reduction of airborne organisms in usually occupied locations.

4. Radiation of packaging material prior to filling, e.g. Tetra Pak and Pitcher-Pak application. Hydrogen peroxide is also used for pre-treatment of packaging materials.

Since the action of UV on microorganisms depends upon the quantity of radiation that reaches the organisms, it must be properly engineered and maintained. A lighting engineer should be consulted to design the proper spacing, light radiation, and protection for employees. Eye exposure to UV radiation can cause severe eye damage.

It must be remembered that UV radiation will not work effectively unless environmental sanitation is maintained.

Hydrogen Peroxide - (H_2O_2)

Hydrogen peroxide is a strong oxidizing agent and is not considered a strong bactericide. It has the ability to change the environment so that it becomes unsuitable for the growth of organisms. It has found an application in dairy processing as a head space mist in Pure-Pak packaging of Ultra-pasteurized products. A 15% solution H_2O_2 is recommended, and analytical data should be obtained so that proper concentration is used. Higher concentration can cause carryover into product and a positive growth inhibitor (GI) test will result.

Extreme care should be exercised in handling hydrogen peroxide. It is a strong oxidizing agent and is potentially explosive.

MISCELLANEOUS

Housekeeping

Floors, Walls, Ceilings, Drains

Floors, walls, ceilings and drains must meet the construction requirements as specified in the latest edition of the USPHS Grade "A" Pasteurized Milk Ordinance. Good housekeeping practices and maintenance are a prerequisite to a clean environment. Good housekeeping should include a written schedule for appropriate employees so that proper procedures are used in the same manner each day.

Floors, walls and ceilings should be washed routinely to avoid buildup of soil, microbial, and mold densities, and to prevent staining and avoid obnoxious odors. Washing solutions of a good chlorinated detergent or equivalent should be used on floors, walls, and ceilings.

Drains should be cleaned each day or more frequently if required. Improperly trapped drains or clogged drains can be a source of contamination and odor and should be repaired.

To clean up mold infestation on floors, walls, or ceilings, surfaces should be brushed and cleaned thoroughly with a good detergent. It is important that all cracks, recessed, and remote areas be thoroughly cleaned.

A solution of 1-5,000 ppm of a quaternary ammonium compound may be applied so that a residual effect may prevent a recurrence of the problem. It is important that the type of quaternary ammonium compound does produce fungicidal activity.

Conveyors

Conveyors in a dairy plant are expensive pieces of equipment to keep lubricated and clean. A dairy conveyor chain which lacks lubricity will cause bottles to fall over and affect production at the filler. A dirty chain will transfer dirt to the bottom of the bottles and cause marks on the housewives' tablecloths or dirty the bottom of the cases, thereby soiling the salesmens' uniforms.

The soil on a conveyor if analyzed under a microscope will be seen to be 90% ground steel and sand, making a wonderful grinding compound to shorten the life of the conveyor. This soil also harbors bacteria that cause odors and may be of public health significance.

Most plants are cleaning conveyor chains with a central lubrication system. The lube is drawn out of the drum, accurately proportioned with water, and sprayed or foamed onto each conveyor. The framework of the conveyor itself is most readily cleaned with a pressure washer.

Personal Hygiene

All processing personnel should practice strict personal hygiene. In food plants, this should include the wearing of clean clothing, hats, and footwear. Persons who work directly with food should wear hair nets. Single service plastic or sanitized rubber gloves should be worn by persons who directly handle food.

Lockers should be provided for storing street clothing and leaving personal belongings. Areas should be provided for eating and smoking other than in food processing rooms.

Hand sanitation is very important. Hands and fingernails should be kept as clean as possible and always washed and sanitized after using the toilet, taking a rest or lunch break, leaving the work areas, or handling nonfood items such as boxes of supplies.

Rinsing hands or scrubbing with soap and water is not enough. An antiseptic hand soap or hand cleaner-sanitizer which meets USDA approval for food processing plants should be used.

Hand wash stations in processing rooms and restrooms should have dispensers for these liquid cleaner-sanitizers. Hands should be dried with individual paper towels after being thoroughly washed.

SUMMARY

It is essential that milk plant production personnel have a thorough understanding of cleaning and sanitizing principles and that they apply these principles if industry's goals of producing high quality and extended shelf life products are to be achieved. Giving proper credit and recognition to the role that the "clean up" man or team plays in achieving the aforementioned goals is also important.

Milk plant management must provide the required resources (cleaners and sanitizers) and facilities as a prerequisite for proceeding with a complete sanitation program. Supervisory personnel must be aware of the critical checkpoints for evaluating program effectiveness. Quality assurance personnel also serve a key role in ascertaining the effectiveness of the cleaning and sanitization efforts through monitoring of bacteriological content of fresh and stored samples and the rate of product flavor deterioration. If sanitation is properly practiced, it is obvious that it doesn't cost but instead pays in terms of higher quality, extended shelf life, and more satisfied customers for the fluid milk products.

APPENDIX

Chart I: Manual Cleaning

	PRE-RINSE	WASH	POST-RINSE	ACIDIFIED RINSE
Equipment	110°F(43.3°C)	125°F(51.7°C)	Cold	Cold
Pipes, Parts and Fittings Wash Tank	110°F(43.3°C)	0.25%/2500 ppm of alkalinity or neutral	Cold	pH 5
Storage Tanks Raw & Past.	110°F(43.3°C)	0.25%/2500 ppm of alkalinity or neutral	Cold	pH 5
Vat Processors	110°F(43.3°C)	1.0%/10,000 ppm of alkalinity	Cold	pH 5
Separators/ Clarifier	110°F(43.3°C)	0.25%/2500 ppm of alkalinity or neutral	Cold	pH 5
HTST (Exterior)	110°F(43.3°C)	0.25%/2500 ppm of alkalinity or neutral	Cold	pH 5
Fillers	110°F(43.3°C)	0.25%/2500 ppm of alkalinity or neutral	Cold	pH 5
Exterior of Equipment	110°F(43.3°C)	0.25%/2500 ppm of alkalinity or neutral	Cold	pH 5
Conveyors	110°F(43.3°C)	0.4%/4000 ppm of alkalinity	Cold	------
Walls	110°F(43.3°C)	0.15%/1500 ppm of alkalinity or neutral	Cold	------
Floors	110°F(43.3°C)	0.5%/5000 ppm of alkalinity	Cold	--------

Chart II: CIP Cleaning – Single Use System

	PRE-RINSE	WASH	POST-RINSE	ACIDIFIED RINSE
Equipment	Cold to 110°F (43.3°C)	Temperature varies with types of equipment to be cleaned	Cold	Cold pH
Lines (Raw) incl. plate or tubular coolers and desludging clarifiers	Cold to 110°F (43.3°C)	0.15%/1500 ppm - 0.18%/1800 ppm ALK 30-50 ppm CHL 150°F (65.6°C) 30 minutes (Min.)	Cold	4.0-5.0
Lines (Past.)	Cold to 110°F (43.3°C)	0.23%/2300 ppm ALK 50-70 ppm CHL 160°F(71.1°C) 30 minutes (Min.)	Cold	4.0-5.0
Storage Tanks (Raw) Silo or Horizontal	Cold to 110°F(43.3°C)	0.15%/1500 ppm-0.18%/18000 ppm ALK 30-50 ppm CHL 145°F(62.8°C) 15 Minutes	Cold	4.0-5.0
Storage Tanks (Past.)	Cold to 110°F(43.3°C)	0.20%/2000 ppm ALK 30-50 ppm CHL 145°F(62.8°C) 15 minutes	Cold	4.0-5.0
Vat Processors	Cold to 110°F(43.3°C)	pH 2.0 to 3.5 Acid 10 minutes @ 150°F(65.6°C) 0.30%/3000 ppm -0.40%/4000 ppm ALK 30-50 ppm CHL 15 minutes @ 150°F(65.6°C) (Over-ride Method)	Cold	4.0-5.0
Bulk Trucks and tankers	Cold to 110°F(43.3°C)	0.13%/1300 ppm ALK 30-50 ppm CHL 130°- 135°F(54.4°- 57.2°C) 15 Minutes	Cold	4.0-5.0
HTST (independent of Central CIP System)	Cold to 120°F(48.9°C)	pH 2.5 - 2.7 Acid 20-30 mins. @ 170°F(76.7°C) 0.7 - 1.0% Causticity 30 mins. @ 175°F(79.4°C)	Cold	4.0-5.0

Chart III: CIP Cleaning – Single Use/Solution Recovery System

	PRE-RINSE	WASH	POST-RINSE	ACIDIFIED RINSE
Equipment	Cold to Temperature of Rinse Recovery tank	Temperature varies with types of equipment to be cleaned	Cold	Cold pH
Lines (Raw) incl. plate or tubular coolers and desludging clarifiers	Cold to Temperature of Rinse Recovery tank	0.12%/1200 ppm - 0.16%/1600 ppm ALK 30-50 ppm CHL 150°F (65.6°C) 30 minutes (Min.)	Cold	4.0-5.0
Lines (Past.)	Cold to Temperature of Rinse Recovery tank	0.20%/2000 ppm ALK 50-70 ppm CHL 160°F(71.1°C) 30 minutes (Min.)	Cold	4.0-5.0
Storage Tanks (Raw) Silo or Horizontal	Cold to Temperature of Rinse Recovery tank	0.13%/1300 ppm ALK 30-50 ppm CHL 145°F(62.8°C) 15 Minutes	Cold	4.0-5.0
Storage Tanks (Past.)	Cold to Temperature of Rinse Recovery tank	0.18%/1800 ppm ALK 30-50 ppm CHL 145°F(62.8°C) 15 minutes	Cold	4.0-5.0
Vat Processors	Cold to Temperature of Rinse Recovery tank	pH 2.0 to 3.5 Acid 10 minutes @ 150°F(65.6°C) 0.30%/3000 ppm -0.40%/4000 ppm ALK 30-50 ppm CHL 15 minutes @ 150°F(65.6°C) (Over-ride Method)	Cold	4.0-5.0
Bulk trucks and tankers	Cold to Temperature of Rinse Recovery tank	0.09%/900 ppm-0.11%/1100 ppm ALK 30-50 ppm CHL 130°- 135°F(54.4°- 57.2°C) 15 Minutes	Cold	4.0-5.0

*In this system, the wash solution is recovered for use as the pre-rinse on following cycles.

Chart IV: CIP Cleaning – Multi-Tank “Soil Bank” Systems *

	ACIDIFIED PRE-RINSE RINSE	WASH	POST- RINSE	
Equipment	Cold to Cold 110°F(43.3°C)	145°F(62.8°C)	Cold	
Lines (Raw) Incl. Plate or Tubular Coolers and Desludging Clarifiers	Cold to 110°F(43.3°C)	0.25%/2500 ppm ALK 30-50 ppm CHL 30 minutes (Min.)	Cold	pH 4-5
Lines (Pasteurized)	Cold to 110°F(43.3°C)	0.25%/2500 ppm ALK 30-50 ppm CHL 30 minutes (Min.)	Cold	pH 4-5
Storage Tanks (Silo or Horizontal) (Raw)	Cold to 110°F(43.3°C)	20 minutes (Min.)	Cold	pH 4-5
Storage Tanks (Pasteurized)	Cold to 110°F(43.3°C)	25 minutes (Min.)	Cold	pH 4-5
Bulk Trucks and Tankers	Cold to 110°F(43.3°C)	20 minutes	Cold	pH 4-5
Vat Proccessors	Cold to 110°F(43.3°C)	0.25%/5000 ppm ALK 40-60 ppm CHL 30-40 minutes	Cold	pH 4-5

*TEMPERATURE and CONCENTRATION are not flexible on these systems. To acquire higher concentrations for heat processing equipment, the wash tank must be hand "spiked".

CIP CLEANING OF FILLERS

	ACIDIFIED PRE-RINSE	WASH	POST - RINSE	RINSE
Fillers (Independent of Central CIP System)	Cold to 110°F(43.3°C)	0.25%/2500 ppm ALK 30-50 ppm CHL 150°F (65.6°C)	Cool	Cold ph 5

Chart V: COP Cleaning

	PRE-RINSE	WASH	POST-RINSE	ACIDIFIED RINSE
Equipment	110°F (43.3°C)	140°F (60°C) or higher if necessary	Cold	Cold
Pipes	110°F (43.3°C)	140°F (60°C) 0.40%/4000 ppm ALK 30-50 ppm CHL	Cold	pH 4-5
Separator/ Clarifier(Hot Process)	110°F (43.3°C)	160°F (71.1°C) 1.0%/10,000 ppm ALK 100 ppm CHL	Cold	pH 4-5
Fittings and Small Parts	110°F (43.3°C)	140°F (60°C) 0.40%/4000 ALK 30-50 ppm CHL	Cold	pH 4-5

Chart VI: High Pressure/Low Volume Cleaning

	PRE-RINSE	WASH RINSE	POST-RINSE	ACIDIFIED
Equipment	110°F(43.3°C)	135°- 140°F (57.2°- 60.0°C)	Cold	Cold
Exterior of Equipment Conveyors Walls (Tile) Floors	110°F(43.3°C)	0.25%/2500 ppm ALK or neutral w/High Wetting	Cold	pH 5
Painted Surfaces		0.10%/1000 ppm ALK or neutral w/High Wetting	Cold	