DAIRY PLANT SANITATION[1]

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Our ordinances and codes stipulate the minimal requirements for dairy plant sanitation. As practising inspectors, it can be assumed that all of us are well versed in them. Because the dairy industries are now more highly competitive than ever before, it is essential that all operations be kept as efficient as possible. Equipment must be maintained in its best condition, to avoid too high depreciation and replacement charges. Hand labor is costly and sometimes erratic; automatic, fatigue-free mechanical aids, while initially expensive, are more economical, from the aspect of total operating cost.

This paper will review some of the recent developments in the direction of better dairy plant sanitation at lower cost.

CARE OF STAINLESS STEEL EQUIPMENT

Stainless steel's virtues are well known. It is extremely rugged, and can be welded, formed, machined and drawn readily. It is more suitable for use in dairy processing plants than the tinned copper, nickel-plated copper, "white metal" and monel alloys which were previously employed. It does not impart metallic flavor, nor induce oxidized flavor. When it first came into use, many assumed that stainless steel was substantially indestructible.

It is certainly much more durable than the metals its replaced; but it is subject to breakdown, as some dairy plant operators have already learned—first hand. The mechanism of stainless steel deterioration, and how to avoid it, has been investigated for the past few years, and has just recently been charted.

Stainless steel is an alloy of iron, chromium and nickel. Its inertness is due to the formation, and retention at its surface of a chromium-nickel oxide film. When this film formation is inhibited or interfered with, galvanic action causes "pitting".

The smoother the surface of the stainless steel, the greater the effectiveness of the oxide layer. An electro-polished, mirror or fine-grit finished surface is thus more resistant than one finished with a coarse grit. To avoid local action at welds, the joined area must be ground-down carefully and finished indentically as the balance. At junctions between stainless steel and other metals, galvanic action will cause accelerated deterioration.

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Abrasives harder than stainless steel will score the surface. Pitting will be initiated at the grooves formed. Stainless steel is preferably cleaned by using detergent solutions which can solubilize the residues. If these are not wholly effective and if abrasives must be used, they must be selected carefully—must not contain any components harder than stainless steel. Stainless steel sponge is satisfactory. No other metal sponge or ribbon or wool should ever be used on stainless steel.

Ordinary steel wool should never be used—not only because it is prohibited by codes, and portions may find their way into the product—but because microscopic particles of the steel fibers will be strongly adsorbed on the stainless steel surface and will turn to rust. This iron oxide will unstabilize the chrome-nickel oxide film and result in rapid pitting.

Residues of any nature or size, even inert dust particles, will unstabilize the oxide film, also. Detergents

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and sanitizing solutions must be rinsed away thoroughly, immediately after use, and the final rinse should be with a non-ionic, or low-ionic, clear water. When permitted to remain on stainless steel surfaces, detergent solutions stimulate galvanic deterioration. (Highly ionizing inorganics are more harmful than lower-ionizing organics). The residues of detergent solutions, after drying, are as destabilizing to the chrome-nickel oxide of the stainless steel surface, as residues of any other origin.

THE WATER SUPPLY

The need was noted above, for water of low-ionic character, for the final rinsing of cleaned stainless steel equipment. The waters used in many plants, derived from their wells or from city systems, while they may meet sanitary code specifications, are hardly describable as "low-ion". To convert a "high-ion" water to "low" requires equipment somewhat more elaborate than that employed for merely "softening".

The water supplies of many plants contain appreciable concentrations of iron or manganese, or both. The residues from such waters result in accelerated stainless steel deterioration. Equipment becomes particularly unsightly, and difficult to clean. The film formed on heat transfer equipment surfaces acts as an efficient insulator, to make fuel costs excessive. Troubles from iron and manganese are avoided by appropriate water treatment.

Waters which satisfy sanitary standards may contain many varieties of psychrophilic bacteria. Perfectly processed products, traversing equipment rinsed with such water, will be inoculated. Subsequent storage may permit sufficient elaboration of the psychrophiles to result in spoilage and consumer complaints. A proper control program should include the regular checking of the water supply both before and after treatment.

The flavor of water must be watched carefully too. Supplies whose flavors are other than constantly "good" should be subjected to activated charcoal or equivalent treatment. Consumers, after once noting a flavor abnormality in a product, seem to look for recurrences forever after.

Many studies have shown that the money paid for the extra chemicals needed to soften a hard water for regular plant cleaning would, within three or four years, fully pay for the installation and operation of a system to treat their whole water supply. Most plant operators do not yet realize the serious losses they suffer through continuing to employ inadequate water.

CLEANING AIDS

Many of us can recall when codes regularly stipulated that only certain alkaline compounds were permitted for employment in dairy plant equipment cleaning operations. The realization that alkaline residues can best be solubilized by acid media has removed these limiting regulations, excepting only that there are still many codes which continue to specify that high concentrations of caustic must be used in bottle washers.

Practically all of the detergent manufacturers serving the dairy industries prepare bottle washer compounds of low causticity and cost, which outperform the old-fashioned alkali. These yield cleaner, brighter, rapid-draining surfaces, and do not etch the glass so that the bottles must be discarded after a few trips. The requirement of high causticity in bottle washer solutions is obsolete; no useful purpose is served by keeping it on the books.

Some of us can recall when dairy plant chemical cleaners consisted only of soda ash and caustic soda. Much progress was made when the simple phosphates came into use. The complex phosphates, tripoly, tetra-pyro and hexameta, came into employment when their abilities to "sequester" or "chelate" polyvalent metallic ions into soluble non-ionic association, was recognized. Complex phosphates' solutions hydrolyze into simple form on aging, heating or variations of hydrogen ion range, and thus lose their sequestering ability.

During the past few years, the abilities of many salts of ethylene diamine tetra acetic acid to permanently chelate polyvalent metal ions into soluble non-ionic form, has brought a number of these compounds into existence. Some are already being incorporated into cleaning compounds offered to the dairy industries. Others are intended for use in water treatment plants.

"Wetting agents" which increase penetrating ability by affecting interfacial tension, were chemical curios a few years ago, but have been developed into a number of specialized compounds today. Non-foaming and foaming types, stable at high or low temperature, and at high or low hydrogen ion concentration, are commercially available alone, or as components of cleaning compounds offered for sale to dairy plants.

There is no doubt but that chemicals for cleaning will continue to be improved. Today's chemicals should be used today. Coupled with a good water, they make mechanical cleaning faster, and circulation cleaning most practical.

CIRCULATION CLEANING

Look at any river bed. Plain water traveling over a surface, will ultimately erode it. The higher the velocity, the more rapid the erosion. Milk residues, deposited on pipes' internal surfaces, will be eroded by the flow of milk, as is shown by the tapering off of

coliform concentrations, in milk processed through unprepared equipment.

The principle of circulation cleaning is sound. Detergent manufacturers have learned how to incorporate wetting, chelating and oxidizing agents into their formulations, to make them most effective. Plate, barrel and internal tube heat exchange equipment and piping, have been cleaned successfully with this method for several years. Equipment has been developed and reported as successful, for cleaning storage tanks, tank trucks, pasteurizer vats, surge tanks, vacuum pans and multiple effect evaporators.

Studies have shown that gaskets of various types used on standard and special fittings for stainless steel and glass piping cause no serious trouble, or threat to health, even when self-centering molded items didn't seat as properly as calculated, provided the circulation solutions and duration of cycles was adequate.

Automatic temperature maintenance charted on recording thermometers, pumps of adequate displacement and detergent solution tanks of proper capacity help to make circulation cleaning effective.

Circulation cleaning hook-ups will generally include some portions of equipment which must be hand-cleaned. The qualifications and character of the men to whom this manual cleaning is assigned becomes a question of tremendous importance. Do they know how to clean parts thoroughly? Which parts must they clean regularly? Will they (and their relief men) do so regularly? This should not be left to chance; frequently, it is when all of the cleaning is manual. It has been demonstrated too often that cleaning personnel have not been adequately trained, or are not sufficiently reliable. In plants which employ circulation cleaning, inspection systems should be instituted to check with particular care, daily, on the treatment of the manually cleaned equipment, as well as of that cleaned by circulation.

THE CLEANING ROUTINE

The purpose of each cleaning operation must be fully explained to the men entrusted with the cleaning. If they don't understand what they are supposed to do, and how to do it, good performance will never be attained. The acid and alkaline solutions for circulating high temperature presses have been mixed together in more than one plant!

Directly after use, after all product has been drained out of lowest points, as much as possible of the fully-connected system should be flushed out with warm (110°-120°F.) soft or softened water, fortified with some alkaline-wetting agent-sequestering agent cleaner. This will remove the fat mechanically, disperse the bulk of the other solids which might dry on equipment surfaces, and retard molecular calcium precipitation.

Portions of the hook-up which are to be hand-cleaned, should be removed and brought to the cleaning sink or trough. Small, stiff bristled brushes should be provided. They permit exertion of higher pressures. The moist brush, shaken free of water, may be dipped into dry detergent and then used to brush the equipment surfaces thoroughly. The dry detergent, wetted by the brush, produces a saturated solution at the utensil surface; this is extremely effective in removing soil. Less detergent is used by this method than is employed in making the usual solution. The equipment then should be rinsed thoroughly with clean water.

Sections of hot systems should be soaked for a few minutes in an acid-wetting agent (milk-stone removing) solution, water rinsed, and racked until reassembly.

Circulation-cleaned sections may be given acid and alkali treatments adequate to remove all residues without hand brushing. The only way in which the proper duration of treatment can be established, is by experimentally determining how long it takes to displace the soil residue from the most resistant surface after a peak capacity run, and then gearing the daily treatment at 25% additional.

LIMITING THERMODURIC AND COLIFORM BACTERIA

Calcium salts are excellent nutrients for thermoduric organisms. The usually slight daily accumulation of precipitated molecular calcium is readily displaced by rinsing the entire processing line, daily, with a solution of a mixture of an acid (whose calcium salt is soluble) and a compatible wetting agent. This will prevent growth of thermodurics on plant equipment and will limit the thermoduric level to that of the raw supply.

Perfect cleaning of equipment surfaces will prevent nutrients from being available for extensive growth of coliforms which might find their way to such surfaces introduced either by mishandling or carelessness. Recognize that in the periods of non-use, equipment incubates at room temperature, and moisture and oxygen demands for bacterial metabolism are more than satisfactorily met.

There is only one positive way of insuring against the entry of coliforms into a freshly pasteurized product. It is to heat all surfaces to be contacted by the product, after it leaves the pasteurizer gate valve or the flow diversion valve in forward flow, to not less than 165°F. for not less than one minute. Excepting only for large surge or storage tanks, and fillers whose closely articulating parts may be damaged by such heating, this system is entirely practical.

A supply of hot water at 180°F. should be prepared (in the pasteurizer furthest from the pump to the

cooler, or by introducing it into the balance tank of a high temperature system) and directed to the remainder of the fully connected hook-up. "Tempelstiks" are most convenient for determining metal temperatures. The hot water treatment should not be stopped until all surfaces have achieved the temperature desired, for the exposure required. This treatment will inactivate coliforms, even if the equipment has not been cleaned perfectly.

Parts which cannot be treated with hot water can be sanitized with hypochlorite solution. Surfaces must be perfectly clean for this method to be effective. The hypochlorite solution should be brought to a pH of 6.5-7.0 immediately before use, by the addition of acetic (or any other organic) acid. At this lower hydrogen ion concentration, the hypochlorite is much more effective than it is in the usual alkaline range. Fog or spray surfaces with 400 p.p.m. hypochlorite fifteen minutes before use or soak in 100 p.p.m. for one minute before use. Then drain and rinse with clean water.

Rubber parts whose surfaces may be cut (bottle filler valves, etc.) must be treated by hot water. Sanitizing solutions cannot penetrate cuts until the rubber is stretched.

After the system is prepared, it must be handled aseptically, if at all. Personnel must be trained to avoid careless, reflexive handling. The man who has just pushed a dirty case of bottles will contaminate bottle cappers or valves if he handles them.

THE PREMISES

The construction of a plant can simplify or complicate its maintenance in a sanitary condition. Hose stations, sinks and troughs should be located where needed. Less fuel is wasted when hot water is drawn from a tap, than when made by mixing steam and cold water.

Convenient drains should be spotted immediately below exhaust lines. Center drains, and floors pitched to them, keep men walking in the wet all day, and is unpleasant. Floors should be pitched to the sides, gently, to side-gutters. This will keep the working area of the floor dry and much more comfortable for the workers.

Hose stations and drains should be located in driveway areas to permit prompt flushing down after spillage. Milk solids not removed rapidly, will create a nuisance.

Floors, walls and ceilings of operating areas are supposed, by code, to be impervious to moisture. Tile, grouted with thermoplastic resin, is truly so, but most expensive. Tile, grouted with regular (Portland) cement masonry, does not long remain satisfactory. Every concrete sidewalk shows that such masonry is not impervious, after the surface finish is worn off. When the grouting becomes absorbent, milk solids are imbibed and begin to ferment. Floor fermentation aroma annoys personnel, irritates visitors and may even affect product flavor. The end products of the fermentation deteriorate the masonry rapidly. Floor fermentation aroma thus is a sign that repairs soon will be needed.

Anti-bacterial cement masonries are not as chemically inert as thermoplastic resin, but they are substantially impervious and they fully prevent milk solids fermentation. Its cost is very little above than that of Portland cement mortar when employed for grouting tile. The difference in expense is more than covered by the costs of repairs avoided.

Air-borne contamination is not a significant problem in the processing of fluid milk; however, it is in the manufacture of those products which are processed after the pasteurization treatment—buttermilk, cottage cheese, butter, sour cream, etc. The walls, ceilings and floors of rooms in which such products are handled must be kept as clean as the equipment surfaces; otherwise microorganism prolififeration will permit them to seed air currents endlessly with spoilage flora. Use of antibacterial cement for grouting wall and ceiling tile is therefore particularly desirable in these rooms. Lowered maintenance recommends it in the milk rooms as well.

The high maintenance costs of floors, walls and ceilings made of integral anti bacterial cement masonry can be avoided by two-layer construction, employing anti-bacterial cement mortar for the exposed surfaces. This is recommended too, for top dressing the surfaces in tank truck unloading rooms, and for use on the driveways adjacent to milk plants.

While equipment is generally installed to keep pipe runs to minimum length, more attention should be paid to spacing to insure that workers are not so crowded as to jostle each other. Discomfort decreases efficiency. Keeping the operating rooms at a comfortable temperature, and properly ventilated is at least as important as creating a pleasant atmosphere in the plant manager's office.

Insect activity increases with temperature. Dirty bottles and cases are not as strong a fly-bait on cool days, as they are on warm days. To minimize the fly problem, unloading docks should be designed to be kept cool during the hot weather. This, coupled with blowers to create air barriers at doors which must be opened, and general good housekeeping will prevent insect control from becoming a major headache.

Conservation laws, designed to minimize pollution of water resources, are now being enforced rigorously. Dairy plants have been instructed that they can no longer discharge their untreated wastes into conven-

ient brooks, streams or rivers.

A pound of dairy effluent is as difficult to handle in a municipal treatment facility as twelve of human waste. Plants which can hook into city systems are fortunate in that they do not have to install and maintain individual disposal units, but they must learn to keep their waste-solids to a minimum. More cities every year are basing sewer rental charges on the amount of solids treated, measured by automatic samplers.

"Good housekeeping" entails segregating concentrated waste and disposing of it separately (it can frequently be used as animal food); keeping dilute waste to a minimum by preventing milk and milk product leakages and spillages; and avoiding continuous water loss through careless rinsing, open lines, etc.

The "aeration-oxidation" disposal system, developed by the Philadelphia Regional Laboratory of the U.S.D.A., has been demonstrated in actual plant use to be much more economical to install and operate than any other. In this system, dairy solids are rapidly digested by intensive (but odorless) bacterial metabolism induced by supplying oxygen at a very high rate in the form of air. No chemicals need be used; the entire operating cycle can be made automatic by the use of simple timers. This method is recommended even for city plants where sewer-rental charges become excessive.

SUMMARY

1. Stainless steel equipment should, for best performance, be finished with a high polish; cleaned thoroughly to the complete removal of residues; and rinsed with non-ionic water.

2. A good water supply is essential to efficient dairy plant santitation. Treating water by "batch" addition of chemicals is much more expensive than by installing a permanent system.

3. Cleaning aids presently available, the wetting agents, inorganic and organic chelating compounds, make residue removal easier.

4. Circulation cleaning is not automatic; operating personnel must be fully trained and responsible to make it, and manual cleaning, proper and efficient.

5. Careful equipment preparation is essential for the control of thermoduric and coliform bacteria.

6. Anti-bacterial cement masonries improve sanitary conditions and decrease maintenance costs.

7. Dairy plant sanitation is a function of many factors, and is efficient when all are correlated.

FORTY-THIRD ANNUAL MEETING
HOTEL OLYMPIC — SEATTLE, WASH., SEPTEMBER 5, 6, 7, 1956

RAILWAY ITINERARY AND RATES
MILWAUKEE RAILROAD

	Station	*Railroad*	*Train*	*Time*	*Date*
LV Chicago	Union	Milw. R.R.	Olympian Hia.	3:00 PM	9/3
AR Seattle	Union	NP	Olympian Hia.	9:30 AM	9/5
Attend Convention Sept. 5-7, 1956					
LV Seattle	King St.	NP	City of Portland	12:30 PM	9/8
AR Chicago	Union	Milw. R.R.	City of Portland	11:30 AM	9/10
No. 2					
LV Chicago	Union	Milw. R.R.	Olympian Hia.	3:00 PM	9/3
AR Seattle	Union	Milw. R.R.	Olympian Hia.	9:30 AM	9/5
Attend Convention Sept. 5-7, 1956					
LV Seattle	King St.	NP	Cascade	12:30 PM	9/8
AR Portland	SP	NP	Cascade	4:30 PM	9/8
LV Portland	SP	SP	Cascade	4:45 PM	9/8
AR San Francisco	Market St.	SP	Cascade	9:15 AM	9/9
LV San Francisco	Market St.	SP	C. of San Fran.	4:00 PM	9/9
AR Chicago	Union	Milw. R.R.	C. of San Fran.	11:15 AM	9/11

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