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Managing Chloride and Phosphorus by Minimizing Waste

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Minimizing waste will be a key component of future dairy plants. It doesn't take a crystal ball to predict this trend – within the past several years, two new state environmental regulations have been adopted that will have a significant impact on the Wisconsin dairy industry. In 1990, NR 214 (Land Treatment of Industrial Liquid Wastes, By-Product Solids and Sludges) was adopted. This rule limits the amount of total chlorides that you can apply to land to less than 170 pounds per acre per year. In December 1992, NR 217 (Effluent Standards and Limitations) was established. It affects Wisconsin Pollution Discharge Elimination System (WPDES) permits for waste waters discharged to surface waters, limiting total phosphorus to less than 1.0 mg/L. To effectively address both of these environmental regulations, dairy plants must first characterize the waste streams throughout the plant and then work to minimize contributions to those waste streams.

Chloride limits

Based on average rainfall amounts in Wisconsin, the chloride limit established in NR 214 (<170 lb. of total chlorides per acre per year) was calculated to limit potential chloride levels in groundwater to less than 125 mg/L (EPA Preventative Action Limit). Since high concentrations of chloride in drinking water may harm people suffering from heart or kidney diseases (6), the U.S. Public Health Service Drinking Water Standards (7) recommend that chloride not exceed 250 mg/L (EPA Enforcement Limit). In order to help people meet the new requirement in NR 214, we conducted a survey of whey and whey permeates and determined their typical chloride levels (5). Based on our results, we revised guidelines for landspreading whey, whey permeates, salt whey drippings and used brines (9). See Table 1 for average chloride contents and recommended landspreading rates.

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What's Inside:

Coliforms: Why the Concern?

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Over the years many committees and commissions have considered the question of microbiological standards for foods. Should standards be established? For what foods? How many and what types of microorganisms should be acceptable?

Although individual dairy processors may have their own microbiological specifications for raw materials and finished products, the dairy industry as a whole has lived for decades with two microbiological standards for many pasteurized products. They are the Standard Plate Count which determines the number of aerobic bacteria and the Coliform Count, which tallies the numbers of coliform bacteria. This article deals with coliforms, fecal coliforms and with one coliform, *Escherichia coli*, that has become particularly significant.

Coliforms

The term "coliform bacteria" is not a taxonomically valid designation for a genus of bacteria. Rather, it is a term we conveniently use to refer to a group of bacteria with similar characteristics even though they are classified in several genera. Coliforms include all aerobic and facultatively anaerobic gram-negative, nonsporeforming rod-shaped bacteria which can ferment lactose with production of acid and gas. Such fermentation occurs during the normal incubation at 32 or 35°C for 48 hours. Commonly, these bacteria are classified in the genera *Escherichia, Enterobacter,* and *Klebsiella.*

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Table 1
Landspreading Rates for Dairy Wastes

	Avg. Cl^- (mg/L)	gal/acre/yr
Whey permeate	1183	16,000
Salt whey drippings	56,900	500
Used salt brines	187,000	89

Reducing the total chloride concentration of dairy wastes can reduce the cost of waste disposal because chloride reduction will allow you to landspread more liquid wastes. Some critical areas where you can control chlorides in the dairy plant are:

◊ Use salt efficiently in direct salted cheeses. Strive to increase salt retention by optimizing processing conditions.

◊ Isolate pressings and drippings and treat with membrane processes if economically feasible.

◊ Establish a good brine maintenance program to eliminate potential yeast or bacterial contamination.

◊ Redesign systems to eliminate or reduce salt wastage, e.g., No-brine Mozzarella, etc.

Phosphorus limits

NR 217 established a phosphorus limit of 1.0 mg/L on treated wastewater effluents discharged to surface waters. This new limit, placed in many of the renewed WPDES permits in 1995, means that plants will have to comply by 1998. Plants discharging to municipal sewer systems will face new limits, including a phosphorus limit of 10mg/L or less on discharges to the sewer system.

We have previously described the impact this new standard will have on dairy plants (8). Since milk is very rich in phosphorus (930 mg/L), any milk or whey that is lost in process wastewater will contribute significantly to the phosphorus load of that wastewater. For example, a 1% milk loss will contribute 1000mg/L of BOD (See sidebar) and 10 mg/L of P (or phosphorus) to the wastewater. Dr. Roy Carawan of North Carolina State University has reported milk losses in dairy plants from 2 to 5% (1,4). Over 90% of the waste load in dairy plants comes from milk or milk products (4). Current typical loads for P from dairy plants are shown in Table 2.

To meet the new phosphorus limit in treated wastewater, you will have to make a concerted effort to reduce milk wastage. To meet the 1.0 mg/L limit on their treated wastewater, dairy plants will have to lower the P concentration in their process wastewater to 10-20 mg/L by minimizing waste, or minimizing waste plus

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Table 2
Current Typical P Loads from Dairy Plants

Type of plant	P level (mg/L)
Fluid milk	10-50
WI cheese plants	35-150
Cottage cheese	40-80
NZ mech. Cheddar	17-79
NZ traditional Cheddar	45-180

BOD –Biochemical oxygen demand

The BOD is an analytical test that estimates the ability of waste to damage a stream or lake. Microbes in streams and waterways use dissolved oxygen to break down organic compounds, like whey and milk. Too many organic compounds at one time can "kill"a lake or stream by using up all the dissolved oxygen.

The BOD takes advantage of this process in order to measure and standardize the effect of wastewater on natural water systems. It does this by measuring the amount of oxygen used by one liter of wastewater under standard conditions. The BOD of unpolluted water is about 5, untreated municipal waste has a BOD around 250.

Standard Methods for the Examination of Water and Wastewater. Prepared and published jointly by American Public Health Association, American Water Works Association, Water Pollution Control Federation ; joint editorial board, M. C. Rand ... [et al.]. — 14th ed. — Washington : American Public Health Association, c1976.

The Madison Metropolitan Sewerage District originally figured that they would be spending $54 million over the next 20 years to cut discharges of phosphorus. That was before they turned to the UW-Madison's Department of Civil and Environmental Engineering. Wayne Karlovich and Todd Rubens, grad students, and Professor William Boyle built a pilot plant that introduced bacteria to consume the phosphorus. After running the plant for a year, they found the biological technique both effective and less expensive. The DNR has granted a variance to the District, allowing them to use the technique and they are encouraging others to consider biological removal.

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pretreatment. That means that plants will have to limit milk losses to less than 1-2%. Tables 3 and 4 detail milk losses in a modern fluid milk plant and an ice cream plant, reported by Harper et al. (3).

As shown in these two typical plants, each process step contributes to milk loss. However, for those plants to meet the new limits on P, each process will have to be closely scrutinized to find a way to reduce milk losses and reach the ultimate goal of less than 2% milk loss. We are currently studying possible methods to minimize milk losses during processing in a dairy plant. We hope to have those results by June 1996.

Meanwhile, Harper and Carawan (2) have already reported some steps that you can take to minimize wastes in dairy plants:

Receiving operations:

- Proper connections
- Immediate attention to leaks
- Limit standing of raw milk loads to reduce fat separation
- Allow adequate drainage time
- Allow hoses to empty before uncoupling

Processing operations:

- Eliminate the cause of spillage
- Thoroughly drain all lines before rinsing
- Rinse surfaces immediately after draining
- Avoid overflows on filling tanks
- Handle spilled dry ingredients and cheese fines as solid waste, do not wash them down the drain

Packaging operations:

- Frequent checks on package formation
- Check proper fill on containers
- Eliminate foaming on filler bowls
- Proper handling during casing, loading, etc.

Plant design:

- Use fewer and larger storage tanks
- Improve locations to reduce amount of piping
- Segregation of waste discharge lines
- Elevation of storage tanks for gravity flow
- Operate equipment at full capacity

Equipment design:

- Automatic shutoff valves on all hoses
- Cover all drains with screens for solids retention
- Identify all utility lines to avoid cross-contamination
- Suitable level control sensors at critical tanks
- Adequate temperature controls

Table 3
Milk Losses in a Fluid Milk Plant

Process	% Milk Loss
Receiving	.23
Separation	.82
Storage	.44
Pasteurization	.83
Filling	.50
Miscellaneous (spills, etc.)	.50
TOTAL	3.32

Table 4
Milk Losses in an Ice Cream Plant

Process	% Milk Loss
Receiving	.20
Standardization	.08
Storage (milk)	.28
Pasteurization	1.40
Freezing	.50
Filling	.75
Miscellaneous	.91
TOTAL	4.12

Summary

To address future environmental limits for both chloride and phosphorus, you will need to reduce milk losses in the dairy plant. To handle the upcoming P limit in WPDES permits, dairy plants will need to limit milk losses to 1-2%, based on waste analysis. This means that BOD's of process wastewater should be less than 1500 mg/L and P levels should be less than 15 mg/L. To approach these future limits, review each of the above mentioned waste minimization steps to determine where plants can reduce potential milk losses. With an effective waste minimization program, dairy plants can meet the environmental standards for compliance of NR 214 and NR 217 without compromising their cleaning and sanitation program.

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Coliforms

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Coliforms are widespread in the environment, including untreated surface water, soil, plants (and hence feed), feces of warm-blooded animals and humans, air under some conditions, sewage, improperly cleaned and sanitized food processing equipment, the general environment of the food factory and probably a few other places. Since coliforms are so widespread in the environment, it is no surprise that small numbers appear in raw milk from some farms. Thus, the Coliform Count usually is not done on raw milk. However, sometimes the test is used on raw milk to determine the degree of contamination during milk production. For such test results to be valid, milk must be cooled promptly to preclude growth of coliform and other bacteria. When the Coliform Count is applied to raw milk, different criteria are needed for interpreting results than when the test is applied to pasteurized products.

The Coliform Count, when applied to pasteurized products, indicates the absence or presence of post-pasteurization contamination. It is not an indicator of fecal contamination. Also, a satisfactory coliform test result **does not** indicate absence of other unwanted bacteria including pathogens such as *Listeria monocytogenes*. When testing cultured milks (cultured buttermilk, yogurt, etc.) for coliforms, the test should be done only on products that are less than 24 hours old. This is because the action of lactic acid (low pH) on the bacteria will markedly reduce the number of viable coliforms in older products. An exceptionally acid tolerant coliform, however, is the pathogen *E. Coli* 0157:H7. Since, in its manufacture, cheese is exposed to the environment of the factory, small numbers of coliforms may be present in the finished product. Aside from being undesirable from a sanitary standpoint, large numbers of coliforms can produce gas and other metabolites which result in an excessively "open" cheese with off-flavors.

Tests for coliform bacteria in dairy foods employ either violet red bile agar and incubation at 32°C for 24 hours or lauryl sulfate tryptose broth in fermentation tubes with incubation at 35°C for 24 hours, followed by an additional 24 hours if tubes are gas-negative after the initial incubation period. These two tests give presumptive results, and if needed, confirmatory tests can be done. The current edition of Standard Methods for the Examination of Diary Products also describes determination of coliforms with the Petrifilm procedure, the VRB Redigel™ technique, the impedance method and the hydrophobic grid membrane filtration method.

Fecal coliforms

An incubation temperature higher than 32 or 35°C is used to separate coliforms of fecal origin from those of non-fecal origin. However, this procedure does not measure only coliforms of fecal origin. As with the term "coliform," "fecal coliform" has no taxonomic validity and can refer to organisms in several genera.

Shell fish and sea water are commonly tested for fecal coliforms, but the test is used less frequently for other foods. Dairy foods are not commonly tested for fecal coliforms, although they could be if a need develops. For example, in 1978, while working in my laboratory, Dr. Joseph Frank, now a professor at the University of Georgia, tested 102 samples of commercial semi-soft and soft ripened cheeses for presence of fecal coliforms. He found that 57.5% of the samples contained 100 or less fecal coliforms per gram, 25.5% contained from 100 to 10,000 per gram and 17.0% contained more than 10,000 per gram. Clearly, there was excessive contamination in some of the cheeses, probably due to poor sanitation. A recent (1994) study at South Dakota State University found that 48% of 50 commercial cheese samples contained up to 1000 coliforms per gram, although the study did not specifically determine fecal coliforms.

Testing for fecal coliforms involves first inoculating the sample into tubes of lauryl sulfate tryptose broth and incubating as described earlier for coliform bacteria. After incubation, tubes of EC broth are inoculated with a loopful of material from tubes of

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Inventing a New Niche Product, Part 6

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Reflecting on the last few months, Don realized that the Reenap Company had come a long way in a short time. The company, a small manufacturer of Cheddar cheese, recently started the process of creating some new products. They began by forming a New Product Development Team; then they assessed the capabilities of their company, making sure that any new product the Team developed could be produced in their plant. The Team did their research on the competitive products that were already in the marketplace, analyzed the needs of their customers and consumers, and then brainstormed many new product ideas. Finally, they used consumer feedback to develop a "positioned" concept statement for the Team's favorite new product ideas. The question now, thought Don, is whether any of these concepts are worth pursuing.

First Refine your Concepts, Then Test

The New Product Development Team divided into four groups to pursue the six concepts that the Team considered likely winners. In my last article I showed how Don's group had used consumer feedback to develop a "positioned" concept for their idea. Now, the groups shared "positioned" concepts with each other.

As each group presented their concepts to the entire Team, Don could see contradictory emotions on the Team members' faces. Clearly, the presenters were excited about their concepts. Equally clear, however, was the obvious confusion that the rest of the Team was experiencing. Don listened as the Team members asked questions about each other's concepts. He heard these same questions repeated many times:

"So, what would it taste like?"
"How would we package it?"
"What would it cost?"
"What sizes would it come in?"
"What would you use it for?"

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lauryl sulfate tryptose broth showing gas and then incubating the newly inoculated tubes of broth 3 hours at 35°C followed by 21 hours at 44.5°C. For some foods the incubation at 44.5°C is extended by 24 hours. Incubation at 45°C or 45.5°C and use of liquid media other than EC broth also have been suggested. Incubated tubes are examined for gas and the broth from tubes in which gas was produced can be used as inoculum for isolating *E. coli*, the fecal coliform most likely to be present.

Escherichia coli

The coliform bacterium of greatest significance is *E. coli*, not only because of its likely fecal origin but also because some strains can cause foodborne illness. This was demonstrated late in 1971 when at least 227 persons in the U.S. became ill after consuming imported French Brie or Camembert cheese contaminated with enteropathogenic strains of *E. coli.* Another outbreak, also caused by imported French cheese contaminated with *E. coli,* occurred in the U.S. in 1983. Several other dairy foods have been involved in outbreaks of illness caused by *E. coli.*

E. coli grows at temperatures in the range of 2.5 to 45°C (or slightly higher), at pH values of 4.67 to 9.53 and at water activity values above 0.935. The organism is subject to cold shock; for example, when a culture grown at 45°C is suddenly moved to 10°C, about 95% of the cells are killed in 1 hour. The organism is quite heat sensitive; its D-value (time for 90% of the population to be killed at a given temperature) is 0.00195 minute in milk at 75.6°C and 0.00093 minute in cream (40% milk fat). This, of course, means that *E. coli* will not survive pasteurization. The same is true for other coliforms. Cells of *E. coli* have somatic (O), capsular (K), and flagellan (H) antigens which are used to distinguish among serotypes of the pathogen.

Serotyping is an important technique for identifying the four principle groups of pathogenic *E. coli*: (a) enteropathogenic, (b) enterotoxigenic, (c) enteroinvasive and (d) enterohemorrhagic. The enteropathogenic strains produce a diarrheal illness often severe in infants, but the bacteria do not invade intestinal cells or produce an enterotoxin. An enterotoxin, either heat-labile or heat-stable, is produced by enterotoxigenic strains which commonly cause "traveler's diarrhea." The enteroinvasive strains, as the designation suggests, invade the intestinal cells and cause voluminous non-bloody diarrhea. Finally, the enterohemorrhagic strains cause a severe bloody diarrhea and sometimes also cause hemolytic uremic syndrome (a form of kidney failure) or thrombocytopenia purpura (a brain disease with a high mortality rate). *E. coli* 0157:H7 is an example of an enterohemorrhagic strain. A small percentage of beef and dairy cattle carry *E. coli* 0157:H7. This serotype has appeared in raw milk, which caused illness when consumed.

The coliform, *E. coli,* has taken on special significance in the last 15 or so years. Thus, the Coliform Count on finished products also has grown in importance. Methods to isolate, identify and serotype *E. coli* appear in current editions of the Compendium of Methods for the Microbiological Examination of Foods, the Bacteriological Analytical Manual, and , with some details missing, in Standard Methods for the Examination of Dairy Products. Readers interested in such methods should consult these sources of information.

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After all the groups presented their concepts to the entire Team, Don realized that none of the concepts were ready for consumer evaluation. "You know folks," he said, "if we are asking all these questions of each other – and we're supposed to be the experts on our new products – then how can we expect consumer to give us a thumbs up or down. No one will really understand our concepts. I think each group ought to go back and answer all the questions they heard before we talk to consumers again."

Sara spoke up at that point, "Let me build on that thought. Why doesn't the Team develop a list of questions that we want each concept to answer. That way we can be sure all the concepts will be clear to consumers."

"Nice, and let me add to that thought" said Jim to Sara. "After we complete the concepts, let's ask some consumers to improve them before we evaluate them. I bet some of our friends could help us catch the problems with our concepts before we go to the trouble of having consumers evaluate them. After all, they aren't as close to this new product process as we are."

The Team agreed. They developed a list of questions that each concept had to answer.

WHO is this product intended for?
WHAT is it? (Describe the package, the sizes, the flavor, the taste)
WHEN would one want to use it? (As a snack, as an ingredient, etc.)
WHY would one want to use it? (Describe its benefit)
HOW is it used? (Describe the way to prepare the product)
WHERE would you expect to buy it?(Dairy, deli, fancy food)
PRICE?

Don's group looked at their concept and realized it needed some clarification. The Team had to do some "guesstimating" to come up with a price, but they realized that people could not give realistic feedback on their concept unless they had some idea of its cost. They revised their concept statement to read:

Introducing Reenap Aged Cheddar
The Taste of Cheddar the Way it Used to Be!

New Reenap brand aged Cheddar is actually not so new. We make it taste the way Cheddar ought to taste by making it the old fashioned way. In our small cheese factory in Wisconsin, we remember the traditions of cheesemaking – and live by them. In fact, we use more, stronger cheese cultures than most commercial Cheddar, so our cheese develops as much real Cheddar flavor as cheese "used to have."

Reenap brand aged Cheddar is ideal for people who remember what aged Cheddar ought to taste like, but can't seem to find it today. It's a great cheese for snacking, and it works as an ingredient to give any cooked dish added flavor and delightful, rich texture.

We realize that you don't need to buy big packages of cheese to enjoy our big flavor so we've packaged Reenap brand aged Cheddar in a sensible 4 ounce package for just 99 cents. It's available in orange and white varieties and every package delivers the aged sharp taste you remember. Look for it in the dairy or deli section of better stores and gourmet shops.

Ask Consumers to Improve the Concept

When the Team reassembled a few days later, each group had worked on their concept, answering the questions listed above. Over the following two weeks, the Team asked friends and acquaintances for their opinion of the concepts. As a result, they had to reword some concepts and some had to have more extensive reworking. By the end of the month, however, all the concepts had been refined to clearly communicate their intended message. Now the Team was ready for a concept test.

What is a Concept Test?

The Team agreed that they would pursue only the highest scoring concepts of their six possible new product ideas. They used a concept test, designed to help them decide which concepts were the most appealing to their targeted consumers. They also wanted to know if the leading concept would have enough appeal to gain a successful trial level in the marketplace.

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One of the Team members had a background in statistics. He explained that sampling a small group of people can give valid information about a larger group, particularly when the groups are very similar. Thus, to be 95% sure of their results they would have to sample about 200 consumers from each target group. However, the Team agreed they did not need 95% certainty at this stage. They figured that they could accept 80% certainty, and their teammate told them that asking about 100 people from each target group would accomplish the task.

How do You get 100 People to Answer your Questions?

The Team talked about different ways to get 100 people to answer questions about each of their six concepts. They realized that getting 600 respondents to complete their questionnaire would require both keeping the questionnaire short and finding many more than 600 people to ask. They knew many people would not be willing to complete even a short questionnaire.

Instead, the Team decided to set a goal of asking 50 targeted people about each concept. If they got inconclusive results, then they could ask more people about the leading concepts to conclusively determine which concepts the Team should pursue in the marketplace.

One possibility the Team discussed was sending out questionnaires to random people around the country. That option was discarded, because it was hard to target their mailings to people appropriate for each concept. Instead, the Team decided that they would go to a major shopping mall and ask permission from its manager to question shoppers in the mall. The Team figured they could "eyeball" which concept would be appropriate for each potential respondent. For example, they could easily choose older shoppers to gather information about the concept of small packages of aged Cheddar for seniors. In fact, the mall might even have a special discount day for senior citizens, an ideal day for them to interview their targeted group.

Design a Questionnaire

So the Team put together a questionnaire that they could use to evaluate the merits of all the concepts among their target groups. The format was simple. First, thank the respondent for participating. Second, show the respondent the concept. Third, ask the respondent how likely they would be to purchase the new product. Fourth, ask any other useful questions while still keeping the questionnaire short enough that it could be finished in 3-5 minutes. Finally, ask the respondent a few questions, verifying that he/she fits in the target group.
This is the questionnaire they developed.

Thank you for taking a few minutes to answer our survey Please read the new product description below and then answer the questions following it. Feel free to refer to the description while answering the questionnaire.

(*Put the appropriate Concept Statement here*)

1. If this product was available in stores in your area for $_____ per package, would you buy it? Put an X in the box in front of the statement which best describes how you feel about buying this product?

☐ Definitely would buy it
☐ Probably would buy it
☐ Might or might not buy it
☐ Probably would not buy it
☐ Definitely would not buy it

2. In your family, who eats this product? ("X" all that apply).

☐ Children under 6 years
☐ Children 6-12 years
☐ Teenagers 13-17 years
☐ Adult female 18-25 years
☐ Adult female 26 years or more
☐ Adult male 18-25 years
☐ Adult male 26 years or more

3. Below are a list of benefits this product offers. Please select the two benefits that are most important to you when you decide to buy the product. ("X" only two selections). (*Each group would list their concept's benefits. Don's group developed this list for their concept.)*

☐ It's ready to eat right out of the package.
☐ This is a healthier food than other alternatives.
☐ It looks like it would taste great.
☐ It's nutritious.
☐ It's very satisfying to eat.
☐ It's an easy way to enjoy cheese anywhere, anytime.
☐ It's something I think tastes great and it is wholesome, too.
☐ It tastes better than most convenience foods.
☐ This is a real treat compared to the same boring snacks and lunches.

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Using Quat in Dairy Plant Foot Baths - Does it Work?

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It is well established that the sanitizer of choice for the environment of a dairy plant is a quaternary ammonium compound (quat). However, quat is distinctly limited as a routine sanitizer because of its minimal activity against E*scherichia coli*, *Staphylococcus aureus* and psychrotrophs. Also, a quat level of 20 ppm level in milk will inhibit cheese cultures.

Several decades ago, when quat was initially developed it was accepted as a sanitizer. Then, because residual quat never seemed to degrade, it was taken off the list of acceptable sanitizers. Subsequently, quat was reinstated as acceptable with a 200 ppm limitation as the "no rinse" concentration on food contact surfaces. It is this 200 ppm dilution that allows the growth of *E. coli*, *S. aureus*, and some psychrotrophs, bacteria that are undesirable in finished dairy foods. The lack of broad spectrum activity against all microorganisms makes this sanitizer undesirable for use on any food product contact surface.

Quat is, on the other hand, highly desirable as an environmental sanitizer (a sanitizer on nonfood contact surfaces) in dairy and food plants for two reasons: it resists degradation in the environment and it is active against organisms like *Listeria monocytogenes*. For these reasons, quat has found new life as the sanitizer of choice in dairy and food plant environments. However, you must use a concentration in the range of 1000 ppm for satisfactory environmental sanitizing.

Comments from industry about microbial growth in foot baths using quat as a sanitizer prompted this evaluation. We selected three dairy plants with foot baths in entrance ways. On two visits to each plant, samples of the fluid in selected foot baths were collected by pouring the solution into a Whirl-Pak™ bag from the foot bath. In addition, we swabbed the floor underneath each foot bath to determine microbial contaminants. Microbial populations in these samples were determined as directed in Standard Methods for the Examination of Dairy Products, 16th edition, 1995. Concentration of quat was measured by commercially available dip sticks (QAC Test Papers; LaMotte, Chestertown, MD). Data are shown in Table 1.

Our results indicate that plants 1 and 2 have high populations of bacteria growing in and around the foot baths. Between visit 1 and 2, high populations in the foot bath solutions in plant 1 were reduced markedly by effective cleaning. Yet both plants exhibited high counts under all mats sampled. Counts from the foot baths at plant 3 showed evidence of daily cleaning. Under the mats, however, Standard Plate counts and Coliform counts were as high those in the other plants.

Alternatives to foot baths

Some dairy plants have adopted other methods for sanitizing footgear. These alternative measures have been installed for a variety of reasons: workers do not always use the foot baths, fork lifts use the same entrance as workers, the slope of the floor does not permit effective use of a bath, or workers slip after using the footbath. All alternative measures appear to be more expensive than foot baths. However, effectiveness and plant sanitation have to be weighed against cost. One substitute for foot baths is a light beam activated spray that focuses on the 6 inch height from the floor and is mounted in a doorway. Another spray uses a timer controlled rinse on the floor in the doorway where workers enter. Yet another method is a 1-2" deep trench in the floor specifically constructed as a foot bath. While these alternatives may seem better, none reach the instep of a boot except the deep foot bath, which is difficult to clean.

In conclusion, there is no absolute measure that prevents transport of microorganisms into or around a dairy plant. The best protections we have are limiting traffic, effective worker training and understanding, worker dedication, and efficient daily cleaning and sanitation.

The following information can be useful to all dairy plants.

1. Quat is still the **environmental** sanitizer of choice for all dairy plants because of its residual properties. However, the effective concentration for a foot bath is 800-1000 ppm. You must change this solution daily.

2. Clean foot baths daily. Furthermore, you need to clean the bottom, side, and floor underneath daily. Otherwise, these areas will harbor bacteria that could spread throughout the plant.

3. We checked the stability of quat at 400 ppm in a foot bath. (The concentration recommended by the manufacturer.) The foot bath material itself caused decomposition of the quat in 46 hours to <100 ppm. We saved the diluted quat solution in the same plastic pail we mixed it in, and we checked the stability of this solution, too. There was no decomposition of the plastic pail quat solution.

4. Because quat is a wetting agent, it can cause workers to slip on the floor after stepping from the bath. Use caution.

Table 1. Bacterial populations found in and under foot baths

Visit	Bath Location	Counts in Quat/ml			Counts under Baths/50 cm^2		
		SPC[a]	VRB[b]	Psychrotrophs	SPC	VRB	Psychrotrophs
Plant 1							
1	Main entrance	160	100	20	$>1.2 \times 10^5$	$>7.5 \times 10^4$	$>1.2 \times 10^5$
	Side entrance	10	400	<10	$>1.2 \times 10^5$	$>7.5 \times 10^4$	$>1.2 \times 10^5$
2	Main entrance	100	<10	<10	$>1.2 \times 10^5$	$>7.5 \times 10^4$	$>1.2 \times 10^5$
	Side entrance	<10	<10	<10	1000	$>7.5 \times 10^4$	1000
Plant 2							
1	Main entrance	40	>1500	10	$>1.2 \times 10^5$	$>7.5 \times 10^4$	$>1.2 \times 10^5$
	Stairway entrance	70	>1500	20	$>1.2 \times 10^5$	$>7.5 \times 10^4$	$>1.2 \times 10^5$
2	Main entrance	540	>1500	<10	$>1.2 \times 10^5$	$>7.5 \times 10^4$	$>1.2 \times 10^5$
	Stairway entrance	10	>1500	<10	$>1.2 \times 10^5$	$>7.5 \times 10^4$	<500
Plant 3							
1	Center mat	<10	10	<10	$>1.2 \times 10^5$	$>7.5 \times 10^4$	<500
	Left mat	<10	10	<10	$>1.2 \times 10^5$	$>7.5 \times 10^4$	<500
	Right mat	<10	<10	<10	$>1.2 \times 10^5$	$>7.5 \times 10^4$	<500
2	Center mat	<10	<10	<10	$>1.2 \times 10^5$	$>7.5 \times 10^4$	<500
	Left mat	<10	10	<10	$>1.2 \times 10^5$	$>7.5 \times 10^4$	<500
	Right mat	<10	<10	<10	$>1.2 \times 10^5$	$>7.5 \times 10^4$	<500

a = Standard Plate Count
b = Coliform Count
Note: All footbaths sampled were >400ppm Quat

continued from page 7

4. We are not certain what the best name for our new product should be. Please mark the three names that you, personally, would pick for this new product. ("X" only three names).
(*Each group would list potential names for their concept. The following list is from Don's group.*)

☐ Munchy Cheese
☐ Real Cheddar
☐ Cheddar Smokers
☐ Fun Cheese
☐ Cheddar for Seniors
☐ Cheddar the way it used to be
☐ Reenap Aged Cheddar
☐ Old Fashioned Aged Cheddar
☐ Zesty Cheddar
☐ Pure Aged Cheddar

Finally, we have a few questions for classification purposes.
5. Are you... ☐ Male or ☐ Female?

6. Including yourself, how many of the people currently living in your household are... (Write in numbers for all that apply.)

_____ Children under 6 years
_____ Children 6-12 years
_____ Teenagers 13-17 years
_____ Adult female 18-25 years
_____ Adult female 26 years or more
_____ Adult male 18-25 years
_____ Adult male 26 years or more

7. Who in your household actually goes to the store and shops for food products like this one? ("X" one box.)

☐ I usually purchase food products like this one.
☐ Someone else in my household usually purchases food products like this one.

Thank you very much for your time!

Quality and Diversity – a world-wide strategy for success in the cheese industry

When cheesemakers journey to Wisconsin from other parts of the world to teach in Jim Path's Artisan Workshops they share more than their cheesemaking skills. Often we learn about another culture, including customs and some of the history behind cheesemaking in other countries. Between breaks in a busy schedule, Andrew Lamberton, of Reaseheath College and instructor in the latest workshop, talked with me about making cheese in the United Kingdom.

The dairy industry in England is in the midst of major changes due to the disbanding of the Milk Marketing Boards, a pivotal event in November, 1994. These Marketing Boards, formed in 1933, concentrated on fluid milk, buying milk from farmers and then selling it to maximize profits for the farmer. For many years, doorstep delivery of fluid milk brought the most profit, but in the last five years supermarket sales of milk have increased and doorstep delivery is now declining.

Under the influence of the Milk Marketing Boards, the fluid milk market had the highest priority, then cream. Cheese was near the bottom; only 22% of whole milk went to cheese manufacture. One result of the changes is that cheesemakers can now buy milk directly from the farmer. The other option for cheesemakers is buying from replacement milk marketing organizations, like Milk Marque. Unfortunately, after disbanding the Boards, the price of milk for cheese jumped 12%. This overnight increase has not been passed on to consumers since cheese made in the United Kingdom faces stiff competition from France, Ireland, even Australia, and the supermarkets refused to pass the price rise on to the consumers.

Like the advice we hear, cheesemakers in the United Kingdom have been advised to maintain the identity and quality of the cheeses they make. We emphasize the quality of Wisconsin cheese; the English highlight their own "English" cheeses. Dairy consultants have also advised them to increase the diversity of the cheeses they make. Sound familiar?

Some cheesemakers have found a successful niche in the English market. For example, the Wensleydale Creamery in Yorkshire attracts growing numbers of tourists with a museum, viewing gallery, restaurant, gift shop and cheese shop featuring their own unique cheeses. Planning a trip to England? Andrew recommends that you put this Yorkshire creamery on your itinerary. In fact, he thinks Wisconsin is an ideal setting for a similar venture and someday he'd like to come back and visit one here.

Photos from the most recent CDR artisan workshop, Great Cheeses from Great Britain, held on Sept. 26-28.

Left, Keith Hintz, Springside Cheese Corp, and on the right, Daryl Schleim, Swiss Valley Farms.

***Below**, Mark Johnson, CDR, on the left and Andrew Lamberton, Reaseheath College, Nantwich, right, discuss some fine points of cheesemaking.*

Curd Clinic

Q. Sometimes I notice that the color of my higher moisture cheeses aren't uniform, I can see irregular, bleached patches on the surface. Then, just when I've concluded that these white spots might mean trouble, they disappear. What are they and what should I do about them?

A. You are seeing acid spots in your cheese. These areas of higher acidity are easily seen in annatto colored cheeses, but if you look closely you can find them in white cheeses, too. You can confirm the cause of acid spots by measuring their pH. Commonly you'll find that the pH of the spot is around 4.95 or 5.0 while the surrounding cheese has a pH of 5.2 or 5.15. This is a small difference, but enough to cause problems.

Sometimes this acidic defect is found uniformly throughout Cheddar cheese. You'll notice that the interior is lighter than usual and lacks the normal translucence. We call this an acid-cut, or bleached defect. It's possible to notice bleaching soon after the cheese is made, but you'll also start seeing it when the acidity is reaching a maximum – during the first week.

Acid spots and acid bleaching disappear after a few weeks, when the pH changes. But that doesn't mean that you should ignore this defect. For one thing, it is hard to sell your young cheese when it is covered with spots. However, the main reason you should pay attention to acid spots is because they indicate a potential manufacturing problem that involves buffering.

One route to acid spot formation is inadequate whey draining. Whey gets trapped in the curd and shows up as an acid spot after the cheese is pressed. Along with this visual defect, you can get off flavors developing, particularly acidic flavor defects, and whey taint. Thoroughly rinsing the curd with enough water can dilute the whey, remove the sugar and prevent problems.

Moisture content of cheese plays an influential role in the buffering capacity since lactose, or milk sugar, is carried by moisture. The lactose is changed by bacteria to acids, mostly lactic acid. Thus, anything that leads to a high moisture content (particularly when lactose is available), like salting too early or pressing too early, can also produce higher acidity and acid defects. This is why acid spots are more common in higher moisture cheeses, like Colby.

You can ignore this defect and it looks like it goes away, but it is a useful cue suggesting that you fine tune your manufacturing process. Preventing acid spots is actually the best way to handle them.

Curd Clinic doctor is Mark Johnson, Senior Scientist, CDR

Questions for the Curd Clinic?
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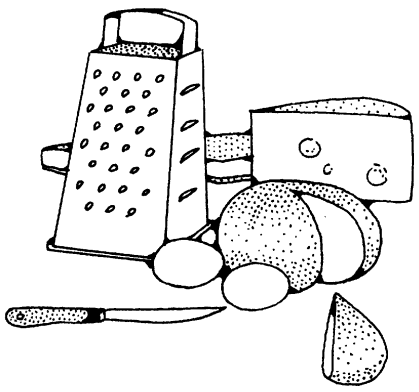

News from CDR

We now have a World Wide Web site on the Internet. Point your browser to our address at http://www.cdr.wisc.edu/. By January 1996, we will be closing CDR's current dial-in bulletin board service because the web site will replace it. You can preview our a web site now, although it is still evolving. It includes CDR Research Projects, CDR Calendar of Events, Center for Dairy Research Staff, and other Dairy Related Web sites. If there is something you'd like to see on our web site, call Tom Rowe at (608) 265-6194. E-mail trowe@ae.agecon.wisc.edu

UW Dairy Pipeline
Calendar

Jan. 2-5 Milk Pasteurization and Process Control School. Madison, WI. Call Bob Bradley at (608) 263-2007 for information, or the CALS Conference Office (608) 263-1672 to register.

Jan. 8-12 Ice Cream Makers Short Course. Madison, WI. Call Bob Bradley at (608) 263-2007 for information, or the CALS Conference Office (608) 263-1672 to register.

Feb. 27-28 Process Cheese Short Course. Madison, WI. Call Jim Path for more information, (608) 262-2253

March 27 CDR Open House

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