December 2002
Volume 2, No. 11

Western Dairy News

For the West, About the West, From the West

A collaborative effort of Dairy Specialists from Colorado State University, K-State Research & Extension, New Mexico State University, Texas Cooperative Extension, University of Idaho Cooperative Extension System, Oregon State University, Utah State University Extension, Washington State University Cooperative Extension, NDSU Extension Service

A Quality Approach to Dairy Management

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In their article Mooooving Toward Six Sigma; A quality management program helps one farm manage its feed costs, Mr. Thomas Tylutki and Dr. Danny Fox indicate that the management approach currently used on most dairies is one of problem-solving. They state that for the U.S. dairy industry to improve its economic viability, social acceptance and environmental impacts "a sweeping cultural change is needed in production agriculture to improve its long-term competitiveness in global markets, while maintaining environmental quality." The authors believe the current management style used on dairies must change. Dairy owner/operators must undertake an active engagement, much like other corporations, to create strategic plans for their long-term goals. The "sweeping cultural change" can only be accomplished by **people,** not by hardware (computers, automation, and new machinery). Teamwork is essential, and good leadership of teams must bring consistency of effort, along with knowledge.

W. Edwards Deming is the "father of the modern quality movement", also referred to as Total Quality Management or Continuous Quality Improvement. David Hutton has pointed out that "this approach is based upon a body of knowledge – a philosophy and set of principles that are translated into action by means of proven methodologies, tools, and techniques." Deming's system consists of four interrelated parts: (1) appreciation for a system, (2) knowledge about variation, (3) theory of knowledge and (4) psychology. This article shall deal with the first two parts in an effort to create a "yearning for learning".

Appreciation of system dynamics is the basis for system management. A system is a group of interrelated processes. The greater the degree of interdependency between the components of the system, the greater the need to manage the system. Tylutki and Fox point out that the enterprises on a dairy could be characterized as "five manufacturing systems (cropping, feeding, managing replacements, milking and manure/nutrient handling)" that tend to share system analysis challenges regarding capital, labor, management and some times equipment making. The quality improvement view of agriculture emphasizes that the aim of management is to optimize the entire system, not just its components.

Knowledge about variation begins with the understanding that systems have a given capability that will exhibit variation. Approximately 94 % of all system variations are common-cause, the result of the normal random variation present in all processes. Improvements aimed at reducing common-cause variation can only be achieved by changing the system (for example, buying a new separator). In contrast, variations considered to be the result of special causes (which account for only 6 % of system problems) require immediate corrective action (for example, repairing a lagoon embankment following a breach). Corrective actions concern themselves with non-acceptable defects that move the system toward minimum expectation. Corrective actions work to eliminate special causes that must be eliminated before a process is considered stable or "in control." Only those systems considered to be "in control", having no special cause variation, have the capability of process improvement and innovation.

Dairy owner/operators and their advisors tend to depend upon conservation and resource management approaches such as Whole Farm Planning, Conservation Plans, Comprehensive Nutri-

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Four Basics of Cleaning

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Milk of consistently good quality increases or maintains dairy product consumption and sales. High quality milk with low bacteria counts and the potential for long shelf life starts on the farm with clean, sanitized cows and equipment. Bacteria use milk nutrients that remain on your dairy equipment to grow and multiply between milkings. The most important step in reaching top milk quality is to remove all milk residues (or "soil") after each milking. Appreciation of the four basics of cleaning - time, temperature, concentration and physical action - will help with this task.

1. Time: Cleaning solutions need about 10 minutes to dissolve or suspend milk soils on most farm equipment.

2. Temperature : Hot water is critical to emulsify milkfat and to disperse milk proteins. Water for chlorinated alkaline detergent solutions must enter the wash sink at no less than 150°F, and it must be discharged to the drain at no less than 120°. Gloves will be needed for manual cleaning of buckets, milking units, bulk tanks, and filter pans.
Dairy farms require heavy-duty, commercial water heaters or on-demand flow heaters to produce the volume of hot water necessary for cleaning cows and dairy equipment. Supplemental heaters in the wash vat can boost the temperature of cleaning solutions during washing. Generally, adequate temperature is more critical than the precise minutes of contact time of cleaning solutions. Therefore, don't circulate solutions so long they cool below minimum recommended temperatures (120ºF).

3. Concentration: Don't try to save money on bargain-priced cleaning chemicals. Always use the recommended amounts of the better quality cleaners and sanitizers. Most package labels will specify the amount to use per quantity of water, according to the grains of water hardness which can reduce the effectiveness of dairy cleaning chemicals. Test your water hardness periodically and install a commercial water softener when necessary.

If a label is unavailable, a rule of thumb for adding chlorinated cleaners to water is 1 % weight per volume. For example, 1.25 ounces of cleaner to 1 gallon (128 ounces) of hot water. Chlorine detergents and sanitizers can lose their strength when stored in warm, moist areas. Store them in a cool, dry room. Keep all containers of alkaline cleaners and sanitizer concentrates tightly closed.

4. Physical action: In modern, clean-in-place (CIP) systems, the scrub brush has been replaced with fast-moving solutions pushed by "slugs" of air. For pipelines, air injectors are essential for proper CIP cleaning. Make sure the injectors are set correctly and creating a good scrubbing action. Check the design of your equipment for dead ends, rough spots, and sharp corners that can slow cleaning solutions.

Physical action is also important in automated bulk tank cleaning. The spray ball or tube must direct cleaning solution to contact all interior parts of the bulk tank with sufficient force to remove milk soil. Watch for plugged spray heads; never let the level of the cleaning solution cover the spray head during the wash cycle. Always use a brush of a proper size and shape to manually clean the outlet valve as the cleaning solution drains.

The Ideal CIP Procedure

1. Pre-rinse all equipment with lukewarm water (110°) to remove most of the remaining milk from equipment surfaces. Hot water cooks (bonds) protein films to surfaces; cold water tends to "set" milkfat.
2. Wash for about 10 minutes with a hot solution of chlorinated, alkaline cleaner. Maintain solution between 135 and 155°F. Drain thoroughly.
3. Rinse equipment completely with modest amount of cold water.
4. Post-rinse with a dilute acid solution (pH 5.0 to 5.5) for 5 minutes. This will limit mineral or milkstone buildup and bacterial growth between milkings. Never mix acid cleaners with chemicals that contain chlorine. Alternately, you can clean the system with a stronger acid solution (pH 3.5 to 4.0) each week to remove milkstone that may build up.
5. Drain the system completely. Residual water can allow bacterial growth to occur before the next milking.
6. Sanitize immediately before the next milking. This will destroy bacteria that may have grown on equipment surfaces between milkings. Newer, more sensitive milk quality tests can readily show the difference between equipment sanitized just before milking and equipment not sanitized. Use iodine (at 25 parts per million) or chlorine (at 100 ppm) sanitizers according to directions. Chlorine can gradually deteriorate rubber and corrode stainless steel if it's left in contact with equipment surfaces too long (45 to 60 minutes) before milking.

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Evaluating the Effectivenessof Your Cleaning Program

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For any dairy food, milk bacteria counts, handling, and cleanliness dictate the flavor and "keeping quality" of the finished product. Milk processors and regulatory agencies use bacteria counts to evaluate the effectiveness of your cleaning program. Understanding the test procedures and results can help you maintain high quality milk with low bacteria counts.

Standard Plate Count (SPC)

This is a universal quality test for milk and many other foods. It's run under strict standards that assure uniform results in any laboratory. A raw milk sample is diluted and mixed with a standard culture medium that supports bacterial growth. This mixture or "pour" plate is incubated (cultured) for 48 hours at 86°F (30ºC). This procedure counts most live bacteria in the milk, whether they're derived from equipment, cows, or the environment. This method is also called the "total aerobic plate count."

A goal for highest quality milk is to consistently keep this count under 5,000 cfu/ml. Unfortunately, the SPC may provide only limited information on your milk quality program. Undesirable bacteria can come from many sources, and rapid milk cooling will hide the presence of those bacteria that later deteriorate milk flavor or severely limit product shelf life—or both.

Preliminary Incubation Count (PI)

This is a somewhat different approach for conducting the SPC. The raw milk sample is held at 55°F (13°C) for exactly 18 hours, simulating poor milk refrigeration, then a SPC is performed on the "cool" incubated sample. Holding the sample at 55° lets the milk-spoilage bacteria "bloom," if they're present. This test is an excellent measure of sanitation practices in milk production.

While the PI count isn't an official test of regulatory agencies, it's frequently part of milk quality premium programs of processors and cooperatives. The PI count allows bacteria from dirty cows and equipment to multiply faster than the SPC. Milk that's cooled slowly or held in farm bulk tanks above 40°F (4.4°C) will also have higher PI counts. Whenever your PI count is more than four times your SPC, or when the PI exceeds 50,000 cfu/ml, reevaluate the cleanliness of your cows, equipment or water source. These trouble spots are further detailed in the companion article on page 2 and 4 in this issue, Four Basics of Cleaning. Generally, PI counts over 100,000 cfu/ml indicate serious cleaning problems. It's possible to keep your PI count below 40,000 cfu/ml on a consistent basis.

Laboratory Pasteurized Count (LPC)

For the LPC, raw milk is first pasteurized in the laboratory by heating in a water bath, then an SPC is performed. This test counts bacteria that survive pasteurization and remain in processed milk. Many of these bacteria come from the farm environment and grow readily on improperly cleaned or unsanitized milk equipment.

Typically, a high SPC with a low LPC indicates that many of the bacteria in milk are directly from cows' udders. This points to a mastitis problem, rather than dirty equipment or cows. However, certain environmental mastitis bacteria, like Streptococcus uberis, can initially come from cows in low numbers. These organisms grow out on dirty milking equipment between milkings or on the in-line milk filter during longer milking cycles (more than 4 hours), resulting in a high SPC and a low LPC with few infected cows. Guidelines for satisfactory pasteurized counts are approximately 500 cfu/ml, but maintaining the LPC under 100/ml should be your "high quality" goal.

Coliform Count

Coliform bacteria in milk indicate unsanitary production conditions. While coliforms come from the digestive tract of animals, they can be carried on hands, on clothes, on milk-handling equipment, in mud, and even in the air. They're easily killed by pasteurization, so they don't often cause milk spoilage; but high number of coliforms in milk usually come with high counts of cold-loving, pasteurization-resistant spoilage bacteria.

I believe a sound goal for the average producer is to ALWAYS have a coliform count under 10/ml in raw milk. If you have 25 or more, watch for dirty cows, milking wet udders, or poor premilking sanitation.

The results of each of these tests individually as well as the combination of the test results tells a story about the cleanliness on your dairy. They should be evaluated individually and as a group to further your efforts to produce high quality milk.

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Cleaning other parts of the system

Air can carry bacteria into milk from other equipment surfaces. Cleaning airlines and the sanitary or moisture trap every 2 weeks will help keep bacteria counts low. To clean the air or pulsation lines, start the vacuum pump and draw a measured amount (less than the moisture trap will hold) of hot, low-foaming detergent solution through the stall cock furthest from the trap.

Stop the pump and allow the trap to drain. Repeat the procedure, occasionally lifting the hose; this draws the solution out of the bucket and injects some air to increase the scrubbing action. If the pulsator line is capped at both ends, you can simply flush it with a high- pressure hose, with the vacuum pump turned off. This requires much less time and effort than stopping the pump and letting it drain. Manually clean the sanitary trap and the pipe leading from it to the receiver after cleaning the airlines.

Common trouble spots

Cows

Mud and manure on the skin of the udder. Clip hair from the udder regularly to reduce the presence of dirt and moisture during milking.

Milking wet udders and teats. Bacteria can move into milk with the water.

Bacteria from mastitis-infected cows. Cows can shed bacteria into milk without showing clinical mastitis.

Equipment

Dead ends and sharp corners in pipelines can reduce cleaning action. Check for them.

Incorrectly placed and sized air injectors.

An undersized CIP wash line to milking units.

Environmental bacteria growth, especially on in-line filters, during milkings longer than 4 hours.

Vacuum air flow not strong enough for adequate CIP washing. Maintain at least 6 cubic feet per minute per unit, measured at the receiver.

Loose-fitting pipeline joints. If milk can leak out, bacteria-laden air can get in.

Poor drainage after cleaning. Bacteria need moisture to grow.

Worn rubber parts: gaskets, inflations, milk hoses, diaphragms on automatic take-offs.

Incomplete cleaning of the top interior or sides of the bulk tank, the agitator paddle, the dipstick, or the outlet valve.

Soiled air lines, sanitary trap, and/or the pipe connecting the trap to the receiver.

Inadequate cooling. Milk should reach 40°F or below within 2 hours after milking.

Contaminated water supply.

Processors recognize the value of high quality milk with premium or incentive payments to dairy farmers. Follow the sanitation basics and receive this additional income. It requires only your attention and follow-through.

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ent Management Plans (CNMPs), and others. Each of these approaches has been developed to address specific events that are "special cause variations". Although immediate corrective actions should be implemented, these events only account for 6% of the system problems. The "quick fix" that relieves the problem for the short term does not address the systemic problems (the other 94 %), thus, the problem will and does expresses itself again, often in a more pronounced manner. This results in owner/operators dashing between various approaches without vision, values, purpose and goals.

The three most commonly used quality management systems models are; (1) the *Baldrige National Quality Program for Performance Excellence*, (2) the eight quality management principles that form the basis of *ANSI/ISO 9000:2000* family of quality management system standards, and (3) the *ANSI/ISO 14000* family of environmental management system standards. Each of these models are fundamentally quality improvement tools, the focus of which is to **get better business results, including improving the bottom line.** W. Edward Deming realized that this approach is the vehicle for constant, continual improvement and innovation, enabling people to solve problems and be more creative.

Many of these ideas are new and not well understood. Peter Senge says that, "Ideas such as these, which represent significant shifts in our predominant way of thinking, can be daunting. The point in raising them is not to have people grasp them intellectually, nor to have people adopt them posthaste – but to find a way to pursue them meaningfully. It may be enough that they challenge all of us to think more deeply. If they stand the test of time, they will have to find their way into the way we conduct our work."

Western Dairy News *is published as a service to the people interested in the health and welfare of the western dairy industry. Archives of this publication may be found at http://animalscience-extension.tamu.edu/dairy/wdn/wdn.html*

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