MnTAP Dairy Plant Reduces Water Use and BOD Saving Over $26,000

Minnesota Technical Assistance Program ■ INTERN SUMMARY

Fine Tuning Clean-In-Place Systems (CIP)

Company	110-employee Minnesota dairy
Results	Decreased water use by adjusting CIP systems. Saved over 8.5 million gallons of water and over $20,000 annually. Decreased biochemical oxygen demand (BOD) loading by 2.5 percent, saving an additional $6,000 per year.

Process Background

In 1999, a Minnesota dairy plant received 1.7 million pounds of milk daily to produce cream, cheese, lactose products and protein concentrates. The 110-employee facility made 96,000 to 160,000 pounds of cheese per day. At the end of each day's run, clean-in-place (CIP) systems sanitized the equipment, readying it for the next day.

Incentives for Change

Together, the plant and its adjunct product drying facility started overloading its water pretreatment plant—both with water volume and BOD. BOD is a measure of how much oxygen is required to biologically decompose organic matter in the water. Because the water pretreatment plant was at capacity, the company could not expand the operation at the dairy plant and it was charged for the excess loading.

The dairy speculated that the flushes and rinses of its CIP systems were too long, contributing to the overloading of the water pretreatment plant. With all employees focused on production, the company did not have extra staff time to analyze water use from all of its CIP systems or to fine tune the computer program that ran the CIPs.

In the summer of 1999, the dairy requested a **MnTAP intern** to review most of its CIP systems. The intern's research confirmed that the rinses were consuming excess water. He evaluated and adjusted the duration of the water flushes and rinses, and also investigated ways to reduce BOD loading.

CIP Systems

CIP eliminates the need to dismantle equipment in order to clean and sanitize. Many production facilities manually run CIP systems. Fully automated CIP is more consistent than manual operations and the level of cleaning is typically more effective. If facilities produce multiple products, fully automated CIPs help maximize the use of equipment.

The technology of each room's CIP system at the dairy varied. Aside from the few manually operated CIP systems, all CIP systems were controlled and monitored by the Programmable Logic Controller (PLC). It was programmed to run pumps and valves, control timing and temperatures, and monitor conductivity and other parameters. The CIP process generally consists of rinses, which go to the drain, and acid and caustic washes, which return to the tanks for reuse.

Reducing Rinse Water

The CIPs assured product consistency and sanitary production conditions. But, the company speculated that the flushes and rinses for production cleaning were generous and possibly excessive. Working with dairy's employees, the intern optimized CIP rinse times for:

- pre-rinses which clear the line of material.
- rinses between wash solutions which separate chemical washes.
- post-rinses which clear the line of all chemical wash solution.

Overall, pre and post rinses were shortened slightly and wash rinses were shortened substantially.

(continued)

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Example of CIP changes: evaporator room

In the evaporator room, whey permeate and whey protein are concentrated. It was the plant's most diverse room and the one with the most advanced CIP. The rinse that falls in between the wash solutions had the greatest potential for reduced water use.

The CIP systems were set to rinse wash solutions completely from the lines—bringing the conductivity to zero—before the next wash solution was added. Depending on the length of the line or tank being cleaned, hundreds of gallons of fresh water went down the drain. The intern found that conductivity did not need to return to zero. Rather, it only needed to dip down to a minimum conductivity to signal the PLC when the solution could be returned to the tank for reuse and when to begin the next wash.

Because conductivity was measured at the end of the line and the supply pumps and valves were at the beginning, the CIP was programmed with a "wash return delay." This prevented the CIP from using the conductivity measure of the exiting wash solution to represent the wash solution entering the system.

Rinse results

Adjustments like those in the evaporator room yielded similar water use reductions in most of the dairy's production rooms. All together, the company saved nearly 8,500,000 gallons of water and $20,100 annually.

CIP savings

	gal water/yr	$/yr
Evaporator room	1,858,000	$4,070
Make room	4,243,000	9,970
Standardizing room	216,000	550
Intake room	1,474,200	3,940
Block former	680,400	1,570
Totals	8,471,600	$20,100

Decreasing BOD Loading

BOD waste streams all resulted from either mechanical or operational procedures. Often CIP procedures contributed significantly to BOD loading, especially during cleaning at the end of a day's run when the product remaining in the line is washed down the drain. Other operations also resulted in excess BOD loading. For example, when sanitizing was initiated too early on the slurry line the amount of product loss doubled.

The solutions to most of these problems were adjustments to operating procedures. By requiring operators to flush systems before they are drained at the end of the day, only five to six percent solid waste exited the machine instead of 20 percent. By not pushing the sanitizing button while the clarifier was desludging, BOD loading was reduced by almost a third in that room.

Overall Results

With the assistance of a MnTAP intern and a MnTAP staff person, the dairy was able to reduce its waste effectively without overhauling its current technology. The company decreased water use by nearly 8.5 million gallons annually, saving over $20,000. The dairy also decreased its BOD loading by 2.5 percent, saving an additional $6,000 per year. The company has since expanded production.

More Information

MnTAP has a variety of technical assistance services available to help Minnesota businesses implement industry-tailored solutions that maximize resource efficiency, prevent pollution and reduce costs.
Our information resources are available online at <mntap.umn.edu>. Or, call MnTAP at 612/624-1300 or 800/247-0015 from greater Minnesota for personal assistance or more information about MnTAP's Intern Program.

This project was conducted in 1999 by MnTAP intern, Zachery Perry a junior at University of Notre-Dame.