DeLaval Cleaning Solutions

IMPROVING YOUR PRODUCTION THROUGH INNOVATIVE AND SUSTAINABLE CIP CLEANING

Carolina Mateus, Ph.D; Mark Garrett, Steve Gray
DeLaval Cleaning Solutions

Abstract

One Step Alkali (OSAlk) is a high performance, KOH based CIP detergent, developed by DeLaval Cleaning Solutions, that in addition to removing fats and proteins also significantly reduces mineral scale deposition. A medium sized commercial milk processing facility that switched to OSAlk cleaning regimen reported a decrease in cleaning time of 1.5 h with an extension of production runs from 20 hr to 24 hr and increased production of 4.25 million lb per quarter. This study demonstrates the superior performance of OSAlk over traditional cleaning and its additional benefit of increasing the efficiency of the production facility.

Introduction

As part of our vision of making sustainable food production possible, DeLaval Cleaning Solutions has designed a line of cycle time reduction cleaners. One Step Alkali (OSAlk) is an integral part of this line.

Traditional cleaning of food processing plants through either clean in place (CIP) or manual (COP) programs involves the following basic steps:

- Pre-rinse for removal of gross soil particles
- Alkaline wash, including chloralkaline detergents, for removal of proteins, fats and other organic soils
- Rinse
- Acid rinse for removal of mineral deposits
- Sanitizing rinse for final preparation of the surface for food production

The length and frequency of each of these steps is dependent on the type of soil being cleaned, the size of the operation, the equipment being cleaned, and the chemicals used. For example, heat applied during food processing can bind proteins onto the surface, making their removal more difficult and requiring shorter production cycles to prevent high soil deposition and longer cleaning times.

In any food processing plant, but particularly those that run continuously, the down time spent cleaning and sanitizing surfaces has a direct impact on production time and thus on overall profitability of the operation. Food producers are constantly looking to improve the cleaning cycle times to allow for either longer processing runs and/or shorter cleaning times. A product that seeks to accomplish this goal is One Step Alkali, by DeLaval Cleaning Solutions.

One Step Alkali is a fully built caustic detergent designed to dramatically improve the cleaning efficiency of high temperature CIP circuits. The formula contains a combination of surfactants and sequestrants that allow the product to effectively remove both organic and inorganic soil in a single step (Figure 1). This combination effectively combines the traditional caustic wash and the acid rinse functions into a single step. The product is potassium based to provide high rinsability; avoiding costly issues with sodium discharge. This high rinsability equates to shorter rinse cycles after the wash.

The reduction in cleaning steps also provides reduced water use, reduced energy use, and reduced chemical use, all of which have an important environmental impact. Properties for OSAlk are given in table 1 for the concentrate and recommended use dilutions.

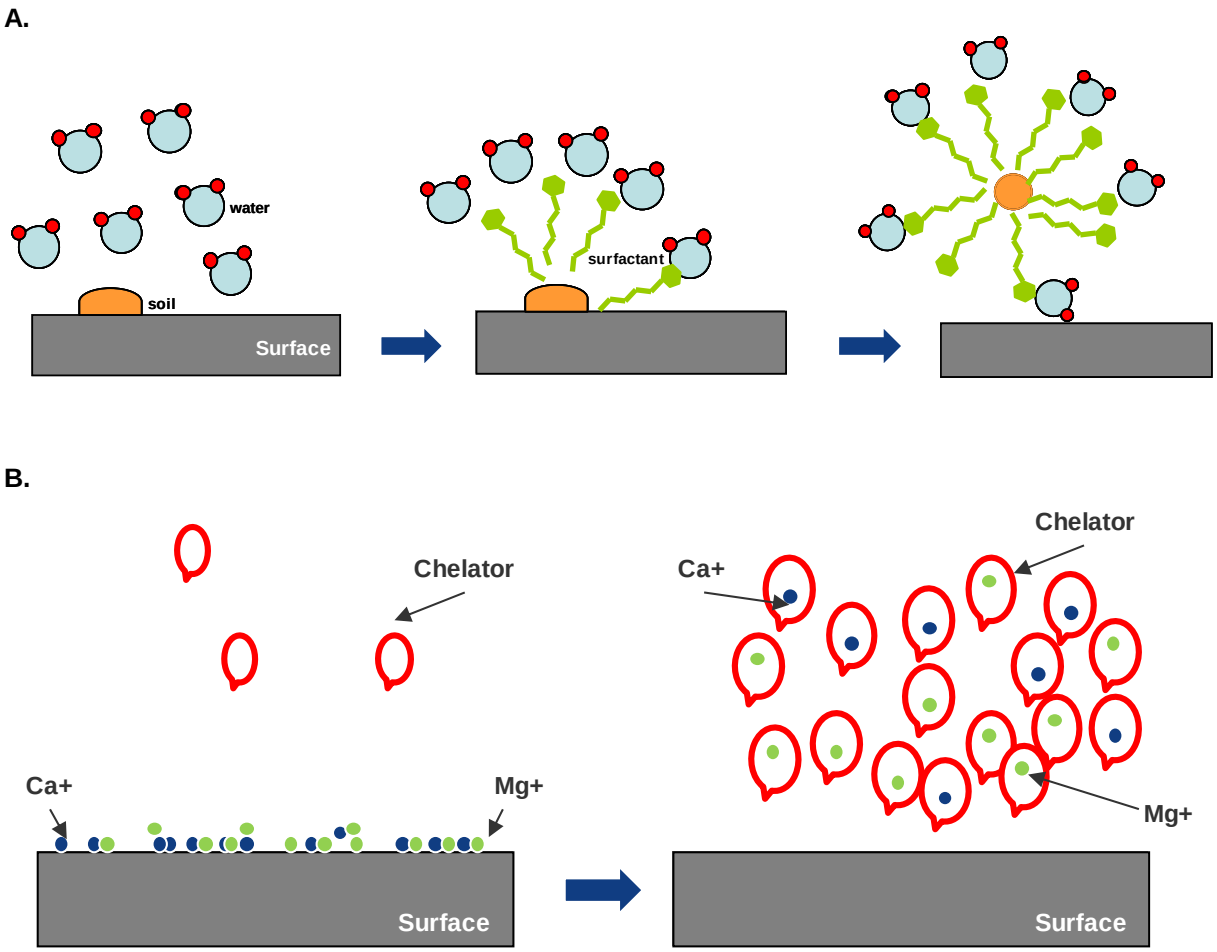


Figure 1. Representation of the mode of action of OSA. **A.** The surfactant molecules solubilize organic soil residues (such as a fat deposit). As a result the soil is lifted from the surface and kept in suspension so that it can be effectively "washed" away. **B.** Chelating agents trap and suspend inorganic soil (such as milk soil and hard water deposits) that normally is poorly soluble in water.

Property	Concentrate	1 oz/gal	10 oz/gal
pH	13.5	12.3 – 13.3	12.3 – 13.3
Active Alkalinity (% KOH)	39.9%	0.5%	4.6%

Table 1. Properties of OSAlk at different use concentrations.

The combined organic and inorganic soil removal results in a cleaner surface, which directly translates on improved equipment performance. Although it can certainly be used through the entire CIP system, this product is particularly designed for high temperature processing equipment surfaces such as evaporators, HTST, HHST, VTIS, Cheese Vats, UHT Fillers and Separators.

Methods

The ability to eliminate the acid wash by replacing both caustic and acid detergents with One Step Alkali was evaluated at a milk processing facility in the Midwest. The facility receives milk from 7200 cows daily and processes approximately 3.5 million lb of raw milk per week for production of cream, condensed and skim milk.
The CIP programs for both a 3 stage evaporator and the cream HTST were modified to replace the caustic wash and acid rinse with a single step procedure utilizing One Step Alkali. The following parameters were monitored over a 5 month period between the Fall of 2013 and the Spring 2014:

- Overall cleanliness via pre-op observations.
- Cycle time automatically recorded in CIP system.
- Production time both in terms of cycle extension and total additional hours f production.
- Water usage, as compared with the same time frame a year prior to the study.
- Energy usage, as compared with the same time frame a year prior to the study.
- Microbiological quality of the surface.

Results

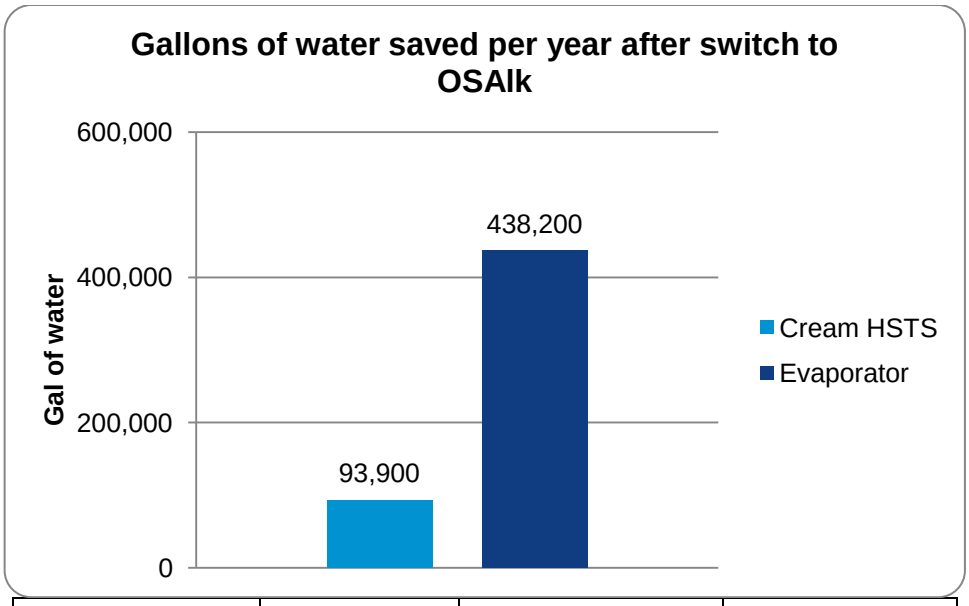
The test facility is a commercial facility that runs 24 hr per day, 7 days per week. The total CIP cycle in the test facility, using a conventional caustic detergent with chelating additives, was approximately 4 hrs per day (Table 2). This resulted in 7 CIP cycles per week per system cleaned and approximately 20 hr production runs. The trial resulted in the successful elimination of the acid rinse step without affecting the cleanliness of the surfaces. Cleaning time was reduced by 1.5 hr per cycle (Table 2). The cream HTST was the rate limiting step in the production process. To increase overall throughput in the facility it was a necessity to gain production time through both the evaporator and Cream HTST simultaneously. By providing cleaner surfaces and decreasing the cleaning time of both the Cream HTST and Evaporator with One Step Alkali, production time was extended from 20 hr runs to 24 hr runs. The overall effect was a net increase of 11 production hours per week. This translated to an additional 3 million pounds of product produced per quarter without any additional capital investment or new equipment purchased.

Equipment	Standard Chemical Usage	Standard CIP cycle time / production time	One Step Alkali Usage	One Step Alkali CIP cycle time / production time	Time Savings
Evaporator	4 – 5 oz/gal caustic 2 – 3 oz/gal acid	4 hr / 20 hr	2 – 3 oz/gal	2.5 hr / 24 hr	1.5 hr.
HTST	4 – 5 oz/gal caustic 2 – 3 oz/gal acid	4 hr / 20 hr	2 – 3 oz/gal	2.5 hr / 24 hr	1.5 hr.

Table 2. CIP cycle time savings and extended production after implementation of One Step Alkali cleaning regimen.

After introduction of OSAlk washes, the test facility has continued to perform one standard CIP wash (i.e. caustic wash and acid rinse, 4 hr total) per week. The overall result in CIP time of the OSAlk implementation was the elimination of 2 CIP cycles per week, with a CIP time savings of 7 hr per week.

Elimination of steps in the CIP cycle and of total cycle time, also translates into both water and energy savings. While enabling increased production of 3 million lb per quarter, the facility saw a reduction in water and energy usage. As less water was being used, the total amount of energy needed to heat the water was also reduced. The total water savings for the test facility were approximately 530 thousand gallons per year – approx. 1.6 acre feet (Figure 2).



Equipment	Gal of water saved / day	Days/ yr using One Step Alkali	Gal of water saved / yr
Cream HSTS	300	313	93,900
Evaporator	1400	313	438,200

Figure 2. Total water savings for cycles using One Step Alkali (2013 vs. 2014 data). For some of the equipment, one standard CIP cycle (caustic and acid steps) is run per week, thus the number of OSAlk CIP cycles is 313 instead of 365.

Overall cleanliness of the system was maintained at a high level. One Step Alkali renders the surfaces free of protein and mineral deposits, even along edges or other hard to reach areas (Figure 3a. and 3b). A summary of the overall plant improvement and OSAlk benefits is provided on table 3.

The facility maintained their current microbiological testing procedures throughout this study and reported that their level of microbiological quality was not impacted negatively during the trial. Quality levels stayed within acceptable parameters (confidential data – not reported).

Figure 3a. Evaporator prior to CIP cycle after 30 hours of production equivalent to 670K gallons of milk.

Figure 3b. Evaporator after CIP cylcle using 1.8 – 2.2% OSAlk.

	Before	Trial	% improvement
Alkali chemical use (gal/yr)	18,707	10,393	44%
Acid chemical use (gal/yr)	10,393	1,727	83%
Cleaning time (h / year)	1456	884	40%
Cleaning water (acre feet/ year)	16.8	14.8	11%
CIP Cycles / year	365	286	22%
Production time (h / year)	7280	7852	8%
Production (M lbs / year)	213	230	9%

Table 3. Summary of OSAlk benefits in the test production facility at the time of conclusion of the trial. Productivity increased after conclusion of the trial due to greater processing capacity.

Three months after the conclusion of this trial the plant obtained an increased supply of milk that allowed it to go from processing 480,000 gallons per day to 640,000 gallons per day with both the Cream HTST and Evaporator running thirty plus hours before being taken down for cleaning. This represents approximately a 33% increase in daily productivity without attendant material changes to the plant's processing environment.

Conclusions

The data presented in this study is typical of a milk processing facility. However, depending on the specific details on equipment, schedule and production for each facility, the impact of OSAlk may vary. While in some processing plants the acid rinse step may be totally eliminated, in others, as it was the case in this study, its frequency is at least significantly reduced.

The advantages of One Step Alkali detergent have been proven in a typical medium milk processing facility. The facility was able to reduce their total CIP cycle time and gain water and energy savings. An additional benefit was that as the production limiting step, cleaning of the evaporator, was optimized, production runtimes were extended mitigating a need to invest in additional equipment. Production increased by 572 hr / yr resulting in an additional 17 million lbs of dairy product processed per year. The overall economic impact was a 10% increase in raw milk lbs/hr processed.

As demonstrated in this study, cleaner surfaces allow improved equipment performance and longer production runs. However, the benefits of OSAlk are not limited to production efficiency and economic impact alone. The changes in the CIP cycles also imply lower chemical use through lower doses of the alkaline cleaner and greatly reduced levels of harsh acid cleaners. Additionally, OSAlk is a potassium hydroxide based product, making a minimal contribution to sodium discharge. Both characteristics lessen the complexity of waste water management by the processing plant and positively impact its environmental footprint.