Using additives with caustic cleaners improves results

Better cleaning means reduced contamination, less antibiotic use, better yields and even energy savings.

by Brian Moffatt

During a time of rising costs for raw materials, energy and transportation, effective plant cleaning and sanitation is often overlooked. A well-designed and thorough cleaning and sanitation program, using the best cleaning agents for the job, can be a key to profit recovery. Using a complete cleaner can recover profits by saving time, energy, water and potentially even increase yields.

Food processing facilities use sanitation programs and cleaning products to eliminate microorganisms and pathogens in order to maintain product safety and reduce spoilage. Fermentation plants can use the same products and technology to give their facilities the best opportunity to deliver maximum yields. Elimination of contamination and competition for nutrients by outside microorganisms can keep expensive antibiotic usage down while increasing productivity and yields. The yeast, without competition and in a clean environment, has the best chance to deliver its maximum potential.

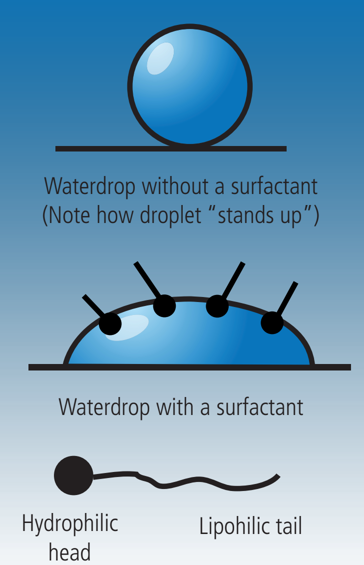
IDENTIFYING GOOD CLEANERS

A good, complete cleaner will bring the cleaning agents into intimate contact with the soil or soils to be removed and remove them through saponification (the process of turning oils and fatty acids into soap and glycerin), emulsification, direct chemical reaction, peptizing, and/or sequestering. Proper cleaning temperature and physical impingement also play a roll but are matters of flow rate and physical characteristics.

Specific to fermentation cleaning needs, using a caustic solution alone for clean-in-place (CIP) will only address the areas of saponification and chemical reaction. While caustic is best suited for some chemical reactions, mainly saponification, it will not emulsify soils, suspend soils in solution, or allow for better rinsing properties.

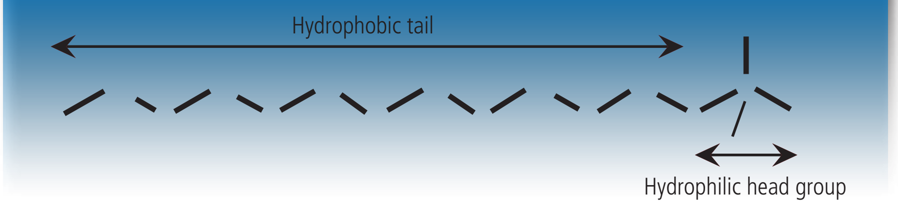
Why? The answer for this lies in the concept of surface tension. Surface tension is an effect within the surface layer of a liquid that causes that layer to behave as an elastic sheet or membrane. Surface tension can be defined as a measurement of the cohesive energy present at a surface or interface (measured in dynes/square centimeters). More simply, it's a concept of how much a solu-

Figure 1: Surface tension



The structure of a surfactant molecule

Figure 2: Typical molecule

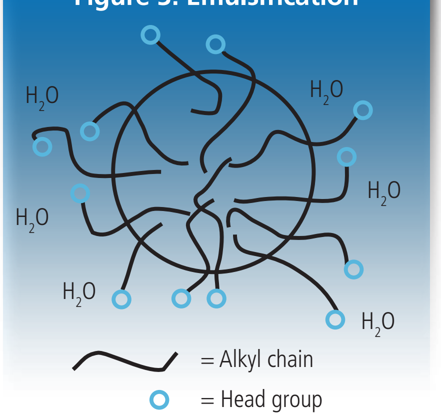


tion or substance would prefer to "stick" to itself – like a water droplet or bead – and how much it would like to spread out and "wet" a surface or material. The higher the surface tension, the greater the solution or material would like to stick together or stay in place, and the less likely it is to interact or blend (i.e. penetrate) with other solutions or materials (see Figure 1).

The physical and chemical behavior of liquids cannot be understood without taking surface tension into account. It governs the shape that a liquid can assume and the degree of contact a liquid can make with another substance. This "contact with another surface" is the intimate contact needed between a cleaner and soil and is often referred to as soil penetration. The higher the tension, the less the penetration of the cleaner into and throughout the soil. Reduced penetration into the soil reduces the intimate contact between soil and cleaner and thereby reduces the overall effectiveness of the cleaning agent. Hence, a higher surface tension leads to poor penetration and cleaning ability with respect to emulsification.

A 15% solution of sodium hydroxide will have a surface tension of approximately 80-85 dynes/square centimeters. However, the addition of an additive, sometimes referred to as a detergent or wetter, can reduce that to under 55 dynes/square centimeters. The use of a detergent system, compatible with caustic solution and with the appropriate safety and environmental profile and required regulatory approvals, can enhance cleaning drastically. Moreover, it can achieve this at a mere 2% to 4% caustic concentration instead of 10% or more.

Figure 3: Emulsification



DETERGENT USE

Most detergents are structured with a hydrophobic (water-hating) end of the molecule, and a hydrophilic (water-loving) portion. This gives it properties of both oil and water. Figure 2 provides a general view of a typical molecule.

Once the cleaning solution has penetrated the soils through the reduction of surface tension, the hydrophobic end of the molecule surrounds the soil particles, the soil dissolves into the hydrophobic end (and vice-versa) and is locked there. This leaves the hydrophilic end to bind with and hold to the water in the cleaning solution. In short, a type of bridging is formed between the soil, detergent, water, and caustic. This is not temperature based and is referred to as emulsification. For a graphic depiction, see Figure 3.

By using a caustic solution with the proper additive, the cleaning solution will be able to penetrate soils in the system (fermenter, heat exchangers, distillation column) more effectively. This better penetration allows for a more complete removal of soils from the system, and by the binding and emulsification properties, allows for those soils to be rinsed effectively and not moved or redeposited elsewhere.

Better overall cleaning results in the reduction or elimination of foreign contaminants. Reducing these "leftovers" reduces the potential for outside microorganisms to take hold and begin an infection. This may directly relate to a reduced need for antibiotics to treat these infections. It may also lead to better yields due to better or more complete performance of yeast.

By making the cleaning solution more effective, a plant would be able to reduce the concentration at which the caustic cleaning solution is used. This saves in terms of direct caustic usage needs, which is often a large chemical cost for fermentation plants. The emulsification and water binding properties will result in a quicker, more complete rinse, thus saving water and time during the cleaning cycle.

Some detergents even have foam controlling properties, reducing needs for additional defoamers used in CIP cleaning. Finally, by making the cleaner more powerful, a plant may also save energy in reduced temperature needs for CIP operations.

For example, one U.S. Midwestern facility recently experienced issues relating to their effluent treatment operations. Initially, it was thought the additive in the plant's cleaning caustic was the cause and its usage was stopped. Outside investigation determined it was not the additive, but misuse of an acid.

During this additive downtime, a greater number of infections and contaminant problems were noted in the plant. Once the additive program was reinstated, the infections were under control.

As more plants are built and others grow, more attention is focused on operations and cleaning efficacy. A designed, effective cleaning program and product can benefit these plants with money savings in chemicals, antibiotics, time, water and energy. BB

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