Improving Clean-In Place Technology

Clean-in-place (CIP) is used in beverage bottling to clean syrup and water lines for a variety of reasons including flavor carryover prevention and microbial control. CIP also eliminates organic residues like precipitated proteins, carbohydrates, fats, minerals and other contaminants that harbor bacteria and may lead to microbial induced corrosion (MIC).

Older, more traditional methods of CIP require disassembly for cleaning, and even though in-situ CIP is faster, it can still be a significantly time-consuming aspect of plant operation and maintenance. Because time lost to CIP is also lost production time, many producers are constantly looking for ways to reduce their CIP cycle times without sacrificing safety and without adding burdensome additional cost.

Implementing onsite generation (OSG) of oxidant for CIP can enable beverage processing plants to increase production time with a rapid three-step cold CIP process.

The advanced mixed oxidant system technology from MIOX, which has been used for more than 15 years in 30 countries, is one option for CIP beverage processing. The process reduces costs by generating sanitizer on site and on demand, increasing efficiency and increasing valuable beverage production time. The mixed oxidant CIP cleaning solution is an environmentally sustainable and single-component solution that replaces four- and five-step CIP processes with a rapid three-step cold-CIP process consisting of rinse, treatment and final rinse. The nonthermal technology reduces energy consumption, and the rapid cleaning cycle significantly improves beverage facility production rates.

How It Works

Onsite generators (OSGs) apply electricity to a solution of salt and water, which produces chlorine and other oxidant species. OSGs have a number of industrial applications and are used to treat municipal water to U.S. Environmental Protection Agency drinking water standards.

OSGs produce chlorine when a solution of sodium chloride is passed through an electrolytic cell and electricity is added. Incoming water goes through an ion exchange water softener to remove calcium. Softened water feeds the electrolytic cell while a soft water sidestream fills a brine tank, which generates a concentrated salt solution. The near-saturated brine is then injected into the softened water stream entering the electrolytic cell.

When the dilute salt solution is inside the electrochemical cell, current passes through the cell producing a strong oxidant solution. After exiting the electrolytic cell, the oxidant solution is stored in an oxidant tank.

The electrolytic cell is fundamental to the OSG. Electrolytic cells consist of two electrodes—the anode and cathode—designed so that both make contact with the mixed water and brine solution. A voltage is applied to the cell so that current flows through the cell, causing chemical reactions to take place at the surfaces of both electrodes, producing the disinfectants. Oxidation reactions are carried out at the anode where two chloride ions are stripped of one electron each to produce chlorine, which is dissolved in the solution.

Chlorine production is balanced by the reduction reactions that occur at the cathode where water is converted into hydroxide ions and hydrogen gas. Hydrogen gas in the form of bubbles is produced during electrolysis at the cathode. Passive and active ventilation systems remove the gas from the OSG and piping before it can enter the oxidant storage tanks, thereby providing the maximum in system safety.
OSG offers significant sanitation benefits for beverage processing, including increased beverage production, chemical cost savings, improved safety, more effective sanitation and greener applications.

**Cost Savings**

Increased beverage production time using the 3-step OSG CIP process can result in significant margin improvement, chemical cost savings and the non-thermal cleaning method reduced energy consumption.

Because there is no need to continuously purchase expensive chlorine chemicals, OSGs typically produce chlorine at a much lower cost than traditional delivery methods, as the only consumables are salt and electricity used to generate the chemical. In fact, many beverage plants will already have high-quality food-grade salt available, simplifying procurement of the only “chemical” required for the generator.

Although OSG systems can present a larger upfront capital equipment cost, most beverage processing plants realize a return on their investment in OSG equipment in a very short period of time. Decreased transportation and safety-related costs and lower insurance premiums offer additional savings.

**Improved Safety**

Produced on site, on demand, the mixed oxidant solution is an inherently safer beverage CIP disinfectant, using only salt, water and power to generate disinfectant. The solution produced has a relatively low concentration with moderate pH, unlike other “quick CIP” chemicals such as peracetic acid.

Without hazardous chemicals transported, generated or stored, OSG offers safety for beverage plant personnel and the community.

**Improved Performance**

Because mixed oxidants are highly effective at eliminating biofilm, bacterial contamination is reduced or eliminated and disinfectant requirements are reduced. A more durable disinfectant residual safely prevents recontamination. Taste and odor carryover are eliminated when switching from one beverage to the next, plus the solution is easily rinsed from the system, quickly eliminating residual “chlorine” taste and odor. With fewer organics in beverage distribution piping, fewer disinfection byproducts are formed and microbial-induced corrosion is reduced.

Compatibility of the solution with existing materials of construction (304 and 316 stainless steel, etc.) is excellent and below industry standards for corrosion.

**Environmentally Sustainable**

OSGs offer greener operations compared to traditional chlorination methods. In addition to the reduction in use and potential accidental release of toxic chemicals, transportation of chemicals from factories to the beverage processing plant is reduced. Many purchased sanitizers are diluted in water to make handling safer, but the dilution water requires transportation, often significantly more weight and volume than the salt needed for OSG processes. This reduces the carbon footprint of the plant since less fossil fuel is needed to supply the plant with disinfectant.

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