Mazzei®

CASE STUDY

Evaluation and Optimization of Clean-In-Place Using Ozone

Mazzei Packaged Ozone System for Bottling Plant's Clean-In-Place System

Laboratorios Sanox, SA de CV (Mérida, Yucatán, Mexico)

The Problem: Laboratorios Sanox, SA de CV (Sanox), a chemical company which specializes in Clean-In-Place (CIP) systems, contacted Mazzei Injector Company (Mazzei) to discuss the use of ozone as an alternative to peracetic acid sanitation or heat sterilization at their customers' plants. A review of the published literature provided by Mazzei convinced Sanox to add ozone disinfection to the CIP system of a local bottling plant in Mérida, Yucatán, Mexico.

Prior to installing an ozone system, the plant's existing CIP process was evaluated and the following deficiencies and concerns were found:

1. Non-wetted surfaces within vessels (shadowing) following CIP spray.
2. Stagnant dead legs in pipeline system.
3. Non-turbulent flow within pipelines.
4. High energy costs from the use of hot caustic solution and rinse water.
5. Programming issues with the CIP central PLC controller.
6. Safety concerns on the handling and storage of peracetic acid (blend of acetic acid + hydrogen peroxide) to disinfect syrup lines and storage vessels.

The Solutions: The issue of shadowing and the existence of dead legs in the process pipeline was of serious concern because it meant that some internal surfaces of the process piping and vessels were not adequately cleaned and sanitized during the CIP procedure. To correct these problems, portions of the process piping were modified to eliminate dead legs, and additional spray heads were installed in those tanks with shadowing. The optimum orientation of all tank spray heads was confirmed through visual inspection following a CIP trial rinse.

Turbulent flow is required within a pipeline to ensure that the CIP detergent lifts and removes product residue (soil) from pipe surfaces and to prevent the redeposit of soil to downstream areas of low velocity. In the critical sections of the CIP loop, piping was changed to ensure a minimum fluid velocity of 1.5 m/second.

Soil remaining on beverage pipe and vessel surfaces following a product run was composed of simple carbohydrates, primarily sucrose and fructose sugar solutions. Removing this soil is an essential step in preparing a surface for sanitation, because remaining soil residue increases ozone demand, making it difficult to achieve a dissolved ozone residual at the end of the CIP loop. If any soil remains on the surface following the final ozone rinse, it then serves as a precursor substrate for bio-film formation.

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To reduce energy costs and eliminate safety concerns on the use of peracetic acid, an ambient temperature, surfactant enriched detergent followed by an ozone rinse was proposed for adoption plant-wide following validation through pilot testing in a limited plant area. PLC reprogramming was offered as part of the proposed ozone pilot.

The ozone retrofit consisted of an oxygen fed, 30 gram per hour ozone generator, an oxygen concentrator, and a Mazzei GDT™ Ozone Contacting System skid. To minimize space and pump energy requirements, the GDT system was designed to be operated as a sidestream (FIGURE 1).

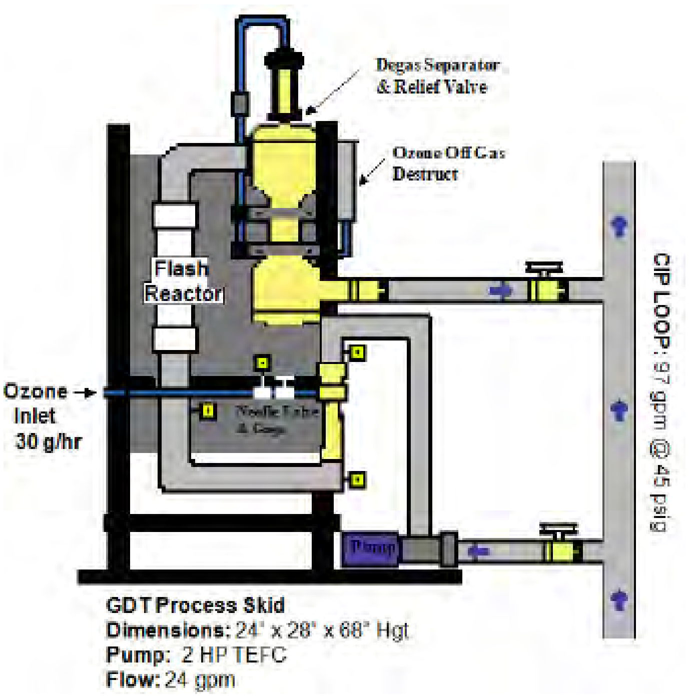

FIGURE 1: GDT Ozone Contacting Process System for Sanox Ozone Pilot.

Initial runs of the ozone pilot were conducted at 30°C water temperatures which limited the distance the system could reach with a dissolved ozone residual. It was concluded that the starting ozone dosage was insufficient to handle the demand and decay rate of the entire CIP pilot loop. With all available funding spent, the CIP ozone pilot team decided to increase gas solubility and reduce the ozone decay rate by chilling the CIP rinse water to 14°C using the plant's Carbo Cooler, a standard piece of bottling equipment which is designed to simultaneously chill and carbonate beverages.

The Results: Colony forming units (CFU's) on all systems tested were well within the plants microbiological control targets for bacteria, fungi and yeast; most systems showed 0 CFU's on post ozone rinse samples held for up to 120 hours. The counts obtained from filler valves and Canes (valve stems) are surface swab cultures. The CFU's present are a consequence of the fillers not rotating during the CIP cycle. Those surfaces not exposed to the CIP solutions undergo a second manual cleaning.

The final modification, a diversion of ozone rinse water from drain to the (former) hot water storage vessel, will allow the plant to recycle water for use in the pre and post detergent rinse cycles, saving over 1,500 gallons of water per CIP cycle or more than 7,500 gallons per day. The switch from hot detergent–hot water to ambient temperature (surfactant) detergent–ozone is saving over 47 million BTU's (British Thermal Units) per day, resulting in a fuel savings of $1,384 per day.

The final and most significant savings is the recovery in lost production time. When utilizing the hot detergent–hot water CIP process, the plant must wait 36 minutes for the caustic detergent and hot water tanks to reach the 86°C application temperature. At a plant average of 5 CIP cycles per day, the switch to the ambient temperature surfactant detergent–ozone CIP process has added an additional 180 minutes of bottling time per production day. The monetary value of this recovered time is considered confidential and has not been released; however, the plant typically produces 14,000 bottles per hour, consequently, the recovered time results in an additional 2.5 million units of bottled beverage in a typical production day.

To get a better understanding about how a Mazzei GDT system works, take a look at this animation.