Perfecting the Tomato Plant

Ozone improves efficiency and cleanliness for processing facility

By Chris Rombach

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Each day 150 big rigs, each pulling two large containers of tomatoes, rumble through a rural California town to the local tomato processing plant. From July to September each year, the plant receives 810,000 lb of tomatoes each day. Operating three shifts 24/7 during the harvest season, the company produces more than 100 different products, such as pizza sauce, marinara sauce and tomato sauce, largely for the food service industry.

The facility is three years into a plantwide process improvement program that includes the application of ozone-injected water to replace chlorine dioxide in key cleaning processes. The project was implemented stepwise, beginning with the application of ozone on part of one production line to effectively compare its performance versus traditional methods. The success of the pilot program led to the expansion of ozone-based sanitation throughout the plant.

Background

The plant is a tomato processing facility located in the heart of California's San Joaquin Valley. With operations expanding each year for the past nine tomato-processing seasons, the company has become the town's largest employer and maintains an active role in the community.

The company nurtures a unique family culture that drives its passion to produce the industry's best tomato products and honor its founder's legacy.

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The Challenge

The plant receives tomatoes for 100 straight days beginning every July. As the tomatoes enter the facility, they are sorted and sent to steam-peeling equipment to begin processing. From that point, the now-skinless tomatoes are transported through the facility via a series of conveyor belts to final blending, mixing, cooking, processing and canning. Tomato juice and remnants quickly coat the conveyors and elevators, creating a potential source of contamination.

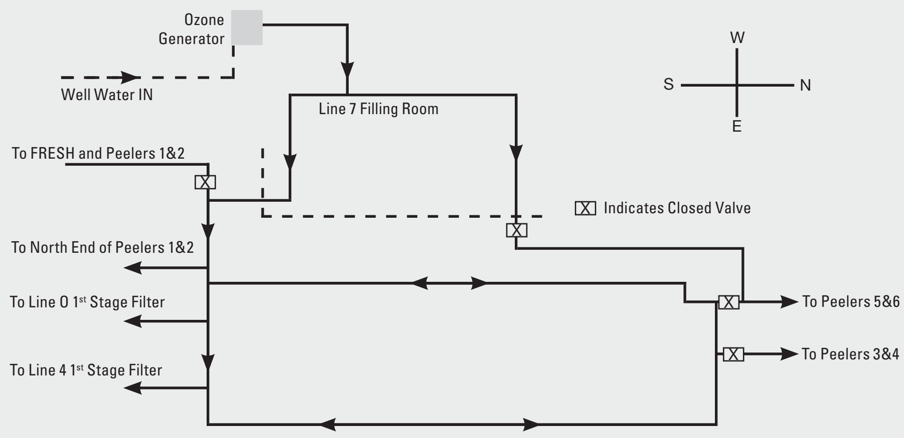
The company continuously monitors for lactate levels as an indicator of bacterial contamination, and schedules cleaning cycles upon reaching specific internal thresholds. The belts are required to be removed from service and cleaned by hand. This results in processing delays, additional labor and excessive wear and damage to the conveyors.

In 2007, the quality, continuous improvement and engineering teams initiated a project to improve the overall efficiency and cleanliness of the plant.

"The core idea behind the project was to find ways to run the plant longer with less downtime for cleaning and sanitation," the West Coast quality manager said. "Other biocides simply retard microbial growth. We turned to ozone because it completely kills microbes so the system stays cleaner longer."

The group began by assessing the effectiveness of existing processes by measuring lactate levels—a surrogate indicator for bacterial contamination—at each step of the process.

Figure 1. Map of Plantwide Ozone Loop



Lactate reduction indicates decreased growth in spoilage organisms.

"The initial testing and assessments allowed us to identify and concentrate on the process points needing the most improvement," said the continuous improvement coordinator.

The team implemented engineering changes to improve product flow and cleanliness of key process steps and replaced chlorine dioxide with ozone-injected water to sanitize the conveyor belts on one production line.

A portable ozone generation cart was adapted to produce ozone-injected water for the test line. The system delivered water with 2 parts per million (ppm) dissolved ozone at the nozzles of spray bars placed at several locations along the conveyor system. This pilot program resulted in a 37.5% reduction in lost production time due to line shutdown for cleanup. These impressive results convinced the team to expand the ozone project to deliver ozone-injected water to several production lines.

The Plant Process

The plantwide ozone system is diagrammed in Figure 1. The ozone loop is being applied to line 0, to the north end of peeler lines 1 and 2 and to line 4. Peeler lines 3 to 6 are isolated from the ozone loop by closed valves and continue to be sanitized with chlorine dioxide. Lines 3 to 6 provide a control area to which the team can compare the results of ozone sanitation, such as the effect of long-term use of ozone on the plastic parts and conveyor belts.

The ozone loop services spray bars on all major elevator and conveyor belt systems—from the introduction of the tomatoes in the accumulation and distribution station to multiple peeling, processing and filling lines. The entire system services 136 spray nozzles at 0.8 to 1.5 gal per minute (gpm) at 40 psi. Due to ozone's rapid dissociation

and Organic Food and Food and Drug Adminstration status, the company is capable of collecting any rinse waters that may contain product, sending them to an evaporator to collect any product that may have been rinsed away without concerns of contamination from the sanitizer.

Ozone System

The integrated ozone system, pictured on page 22, is a Pacific Ozone Horizon Series skid powered by a Pacific Ozone SGA64 ozone generator. The ozone generator produces up to 240 grams of ozone per hour (12.7 lb per day), while ozone mass transfer is accomplished with a Mazzei venturi injector and a 375-gal 304L stainless steel contacting tank. The system is monitored and controlled by a PID controller with two channels of dissolved ozone detection. Operator safety is ensured via an ambient ozone detector with safety interlock, which is designed to shut down the ozone skid in the event of an ozone gas leak.

Well water is fed to the integrated ozone system skid, which delivers 3 ppm dissolved ozone at 175 gpm into a factorywide loop of spray bars. The system is optimized to compensate for losses in dissolved ozone due to water turbulence within the loop and pressure drops across the spray heads.

Results

Both quantitative and qualitative benefits were found by switching to ozone-based sanitation. Reduction in the microbial load for the pilot production line was measured by the net change in lactate concentration over the course of the processing line. The data for 2007 was collected before the conversion to ozone. The 2008 data, after partial implementation of ozone sanitation, reveals a modest decrease in net lactate concentration. The 2009 data, after complete implementation of ozone on the accumulation and distribution station, demonstrates a substantial decrease in the net lactate concentration. This progressive reduction in net lactate concentration indicates that ozone sanitation is keeping the system cleaner and reducing the microbial load over the course of the process.

Ozone-treated production lines also stay cleaner longer, extending the time between shutdowns for cleaning procedures. Ozone-based sanitation yielded an eight-fold reduction in cleanups. Each cleaning procedure typically takes 15 to 30 minutes of run time out of production.

"The cleaner the plant, the lower the microbial load, the less often key equipment and processes need to be shut down for sanitation," said the engineering manager. "So, ozone sanitation allows us to produce more product with less effort and cost."

The process improvement team found that the switch to ozone sanitation yielded significant economic benefits through increased production and cost savings. Less downtime for cleanups translates directly into greater plant efficiency and output.

Pacific Ozone Horizon Series integrated ozone system.

Elevator belt before (top) and after (bottom) ozone treatment.

The reduction of lost production due to downtime for cleanup procedures was measured. The baseline was established in 2007, before the introduction of ozone. Partial implementation of ozone on one production line in 2008 reduced downtime and lost production by 37.5%.

Complete implementation of ozone on the same line reduced production loss by 87.5%. Ozone also eliminated costs for purchasing, storing and handling hazardous chemicals.

If the savings and production increases from ozone are applied across the entire plant, the break-even time with the ozone system occurs in just one harvest season.

The qualitative benefits of ozone on the production lines that utilize ozone are obvious. The photos at the top of this page show an elevator prior to ozone sanitation. The “before” picture shows product buildup, which is a potential harbor of bacteria. Manual cleaning must be performed to remove the buildup at specified periods to prevent contamination. The “after” photo shows the same equipment with ozone in operation. In addition to the obvious cleanliness on the ozone-treated lines, these areas of the plant also have less slime buildup and smell better.

Employee Health & Safety

Integrated ambient ozone monitoring equipment was installed to monitor for fugitive ozone emissions within the plant in the event of system failure. With the proper balance of concentration, application rate, facility ventilation and overall ozone demand, the system works effectively while keeping the work area odor free and comfortable. Many plant employees commented that they were relieved to have traditional chemical sanitizers replaced by ozone. *wqp*

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