FOOD PROCESSING

Ozone Sanitation in a Tomato Processing Plant

Cleanliness is said to be next to godliness. In food processing, plant cleanliness is an absolute imperative. Product spillage and buildup on conveyors and machinery provides opportunities for expansion of spoilage organisms, which could contaminate the food products – costing millions of dollars in lost production.

A major processor of tomato products implemented an ozone-based sanitation system to improve plant cleanliness. While the plant has a longstanding and excellent record of cleanliness, the continuous improvement team set out to further improve sanitation with less effort and plant downtime for cleaning.

The facility is two years into a plant-wide process improvement program that includes the application of ozone-injected water to replace chlorine dioxide in key cleaning processes. This step-wise project began with the application of ozone on part of one production line to allow the team to measure and compare the results of the improvements. The successes of the pilot program led to expansion of ozone-based sanitation within the plant.

The team found that ozone sanitation yielded significant, measurable reductions in microbial load, production down time, and cost savings. The team also noted qualitative benefits including cleaner plant appearance, reduction of staining and product buildup on conveyor belts and other surfaces. Switching to ozone disinfection also improved the working environment and morale in the plant by reducing staining and spoilage odors.

A plant-wide conveyor system transports fresh tomatoes to various processing lines throughout the processing plant. A two-year project to improve the overall efficiency and cleanliness of the plant succeeded in finding ways to run the plant longer with less downtime for cleaning and sanitation – all without compromising cleanliness or food safety. The team replaced traditional biocides with ozone-based sanitation, because ozone completely kills microbes. A plant-wide ozone loop delivers ozone-injected water to spray bars on all major elevator and conveyor belt systems.

The Challenge

Minimizing downtime while maintaining excellent plant sanitation and smooth operations are critical in processing fresh produce, such as tomatoes, which have a limited harvest season of approximately 100 days. With hundreds of tons of tomatoes arriving by truck daily, the plant needs every advantage to ensure cleanliness and keep it running like clockwork.

Two years ago, the continuous improvement team 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 without compromising cleanliness or food safety. Traditional biocides simply retard microbial growth. Periodic plant sanitization shutdowns are required since these biocides do not completely kill the bacteria.

The team turned to ozone-based sanitation to keep the plant cleaner longer because ozone completely kills microbes. The cleaner the plant, the lower the microbial load, the less often key equipment and processes need to be shut down for sanitation. Ozone sanitation allows the plant to produce more product with less effort and cost

The team began by assessing the effectiveness of existing processes by measuring lactate levels – an indicator of microbial growth – at each step of the process. Reduction in the concentrations of lactate indicate decreased growth of spoilage organisms. The initial testing and assessments allowed the team to identify and concentrate on the process points needing the most improvement. 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 the central accumulation and distribution station.

A portable ozone generation cart was adapted to produce ozone-injected water for a portion of the distribution station. The ozone 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 implementation resulted in a 37.5% reduction in lost production time due to line shutdown for clean up. These impressive results convinced the team to expand the ozone project to deliver ozone-injected water to the rest of the distribution station.

The Ozone System

A plant-wide ozone loop was designed and installed at the facility. The source water at 65-75 degrees Fahrenheit and 270 mg/L total dissolved solids at pH 7.1 is fed to an integrated ozone system skid which is capable of delivering up to 3 ppm dissolved ozone at 175 gallons per minute (gpm) @ 50psi into a factory-wide loop of spray bars and applicators. The system is optimized to compensate for losses in dissolved ozone due to decomposition within the loop and pressure drops across the spray heads to yield 1.8-2.0 ppm ozone exiting from the spray heads.

Figure 1: The Pacific Ozone Horizon Series integrated ozone system is the heart of the plant-wide ozone loop.

The ozone loop services spray bars on all major elevator and conveyor belt system from the introduction of the tomatoes in the accumulation and distribution station to multiple peeling, processing, and filling lines. The entire system services over 100 spray nozzles.

The integrated ozone system, pictured in figure 1, is a Pacific Ozone Horizon Series System powered by a Pacific Ozone SGA64 ozone generator. The ozone generator produces up to 240 grams of ozone per hour (12.7 lbs./day), while ozone mass transfer is accomplished with venturi injection and 175 gallon 304L stainless steel reaction vessel.

The system is monitored and controlled using a dissolved ozone analyzer and PID controller. Dissolved ozone monitoring can be expanded in the future to include multiple channels for additional monitoring points in the process and validation. Ozone exposure and operator safety is ensured via an integrated ambient ozone detector that is safety interlocked with the system. Onboard ambient ozone detection is designed to shutdown the ozone production in the unlikely event of an ozone gas leakage.

Results

The process improvement team found both quantitative and qualitative benefits in switching to ozone-based sanitation. Figure 2 shows the reduction in the microbial load for the pilot production line as 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 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 reduced the microbial load over the course of the process.

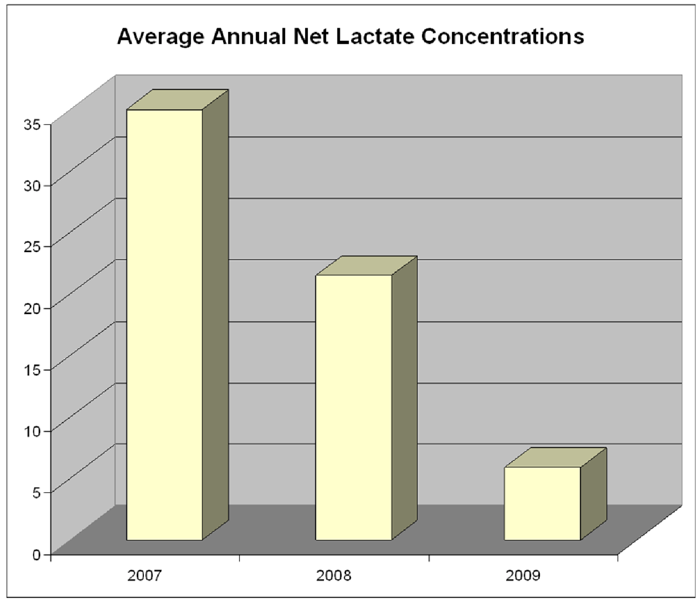

Figure 2: Progressive reductions in net lactate concentrations over time with increased ozone implementation.

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 minutes of run time out of production.

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

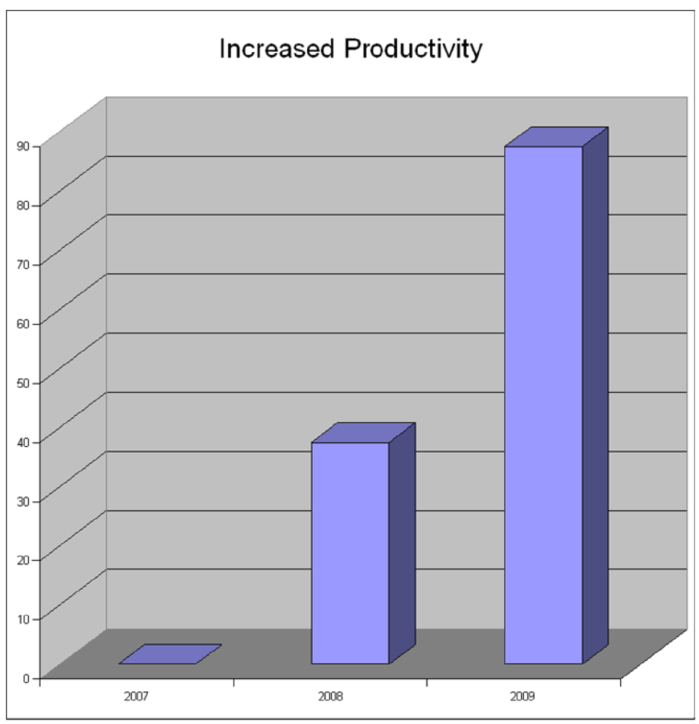

Figure 3: Less downtime for cleanups translates directly into greater plant efficiency and output as measure by the reduction of production lost due to downtime for cleanup procedures.

Figure 3 signifies the reduction of lost production due to downtime for cleanup procedures. 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 losses by 87.5%. Ozone also eliminates the 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 will occur in just one harvest season.

The qualitative benefits of ozone on the production lines that utilize ozone are obvious. The photos below show an elevator prior to ozone sanitation. The before picture, on the left, shows product build- up, which is a potential harborage for bacteria. Manual cleaning must be performed to remove the build-up at specified periods to prevent contamination. The photo on the right 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 too.

Figure 4: Photos of an elevator belt and spindles before (top) and after ozone treatment.

Conclusions and Future Plans

The continuous improvement team is pleased with the results achieved with ozone to date and foresee expanding the use of ozone throughout the plant. The team began limited application of ozone in the filling area this year. They also plan to expand the use of portable ozone carts in cleaning the production line support structures, which currently are sprayed with a chlorine solution. During the upcoming off-season plant maintenance period, they will examine the ozone and control production lines for wear, and degradation of plastic and metal parts.

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