Ozone

Highly visible food safety incidents have been receiving major attention in the mainstream media. These issues are driving food producers, processors, grocers and consumers to look to ozone for more than just safety.

From Farmers' Fields to the Kitchen Table

Tracing the path of ozone applications

By Paul Overbeck

The Field

Ozone applications start in the farmer's field. Many farms in arid regions of the world, such as those in the southwestern U.S., have converted from spray to drip irrigation to save water—a scarce resource for many due to lengthening drought cycles. These surface and subsurface drip irrigation systems deliver water and fertilizers efficiently to the soil in a focused area, maximizing growth while minimizing water loss.

Fouling of the irrigation tubing will occur at rates dependent on the irrigation water chemical characteristics, fertilizer nutrient type and loads and the biological nature of the environment. Typically, the fouling is a combined biofilm matrix (e.g., slimes, scales of inorganic materials that are bonded together on the internal pipe surfaces by enzymatic mucilages, etc.). Fouling reduces water flow at the emitters, tubing and piping, resulting in reduced crop yield and increased maintenance cost.

Farmers have historically worked with chlorine (in water, not gas), sulfuric or hydrochloric acids (solutions in water) and other chemicals for irrigation system cleaning. Such cleaners are applied after slimes, algae, iron bacteria, fungi, scale and other deposits have built up in the irrigation system.

The better alternative is to use ozone. Its use in recirculating cooling tower water treatment as well as clean-in-place systems in electronics, pharmaceutical, beverage and hemodialysis industries has proven that dissolved ozone (DO_3) will oxidize planktonic microorganisms and organic materials in solution and biofilms on surfaces.

In drip irrigation systems, these fouling materials are oxidized, breaking bonds to the pipe surfaces; thereby loosening and ultimately severing films to allow them to be flushed out of the piping system by the flowing water. The rates of oxidation depend on a number of factors such as the concentration of ozone dissolved in the water, water temperature, pH, flow time and the amount of scale or slime on the internal piping surfaces.

The application of ozone in irrigation systems allows for a significant reduction in the use of chemical cleaners because, when applied properly and at appropriate dosages, ozone in water actually prevents or significantly slows the development of slimes and scales that result in the need for cleaning. Therefore, aqueous ozone application is being used as a preventative care process in new or recently cleaned irrigation systems, minimizing the need for and extending the frequency of chemical cleaning required with related environmental, human safety and economic benefits.

In addition, research and commercial application in China, Taiwan and South Africa by IOA member Arid Group, LLC, of Las Cruces, N.M., has shown that gaseous ozone application to irrigation piping during fallow seasons to avoid root damage can remove biological growths from pipelines.

Mobile ozone generator and injection system for subsurface drip irrigation.

The Processor

Slime (biofilm) control in food processing plants is an everyday issue as it is in the farmer's field. Fishing fleets and fish wholesalers store their "fresh catch" on ice, and ice water immersion is used by many whole and fresh-cut packers to cool produce prior to shipment in refrigerated trucks.

High-capacity industrial icemakers are susceptible to slime formation because of sourcewater characteristics and their operating environment. Feeding ozonated water at appropriate dosage to these icemakers can significantly reduce the need for frequent cleaning of slimes.[1] Many current suppliers of commercial-industrial icemakers now include ozone systems as part of their original equipment for slime prevention and control.

All cutting surfaces, knives, floors and cartons used to process, store and transport food products are potential sources of contamination. In the January 2008 issue of *Water Quality Products*, I presented a chart from Del Ozone, an IOA member, on pathogen-reduction performance for an ozone spray wash system certified by the NSF. The performance for 4- to 6-log reduction of specific pathogens detailed the benefits that a properly designed dissolved ozone spray system can deliver to processing operations for surface disinfection, including a 5-log reduction of *E. coli* in as little as 30 seconds.

In the Home

Ozone was receiving strong consumer interest even before the September 2006 spinach outbreak of *E. coli* O157:H7 that has been cited as the cause of five deaths and the illness of more than 205 others in 26 states. Several companies started marketing consumer products for point-of-use food product and handling surface sanitation after ozone was approved as an antimicrobial agent by the U.S. Food and Drug Administration in June 2001.

Many manufacturers' advertising, however, never states that ozone is the star behind the performance. Instead you may see references to "superoxygenated" water that kills microbes and removes toxins.

The truth is that ozone inactivates pathogens when properly applied to water and surfaces at home as well as it does in a food processing plant, pharmaceutical company or water bottler.

As an example of the product evolution and performance verification in this field, I will reference data collected by Element Ozone, an IOA member.

The Element Ozone wash system for food service operation and consumer use was performance tested. Third-party testing and detailed operation and maintenance instructions are critical to the successful use of ozone equipment or any other sanitation and disinfection technology in any environment.

Ozone has been used successfully in many areas of agriculture and food processing to improve yield and protect public health. You will see more applications coming to this arena as both governmental and private research identifies new opportunities and benefits. *wqp*

References

[1] Rice, R.G. and Wrenn, R.W., 2007, "Improving Fish Quality By Means of Ozone at Fresher than Fresh, Inc.," *Proc. Sustainable Agri-Food Industry Use of Ozone & Related Oxidants*, Valencia, Spain, Oct. 2007 (Intl. Ozone Assn., Scottsdale, Ariz.).

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