By Chris Rombach

mastering the fundamentals of ozone: **control**

A final look at the fourth basic element of ozone

In the March 2008 issue of Water Quality Products*, the IOA column initiated a discussion on mastering the fundamental elements of ozone systems: feed gas preparation, ozone generation, mass transfer, and monitoring and control. In the March 2009 issue, we began an examination of the last element with a discussion on monitoring ozone systems.*

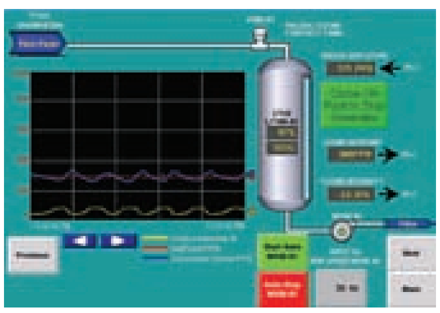

Figure 1. A Graphical Display of Controlling the Distilled Water Ozone System

This month, we conclude this series of articles with a closer look at ozone system control.

For the purposes of this discussion, we will focus on ozone systems in which the ozone gas is dissolved into water and applied to the target application. This article will not cover gaseous ozone systems and applications.

Simple Versus Complex

The range of controls for ozone systems runs the gamut from simple knobs on the ozone generator to programmable logic controllers to centralized computer-controlled systems.

At the simplest level, the basic operation of an ozone generator can be controlled utilizing the knobs that set the power applied to the ozone reactor chamber and the feed gas flow rate and back pressure. Unfortunately, these basic controls cannot automatically respond to changes in operating conditions that can affect the concentration of dissolved ozone in the process.

True ozone system control requires a programmable environment that monitors the input of a range of sensors and adjusts the operating parameters to optimize system performance as process and ambient conditions change from day to day or batch to batch. For example, programmable logic controllers (PLC), digital computers used for process automation, utilize multiple algorithms and programmable variables to adjust and maintain the desired output.

Programmable control systems make use of proportional integral derivative (PID) algorithms that monitor input signals and correct any error between the measured process variables and the desired set points by calculating and then transmitting corrective actions to the ozone system. In complex processes, tight system control can be achieved by nesting multiple PID algorithms—using the output of the first PID loop as input for a second PID loop, and so on.

Local Versus Remote

Ozone system control may reside locally at the ozone generator or remotely in a centralized system in a control room. Basic generator-mounted knobs and PLC controllers typify local control systems. More sophisticated and widely distributed processes make use of Supervisory Control and Data Acquisition (SCADA) systems, which read and coordinate the signals from the monitors, analyzers and subcontrollers.

The type, complexity and location of ozone control must be carefully considered when designing and configuring an integrated ozone system. If properly specified, the system and process requirements should lead to clear decisions about the nature and design of the control system. Simple to moderately complex systems may be well served with local PLC-based setups. More complex and widely distributed processes with multiple subsystems that reside in different locations usually require a centralized SCADA system to coordinate the entire process. SCADA systems are more expensive than standalone PLC systems, but provide more capabilities.

Application: Bottled Water

Ozone is used in the bottled water industry for makeup water purification, bottle and cap washing and final filling. A low concentration is dissolved in the makeup water at final bottling to extend shelf life by providing final sanitation in the bottle and eliminating taste and odor.

Final bottling of spring water often requires tight control of the concentration of ozone to ensure a consistent balance between sanitation and bromate formation. The ozone concentration and contact time must be sufficient to completely disinfect the product during bottling; however, the ozone-dosing parameters must be controlled to minimize conversion of bromide ion to bromate—a suspected carcinogen.

A Pennsylvania spring water company, The Water Guy, utilizes ozone system control for bottled water. Monitoring and control were at the heart of The Water Guy plant design from the planning stages. The bottling plant includes multiple monitoring points for dissolved ozone, water flow, temperature and other critical process parameters. Each facility also includes a master control system, designed by Atlas Automation, which integrates the process inputs and provides precise control for consistent quality.

The control system of the bottling plant utilizes an intuitive graphical human-machine interface. The system collects system performance data from an array of sensors and provides graphs of recent trends in the data. Figure 1 demonstrates a display screen for the distilled water filling line. The system collects and graphs the set point and actual dissolved ozone concentration as well as the ozone generator intensity control value. The latter adjusts the voltage applied to the ozone reactor cell which, in turn, controls the ozone output of the ozone generator.

Conclusions

Without proper controls, ozone dosing is nothing more than costly trial and error. The type, complexity and location of a given ozone control system will depend on the size, scope and layout of the system. Careful consideration of the process and system requirements will greatly simplify the nature and specifications for the ozone control system. *wqp*

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