By Allan Finney, Envron Ozone

Using Ozone for Odor Control

With increasing urbanization, odors are becoming a key issue for all types of agricultural and food processing operations. Ozone provides an excellent solution as a retrofit or when building a new plant and can even be used to kill odors in small point-of-use situations (i.e., tanks, bins, etc.).

Ozone is the fastest acting oxidizer that is commercially available. It is used in industries ranging from water treatment to pollution control and can be utilized in conjunction with existing scrubbers or as a stand-alone system for odor control.

With advancements in ozone generators, the technology is now much more user-friendly. The advantages of ozone are that odor control can be provided very consistently and operating costs are low (just the cost of electricity), with no environmental or disposal fees. However, as with any technology, correct sizing and maintenance are key elements when using ozone.

How it Works

Ozone is "manufactured" on-site using oxygen concentrators and ozone generators so there are no input costs other than electricity. Oxygen concentrators provide over 90 percent pure oxygen to the ozone generators, which puts the oxygen through a high voltage (corona) field. This converts some of the oxygen into ozone. Ozone is a very unstable gas and the fastest acting oxidizer in commercial use. It is more powerful than chlorine and other chemical-based oxidizers. Due to the highly reactive nature of ozone, it cannot be stored and must be used as soon as it is produced.

For odor control in large-scale systems with high throughput (usually measured in tens of thousands of cubic feet per minute), high concentration ozone is introduced into the ventilation system exhaust stream and then given a few seconds for the reactions to take place in a retention/mixing system. The mixing/retention system must be correctly sized to the overall airflow of the ventilation system.

Ozone's job is to oxidize or disassemble compounds that have combined to create the penetrating or truly offensive odors. These odors are typically base substances that have combined to form long-chain molecules, usually through anaerobic processes. The long-chain bonds of these compounds are relatively weak and can be easily broken down in the presence of a strong oxidizer. This is the process that kills the odors (see table 1).

Due to the highly reactive nature of ozone gas, elements with weak bonds are the first to react. This is referred to as instant ozone demand in an airstream. As the instant ozone demand is satisfied (and odors are broken down), the resulting base substances are non-odorous. In this regard, an ozone system functions virtually like an odor switch. Turn the system on and the airstream doesn't stink. Turn it off and the smell returns. It acts that fast.

Therefore, the advantage is that it can be used in relatively simple odor control systems that are not capital intensive. Generating ozone is very inexpensive and typical operating costs, even on a large-scale system, are measured in nickels and dimes per day.

The single biggest problem seen in ozone-based odor control systems is always related to maintenance. When the system quits working it is usually because the level of ozone has dropped due to maintenance issues. Perform regular maintenance and you'll continue to enjoy the benefits. Let maintenance slide and the odors will be back.

Ozone generators and oxygen concentrators in equipment room.

Table 1. Breakdowns of organics using ozone

Sulphur compounds	To CO_2, water, and oxygen
Ammonia	To nitrogen and water vapor
Ammonia hydroxide	To CO_2 and water
Aromatic compounds	To CO_2, water vapor, and oxygen
Aliphatic compounds	To CO_2, water vapor, and oxygen
Cyanide	To cyanate to nitrogen and CO_2
Ferrous iron	To ferric hydroxide
Formaldehyde	To carbonic acid-CO_2 and water
Formic acid	To CO_2 and water
Carbonic acid	To CO_2
Ethylene	To CO_2 and water
Manganese	To manganese dioxide to permanganate
Methane	To CO_2 and water
Nitrite	To nitrate
Organic acids	To CO_2, water vapor, and oxygen
Smoke	To CO_2 and water
Trichloroethylene	To CO_2, water, and hydrogen chloride

Note: CO_2 = carbon dioxide.

System Maintenance

So what does system maintenance look like? Here's the component-by-component breakdown.

An ozone system uses an oxygen concentrator feeding an ozone generator to produce an ozone gas stream. Oxygen concentrators are pressure-swing absorption systems that use a pressurized bed of oxygen-absorbing material to extract and concentrate oxygen from the air. These typically produce over 90 percent pure oxygen. There are two key maintenance items here: a compressor and the pressure bed. Daily maintenance includes a brief inspection to make sure the compressor is running and the flow-meter is showing the correct flow of oxygen from the system.

On a monthly basis, oxygen levels should be checked manually using an oxygen meter. Alternately, larger systems can be set up with continual oxygen monitoring. The compressor typically needs rebuilt every couple of years or so. When oxygen levels start falling, the pressure beds are replaced to ensure adequate oxygen is produced. Both of these items are relatively inexpensive.

Recent advances in ozone generators have greatly decreased maintenance and, in the process, improved ozone generation and concentration. Some manufacturers found they could increase the efficiency of their ozone generators by decreasing the physical gaps in the high voltage field where the ozone is produced, which has the added benefit of speeding up the flow of oxygen through the generator.

Since the oxygen is travelling at a much higher rate (often 10 times or more faster), any unwanted (moisture-producing) reactions are taking place outside the ozone generating tubes. This keeps the ozone-generating corona much cleaner because any moisture produced by the reaction takes place outside of the corona. Some ozone generator manufacturers are guaranteeing their systems for maintenance for five years or more because of this.

The other major considerations when setting up an ozone system are system placement and worker safety. Large-scale ozone generating systems should be installed in a clean equipment room with conduit-shielded distribution lines, at least one ambient ozone monitor in the equipment room, and a remote shut-off. On large systems, a safety interlock with the ventilation system is usually installed so that no ozone is generated unless the ventilation system is working.

When properly sized and maintained, ozone systems are an excellent and very economical plant or point-source odor control system. They can be used in conjunction with scrubbing or biofiltration systems and are a very effective technology for plant managers. **R**