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Keeping an eye on ozone

Monitoring can be simple and inexpensive, but also can be frustrating.

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Ozone is being applied for water treatment in a number of applications such as swimming pools, potable and wastewater treatment, water bottling, carwashes and laundries. Often these ozone systems are engineered without thought to monitoring for dangerous levels of ozone in the immediate area.

If ozone-monitoring equipment is designed into the original system, often operators have little idea how to interpret results and to care for the monitoring equipment. Unfortunately, operators often deal with leak monitoring mostly in a crisis mode when an inspector shows up.

In the last few years several manufacturers have been producing ozone monitors and simple sensing instruments in the $300-$2,000 range. These instruments generally use heated metal oxide sensors or electrochemical sensors. Usually a good single-location monitor with desirable accessories can cost less than $1,000. These ozone instruments can be purchased with the generator package from specialty distributors or sometimes from manufacturers.

Several factors should be considered when using ozone-concentration monitoring near ozone equipment:

• **Workplace safety.** For workplace safety, such as in water-bottling plants, the Occupational Safety and Health Administration limit is currently 0.1 parts per million (ppm) and probably will be lowered in the future.

In areas where the public is involved, many guidelines and regulations set the limit at 0.05 ppm, and 0.03 ppm is often used. These limits apply outdoors as well, but this is harder to control because outdoor ozone often exceeds 0.1 ppm.

• **Monitoring without sensors.** Do not assume that the "sniff test" is all that's needed to monitor for ozone leaks or unhealthy ozone levels.

In calm indoor area situations, a person who doesn't work around ozone or chlorine may smell ozone at low levels. But people who work around ozone or chlorine compounds will quickly develop a reduced sensitivity to these gases.

Also, other gases such as some chlorine compounds can mask ozone or smell similar to it.

• **False readings.** Ozone-sensing instruments almost always have "cross sensitivities," which means they also respond to other gases.

Oxides of nitrogen are a common air pollutant, often noted as NOx, and they can be read as ozone by some ozone sensors. Chlorine compounds can be read as ozone by almost all ozone sensors, and in fact are used as substitutes for ozone to calibrate ozone instruments.

Chlorine additives to swimming pools will affect ozone sensors when they are in high concentrations, such as when dosing them into the system. High levels of hydrocarbon compounds such as oil and gas fumes will often reduce the apparent ozone readings.

• **Ozone in outdoor air.** If it reaches the monitoring area, such as through an open window or door, outdoor ozone will cause the ozone sensor to react just as if there were an ozone leak in the equipment. In urban areas during the summer, outdoor ozone can reach 0.2 ppm or more. Ultraviolet (UV) ozone analyzers are very accurate and largely immune to these interferences except outdoor air ozone, but these instruments are often out of reach of small system budgets. One UV analyzer is often purchased as a master reference for large systems that include several low cost instruments.

Putting all these observations together in the design and management of an ozone-monitoring area means that the ozone monitoring area should be:

• Isolated from all outdoor air.
• Free from hydrocarbon fumes.
• Separated from chlorine-dosing equipment.

As a practical matter, the ozone-sensing element should also be protected from water splashes, dust, vibration, excess heat or cold, and other general abuse.

Installation of the ozone monitor

The ozone monitor should be installed in an area between the generator and the off-gas bleed valve or ozone-destruct device (usually a catalytic canister).

If the monitor is near the generator, it will detect a break in the generator or in the tubing or piping connecting the generator to the water flow (usually a venturi injector).

If it is near the contact tank, where the ozone reacts with the undesired pathogens and chemicals in the water, the monitor will detect leaks in the contact tank's air-relief valve assembly (usually connected to an ozone-destruct canister) or in a failure of the ozone-destruct catalyst unit.

Excess ozone could also get into the treated water area — a swimming pool, for instance — if the carbon filter often placed in the water flow after the contact tank fails. The resultant excess of ozone coming off the water will be hard to detect or monitor in many cases because it will be at low concentrations.

If the ozone generator and the contact tank are more than 15 feet (5 meters) apart, an additional monitor should be installed. The ozone concentration in the air will vary by height because ozone is about 50 percent heavier than air.

Each monitor should be installed at about head height, to sample ozone as breathed by humans. The monitor should be in an area of still air, isolated from outdoor air coming in through doors, vents and windows, and it should be out of the sunlight. Sunlight can create interfering gases if it strikes materials such as hydrocarbons and plastics.

Most ozone monitors have provisions for alarming and for controlling external devices. Assuming that this is the case with your monitor, specify if you want an "active" monitor, which shuts off the ozone generator in the event the ozone concentration is too high, or a "passive" monitor, which only alarms if there is an excess of ozone.

Bear in mind that many ozone monitors also incorporate a "power-safe" design so that they will shut down the ozone generator if the power to the monitor fails or if its sensor fails.

Using small ozone instruments to verify operation

Often overlooked is the value of ozone instruments to verify during start-up and routine operation that the ozone part of the water treatment and handling system is working correctly. This can usually be done by moving around the otherwise fixed monitoring instruments or by using simple handheld ozone sensors.

It is not recommended to break into the ozone feed between the ozone generator and the venturi injector. Dangerously high concentrations of ozone are produced here, and opening the feed tubing could cause equipment damaging pressure differentials.

A useful checkpoint is at the air relief (degas) valve, which vents the contact tank. This often feeds a catalytic ozone destruct unit, but the flow before the catalytic destruct unit can be sampled by a three-way valve.

Often the output here will be sputtering with some water that is very bad for sensors. However, holding the monitor or sensor in the gas-escape path away from the air relief valve — but protected from water — can produce readings above 10 ppm. This is a strong indication that not only is the generator generating, but that there is an efficient ozone feed into the water system and a high concentration of ozone in the contact tank.

Avoid breathing the air/ozone stream from the relief valve. The ozone instrument should be placed just far enough in the gas stream to get an adequately diluted sample of ozone.

Calibrating ozone monitors

The ozone-leak monitor should be delivered calibrated. It should be easy when reading it to determine when the ozone level is at the benchmark concentrations of 0.05 and 0.10 ppm. It would be helpful to have it activate an alarm at a suitable set point.

A good benchmark is 0.1 ppm because if the instrument is near the leak source, the ozone concentration elsewhere in the room will still be considerably less than 0.1 ppm. If the set point is much less than 0.1 ppm, the monitor may set off a false alarm too often due to a combination of many factors such as gusts of outdoor air and chlorine dosing.

After installation, the ozone monitor's calibration should be checked every three months. If there is a lot of dust, water spray or other sensor-damaging elements in the air, the calibration should be checked at least monthly. If the instrument has been dropped on a hard surface, its calibration should be checked immediately. Jarring mechanical shocks can easily damage sensors. Calibration checking is best done with portable miniature ozone sources that generate a known concentration of ozone in the monitor's range, such as at 0.1 ppm.

Annual calibration should be done with a UV analyzer whose calibration is traceable to a government standard, for example, those set by the National Institute of Standards and Technology in the United States.

Ozone monitor manufacturers often provide an annual calibration service. While it is in the instrument manufacturer's shop, it should also be checked to determine if parts need to be replaced and the general fitness of operation.

Ozone monitoring can be simple and inexpensive, but it also can be frustrating. Consult an ozone system vendor or engineering consultant to get the right monitor and agree on the right procedures for using and maintaining it. Time invested in the planning, start-up and training stages will be well invested in terms of trouble-free monitoring later on.

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