High-Tech Focus

Double Option

Two ways to measure dissolved oxygen in wastewater applications

By John Volbeda

Wastewater treatment professionals understand the need to continuously measure dissolved oxygen in aeration basins for improved process control. There are two primary technology options available for continuous dissolved oxygen measurement in aeration basins—bare- or open-electrode sensors, and membrane sensors.

Both options are viable and offer plants specific benefits. The key is for plants to select which sensor will work best for their application and production workflow needs.

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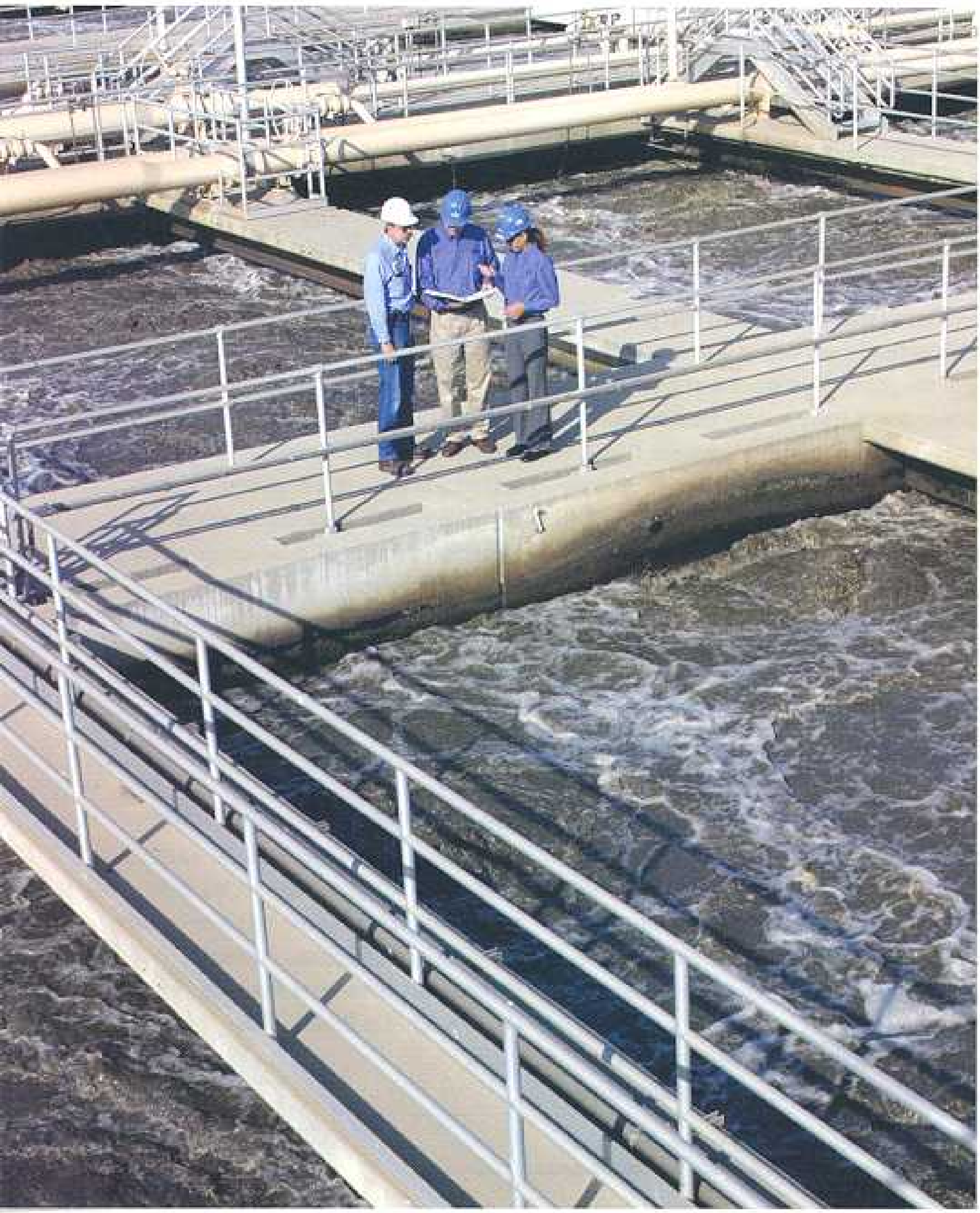

Maintenance challenges

Time-consuming and expensive maintenance requirements represent the primary challenge plants face in dissolved oxygen measurement in aeration basins. Aeration basins in wastewater treatment plants are dirty, high-coating applications. As a result, they have proven to be one of the toughest and most challenging measurement environments requiring extensive maintenance.

When a sensor in an aeration basin becomes coated, it is rendered inaccurate and ineffective, so it's important that plants conduct regular maintenance on dissolved oxygen sensors to avoid this problem. However, this maintenance can become time-consuming and costly if the dissolved oxygen instrumentation being used is not designed specifically to address the application's maintenance needs to reduce the time and cost involved in regular sensor upkeep.

Both of today's open-electrode and membrane dissolved oxygen sensor technologies are designed specifically to meet the needs of this harsh application environment and incorporate several features to reduce maintenance requirements.

The primary benefits open-electrode dissolved oxygen systems offer are a very long life, significantly reduced maintenance and low overall cost of ownership. These sensors are ideal for low-flow or zero-flow environments and those with substantial greases, fats and oils where membrane sensors will be challenged. They also are the best choice for plants that find maintenance schedules difficult to meet consistently due to, for example, staffing challenges or because instruments in aeration basins are difficult to physically access. These kinds of parameters can offset the relatively high initial investment required by the open-electrode sensor over the membrane sensor.

The electrodes in the open-electrode design are two independently spring-loaded concentric rings that are insulated from each other. Fresh sample is pumped to the electrode through an oscillating sample chamber to protect the bare electrodes from exposure to air bubbles and suspended solids in the liquid being treated. Even in low-flow or zero-flow wastewater, this chamber ensures that sufficient sampling occurs.

The electrodes are subject to polluting substances in the process liquid being treated, so a critical element in the design is a self-cleaning feature. Open-electrode sensors incorporate a rotating diamond grindstone that continuously polishes the electrode surfaces, cutting through and cleaning off the material that would otherwise coat the sensor and render it ineffective. This automatic self-cleaning capability can significantly reduce maintenance time over membrane systems. Also, unlike membrane sensors, open-electrode systems do not require plants to clean and replace membranes and replenish the electrolyte solution, which can be time-consuming. In fact, virtually the only maintenance requirement plant personnel must plan for is the replacement of the rotating diamond grindstone every eight to 18 months, and the replacement of the electrodes every three to five years.

Bare-electrode sensors provide the longest life of any dissolved oxygen measurement system available due to the self-cleaning housing. These sensor housings typically last 15-20 years, while membrane sensor housings last three to five years, on average. The initial cost of the open-electrode is higher than a membrane instrument, but over time the very long life and reduced maintenance requirements of the open-electrode options can work best because the probe is built so mechanically rugged that it can typically withstand many applications better than membrane sensors.

Membrane sensors

The primary benefits membrane sensors with air-blast cleaning systems offer include initial cost-effectiveness, ease of service, lightweight structure, and a resistance to heavy metal electrode poisoning. Membrane sensors are an ideal choice for applications where low initial cost is a primary factor, maintenance schedules can be followed consistently, instruments in basins are relatively accessible for maintenance purposes and heavy grease and oil are not present.

The membrane sensor uses a semi-permeable membrane to isolate the measuring electrodes and the electrolyte solution from the process liquid solution. By limiting the flow to gases alone, and especially to oxygen, this membrane also protects the electrode from contamination. A polarizing voltage applied externally drives the electrodes in the most commonly used technique for membrane measurement. Using this methodology, dissolved oxygen is measured by correlating the current flow between the electrodes to the amount of oxygen present in the process.

Traditionally, membrane sensors in aeration basins have been vulnerable to coating and as a result, have required plant personnel to regularly clean the sensor, usually on a weekly basis, by removing the sensor from the process. This is time-consuming and labor-intensive for plant personnel and potentially slows down the process treatment.

New technologies overcome this issue to make membrane dissolved oxygen sensors essentially self-cleaning. Plants can purchase air-blast sensor cleaning systems that can be integrated with a membrane sensor to automatically clean the sensor, thereby reducing plant maintenance requirements.

These air-blast sensor-cleaning systems blow a jet stream of air across the sensor membrane, usually for a duration of one to three minutes, to clear away any material coating the sensor membrane. The plant sets the system to shoot the air blast at certain times, such as every eight hours, and the cleaning frequency is controlled by a programmable timer in the analyzer. The air supply for the instrument is provided by a small, high-efficiency compressor that's situated near the sensor. Membrane sensors with an air-blast cleaning system can last three months or longer before any sensor cleaning maintenance is required—a dramatic improvement over the weekly cleaning needed by most traditional membrane sensors.

Some wastewater treatment plants have found flotation balls to be another valuable component of dissolved oxygen membrane sensor systems. In this measurement technique, the sensor and air-blast cleaning device is attached to a floating ball. This can be beneficial because the sensor comes in contact with the process solution on motion, achieving a higher flow rate, and in some cases, rendering a more accurate measurement.

Additionally, some manufacturers contend that this implementation can reduce maintenance requirements by keeping the sensor cleaner longer as it floats in the aeration basin. Unfortunately, in long-term testing conducted at a major municipal wastewater treatment plant, the flotation-based method has not proven to be an effective cleaning technique.

Overall, the dissolved oxygen membrane sensor with an air-blast cleaning system is cost-effective, easy to calibrate and easy to service because it does not incorporate any moving parts.

Both open-electrode and membrane sensors can effectively monitor dissolved oxygen on a continuous basis in aeration basins. Each offers valuable benefits in terms of cost savings and maintenance reduction.

Wastewater treatment professionals must simply evaluate their specific plant needs to determine which solution will work best for them. WWD

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