

Dissolved Oxygen Measurement in Wastewater Treatment

BACKGROUND

A wastewater treatment plant separates solids from the liquid, and consists of two basic stages: primary treatment and secondary treatment.

In the primary treatment stage, larger solids are removed from wastewater by settling.

Secondary treatment is a large biological process for further removal of the remaining suspended and dissolved solids. Secondary treatment removes up to 85% of the remaining organic material through a biological process of cultivating and adding sewage microorganisms to the wastewater. This process is accomplished in a trickling filter or an aeration tank.

PROCESS

Plants use aeration tanks to suspend microorganisms in wastewater. After leaving the primary treatment stage, sewage is pumped into aeration tanks. The sludge is loaded with microorganisms and mixed with air or pure oxygen. As air is forced into the aeration basins, it increases the activity of these microorganisms and helps keep the organic waste thoroughly mixed.

Dissolved oxygen (DO) is added to the aeration basin to enhance the oxidation process by providing oxygen to aerobic microorganisms so they can successfully turn organic wastes into inorganic byproducts.

In order to metabolize food and reproduce, each microorganism (or bug) must have at least 0.1 to 0.3 mg/L DO.

Most plants maintain about 2 mg/L of DO so the bugs contained inside the floc can also get oxygen. If the DO is less than 2 mg/L, the bugs in the center of the floc may die since the bugs on the outside of the floc use up the DO first. If this happens, the floc breaks up.

If the DO content is too low, the environment is not stable for these bugs and they will die due to anaerobic zones, the sludge will not be properly treated, and plants will be forced to conduct an expensive and time-consuming biomass replacement process. Because of this risk, many plants compensate by adding excessive amounts of DO to their process. However, when the DO levels become too high, energy is wasted, expensive aeration equipment undergoes unnecessary usage, and unwanted organisms (filamentous biology) are promoted.

Power costs associated with the operation of the aeration process in secondary treatment generally run from 30 to 60 percent of the total electrical power used by a typical wastewater treatment facility. Equipping the aeration basin with on-line DO measurement automates the aeration system to maintain the correct amount of DO. And according to the USEPA, plant energy costs may be reduced by as much as 50 percent.

DO introduced in the aeration basins also provides the added benefit of mixing, thus bringing the bugs, oxygen, and nutrient together. Mixing also removes metabolic waste products. Finally, the mixing or aeration keeps this floc suspended and prevents it from settling to the bottom.

INSTRUMENTATION — Membrane Sensor

Model 1056 Dissolved Oxygen Analyzer

- Single or dual DO input.
- NEMA 4X (IP65) weatherproof, corrosion-resistant enclosure.
- Onboard barometric pressure sensor.
- Two Isolated current outputs.



Model Xmt Dissolved Oxygen Transmitter

- Analog output.
- NEMA 4X (IP65) enclosure for panel or pipe/surface.
- Intrinsically safe for hazardous locations.
- Choice of HART or FOUNDATION Fieldbus communication.



Model 499ADO Dissolved Oxygen Sensor

- Amperometric stable measurement and high accuracy.
- Rugged Noryl construction.
- Simple membrane cap replacement.
- Automatic compensation for temperature changes.
- Optional Floating Ball System Model BB11.



Model 54eA Dissolved Oxygen Analyzer

- Three programmable alarms, one fault alarm.
- Two independent outputs.
- NEMA 4X (IP65) enclosure for panel or pipe/surface.
- On-board barometric pressure sensor.
- Programmable timer function for automatic cleaning.
- Optional HART with AMS.



Model 5081A Dissolved Oxygen Transmitter

- Analog output.
- NEMA 4X and NEMA 7B enclosure for pipe/surface.
- Intrinsically safe for hazardous locations.
- Choice of HART or Foundation Fieldbus communication.



Model DO-03/04 Dissolved Oxygen Measurement System with Air Blast Cleaner

- Reduced Sensor Cleaning Maintenance
- Automatic Air Blast System Keeps DO Sensors Clean
- Keeps DO Sensor Clean and Operational Up to 3 Months
- Dramatic Improvement Over Weekly or Daily Cleaning
- Complete System Model DO-03/04
 - Analyzer Model 54eA.
 - DO Sensor Model 499ADO.
 - High Efficiency Compressor.
 - Mounted in NEMA 4X Enclosure.
 - Adjustable Cleaning Cycle – Analyzer Interval Timer.
 - Sensor Washer Head Assembly – No External Parts.
 - Air Tubing with Check Valve.
 - Tubing Quick Disconnect.



INSTRUMENTATION

Continuous and precise measurement of dissolved oxygen is cost effective, keeps the waste treatment process functioning properly, and eliminates the need for frequent sampling and laboratory testing. The measurement of DO is a critical online measurement and can be accomplished using a membrane technology with the DO sensor Model 499ADO

INSTRUMENTATION — Membrane

The DO sensor Model 499ADO is a membrane-covered amperometric sensor. Oxygen diffuses through a gas-permeable membrane. Oxygen is reduced at the cathode and produces a current between the anode and cathode, which is measured by the analyzer or transmitter. An optional Air Blast Cleaning System, Model DO-03/04, is available as a complete system for automatic sensor cleaning and includes a high efficiency air compressor.

The DO analyzer Model 1056 includes analog outputs and alarm relays*. The DO analyzer Model 54eA includes the same features, but offers advanced features such as a programmable timer for automatic sensor cleaning and HART communication. The transmitters Model Xmt and Model 5081-A are two-wire transmitters with a choice of HART or FOUNDATION Fieldbus communications.

All DO sensors stop working when coated with biofilm or a slime layer, and require regular cleaning (weekly or more often). The key to success is not the DO measuring method, but keeping the sensor clean with an Automatic Cleaning System such as the DO-03 or DO-04 system. The Auto Airblast Cleaning System consists of a sensor washer head which includes an integral airblast nozzle, an air compressor in a NEMA 4X (IP65) enclosure, complete with mounting hardware, air hose and quick disconnect fittings. This system can keep the sensor clean for up to three months or longer.

*with optional HART communication

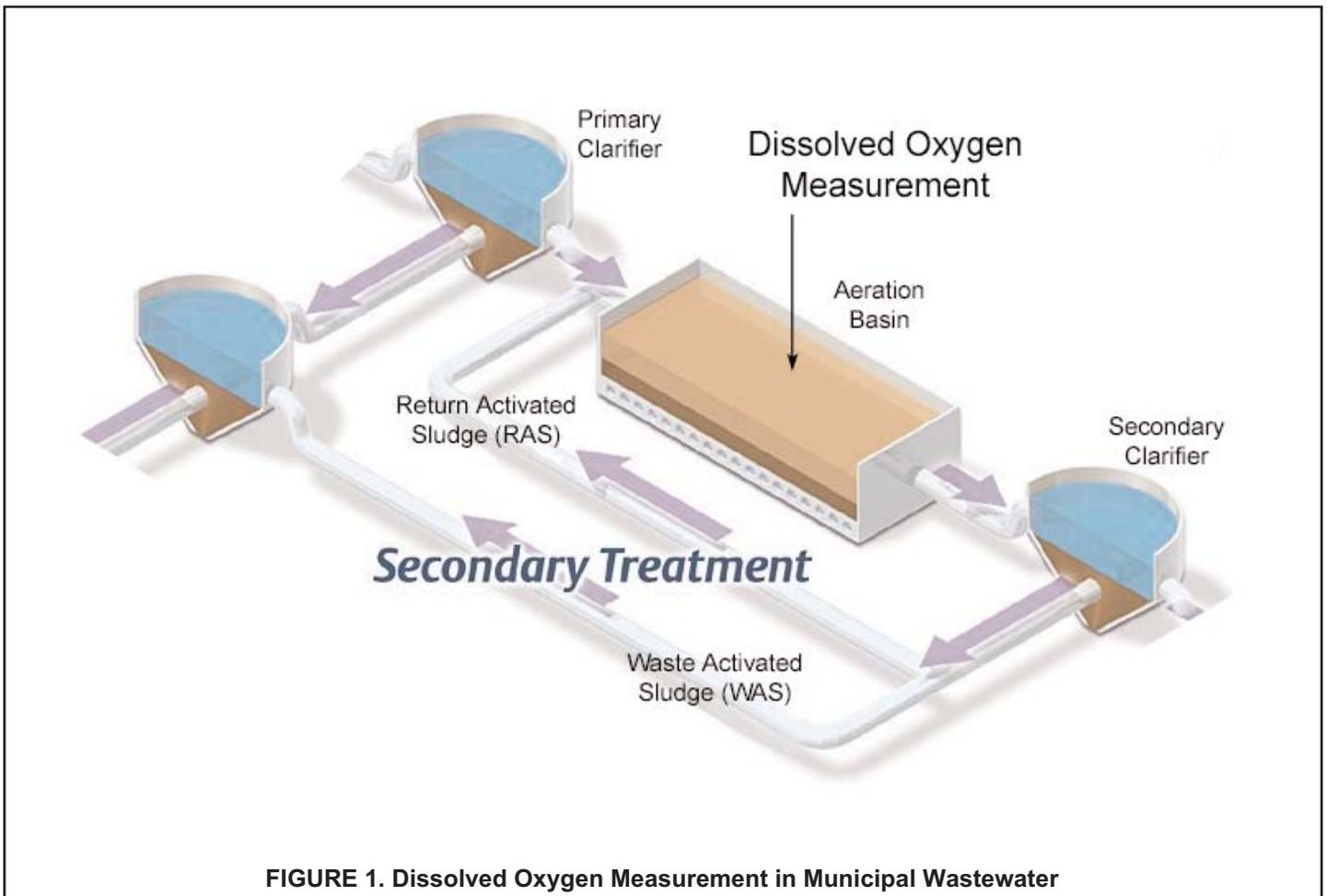


FIGURE 1. Dissolved Oxygen Measurement in Municipal Wastewater



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