Insite Instrumentation Group, Inc
80 Whisperwood Blvd., Ste. 107
Slidell, LA 70458
Phone: (985) 639-0006
Fax: (985) 639-0014
E-mail: info@insiteig.com
www.insiteig.com

Fluorescence Technology for the Measurement of Dissolved Oxygen in Wastewater Treatment

Clark cell (galvanic and polargraphic) based dissolved oxygen sensors have been the predominate methods for measuring dissolved oxygen in wastewater treatment facilities. Constant cleaning of the sensors, the need for membrane and electrolyte replacement, probe fouling, and re-calibrating of the instrument can be so demanding that monitoring, and more importantly control, can be a frustrating, time consuming exercise.

With the introduction of fluorescent based oxygen sensors designed specifically for the wastewater industry an alternate method of making this important measurement is now available. The biggest advantages of fluorescence based sensors are the inherent reliability and low maintenance requirements of this technology. Low maintenance and no replaceable membranes or electrolyte are the key features of this type of sensor.

This in turn reduces hours of lost time for maintenance and eliminates the cost of replacement parts. Another very important feature is that fluorescent-based sensors do not consume oxygen and require no flow across them to work. They also perform very well in harsh environments that normally destroy other conventional sensors.

PRINCIPAL OF OPERATION

1. The emitter sends light, at ~475 nm, to the back side of the sensing element.
2. The wetted side of the sensing element consists of a thin layer of a hydrophobic sol-gel material. A ruthenium complex is trapped in the sol-gel matrix, effectively immobilized and protected from water.
3. The light from the LED excites the ruthenium complex immobilized in the sensing element.
4. The excited ruthenium complex fluoresces, emitting energy at ~600 nm.
5. If the excited ruthenium complex encounters an oxygen molecule, the excess energy is transferred to the oxygen molecule in a non-radiative transfer, decreasing or quenching the fluorescence signal (see Fluorescence Quenching below). The degree of quenching correlates to the level of oxygen concentration in contact with the sensing element.

Fluorescence Quenching

Oxygen is able to efficiently quench the fluorescence and phosphorescence of certain luminophores. This effect (first described by Kautsky in 1939) is called "dynamic fluorescence quenching." Collision of an oxygen molecule with a fluorophore in its excited state leads to a non-radiative transfer of energy. The degree of fluorescence quenching relates to the frequency of collisions, and therefore to the concentration of the oxygen-containing media.