Dissolved Oxygen Technical Information

Theory

For a given partial pressure of oxygen in air, the concentration of dissolved oxygen (DO) in saturated pure water is fixed at any one temperature. Electro-metric methods of DO measurement are based on this fixed relationship. By measuring the partial pressure of oxygen and correcting for factors such as temperature and salinity, DO meters can determine the concentration of oxygen in samples.

The concentration of dissolved oxygen is usually expressed in milligrams of oxygen per liter of water (mg/L) or parts per million (ppm). Some meters compare calculated oxygen content with observed concentration and report percent saturation (% sat.).

Sensors

Oxygen sensors have a thin organic membrane covering a layer of electrolyte and two metal electrodes. Oxygen diffuses through the membrane at a rate proportional to its partial pressure—the greater the oxygen partial pressure, the more oxygen diffuses through the membrane. Oxygen meters measure the current as oxygen is reduced at the cathode and more oxygen diffuses through the membrane. Since the diffusion current is directly proportional to the concentration of dissolved oxygen, the calibrated meter simply converts measured current into concentration units.

Measuring dissolved oxygen with electrodes is more convenient and more accurate than chemical titration. Two types of oxygen sensors are commonly used:

Polarographic Probes require voltage input from the meter to polarize the electrodes. Since the voltage from an external source may take up to 15 minutes to stabilize, polarographic probes usually need to warm up before use to ensure proper polarization of the electrodes.

Galvanic Probes have electrodes made from two different metals that spontaneously polarize to generate the voltage. Since the voltage is spontaneous rather than supplied by an external source, galvanic probes are always operable and do not require the "warm up" time that polarographic probes need for polarization.

Applications

Dissolved oxygen measurements are used to monitor processes where oxygen content affects reaction rates, process efficiency, or environmental conditions:

- **Waste water treatment**
- **Wine production**
- **Bio-reactions**
- **Environmental water testing**

Temperature Compensation

Temperature affects both the solubility and diffusion rate of oxygen; therefore, temperature compensation is necessary for standardized DO measurements. All of our oxygen meters have automatic temperature compensation for various temperature ranges.

Salinity Correction

Since the presence of dissolved salts limits the amount of oxygen that can dissolve in water, the relationship between the partial pressure and concentration of oxygen varies with the salinity of the

sample. Most meters feature manual salinity correction to compensate for variations in ionic concentration—simply enter the salinity of the sample in parts per thousand (ppt) to ensure standardized DO measurements.

Biochemical Oxygen Demand (BOD)

The BOD test measures the molecular oxygen utilized in the biodegradation of organic material and the oxidation of inorganic material. By measuring the amount of oxygen dissolved in samples at the beginning and end of a specified incubation period, the relative oxygen requirements of wastewaters, effluents, and polluted waters can be determined.

$$BOD_t\ (mg/L) = \frac{D_1 - D_2}{P}$$

where:

BOD_t = Oxygen uptake during incubation period t

D_1 = DO of diluted sample immediately after preparation (mg/L)

D_2 = DO of diluted sample after incubation period t (mg/L)

P = decimal volumetric fraction of sample used