DENVER INSTRUMENT

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Application Note

What is Conductivity?

Conductivity is defined as the ability of a substance to conduct electric current. It is the reciprocal of the more commonly known measurement, resistivity. The presence of electrolytes determines the ease with which a solution can carry a current. All substances possess conductivity to some degree, but the amount varies widely. Most liquids consist of ionic compounds dissolved in water therefore conductivity measurements have a direct relationship to impurities. Conductivity measurements range from ultra-pure water (low conductivity) to sea water (high conductivity).

The unit of measurement of resistance is the familiar ohm. Conductance is the reciprocal of resistance and its unit is the siemens (formerly mho). Conductivity is measured between the opposite faces of a 1-cm cube of the material and therefore has the units of siemens/cm. Microsiemens/cm (µS/cm) and millisiemens/cm (ms/cm) are most commonly used to describe the conductivity of aqueous solutions.

Simple conductivity sensors are constructed of an insulating material imbedded with platinum, graphite, stainless steel or other metallic pieces. These metal contacts serve as sensing elements and are placed at a fixed distance apart to make contact with a solution whose conductivity is to be determined. The length between the sensing elements, as well as the surface area of the metallic piece, determines the electrode cell constant defined as length/area. The cell constant is a critical parameter affecting the conductance value produced by the cell and handled by the electronic circuitry.

A cell constant of 1.0 will produce a conductance reading approximately equal to the solution conductivity. For solutions of low conductivity, the sensing electrodes can be placed closer together reducing the length between them to produce a cell constant of 0.5. For use in highly conductivity samples, the sensing electrodes are placed farther apart, producing a cell constant of 10.0.

The meter has the capability of determining the cell constant (K) by using a standard solution of known conductivity:

$$K = \frac{\text{standard solution conductivity value} * \text{nominal cell constant}}{\text{measured conductivity value}}$$