microLAB
Tools for Research - Tools for Learning

Model 160 Conductivity Probe

Overview

The MicroLab Model 160 Conductivity Sensor accurately measures the conductivity of aqueous solutions. Conductivity is a measure of the ability of a solution to conduct an electric current between two electrodes, and is directly related to the presence of mobile positive and negative ions. A standard unit of measure for conductivity is Siemens per square cm area of the electrode.

The cell constant defines the volume of solution between the electrodes. The cell constant 'K' is directly proportional to the distance separating the two conductive plates and inversely proportional to their surface area (K= d/a). The electrode used in the Model 160 has a cell constant of approximately 1.0/cm. A higher cell constant indicates a less sensitive electrode, designed for more concentrated solutions.

To prevent positive and negative ions from accumulating around one or the other electrode, the MicroLab reverses the polarity of the voltage applied to the sensor 1000 times per second.

Functional Description

The electrode is inserted into a liquid sample to determine the concentration of ions. A ± 100 mV square wave is applied to the conductance electrode, and current passing through the solution is measured once at the same point in each cycle. When calibrated, MicroLab *reports this signal as conductivity in uS/cm.*

When used with the MicroLAB Model FS-522 or Model 507 Interface, the Model 160 is selected as a Conductivity sensor input (Figure 1) and calibrated with a series of known conductivity standards, or used with an included standard file. (See table on the back of this page to prepare standard solutions.) One application of conductivity is to determine total dissolved solids (TDS) in a water sample. The presence of electrolytes such as acids, bases or salts will increase the conductance of water.

The conductivity of water solutions of ions changes significantly with changes in temperature. Twenty-five degrees Celsius is the standard temperature for reporting conductance values. As temperature increases, ion mobility and conductivity increases. Conversely, at lower temperatures, ion mobility and conductivity decreases. For most "neutral waters", the change is about 2% per °C, an easy number to remember. For example, if the temperature of a water sample is increased from 25 °C to body temperature, 37 °C, the percentage increase in conductivity due to increasing temperature will be about [0.02 x (38-25)] = 26%.

Specifications

Conductivity Cell:
Cell Constant: ~1.0/cm
Cable: 30 "

Conductance Ranges:
- 0 to 2000 uS
  Resolution 0.05 uS
- 0 to 20,000 uS
  Resolution 0.5 uS

Accuracy: ±3%

MicroLab Input
3.5 mm stereo phone plug

Applications

- Water Quality
- Ionization
- Conductometric titrations
- Total Dissolved Solids (TDS)

Features

- Accurate
- Lightweight
- Rugged

Definitions

Conductance = 1/Resistance
Conductivity = 1/Resistivity

Units

Conductance:
SI units:
- 1 mho = 1 Siemen (S)

Conventional units:
- 1 micromho (μmho) = 1 microSiemen (μS),
- 1 millimho (mmho) = 1 milliSiemen (mS) = 1,000 μS

Conductivity:
SI units:
- 1mho/meter (mho/m)= 1 Siemen/meter (S/m)

Conventional units:
- 1 micromho/centimeter (μmho/cm) = 1 microSiemen/centimeter (μS/cm),
- 1 millimho/centimeter (mmho/cm) = 1 milliSiemen/centimeter (mS/cm) = 1,000 μS/cm

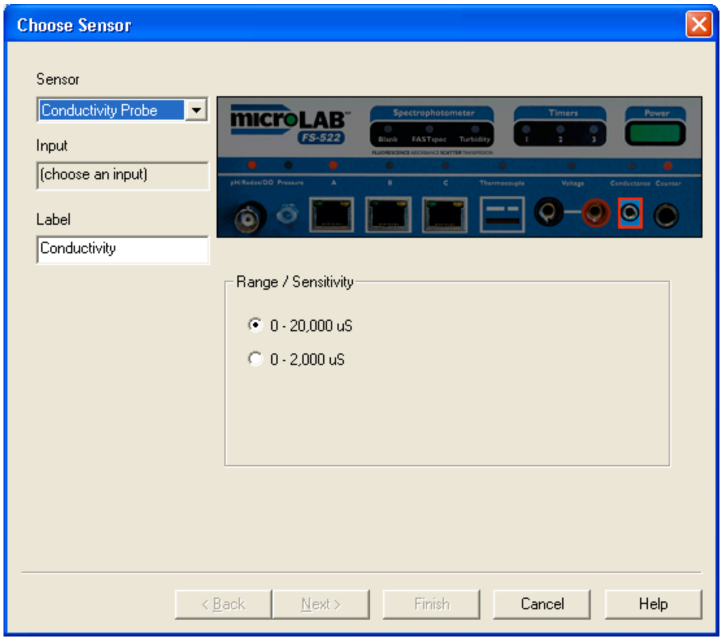

Figure 1: MicroLab's conductance sensor input is a 3.5 mm phone plug.

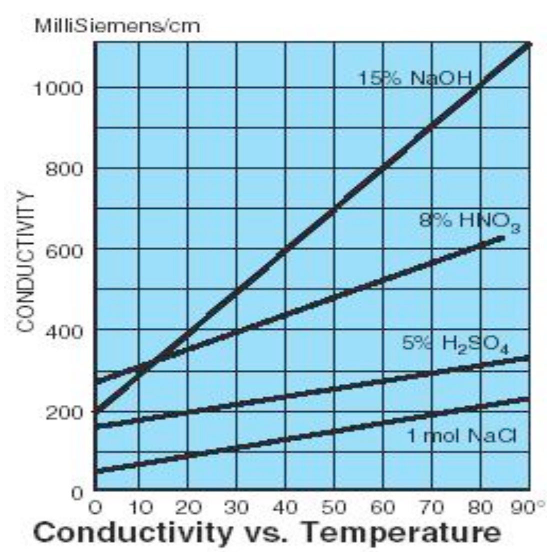

Figure 2: The conductance of a sodium chloride solution has a low sensitivity to changes in solution temperature. It makes a good conductivity standard.

Figure 2 illustrates the sensitivity of conductance to temperature change for several different compounds. To accurately compare the conductance of different solutions of the same material, the measurements must be made at the same temperature. Sodium chloride is used as a conductance standard because, of common compounds, its conductance has the least sensitivity to temperature change.

Table 1
Preparation of Conductance Standards

Grams of NaCl per liter (1000.0 mL) of deionized or distilled water:	
2.000 g	3860 uS/cm
1.500 g	2930 uS/cm
1.000 g	1990 uS/cm
0.500 g	1020 uS/cm
0.200 g	415 uS/cm
0.150 g	315 uS/cm
0.100 g	210 uS/cm
0.050 g	105 uS/cm

Conductivity values are at 25 °C

Note that conductance does not double as the mass of dissolved NaCl is doubled. As the ionic concentration becomes greater, the mobility of individual ions becomes less.