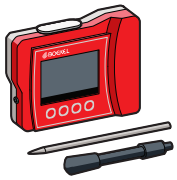

EC Lesson Plan Example

Overview:

Electrical Conductivity (EC) is the measurement of ions in an aqueous solution also reffered to as total dissolved solids. The Open Source Bio Transmitter can measure and log EC values, display calculations, and control EC. Understanding EC and how it is measured is critical in the areas of Chemistry, Biology, Engineering, and Environmental Sciences.

Introductory Lesson Plan:

Materials required:
Boekel OSB Transmitter with EC Probe
Tank or Large Container

Consumables
Distilled Water
Table Salt

Objectives:

- Basic understanding of EC
- Why is EC important?
- Understanding real world levels of EC

Lesson Plan

1) Electrical conductivity (EC) is the measurement how well water conducts electricity. The ability of water to conduct electricity is based on the amount of free ions in the solution. Free ions are available through dissolved salts, alkalis, chlorides, sulfides and carbonate compounds. The higher the concentration of ions, the higher the EC will be of the solution. Conductivity is an important measurement in environmental, chemical, industrial and manufacturing applications because it is a good measure of the purity of water.

Action: Set up the transmitter with an EC probe and place the probe in a tank with some distilled water. The reading should be below 100us/cm. This is because there are very few ions in this solution. Describe how distillation removes the ions by evaporating pure water and leaving behind the impurities.

2) Tap water has a conductivity of 300 – 600 us/cm. This amount can increase in the winter when salt is place on the roads for deicing.

Action: Add a gram of table salt to the solution and mix. This should increase the conductivity to a level close to the concentration of tap water. Continue to add salt until a level of 600 us/cm.

3) Sea water has a conductivity of about 30,000 - 50,000 us/cm.

Action: Add table salt to the solution and mix until the conductivity reaches a level close to that of salt water. It should take 50x that of what was added to simulate tap water. This is a good demonstration of how much solids are in sea water. Organisms that live in sea water have adapted to the high concentrations of salts. Sea water is also very corrosive because of the high levels of salts.

Intermediate Lesson Plan:

Additional Materials required:
Boekel OSB Relay
Small Pump

Consumables
Distilled Water
Table Salt

Objectives:

- Basic understanding of how a EC probe works
- Basic understanding of why and how a EC probe is calibrated
- Understand how to control EC with a computer program

Overview: Conductivity can be reported in Total Dissolved Solids (TDS), parts per million (ppm) or milligram per liter but the reading is based on the electrical property of siemens per meter (S/m). Conductivity is usually reported in microsiemens or millsiemens per centimeter (µS/cm or mS/cm). It can also be reported in micromhos or millimhos per centimneter (µmhos/cm or mmhos/cm) as one mho is equal to one siemen. The term mho is used because conductivity is the inverse of resistivity, which is measured in ohms (mho is ohm spelled backward). Conductivity probes work by measuring the electrical resistance of water. The formula used to calculate the conductivity is below.

Conductivity = (Kcell / R) * (1 / (1+(α/100)*(T-25))

Conductivity = temperature compensates reading in siemens/cm;

Kcell = cell constant in cm-1 (probe supplied has a value of 1)

R = measured resistance in ohms;

α = temperature compensation factor as % change per °C, typically close to 2.0;

T = measured temperature of the sample in °C.

Lesson Plan

1) Conductivity probes require calibration to function properly. The calibration process uses two points to determine the relationship of electrical resistance to the level of solids in solution.

Action: Walk the class through the calibration procedure. The transmitter has step by step instructions on how to calibrate. Electrochemical probes are used in all aspects of chemistry, biology and environmental sciences. It is important to understand how they work.

3) Conductivity can be controlled by adding ionic solids or adding more water to dilute the solution.

Action: Hook the transmitter to a small peristaltic pump via the relay. Connect the pump to a tube and a container of bottle of distilled water. Add salt to the main tank and let the transmitter try to control the concentration of salts by adding distilled water to the tank. Load the control conductivity sketch so that the transmitter controls the conductivity level. Log the data and discuss the trend created by the transmitter

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