

## Water Quality: Conductivity 101

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This month I would like to continue our water quality series with a short discussion of conductivity as a water quality parameter. Conductivity is a measurement of the ability of an aqueous solution to carry an electrical current. A conductivity measurement is an important factor to know when looking at water quality; because, it can be used to determine the applications related to water quality.

The Coquille Indian Tribe's Water Quality Monitoring Program is interested in conductivity measurements to track variation or changes in natural water and wastewaters systems; and to determine mineralization, more commonly called total dissolved solids. Total dissolved solids information is used to determine the overall ionic effect in a water source. Certain physiological effects on plants and animals are often affected by the number of available ions in the water. Along with other factors, the level of dissolved solids in our Tribal waters can affect the presence, abundance, and health of organisms within our aquatic ecology.

So what are ions and what are they doing in my water? You may ask. A fantastic question: an ion is an atom of an element that has gained or lost an electron which will create a negative or positive state. For example, sodium chloride (table salt) consists of sodium ions (Na<sup>+</sup>) and chloride ions (Cl<sup>-</sup>) held together in a crystal. In water it breaks apart into an aqueous solution of sodium and chloride ions. This solution will conduct an electrical current.

There are several factors that determine the degree to which water will carry an electrical current. These include: 1) the concentration or number of ions; 2) mobility of the ion; 3) oxidation state (valence) and; 4) temperature of the water. Because conductivity increases nearly linearly with increasing ion concentration, we can use conductivity measurements to estimate ion concentrations in solutions.

Conductivity is expressed in units of microSiemens ( $\mu\text{S}$ ), and is the reciprocal of electrical resistance (ohms). Seawater conductivity is approximately 5000  $\mu\text{S}$ , Tribal Administration building tap water is about 96.9  $\mu\text{S}$ , and distilled water is near 0  $\mu\text{S}$ . Typically Tribal waters are between 55 – 88  $\mu\text{S}$  within the Empire Reservation waters and 75 – 170  $\mu\text{S}$  within the Coquille Forest waters. We measure water conductivity with a Hach model HQ40d handheld meter system equipped with a conductivity sensor. Calibration of the conductivity sensor with reference solutions of known conductivity is critical to obtaining good measurements.

Empire Reservation streams have moderate conductivities and thus have moderate concentrations of dissolved ions. Conductivity can tell us a lot about the nature of a stream. For example, low-conductivity streams typically have less groundwater input than high-conductivity streams, i.e., they are "precipitation-dominated." Thus, they also

have more dynamic flow and temperature regimes. Conductivity also indicates the degree to which a watershed's bedrock and mineral soil resists erosion. Mead and Rasler Creeks within the Coquille Forest has the highest conductivity values (75 - 170  $\mu$ S) of the streams we regularly monitor indicating that it has relatively higher levels of groundwater input; this is supported by cooler summer water temperatures and easily detected groundwater input.

Indirect effects of excess dissolved solids are primarily the elimination of desirable food plants and habitat-forming plant species. Agricultural uses of water for livestock watering are limited by excessive dissolved solids and high dissolved solids can be a problem in water used for irrigation. Luckily for the Tribal cranberry operators, the Empire Reservation water quality data shows moderate conductivity measurements and thus poses no threat to our agricultural equipment or cranberry production.

Elevated dissolved solids can cause "mineral tastes" in drinking water. Corrosion or encrustation of metallic surfaces by waters high in dissolved solids causes problems with industrial equipment and boilers as well as domestic plumbing, hot water heaters, toilet flushing mechanisms, faucets, and washing machines and dishwashers.

Who knew the concentration of ions, or the level of dissolved solids within our waters could affect so much? Well, now we all know how influential this water quality parameter is, and why the Tribal Biological and Environmental Services personnel monitor for these levels. For conductivity is another piece in the complex puzzle of aquatic systems that enables land managers to understand the complex mechanisms of the emergent aquatic ecology.

Stay Tuned for next month I will talk about the wonderful world of water pH!