

Monitoring Monday – Let's look at Conductivity/Salinity/TDS.

Join us each Monday as the Clean Water Team shares some resources on water quality monitoring. Today we are looking at Conductivity/Salinity/Total Dissolved Solids.

Salinity describes the amount of salt dissolved in a body of water. Salts are compounds like sodium chloride, magnesium sulfate, potassium nitrate, and sodium bicarbonate which dissolve into ions. The salinity of water body greatly affects what types of animals and plants can live there, how drinkable the water is, or whether the water is suitable for certain industrial applications.

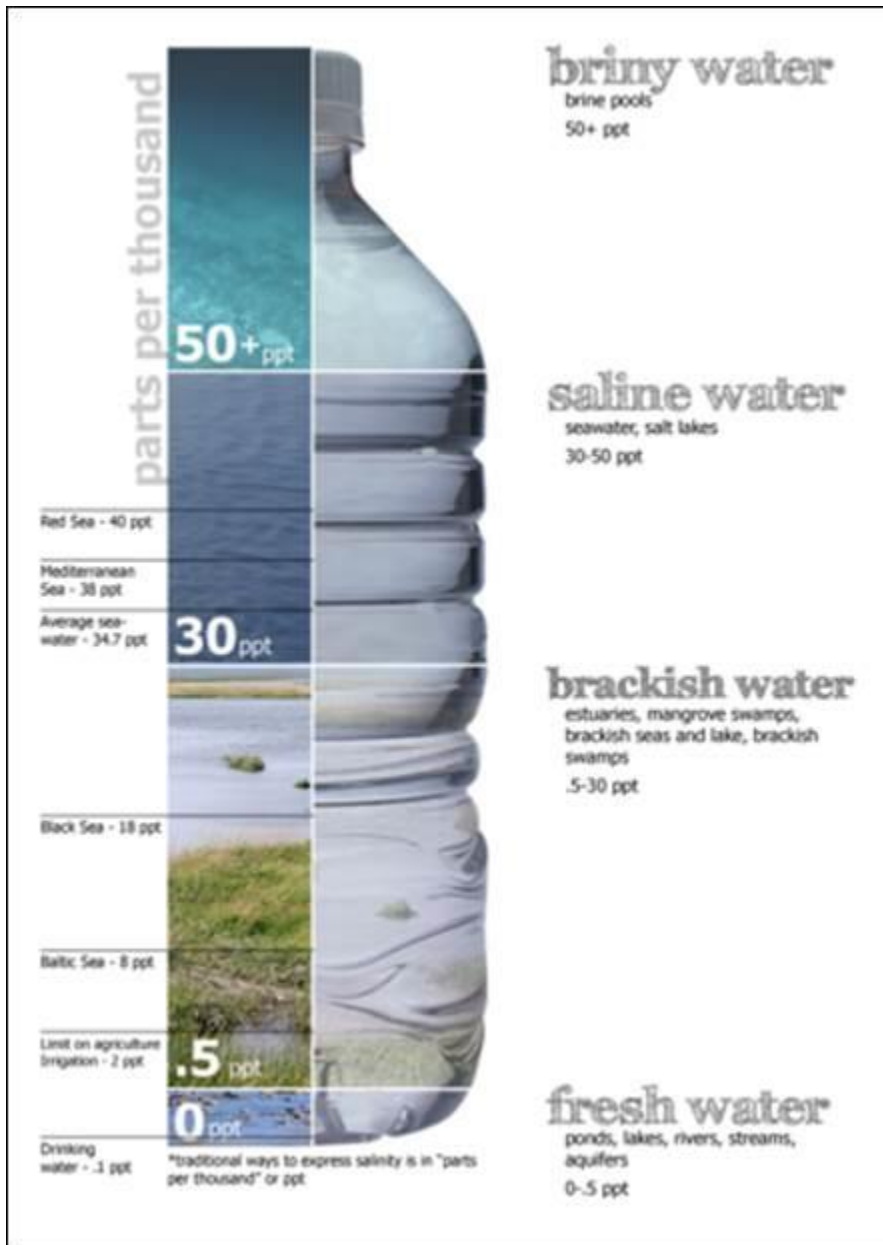
Salinity can be expressed in the form of a mass fraction, i.e., the mass of the dissolved material in a unit mass of solution (ppt) . We can also express salinity as a measure of conductivity (microsiemens per centimeter at 25 °C). Conductivity refers to the degree which a specified material conducts electricity, calculated as the ratio of the current density in the material to the electric field that causes the flow of current. It is the reciprocal of the resistivity.

Before the wide adoption of conductivity meters, several other methods were used. One of the first methods was the use of a hydrometer which measured specific gravity of a water sample. Specific gravity is the ratio of a material's density with that of water at 4 °C (where it is most dense and is taken to have the value 999.974 kg m⁻³). It is therefore a relative quantity with no units. Hydrometers are based on the Archimedes principle that a solid body displaces its own weight within a liquid in which it floats. A weight sits at the bottom, and a scale at the narrow top end. These are still used by those keeping marine fish in aquariums.

Many marine biologists use refractometers to measure salinity. Refractometers are optical instruments used for measuring concentrations of liquids (sugar solutions, brine, engine coolant...). The main component of a refractometer is the prism. A few drops of liquid are placed on the prism. The clear lid is closed, creating a thin layer of water across the prism. When light enters the liquid layer, it changes direction. This is called a refraction. The refractometer measures the amount of light shift, called the angle of refraction. This refraction is converted to a useful unit of measure. With saltwater refractometers the units are specific gravity and salinity. By looking through the eyepiece, you'll see the measurement scale indicating salinity and specific gravity.

Chlorinity, a measure of the chloride content, by mass, can also be measured through titrations. A titration is a technique where a solution of known concentration is used to determine the concentration of an unknown solution. Typically, the titrant (the known solution) is added from a burette to a known quantity of the analyte (the unknown solution) until the reaction is complete. Knowing the volume of titrant added allows the determination of the concentration of the unknown. Often, an indicator is used to usually signal the end of the reaction, the endpoint.

Total Dissolved Solids (TDS) is a measure of the combined total of organic and inorganic substances contained in a liquid. TDS measurements are derived from conductivity. Total dissolved solids are normally discussed only for freshwater systems. Although TDS can be measured with gravimetric analysis, conductivity methods are most often used. When correlated with laboratory TDS measurements, conductivity provides an approximate value for the TDS concentration. Many meters will provide measured outputs in salinity (ppt), conductivity (microsiemens per centimeter at 25 °C), and TDS (mg/L) units.



RESOURCES

Conductivity Meter (Iowa State Univ.- Holme Research Group)

<https://group.chem.iastate.edu/Holme/augmented-reality-in-educational-laboratories/conductivity/>

Information Paper: Conductivity/Salinity Measurement Principles

www.waterboards.ca.gov/water_issues/programs/swamp/docs/cwt/guidance/313.pdf

Fact Sheet: Electrical Conductivity/Salinity Fact Sheet

www.waterboards.ca.gov/water_issues/programs/swamp/docs/cwt/guidance/3130en.pdf English

www.waterboards.ca.gov/water_issues/programs/swamp/docs/cwt/guidance/3130sp.pdf Español

Role of inland saline wetland ecosystems in the face of climate change

<https://www.youtube.com/watch?v=uAMxc3ncAMo>

Saline Water and Salinity

www.usgs.gov/special-topic/water-science-school/science/saline-water-and-salinity?qt-science_center_objects=0#qt-science_center_objects

The Clean Water Team Glossary: A Vocabulary for Water Quality Monitors and Watershed Stewards

www.waterboards.ca.gov/water_issues/programs/swamp/docs/cwt/volunteer/cwt-glo-032321.pdf

Why is the ocean salty, but rivers flowing into it are not?

<https://oceanservice.noaa.gov/facts/riversnotsalty.html>

https://www.usgs.gov/special-topic/water-science-school/science/why-ocean-salty?qt-science_center_objects=0#qt-science_center_objects

VIDEOS

How Conductivity Meters Work

www.youtube.com/watch?v=5qxenj3NpE0

Ocean Salinity Simplified

<https://www.youtube.com/watch?v=6EJ6ZhTx1OA>

Salinity

www.youtube.com/watch?v=jzTBR2APU-k

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