

MARINE AND OCEAN CHEMISTRY

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Read the details of the information provided below from the sources recommended as a reference.

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PLAN – CONTENT – REFERENCES

1. Introduction
2. The water in seawater
3. Salinity, chlorinity, conductivity, and density
4. Major constituents of seawater
5. Simple gases
6. Salts in solution
7. Carbon dioxide
8. Nutrients
9. Trace metals and other minor elements
10. Chemical extraction of useful substances from the sea

References:

1. An Introduction to the Chemistry of the Sea, Michael E. Q. Pilson
2. Marine Chemistry & Geochemistry, John H. Steele et al.
3. Chemistry in the Marine Environment, R. E. Hester and R. M. Harrison
4. Marine Chemistry, P. J. Wangersky

SALINITY, CHLORINITY, CONDUCTIVITY, AND DENSITY

1. Need for accurate determination of salinity and density
2. Salinity
3. Chlorinity
4. Conductivity and salinity
5. Salinity and density

CONDUCTIVITY

Electrical conductivity is the measure of a material's ability to allow the transport of an electric charge. Its SI is the *siemens per meter*, $(\text{A}^2\text{s}^3\text{m}^{-3}\text{kg}^{-1})$ or, more simply, Sm^{-1} .

Electrical resistivity is a fundamental property of a material that quantifies how strongly that material opposes the flow of electric current.

$$\rho = R \frac{A}{l}$$

$$\sigma = \frac{1}{\rho}$$

- Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water. These conductive ions come from dissolved salts and inorganic materials.

Compounds that dissolve into ions are also known as electrolytes

- Distilled or deionized water can act as an insulator due to its very low conductivity value.
 - Sea water has a very high conductivity.

- Conductivity measurements are used routinely in many industrial and environmental applications as a fast, inexpensive and reliable way of measuring the ionic content in a solution.
- The measurement of product conductivity is a typical way to monitor and continuously trend the performance of water purification systems.
- In many cases, conductivity is linked directly to the total dissolved solids.

Sample	Conductivity (mS/m at 25 °C)
High quality deionized water	0.0055
Typical drinking water	5-50
Sea water	5000

Practical Salinity Scale (PSS)

- The salinity is defined in terms of the ratio of the conductivity of samples of seawater to that of the standard KCl solution.
- The scale would be calibrated by measuring the ratio of the conductivity of the standard KCl solution to that of standard seawater diluted or concentrated by the addition or subtraction of pure water.

Why is conductivity important?

- Conductivity is one of the most useful and commonly measured water quality parameters.
- Conductivity is an early indicator of change in a water system.
- Most bodies of water maintain a fairly constant conductivity that can be used as a baseline of comparison to future measurements. Significant change, whether it is due to natural flooding, evaporation or man-made pollution can be very detrimental to water quality.

- Conductivity and salinity have a strong correlation.
- As conductivity is easier to measure, it is used in algorithms estimating salinity and tds (total dissolved solids), both of which affect water quality and aquatic life.

DENSITY

- The density of pure water is 1000 kg/m^3 .
- Density of ocean water at the sea surface is about 1027 kg/m^3 .
- There are two main factors that make ocean water more or less dense:
 - The temperature of the water, and
 - The salinity of the water.
- Ocean water gets more dense as temperature goes down. So, the colder the water, the more dense it is.

RELATIONSHIPS BETWEEN DENSITY AND SALINITY

- Salinity affects water density.
- The higher the dissolved salt concentration, the higher the density of water.
- The increase in density with salt levels is one of the driving forces behind ocean circulation.
- When sea ice forms near the polar regions, it does not include the salt ions.
- The water molecules freeze, forcing the salt into pockets of briny water. This brine eventually drains out of the ice, leaving behind an air pocket and increasing the salinity of the water surrounding the ice. As this saline water is denser than the surrounding water, it sinks, creating a convection pattern that can influence ocean circulation for hundreds of kilometers.