

# MARINE AND OCEAN CHEMISTRY

Dr. Kübra İNAL

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

This content has been prepared for educational purposes only and the responsibility for copying and sharing belongs to third parties.

# 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

If indeed the oceans were present virtually from the day the Earth was formed, there is a further question:

**Was it salty like the present ocean?**

The salts dissolved in the ocean were probably dissolved from the original materials composing the Earth if low-temperature condensation compounds such as the chlorides, sulfates, and carbonates were present.

- More than 97% of liquid water on the earth exists in the ocean.
- The ocean water contains approximately 3.5% by weight of dissolved salt.

What is the elemental composition of the salts, how does it vary from place to place and with depth, and why?

- When dealing with any sample of seawater, the primary information required is usually a **measurement of the salinity**.
- Many properties, such as the concentrations of the conservative elements, can be calculated directly from the salinity, and others are related to it.
- The density is obtained from the salinity and the temperature, as are the solubilities of gases and other substances.

- The IAPSO standard sea water service is responsible for the management of standard seawater.
- This water is adjusted to have a precisely specified salinity of about 35‰, and a precisely specified conductivity ratio.

**IAPSO: International Association For The Physical Sciences  
Of The Oceans**



# SALINITY

- It was first discovered by Robert Boyle (1673), and confirmed by several investigators since, that drying and weighing the residue in order to determine the total salts in a sample of seawater is not practical, because variable results are obtained.
- The reasons for this are:
  - The sea salts hold onto the water.
  - If the salts are heated enough to drive off all the water, the salts themselves start to decompose. The residue that appears on evaporating the water from seawater consists of mixtures of several substances.

Constituent	g kg <sup>-1</sup> seawater	mol kg <sup>-1</sup> seawater
Sodium (Na <sup>+</sup> )	10.76	0.4680
Potassium (K <sup>+</sup> )	0.3992	0.01021
Magnesium (Mg <sup>2+</sup> )	1.292	0.05315
Calcium (Ca <sup>2+</sup> )	0.4128	0.01030
Strontium (Sr <sup>2+</sup> )	0.00815	0.000093
Fluoride (F <sup>-</sup> )	0.00141	0.000074
Chloride (Cl <sup>-</sup> )	19.344	0.54563
Bromide (Br <sup>-</sup> )	0.06712	0.00084
Sulfate (SO <sub>4</sub> <sup>2-</sup> )	2.713	0.02823
Alkalinity (A <sub>t</sub> )	0.413	0.00234
Boron (B)	0.00445	0.000412

# CHLORINITY

About 55% of the total dissolved solids in seawater is chloride, and chloride can be determined with great exactness.

- The Knudsen salinity was thought to be highly reproducible but it was tedious to measure.
- Dittmar and others had suggested that the ratios of the major solid substances of seawater to each other were essentially constant.
- If any of such substance could be determined, and if the ratio of the concentration of that substance to the total salinity were known, the total salinity of the sample could be calculated accurately.

- Sørensen definition: if a sample of seawater is titrated with silver nitrate to the end point, there has been a reaction such that all the chloride, bromide, and iodide have been precipitated.
- It is based on the **Mohr titration** of **silver nitrate** with chloride using **dichromate** as an indicator.

# RELATIONSHIPS BETWEEN CHLORINITY AND SALINITY

- Sørensen measured the salinity of nine samples of seawater. He also measured their chlorinity by the Knudsen method.
- Nine water samples came from various parts of the ocean, all from the surface and varying in salinity from 2.6 to 40.2 ‰.
  - Two were low-salinity waters from the Baltic,
  - Four were intermediate-salinity waters from the North Sea,
  - One was a high salinity water from the Red Sea,
  - Two were typical oceanic Atlantic waters.

$$\text{Salinity } \text{‰} = 1.805 \text{ Chlorinity } \text{‰} + 0.030$$