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

SALTS IN SOLUTION

1. Solubility of salts
2. Freezing point and boiling point
3. Osmotic pressure
4. Activity coefficients
5. Electrostriction
6. Absorption of sound

ELECTROSTRICTION

- An interesting way to note the rather dramatic effects of the presence of dissolved salts on the properties of solutions is to observe their effects on the density or, inversely, on the specific volume of a solution.

Effect of electrostriction on the volume of salt solutions					
Substance	**Density, g L^{-1}**	**Volume, mL**	**Calculated Volume**	**Observed Volume**	**Δ Volume**
H_2O	998.21	971.74			
NaCl	2165	13.86	985.60	980.78	-4.82
$MgCl_2$	2320	12.93	984.67	977.90	-6.77
$MgSO_4$	2660	11.28	983.02	971.91	-11.11
In each case the solution is made to a concentration of 3.0% w/w by adding 30 g of the dry anhydrous salt to 970 g of water at a solution temperature of 20 °C.					

ABSORPTION OF SOUND

- When a sound is emitted, the sound waves are weakened as they spread out in various geometric patterns, depending on conditions. The sound waves also lose energy as they pass through the water. One of the remarkable characteristics of seawater is that sound waves lose much more energy passing through the sea than they do in pure water.

- The absorption of sound energy by pure water depends on the square of the frequency, and is also somewhat affected by the temperature and pressure.
- **$MgSO_4$ in solution** is not fully dissociated into the constituent ions Mg^{2+} and SO_4^{2-}. A fraction of the ions associate as ion pairs that then exist, uncharged, in the solution. The exact fraction depends on the concentration of the magnesium and sulfate ions and also on the conditions of temperature and pressure.

Now imagine what happens when a sound wave passes through water:

- The sound wave is a region of increasing pressure followed by decreasing pressure.
- As pressure increases some of the ion pairs will dissociate, and many water molecules will become packed in some tight arrangement around the charged ions, and the volume of the solution will slightly decrease. As the sound wave passes the pressure decreases and the reverse process will take place. As the water molecules move around and are rearranged, some frictional energy will be dissipated as heat. This is energy lost from the sound wave as it does work on these molecular rearrangements.

- Another substance in seawater has an even bigger effect: **the borate ion**.
- The chemical reaction involved must be slower than the magnesium sulfate reaction, because the borate effect begins to decrease.
- In any sample of seawater the fraction of the total boron present as borate ion depends on the pH; for this reason the energy lost from sound waves passing through the sea is influenced by the pH of the water.
- As the pH decreases the concentration of borate decreases and the portion of the sound absorption due to the borate also decreases, and this effect is large enough to have some consequence.