Relationship Between Conductivity, Red-Ox Potential and Hardness of Tap Water at Different Amount of Salt Content

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Abstract: In this paper, salt water solution with different amount of salt was tested for resistance value, oxidation reduction potential and calcium cation content, and to relate those value to get a new relationship among resistance, red-ox value and calcium content. Salt water is a good conductor of electricity and calcium is one of the element responsible for hardness of water. Oxidation and reduction (Red-Ox) can be taken as measure of the cleanliness of water. All of the three parameters are closely related to water quality. Here, the experiment was done to measure and build a new relationship between those three parameters with different salt content.

1. Introduction:

ORP is a measure of the cleanliness of water and its ability to break down the contaminants. Usually, water has a positive ORP value, which means it is of oxidizing nature. Tap water has an ORP from +200mV to +600mV. Conductivity of water is the property of the water to flow electrical current through them. Conductivity is directly related to the concentrations of ion in water that comes from dissolved chlorides, alkalis, sulfides carbonate compounds. ORP is a function of the negative log of the electron activity whereas conductance is the reciprocal of electrical resistivity.

Water hardness is the amount of dissolved calcium or magnesium in the water. Sea water is the hardest water as it contains various types of salt. In the lab, sodium chloride (NaCl) was added to the tap water to get readings for different parameters.

2. Objective:

The objective was to build a relationship between conductivity, redox potential and hardness of water at different amount of salt content in tap water.

3. Experiment:

A cylindrical mold of 4” height and 2” in diameter was used for the experiment. Four probes were inserted in the mold as shown in fig. 1, and two probe method was used for measuring resistance using LCR meter for different vertical, horizontal and diagonal combinations. The frequency used in the experiment were 300 kHz, 100 kHz and 10 kHz.

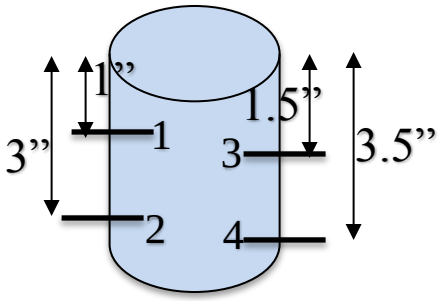

Figure 1. Cylindrical mold with four probes

ORP meter was used for the measurement of the oxidation and reduction potential of salt water solution. Calcium probe with read out meter was used for the measurement of Calcium cation of the solution.

Method:

At first, measurements were done for tap water. Then, 0.1gm of salt (NaCl) was added to 200gm of tap water and measurements were done. Similarly, measurements were noted for 0.3gm and 0.5gm of salt in 200gm of tap water simultaneously.

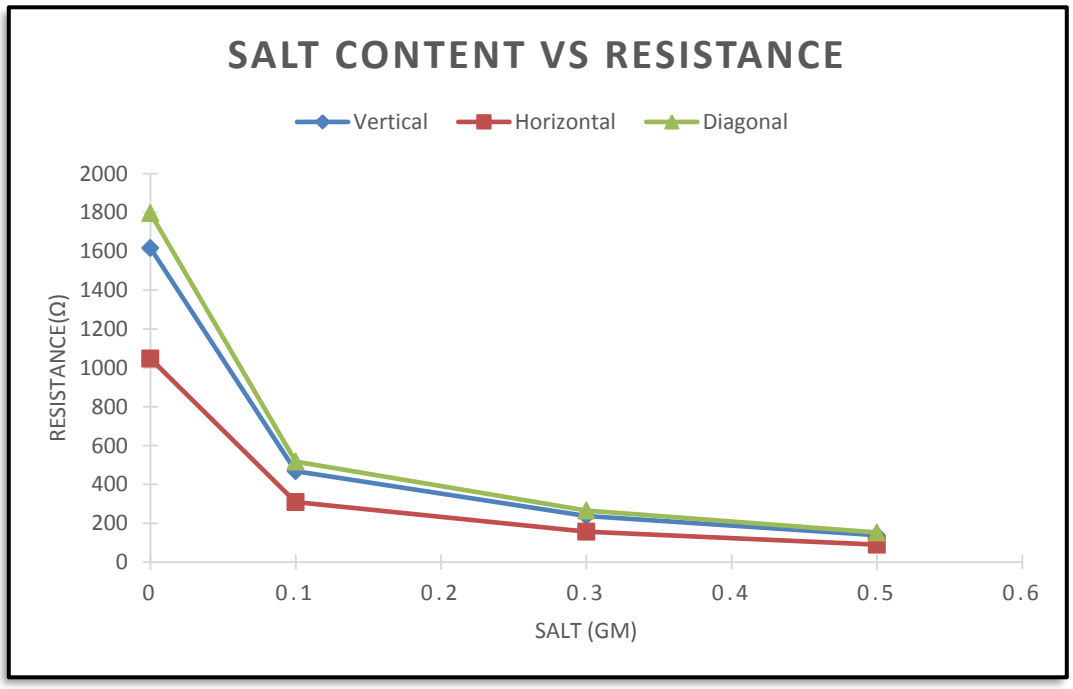

Figure 2. Salt content vs resistance at 300 kHz
(Similar nature graph for 100 kHz and 10 kHz)

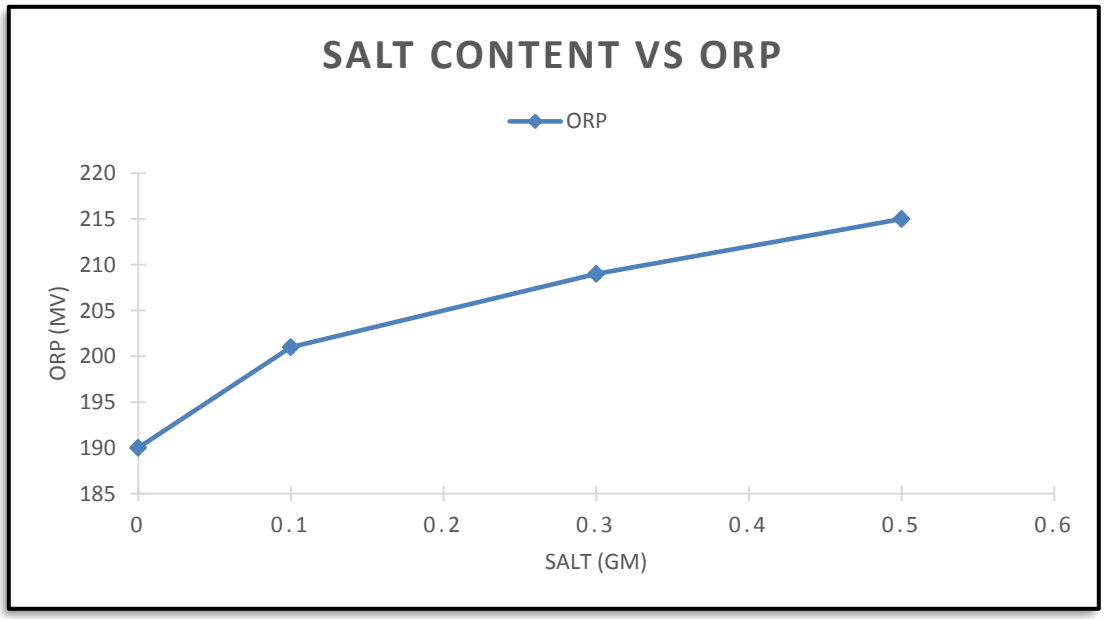

Figure 3. Salt content vs oxidation and reduction potential

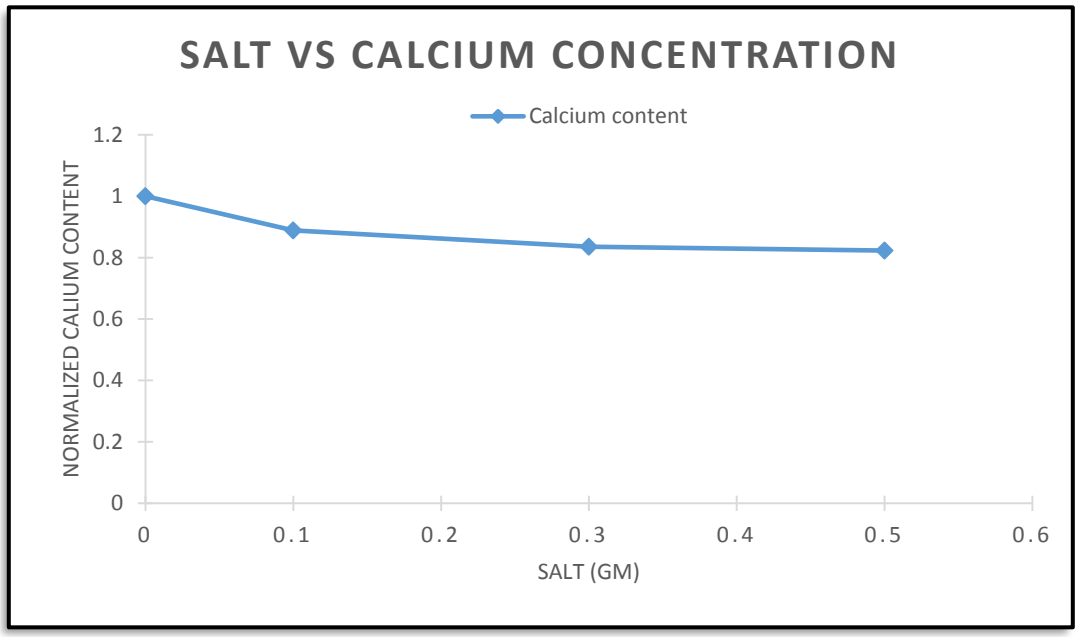

Figure 4. Salt content vs % change in concentration of calcium

Result:

With the addition of salt, water solution become more conductive as in fig. 2. Also, the oxidation capacity of water increased with the amount of salt. Whereas, the percentage change in concentration of calcium decreased by 11% at the beginning and then decreased in low percentage later. Usually, hardness of water increases with addition of salt but in this case, it rather decreased. The reason is, for the hardness of water, multivalent cation in the form of dissolved salt like Ca^{2+} and Mg^{2+} are required, but here we are adding NaCl salt which contains Na^{+} that doesn't contribute on hardening of tap water.

4. Conclusion:

1. From fig 2 and fig 3, we can build a relationship between conductivity and oxidation reduction potential that they are directly proportional to each other and somewhat can have linear graph.
2. However, NaCl doesn't contribute on hardness of the water and decrease the concentration of calcium in water and is inversely proportional to the conductivity and ORP value.

5. Acknowledgements:

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