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The Effect of Magnetic Field on the Solubility of Na_2CO_3 and Na_2CO_3. H_2O at Different Temperature and pH Values

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THE EFFECT of static magnetic field of 450 gauss magnetic power on the electrical conductivity (E.C.) of 1000 ppm anhydrous sodium carbonate and monohydrate sodium carbonate solutions as a function to the solubility at different temperature and pH values was studied. A magnetic funnel of 41.66 ml/sec flow rate was used to prepare the magnetic water by passing the later 1, 5 and 10 times, before dissolving the anhydrous sodium carbonate and monohydrate sodium carbonate salts. It was found that, the increasing in pH value is more influential as compared with the elevation in temperature degree. In general, the E.C. value of magnetic solution of anhydrous sodium carbonate is higher than monohydrate sodium carbonate solution and both are higher than non-magnetic solutions. As a result it can be concluded that the use of magnetized water will increase the solubility of anhydrous sodium carbonate and monohydrate sodium carbonate salts. Therefore, we are recommending using the magnetized solutions of these two kinds of salts in biological, industrial and physiological systems.

Keywords: Magnetic field, Na_2CO_3 & $Na_2CO_3.H_{2O}$ solubility and Different T & pH values.

Water is a good solvent and is often referred to as the "universal solvent". It is a diamagnetic molecule; however, its biophysical properties can be affected by magnetic field. Water structure, under the action of weak varying magnetic field was investigated by the methods of absorption and luminescent spectroscopy, in which the changes in water structure are due to the medium(1). Other authors also performed spectroscopic studies of electromagnetic and magnetic fields (EMF) effects on water structure by observing the changes in UV and the fluorescence spectra of water after magnetic water treatment(2). The changes which occur in the structure of liquid water under the effect of an external magnetic field are important in various applications, *e.g.,* water treatment, biological and biotechnology(3).

The phenomenon of water treatment with an applied magnetic field has been known for many years and reported as being effective in numerous instances(4,5). Magnetized water was used in wound healing and some other soft tissue and in inflammatory diseases treatment since the 18th century(2). It has been reported that the preliminary magnetic water treatment can enhance the growth rate of plants

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and animals[2], accelerate the crystallization of sparingly soluble diamagnetic salts of weak acids such as carbonates and phosphates[6,7] and consequently, the effect of magnetic field can be used as alternative to the chemical methods of plant treatment, for improving the production efficiency[8-10]. The magnetic hard water treatment becomes an important alternative to prevent scaling problems in domestic and industrial system[11]. The magnetic field helps in dissolving minerals and acids by a higher rate than non-magnetized water, in addition to dissolving oxygen and increasing the speed of chemical reaction[12].

Sodium carbonate has significant economic importance because of its applications not only by many industries but it is also used by consumers in solution form for soaking of clothes, dishwashing , floor washing, degreasing operations and for personal care (*e.g.* skin treatment)[13]. Recent works showed that sodium carbonate solution is used in fungicides now in order to control green mould on lemons, oranges and mandarins[14-17]. Similar results were reported for blue mould on oranges , mandarins and citrus fruits[18,19].

The present work is studying the solubility of Na_2CO_3 and $Na_2CO_3.H_2O$ salts by using the magnetized water throughout measuring the electrical conductivities of salt solutions at different temperature and pH values.

Materials and Methods

Na_2CO_3 and Na_2CO_3. H_2O of BHD Company, deionized water, magnetic funnel of 450 gauss magnetic power produced by Magnetic Technologies LLC Dubai, UAE, Electrical Conductivity Device type MARTINI MI 170 Bench Meter , and Beckman Zeromatic ^{R} SS-3 pH Meter have been used in the present study. Anhydrous sodium carbonate and monohydrate sodium carbonate solutions of 1000 ppm concentration were prepared by using normal deionized water (non-magnetized) and magnetized deionized water passing through the magnetic funnel 1, 5 and 10 times with a flow rate of 41.66 ml/sec. (a stop watch was used to measure the of flow rate).The electrical conductivities of Na_2CO_3 and Na_2CO_3. H_2O solutions with normal and magnetized water were recorded at 7.2, 7.4, 7.6, 7.8 and 8.0 pH values under 20, 30, 40 and 50^o C. Likewise, the electrical conductivities of blank solutions (without salt) of normal and magnetized water at the same conditions were deducted from the obtained results of both salt solutions.

Results and Discussion

Water is comprised of two elements – hydrogen (H) and oxygen (O). Distilled water is pure and free of salts; thus it is a very poor conductor of electricity. By adding ordinary table salt to distilled water, it becomes an electrolyte solution, so it is electricity conductor. In this work we are using the solutions of two kinds of salts (Na_2CO_3 & $Na_2CO_3.H_2O$) and trying to prove that the solubility will increase by subjecting the liquid water to a magnetic field before using it to dissolve the selective salts. The study also indicates the effect of temperature and pH values on the solubility of Na_2CO_3 and $Na_2CO_3.H_2O$ through the measurement of electrical conductivities (E.C.). Figures 1 & 2, show the effect of temperature and how many times (1, 5 & 10) the water passes through the magnetic funnel before used to dissolve the salts comparing with non-magnetic water (N). As shown, the experiment was carried out at pH 7.2 for both salts. There are direct proportional relationships between the magnetic treatment (1, 5 & 10) and the electrical conductivities of 1000 ppm concentration salt solutions. The same relationships appear between the temperature degrees and the electrical conductivities of both salt solutions. An increase in a solution's temperature will cause a decrease in its viscosity and an increase in the mobility of the ions in solution, and may also cause an increase in the number of ions in solution due to dissociation of molecules. Since, the conductivity of a solution is dependent on these factors; the increase in the solution's temperature will lead to an increase in its conductivity which in turn increases the solubility. The electrical conductivity of any ionization salt can be used as a function for its solubility(20), therefore, the salt solutions which are subjected to a magnetic field become more soluble(3).

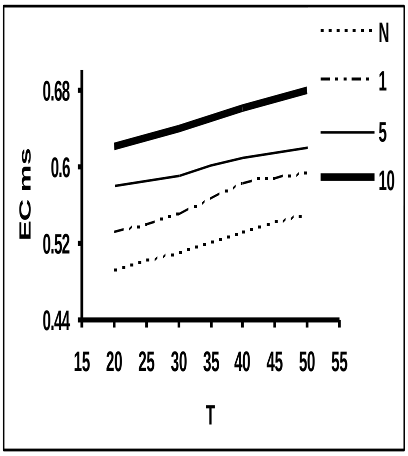

Fig. 1. The effect of 450 gauss static magnetic field on the electrical conductivity of 1000 ppm Na_2CO_3. H_2O solution at pH = 7.2 .

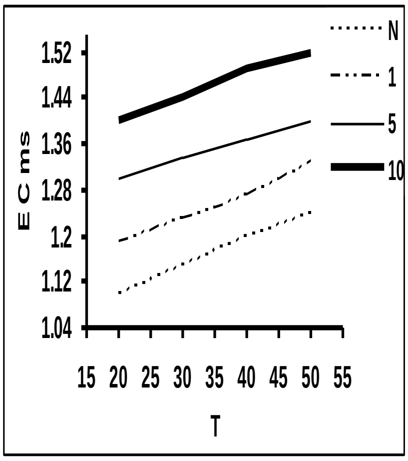

Fig. 2. The effect of 450 gauss static magnetic field on electrical conductivity of 1000 ppm Na_2CO_3 solution at pH =7.2.

As shown in Fig. 3, 4, 5 and 6, the electrical conductivity readings for the magnetized solutions of both salts (Na_2CO_3 and $Na_2CO_3.H_2O$) were increased as compared with these in Fig.1 and 2, due to the elevation in pH values from 7.2 (in Fig.1 and 2) to 7.4 and 7.6 in Fig.3-6.

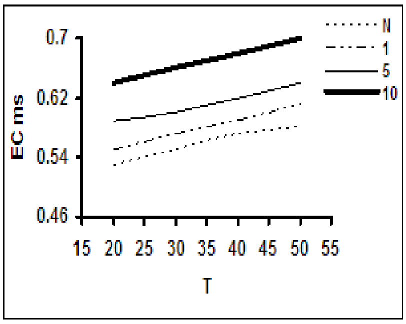

Fig. 3. The effect of 450 gauss static magnetic field on the electrical conductivity of 1000 ppm Na_2CO_3. H_2O solution at pH = 7.4.

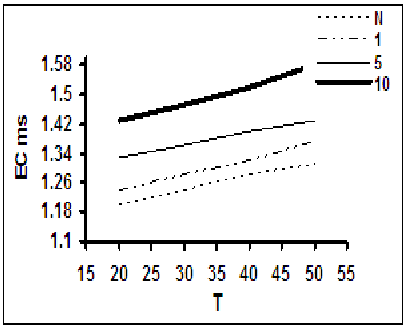

Fig. 4. The effect of 450 gauss static magnetic field on the electrical conductivity of 1000 ppm Na_2CO_3 solution at pH = 7.4.

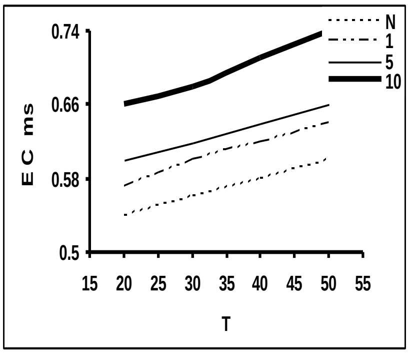

Fig. 5. The effect of 450 gauss static magnetic field on the electrical conductivity of 1000 ppm Na_2CO_3. H_2O solution at pH = 7.6.

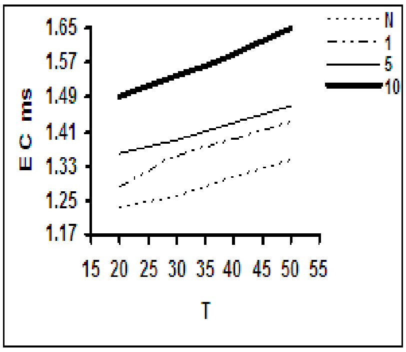

Fig. 6. The effect of 450 gauss static magnetic field on the electrical conductivity of 1000 ppm Na_2CO_3 solution at pH = 7.6.

The results confirm that the higher electrical conductivities are associated with higher pH values. It is clear now, that the ionization of both salts increases by elevating the pH value. This result is linked to other works which declare that, the magnetic treatment of water has been reported to change some of the physical and chemical properties of water, mainly hydrogen bonding, polarity, surface tension, conductivity, pH and solubility of salts(21-24).

Also, the direct proportional relationships between the pH values and the electrical conductivities of both magnetized and non-magnetized solutions of Na_2CO_3 and $Na_2CO_3.H_2O$ have been showed in Fig. 7-10.

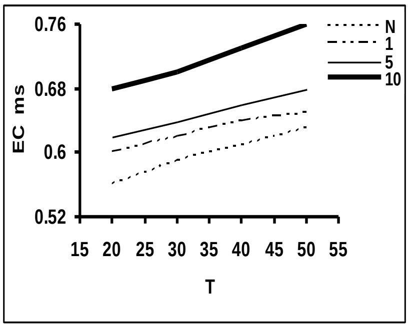

Fig. 7. The effect of 450 gauss static magnetic field on the electrical conductivity of 1000 ppm Na_2CO_3. H_2O solution at pH = 7.8.

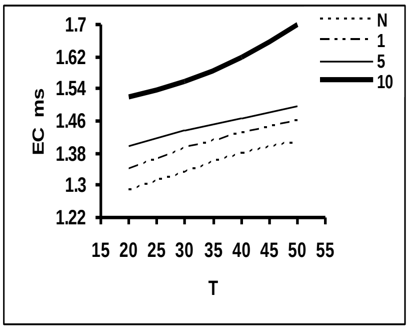

Fig. 8. The effect of 450 gauss static magnetic field on the electrical conductivity of 1000 ppm Na_2CO_3 solution at pH = 7.8.

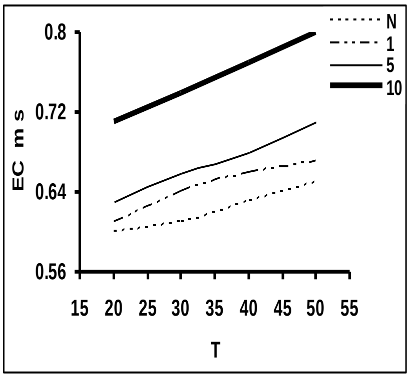

Fig. 9. The effect of 450 gauss static magnetic field on the electrical conductivity of 1000 ppm Na_2CO_3. H_2O solution at pH = 8.

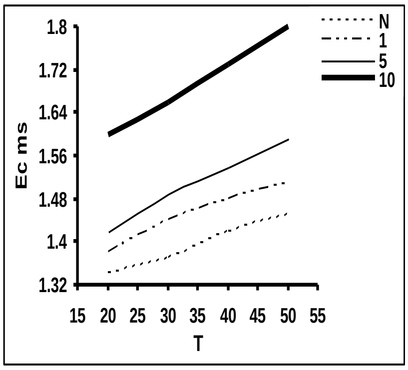

Fig. 10. The effect of 450 gauss static magnetic field on the electrical conductivity of 1000 ppm Na_2CO_3 solution at pH = 8.

In general, the magnetized solutions of both salts show high electrical conductivities as compared with non-magnetized solutions. The pH values of magnetized solutions have increased (as compared with non-magnetized), because more (-OH) groups are created. The pH of magnetized water can reach 7.8 after exposure to a high magnetic field from initial pH of 7.0 in normal tap water. For this reason, the magnetized water is healthier than non-magnetized water since the cancer cells do not survive in an alkaline environment[(25)]. It was observed that magnetized water helps in dissolving minerals and acids by a higher rate than non-magnetized water and increasing the speed of chemical reactions[(12)].

Smirnov[26] noticed that water can receive signals produced from magnetic forces that have a direct effect on living cells and their vital action. It has been reported that the dissolution rate into water of some minerals, *e.g.*, oxygen and copper sulfate, is significantly accelerated by the presence of magnetic field, furthermore, the self-diffusion coefficient of water can also be altered under a magnetic field[3].

Conclusions

The experiments showed that , the effect of magnetic field on the water to produce magnetized water has the ability to increase the solubility of salt solutions compared with non-magnetized water. The results also confirm that the higher electrical conductivities (the solubility) are associated with higher temperature and pH values for both magnetic and non-magnetic salt solutions, but the pH factor affected the electrical conductivity of both salt solutions more than the temperature factor.

Recommendations

1- The using of magnetized sodium carbonate solutions in laundry detergents will improve their softening agent through the preventing of the calcium and magnesium ions from bonding with the detergent materials.

2- The curing treatment of sodium carbonate solutions will be improved when it is used as magnetized solutions to control the postharvest determination by blue and green molds.

3- The sodium carbonate will be more available to be used by the plant, when it is added as magnetized solution (higher solubility).

4- The using of magnetized sodium carbonate solutions will improve the adsorption capacity of Hg^{2+} ions (toxic metal) volcanic ash soil.

5- We think that a high yield of $CaCO_3$ will be achieved by using magnetized reaction solutions of Na_2CO_3 and $CaCl_2$.

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دراســـة تأثيـــــر أستخدام المجـــال المغناطيسي على ذوبانيـــة ملحى Na_2CO_3 و Na_2CO_3 .H_2O فى درجات حرارة وقيم pH مختلفة

وســام صـــلال عليـــوى
شعبة العلوم الأساسية ـ كلية الزراعة ـ جامعة بغداد ـ بغداد ـ العراق .

تمت دراسة تأثير مجال مغناطيسي ثابت وبقوة 450 كاوس على قيم التوصيل الكهربائي (.E.C) لمحلول مائى تركيزه 1000 جزء بالمليون لملحى كاربونات الصوديوم اللامائية وكاربونات الصوديوم احادية التميؤ كدالة للذوبانية تحت درجات حرارة وقيم أس هيدروجيني مختلفة. تم استخدام قمع مغناطيسي لتحضير الماء الممغنط وذلك بأمراره 1 ، 5 و 10 مرات خلال القمع المغناطيسي وبسرعة جريان 41.66 مل/ ثانية قبل استخدامه فى أذابة ملحى كاربونات الصوديوم اللامائية وكاربونات الصوديوم احادية التميؤ. تبين ان لزيادة قيم الأس الهيدروجيني تأثير أكثر مقارنة بارتفاع درجات الحرارة .اعطى المحلول الممغنط لكاربونات الصوديوم اللامائية قيم توصيل كهربائى أعلى مقارنة بمحلول كاربونات الصوديوم أحادى التميؤ والملحين أعطيا قيم توصيل كهربائي عالية مقارنة بمحاليلهم غير الممغنطة .نستنتج من ذلك ان استخدام الماء الممغنط يزيد من ذوبانية ملحى كاربونات الصوديوم اللامائية وكاربونات الصوديوم احادية التميؤ. لذلك نوصى باستخدام الماء الممغنط فى اذابة الملحين اعلاه فى الانظمة البايولوجية والصناعية والفسيولوجية.