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Solvomagnetic crystallization of Co^{2+} and Mn^{2+} choloride under magnetic field and analization of field effect

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ABSTRACT

Solvomagnetic method is a famous method to get pure crystals of organic or inorganic compounds. In this method with applying a certain strong magnetic field new pure crystal structures can be prepared from original samples. The result will be useful for further complete analysis. In this research some new transition metals salts crystals have been produced by using solvomagneticthis method and their crystal structures have been determined using X-ray diffraction pattern and melting point has also been measured.

KEYWORDS

Solvomagnetic;
Pure crystals;
Magnetic field;
X-ray diffraction.

INTRODUCTION

The magnetic technology has been cited in the literature and investigated since the turn of the 19th century, when Lodestones and naturally occurring magnetic mineral formations were used to decrease the formation of scale in cooking and laundry applications. Today, advances in magnetic and electrostatic scale control technologies have led to their becoming reliable energy savers in certain applications[1-4].

For example, magnetic or electrostatic scale control technologies can be used as a replacement for most water-softening equipment. Specifically, chemical softening (lime or lime-soda softening), ion exchange, and reverse osmosis, when used for the control of hardness, could potentially be replaced by non-chemical water conditioning technology. This would include applications both to cooling water treatment and boiler water treatment in once-through and recirculating systems[5,6].

The general operating principle for the magnetic technology is a result of the physics of interaction between a magnetic field and a moving electric charge, in this case in the form of an ion. When ions pass through the magnetic field, a force is exerted on each ion. The forces on ions of opposite charges are in opposite directions. The redirection of the particles tends to increase the frequency with which ions of opposite charge collide and combine to form a mineral precipitate or insoluble compound. Since this reaction takes place in a low-temperature region of a heat exchange system, the scale formed is non-adherent. At the prevailing temperature conditions, this form is preferred over the adherent form, which attaches to heat exchange surfaces.

The operating principles for the electrostatic units are much different. Instead of causing the dissolved ions

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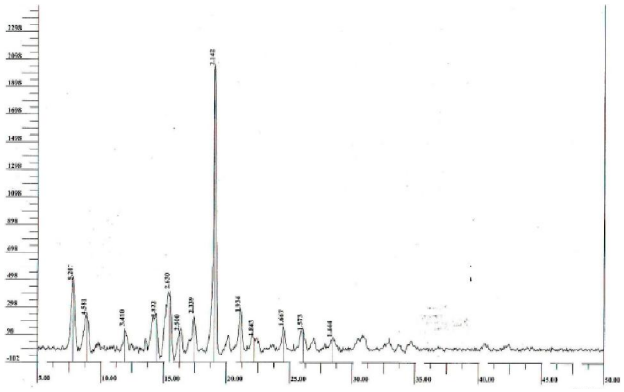

Figure 1 : The XRD diffraction patterns of $CoCl_2$ in the present of applied magnetic field

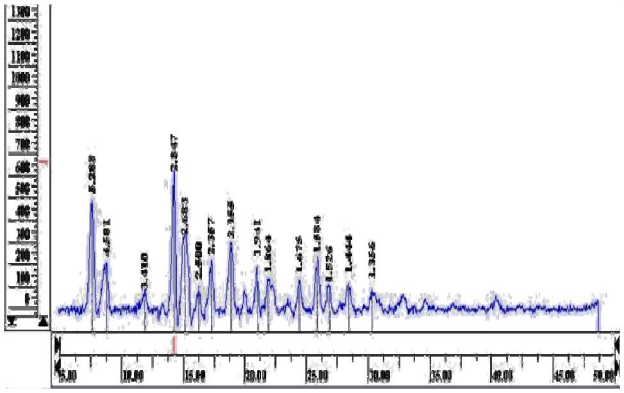

Figure 2 : The XRD diffraction patterns of $CoCl_2$ in the absent of applied magnetic field

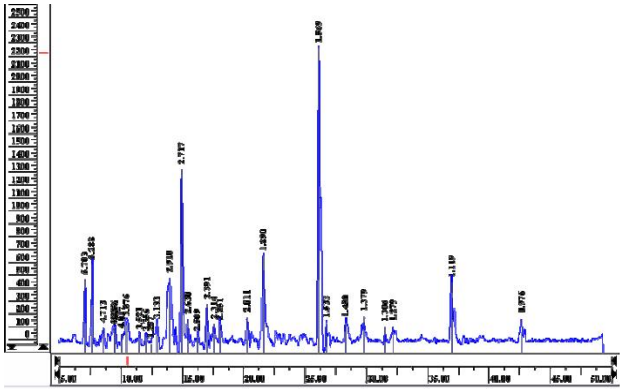

Figure 3 : The XRD diffraction patterns of $MnCl_2$ in the present of applied magnetic field

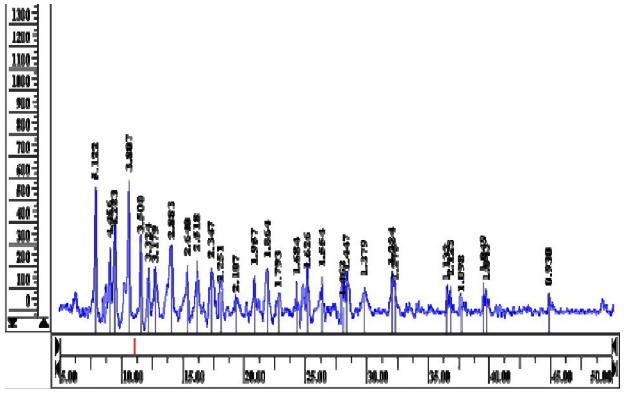

Figure 4 : The XRD diffraction patterns of $MnCl_2$ in the absent of applied magnetic field

to come together and form non-adherent scale, a surface charge is imposed on the ions so that they repel instead of attract each other. Thus the two ions (positive and negative, or cations and anions, respectively) of a kind needed to form scale are never able to come close enough together to initiate the scale-forming reaction. The end result for a user is the same with either technology; scale formation on heat exchange surfaces is greatly reduced or eliminated[7-10].

As we know many technique are being used for characterization of a compound in chemistry like IR, NMR, and mass spectroscopy and UV methods. A complete characterization is not possible with either of them. Actually the only method that gives us a lot of information such as exact structure, spherical orientation and bond lengths is XRD. But for using this method a pure crystal form of the compound is needed. Suitable crystal dimension for using in this method must be 0.5 to 45 mm. There are many ways for getting a suitable crystal of synthesized compound but choosing the right method is depended to some factors like oxidation state, water absorption and so on. One of the important stages in crystallizing is choosing a suitable solvent and also purity of the synthesized compound. One of the most common methods of crystallization is crystallization with slow evaporation of solvent. The best solvent in this method would be a solvent with high solubility toward compound and low boiling point like ethanol, acetonitril and dichloromethane. This paper is organized as follows. Details of the employed experimental technique are presented in section 2 and the results carried out with and without magnetic field effect are interpreted in section 3.

EXPERIMENTAL

First of all 2.5 gr Cobalt Chloride was weighted and also 1.2 gr of Chloride Manganese and separately each one of them was solved in water and heated to 80 degree. Saturated solution was left to be cooled slowly.

Crystalline formed in the bottom of the solution was collected and kept under dry and low temperature. Similar to this method another solution was prepared and left to be cooled slowly but this time under a magnetic field of about 0.18 T. It is shown that the solvomagnetic crystalline formed was collected. The both powdered sample were analyzed by XRD and comparison was performed between spectrums.

RESULTS OF SIMULATION

The spectrums are clearly different to each other and this shows the effectiveness of the magnetic field on the structure of the formed crystals in the presence of magnetic field. From the comparison between the spectrum figure 1 and 2 can be seen that $CoCl_2$ sample in the presence of the magnetic field has an increased intensive diffraction rather than $CoCl_2$ sample in the absence of the magnetic field. This is because of movement and compression of the Co^{+2} ions in the crystalline form under the effect of magnetic field. Also a comparison between the spectrum figures of 3 and 4 it can be seen that $MnCl_2$ sample in the presence of the magnetic field has an increased intensive diffraction rather than $MnCl_2$ sample in the absence of the magnetic field which is due to the movement and compression of the Mn^{+2} in the crystalline form under the effect of magnetic field.

CONCLUSION

Based on these studies, it was clarified that magnetic water does change the crystal structures properties of $CoCl_2$ and $MnCl_2$.

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