Production of irrigation water by crystallization of salts from reject water of Solvay process

Hameed Muhamad [1], Omar Chaalal[1], MD. Hossein[2], Thies Thiemann[2] and Ahmed Sulaiman[2]

[1] *Abu Dhabi University, Dept of Chemical Engineering, Abu Dhabi, UAE*
[2] *United Arab Emirates University, College of Engineering, Al Ain, UAE*

Abstract
There were two major sources of CO2 emissions: power Plants and natural gas treatment plants. CO2 removal from the sources such as fossil-fuel power plants and similar sources is of supreme importance to reduce the effect on global warming. A process involving a chemical reaction between CO2 and ammonia in saline solution was proposed to reduce the global warming effect and produce irrigation water. This study focuses on the crystallization of ammonium chloride in the mixture of sodium bicarbonate salts produced in the process. Organic solvents, Diethylene glycol and 2-Methoxyethanol, were added in the crystallization process. Based on the recovery of the salts, 2-Ethoxyethanol gives the best recovery of the organic solvents tried.

Keywords: Crystallization, irrigation, Solvay, *Ammonia, Carbon dioxide, Desalinated water.*

1. Introduction

One of the major problems facing the world today is global warming. Certain consequences of global warming are now predictable, including sea level rise, more frequent and severe heat waves, growing wildfire risks, and an upsurge of dangerous weather events. This study is prompted by the growing concern of the likely environmental impact of global warming, because of the increasing emission of CO2 and other 'Greenhouse' gases. There are numerous processes available for carbon dioxide capture [1],[2],[3],[4],[5]. Few of them are successful and still have problems when applied in large-scale. In addition, CO2 absorbed in these processes cannot be released and require additional handling systems. Thus, for the last decade chemical engineers have been attracted by innovative processes that can give effective solution to global warming.

This paper reports a simple process that can significantly remove CO_2 from either natural gas or exhaust gases (a conceptual view is shown in Fig.1) by chemically reacting with the salt in the brine in presence of ammonia [6],[7],[8].

The reduction of brine salinity depends on the amount of carbon dioxide (CO2) and ammonia (NH3) concentration and the temperature which results in the production of sodium bicarbonate (NaHCO3) and ammonium chloride [9]. Sodium bicarbonate is a valuable and sellable product. Thus, ideally one would want to combine desalination, CO2 sequestration and sodium bicarbonate/sodium carbonate production into one. In order to reduce the concentration of sodium and ammonium chloride to get irrigation water a crystallization process is used. The crystallization of such salts led to the water that approaches irrigation water in composition. The objectives of the project are to provide an effective method carried out as follows

(1) to reduce carbon dioxide from natural gas and similar sources,

(2) to transform saline water(discharged from desalination or oil and gas plants) into irrigation water

(3) to produce chemicals such as soda ash that has use in chemical, medical and food industries.

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2. Experimental Procedure

Crystallization was carried out in different concentrations of water and solvent after saturating the water with appropriate amounts of sodium bicarbonate or mixtures of sodium bicarbonate and ammonium chloride in equal molar concentrations. The saturation and mixing of solvent was carried out at 55-60 0C [10]. Initially saturation of the sodium bicarbonate was carried out in water of a particular volume. Once saturated, 5 different solvents were added and the crystallized salt was filtered and dried in vacuo. Once filtered, the salt was kept for drying after washing with heptane. After drying, the recovery weights were noted and their percentage was calculated to indicate the amount of recovery from different solvents. The solvents used in the process were: Diethylene-glycol (DEG) and 2-Methoxyethanol (ME).

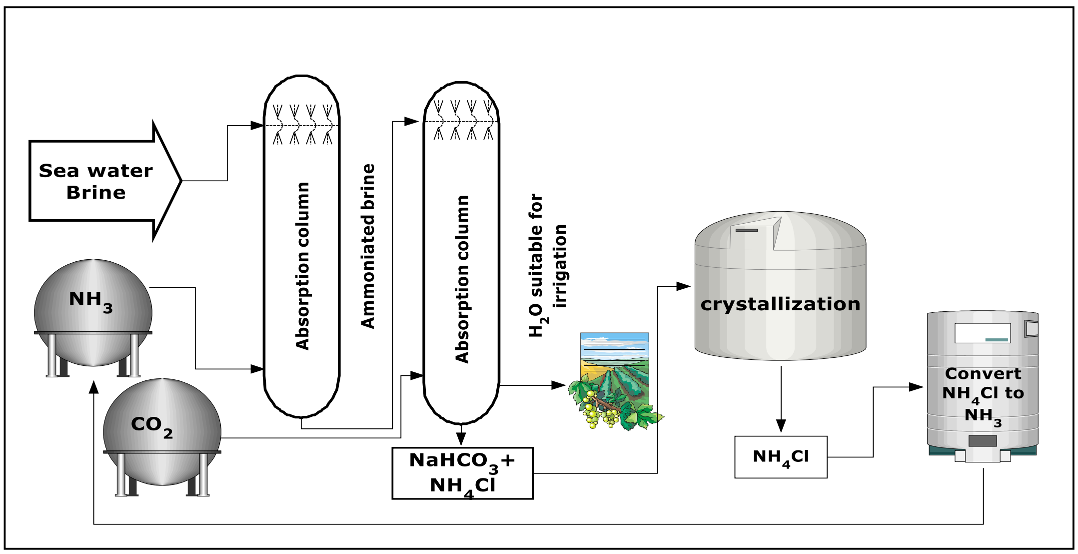

Figure 1. A schematic drawing of the proposed process.

3. Results and Discussions

The Data was used to produce graphs and represented with parameters of solubility of sodium bicarbonate present in the water after crystallization versus weight fraction of organic solvent in the water. The relationship of water based solubility of sodium bicarbonate in aqueous mixtures of different organic solvents, mentioned above, as a function of the salt free weight fraction of solvent was presented in Figure 2 and Figure 3.

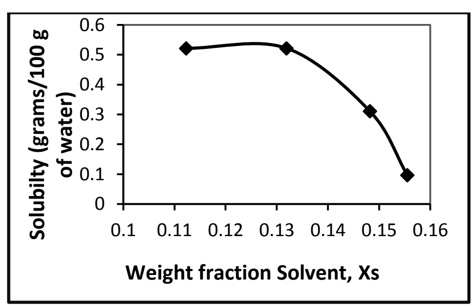

Figure 2: Diethylene glycol weight fraction Vs solubility of Sodium Bicarbonate in water

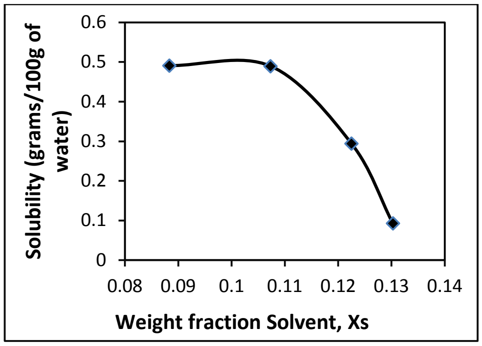

Figure 3: 2-methoxy Ethanol weight fraction Vs solubility of Sodium Bicarbonate in water

4. Conclusion

Amount of Sodium Bicarbonate recovered from Water/Anti solvent mixtures with (Sodium bicarbonate Percentage Recovery) and [Sodium carbonate percentage Recovery]. The Temperature for the saturation was maintained between 55º-60º C. The concentration of the water and solvent used, along with the concentration of sodium bicarbonate added, are given in this study ,along with the type of solvent used and the amount of salt recovered. The relationship of water based solubility of sodium bicarbonate in aqueous mixtures of different organic solvents, Diethylene glycol and 2: 2-methoxy Ethanol, as a function of the salt free weight fraction of solvent was presented. The study showed that 2-Ethoxyethanol gives the best recovery.

5. Acknowledgments

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6. References

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