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Research of Recycled Salt and Glauber' Salt Precipitation Rules of Yabulai Salt Lake Brine

TANG Na^{1,2}, LIU Jianwei¹, ZHANG Lei¹, Xiang Jun¹, CHENG Penggao¹ and WANG Xuekui¹

¹ College of Marine Science and Engineering, Tianjin University of Science & Technology, Tianjin 300457, China

² Tianjin Key Laboratory of Marine Resources and Chemistry, Tianjin University of Science & Technology, Tianjin 300457, China

1 Introduction

The main production of Yabulai salt lake was original salt and recycled salt many years ago. After decade's production, the salt lake resource is more and more deficient. Glauber's salt and magnesium salt are concentrated in brine now. It could affect the quality of the salt. In recent years, research had done much work to changing the Yabulai salt lake condition. Yabulai salt lake is located in the Inner Mongolia plateau. It is dry windy and hot in summer, however it has big temperature difference between day and night in its long and cold winters. In this work, recycled salt and Glauber' salt precipitation rules of Yabulai Salt Lake brine was investigated combining the local climate characteristics in order to further improve the quality and the production of regenerated salt. The production process control parameters was determined to make full use of glauber's salt and magnesium salt.

Figure 1 is the factory layout of Yabulai salt lake. At the end of September, concentration of brine in regenerated salt production area approached saturation. The brine contained a high concentration of Mg^{2+} and SO_4^{2-} , which was not suitable for salt production. Thus, the brine would be transported to the glauber's salt crystallization pool and glauber's salt would precipitate in winter. When the concentration of SO_4^{2-} in mother liquor was lower than 15mg/L, we could mix mother liquor with brine from regenerated salt production areas on February and produce high quality salt in new salt pool.

The rules of recycled salt precipitation under different temperature of brine salting was studied to obtained equilibrium phase diagram of the quaternary system (Na^+ , Mg^{2+} // Cl^- , SO_4^{2-} - H_2O). The composition of brine in regenerated salt production area in April was listed in



Fig. 1. Factory layout of Yabulai salt lake.

Table 1 The brine composition in regenerated salt production areas in April

Ion concentration(g/ml)						Others	
Cl ⁻	SO ₄ ²⁻	Ca ²⁺	Mg ²⁺	Na ⁺	H ₂ O	T (°C)	Density (g/cm ³)
185.16	35.74	Trace	12.71	112.70	878.69	12	1.225

Table 1. When the temperature of the brine was 35°C, Mg^{2+} and SO_4^{2-} began to precipitate. when the density of the brine reach 1.2635 g/cm³, precipitation rate of NaCl at this time was 68.53%. At 25 °C, Mg^{2+} and SO_4^{2-} began to precipitate when the density of the brine reached 1.2619 g/cm³, precipitation rate of NaCl was 68.53%. When the temperature of the brine was 35 °C, Mg^{2+} and SO_4^{2-} began to precipitate when the density of the brine reached 1.2611 g/cm³, precipitation rate of NaCl was 64.39% at this time.

Table 2 is the raw brine composition in low freezing process. With the help of equilibrium phase diagram of the quaternary system (Na^+ , Mg^{2+} // Cl^- , SO_4^{2-} - H_2O), we studied the rules of glauber's salt precipitation in the simulation of the local climate conditions and the results showed that temperature had a great influence on the precipitation rate

* Corresponding author. E-mail: tjtangna@tust.edu.cn

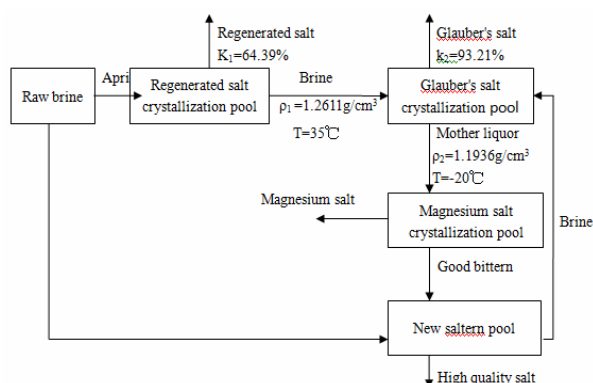


Fig. 2. Technology roadmap for Production control.
(k1. recycled salt precipitation rate, k2. Glauber's salt precipitation rate, p1. Mother liquid density of recycled salt, p2. Mother liquid density of Glauber's salt, T. temperature).

Table 2 Raw brine composition in low freezing process

Ion concentration(g/ml)						Others	
Cl ⁻	SO ₄ ²⁻	Ca ²⁺	Mg ²⁺	Na ⁺	H ₂ O	T (°C)	Density (g/cm ³)
172.11	77.32	0.01	27.82	95.24	883.51	25	1.2560

of glauber's salt. Under room temperature, low temperature is benefit for the precipitation of glauber's salt. At -10 °C, when the rate of adding water was controlled at 7.82%, concentration of SO₄²⁻ fall below 0.15mol/L in the liquid phase and glauber's salt precipitation rate could reach 82.61%. Simulating the salt lake local climate characteristics, we can find that SO₄²⁻ concentration increased with the temperature increasing when the temperature changed from 5°C to -20°C. Concentration of SO₄²⁻ reached 0.12mol/L when the temperature was below 10°C. Glauber's salt precipitation rate was 85.66% in this case.

In the process of production in yabulai, Salt Lake City need to control the concentration of salt lake brine according to the local climate characteristics, which help to ensure the production and quality of NaCl and glauber's salt. In the freezing process in winter, the effect of temperature changes on SO₄²⁻ ion concentration should be paid special attention. According to recycled salt and

glauber' salt precipitation rules of Yabulai salt lake brine, technology roadmap for Production control was determined. Fig. 2 is the technology graph for recycled salt and glauber salt production control.

2 conclusion

In this work, the recycled salt and glauber' salt precipitation rules were investigated, and the technology and production process was designed for recycled salt and glauber salt

Key words: Yabulai salt lake, precipitation rules of recycled salt, glauber, recycled salt, phase diagram

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References

- Pitzer, K.S., 1991. Ion interaction approach: theory and data correction, in activity coefficients in electrolyte solutions[M]. 2nd Edition, Chapter 3, CRC Press, Boca Raton, 75–153.
- Pitzer, K.S., 1977. Electrolytes theory-improvements since Debye-Hückel. *Account Chem. Res.*, 10(10): 371–377.
- Leubner, I.H., 2002. The Balanced Nucleation and Growth Model for Controlled Crystal Size Distribution *Journal of Dispersion Science and Technology*. 23: 577–590.
- Chen Aibing, 2014. Development and Production of Saline Lake Magnesium Chloride Product, Improvement of Resource Utilization Capacity. *Journal of Salt and Chemical Industry*, 42(12): 35–38.
- Wang Zhu, Li Mingli and Shao Bei, 2013. Research of 25°C Isothermal Evaporation of Brine in Eyacuo Salt Lake in Tibet. *Journal of Salt and Chemical Industry*, 42(12): 13–18.