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The Dissolution Experiment of Polyhalite at Different Temperature and Pressure

ZHAO Xianyin[1,2], AN Lianying[1,2*], LI Chunge[1] and CHENG Li

1 College of Materials and Chemistry & Chemical Engineering, Chengdu University of Technology, Chengdu 610059, China;
2 Mineral Resources Chemistry Key Laboratory of the Higher Education Institutions of Sichuan, Chengdu 610059.

Polyhalite (K_2SO_4•$MgSO_4$•$2CaSO_4$•$2H_2O$) is one of the insoluble potassium mineral which is widely distributed in sulfate-type potassium-bearing deposit, and the theoretical concentration of K_2SO_4 is 28%. It can be directly used as a natural、non- chlorine-release mineral fertilizers in the absence of soluble potassium. It has been found that deep marine sedimentary basin is rich in polihalite. By investigating polyhalite solubility under various temperature and pressure in the water-salt system, exploring K^+ transfer between polyhalite and potassium-rich brine, it can reveal the relationship between polyhalite and potassium-rich brine, and provide theoretical guidance and technical support to the polyhalite mining.

It was taken Sichuan Nongle polyhalite as research object, dissolution experiments were conducted in electrically heated autoclave, Solubility of polyhalite in the salt-water system is showed in Table 1.

Table 1 Solubility of Polyhalite in different solvent.

Leaching agent	Liquid Concentration（$g·L^{-1}$）				
	K^+	Ca^{2+}	Mg^{2+}	SO_4^{2-}	Cl^-
Distilled water	14.23	1.33	4.78	33.90	0.030
5%NaCl	19.71	1.53	6.01	52.70	36.55
15%NaCl	24.82	0.31	8.95	64.51	99.42
5%$CaCl_2$	28.99	0.69	9.15	26.94	36.55
15%$CaCl_2$	34.31	22.42	10.07	8.456	95.03

Note: Polihalite 100g, Leaching agent 300mL, 4Mpa, T=130℃,t=9h

The results show that the K^+ in polyhalite is partially dissolved in water, NaCl, $CaCl_2$ solution, and especially in $CaCl_2$, K^+ concentration can be 34.31g/L. It can be inferred that the K^+ in polyhalite will shift into groundwater when groundwater interact with polyhalite in deep formation, and the groundwater will be changed into brine which is rich in K^+, Mg^{2+}.

The effect of temperature, pressure and solid-liquid ratio on the liquid concentration of K^+ in $CaCl_2$ solution showed in figure 1, figure 2 and table 2.

The results show that the liquid concentration of K^+ increased with the temperature and pressure, the effect of temperature is more significant than that of pressure. When the temperature is 130℃, the pressure is 4Mpa, with 5% $CaCl_2$ solution as leaching agent, and groundwater react with a large number of polyhalite, the concentration of K^+ can be reached to 60g/L or more. It provides an experimental basis for the sources of K^+ in potassium-rich brine.

Key words: polyhalite, potassium-rich brine, leaching, calcium chloride

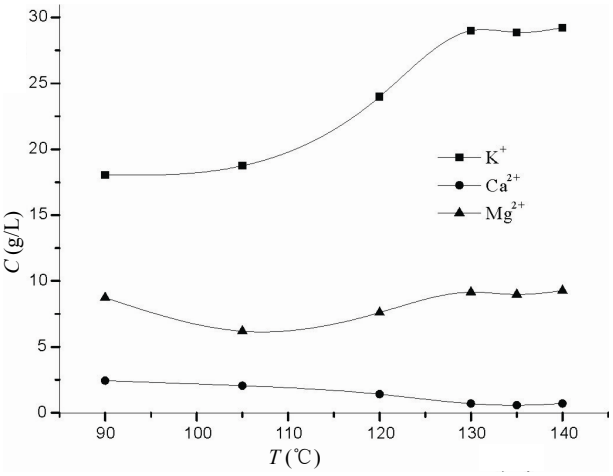

Fig. 1. Relationship between C_M^{n+} and temperature.

Table 2 C_M^{n+} under different Solid- Liquid ratios

Solid-Liquid ratio	K^+	Ca^{2+}	Mg^{2+}	SO_4^{2-}	Cl^-
1:3	34.31	22.42	10.07	8.456	95.03
1:2	53.44	8.72	18.04	16.07	102.7
1:1.5	65.72	0.50	21.71	32.13	100.9
1:1.2	67.56	0.32	22.54	27.79	105.6

Note: T=130℃，4MPa ，Leaching agent 15%$CaCl_2$,

* Corresponding author. E-mail: zhaoxianyin09@cdut.cn

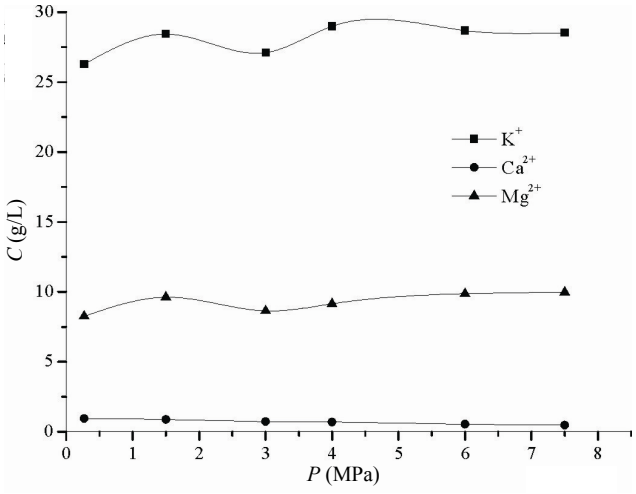

Fig. 2. Relationship between C_M^{n+} and pressure.

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