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Preparation of Ammonium Tungstophosphate-Calcium Alginate Composite Adsorbent and the Separation of Rubidium and Potassium

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As a kind of rare metals, rubidium is often used to prepare special glass, photomultiplier tubes, thermoelectric converter, organic catalysts and antidepressants. Rubidium forms no minerals of its own, hence, it often coexists with other alkali metals in lepidolite, pollucite, lithium pollux, natural carnallite, and underground brine. Especially in underground brine, rubidium coexists with large amount of sodium and potassium. The challenge of isolation and purification of rubidium from brine is its separation from potassium which has similar physical and chemical properties. Phosphomolybdate, phosphowolframate, silicomolybdenate and other polyoxometalates have high selectivity toward rubidium and are considered to be promising materials in the isolation of rubidium and potassium. However, it is so tiny and easy to lose in the process of adsorption and elution that polyoxometalates are often fixed to other supports to make composite adsorbents.

In this paper, a spherical composite adsorbent AWP-CaALG was prepared with ammonium tungstophosphate (AWP) and calcium alginate(CaALG) using sol-gel method. The preparation conditions such as material ratio, $CaCl_2$ concentration, aging time and drying temperature were investigated and optimized using adsorption capacity of rubidium as an evaluation index. The adsorption capacity of the adsorbent of rubidium was determined to be 43mg/g under the preparation conditions of m_{NaALG}:m_{AWP}=1:2, concentration of $CaCl_2$ was 0.5mol/L, aging for 24h, being dried at 105℃. The adsorbent remained good adsorption and elution performance after repetitive operation for 3 times (Fig. 1, 2). The Rb/K ratio increased from 1:10 to 5.7:1 using gradient elution with 1mol/L HCl-0.005mol/L NH_4Cl and 1mol/L HCl-0.5mol/L NH_4Cl (Fig. 3). The Rb/K separation coefficient was 57.

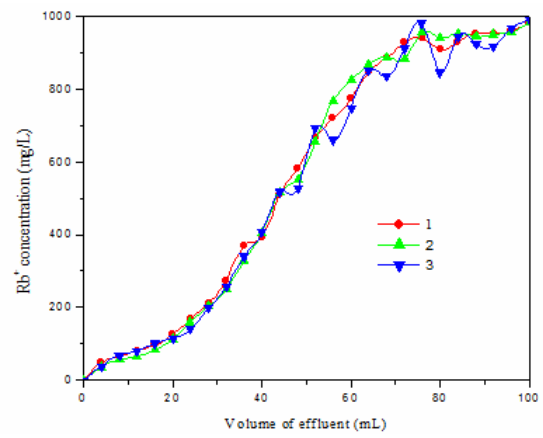

Fig. 1. Breakthrough cures of 3 times uptake tests.
AWP-CaALG: 2.5g; 1.0g/L Rb^+-10g/L K^+; pH=1; height-diameter ratio=3.33; flow rate=5.77BV/h.

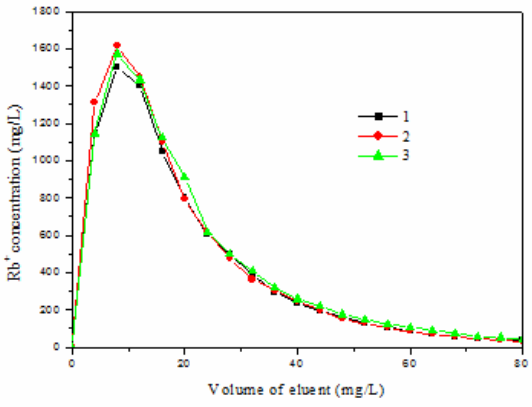

Fig. 2. Elution cures of 3 times elution tests.
AWP-CaALG: 2.5g; 1mol/L HCl-0.5mol/L NH4Cl; height-diameter ratio=3.8; flow rate=2.47BV/h.

Key words: rubidium, potassium, ammonium tungstophosphate, adsorption, composite adsorbent.

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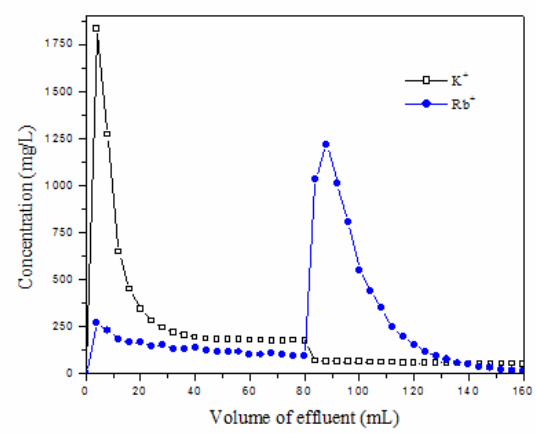

Fig. 3. Gradient elution curves of 1mol/L HCl-0.005mol/L NH_4Cl and 1mol/L HCl-0.5mol/L NH_4Cl.
AWP-CaALG：2.5g; height-diameter ratio=3.33; flow rate=2.47BV/h.

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