Separation of Li^+ in seawater with synthetic inorganic ion exchangers

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Summary

Sea water contains lithium(170 μ g/L), strontium(8500 μ g/L), rubidium(120 μ g/L), molybdenum(10 μ g/L) and others as useful constituents. It is not easy to separate effectively from sea water(concentrated salt solution) by using the conventional method of chemical separation.

Recently, new inorganic ion-exchange materials selective for the above elements have been synthesized by the present authors, et al. That is, antimonic acid with the monoclinic system, antimonates of titanium and tin are selective for lithium. Manganic acid with the tetragonal system is selective for K^+ and Rb^+.

In the present study, new ion-memory ion exchanger selective for lithium ions has been synthesized: 30 g of Nb_2O_5 and 8.34g of Li_2CO_3 were mixed thoroughly and heated at 900 ℃for 24 h to prepare $LiNbO_3$. Lithium in $LiNbO_3$was removed by refluxing in 8M HNO_3 at 105℃. 8M HNO_3 was renewed daily. Finallly the product was washed with water until pH 7 and air-dried. The niobic acid(C-NbA) belongs to the cubic system(Im3, a_o 7.644A) with the chemical composition of $HNbO_3$.

The ion-exchange selectivity was studied for alkali metal ions at low loadings. Plot of Log Kd vs pH showed straight line with the slope of -1. It indicades the ion-exchange ideality. The selectivity increased in the order of $K^+<Rb^+<Na^+<Cs^+<<Li^+$ at pH 10. The separation factor attained over 5,500 for the pair of Cs^+-Li^+. That of Na^+ - Li^+ pair showed 6,400.

The pH titration curve indicated that C-NbA behaves as a monobasic acid for lithium ions at both 30 and 60℃. The pH jump was observed at larger amounts of OH^- added at 60℃. It implys the larger uptake for Li^+ at 60 ℃. The titration curves for Na^+, K^+, NH_4^+. Rb^+ and Cs^+ were the same as those of the blank. The uptake for these cations corresponded to those calculated from the pH titration curve. Only Li^+ was exchanged in the pH range studied($4 < pH < 12$). The uptake increased sharply at pH around 6 and attained nearly a constant of 3.1 meq/g at pH 8 at 30℃ and 4.2 meq/g at pH 9 at 60 ℃.