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Development of high-selective adsorbent for simultaneous recovery of lithium and bromide from seawater

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Summary

In our research group, we have successfully developed the spinel type manganese dioxide (λ-MnO_2) adsorbents with extremely high selectivity of lithium ion. For the purpose of simultaneous recovery of lithium ion and bromide ion from seawater, we are developing a novel adsorbent with bi-ion selectivities as shown in the schematic figure. We synthesize a novel λ-MnO_2 adsorbent with higher adsorption capacity of lithium ion. We have also been developing a novel granulation method of λ-MnO_2 adsorbent with chitin and /or chitosan binder with bromide ion selectivity.

The λ-MnO_2 adsorbents can be prepared from $Li_{1.5}Mn_2O_4$, following the ion exchange of Li^+ to H^+ with acid treatment. This adsorbents show the effective separation and recovery abilities for Li^+ at around pH = 8.1, which is the pH value of the seawater, and against a large amount of other cation.

The granulated λ-MnO_2 adsorbent has adsorptivity and selectivity of bromide ion against chloride ion. However, since adsorption capacity of bromide ion is quite low, we have to search new binder materials with high adsorption capacity of bromide ion. Since bromide ion from this loaded adsorbent is eluted with alkali solution, while lithium ion is eluted with acid solution, we have to consider an alternative elution method of “lithium bromide” from the adsorbent.

From practical experiments for 150 days using a benchmark plant of selective lithium recovery from seawater in Institute of Ocean Energy, Saga University, the concentration ratio of lithium ion in elutant solution to that in seawater can be achieved to 11,000 times and the recovery efficiency of lithium from seawater is 35 % We elucidate that the chromatographic operation using the developed absorbent could be applied to large scale lithium recovery system from seawater.