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Selective Recovery of Bromine from Seawater

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Summary

Bromide ion is well known to be useful as raw materials for refrigerant and drugs. In the materials of the bromide, lithium bromide is one of the attractive ones as the alternative heat pump refrigerant. Bromide ion is presently recovered from seawater, bittern and industrial waste containing the bromide ion. The present recovery method of bromide ion from seawater is that bromine gas is obtained by adding chlorine gas into seawater, and free bromine gas obtained is then treated with alkaline or sulfur gas. This method, however, is required chlorine gas, which is corrosive and toxic, and thus there are issues which should be cleared from the safety operational point of view. Alternative recovery method of bromide ion is therefore one of the important topics for the modern industry. In the present work, the separation method of bromine, such as solvent extraction and ion exchange, has been investigated to construct the selective recovery process of bromine from seawater. Quaternary ammonium salt type extractant and adsorbents were chosen as the separation reagents.

In the case of solvent extraction method, tri-*n*-octylmethylammonium chloride (TOMAC) was used as the extractant followed by dilution to toluene. The extractability of bromine with TOMAC was sufficient in all pH range of the feed solution. The extraction of bromine was, however, suppressed with the existence of chloride ion in the aqueous solution. The continuous process is therefore required for the separation process of bromine from the seawater.

In the case of ion exchange method, commercial ion exchangers (OT-K 1020 and OT-K 1021 supplied by Muromachi Chemical), which possess quaternary ammonium salt group, were used. The adsorbents have sufficient adsorption ability for bromine and it follows with the Langmuir type adsorption mechanism. The pH value hardly affects the adsorption ability for bromide in the range of pH = 4 - 9 and that the adsorption decreases in the range of pH > 10. The elution of loaded bromide ion with alkaline solution is therefore expected to be achieved. When the counter anion of the adsorbents was changed from chloride to hydroxide, the adsorption of bromide progresses as well as chloride type, while the adsorption of chloride hardly occurs. The column operation for the separation of bromine and chloride revealed that the chloride was also contained in the effluent at the elution step. The optimization of the condition and the process is therefore required to construct of the separation process.