Separation of Metal Salts from Sea Water by Membranes Comprised of Schiff Base-Transition Metal Complex

Eizo Oikawa and Toshiki Aoki
Department of Material and Chemical Engineering,
Faculty of Engineering, Niigata University

Summary

Schiff base derivatives of polyallylamine (PAAm) and poly-Schiff bases from a diamine and a dialdehyde were synthesized for the purpose of the membrane use for the recovery of transition and heavy metals from sea water. In this study the influence of polymer composition, the kind and content of crosslinking agent, and membrane-fabricating conditions on the membrane performance was investigated in the pressure-driven separation at 80kg/cm².

In the Schiff base of PAAm (Mw=60,000), salicylaldehyde(S) and 2-pyridinecarboxaldehyde(P) gave most favorable membrane performances among four aldehydes, most of which nearly quantitatively reacted at 40℃ for 2～3 h. The most suitable crosslinking agent was determined for S derivative, for P derivative, and for a hybrid derivative of P and S. All the fabricated membranes showed a good rejection against sodium chloride(NaCl) and cobalt(II) chloride($CoCl_2$) but swelled on contact with $CoCl_2$ supply to such a great extent as to be degraded. However, a composite membrane of PS hybrid derivative using filter paper support was able to be used in repeated supply cycles of NaCl and $CoCl_2$ and for a long period. The equilibrated $CoCl_2$ complexed with the membrane corresponded to about one-fourth of Schiff base groups. Dimethyl sulfoxide (DMSO) gave a significant influence on the separation performance and a PS hybrid membrane cast from DMSO solution showed about 90% difference between NaCl and $CoCl_2$ rejection, but the difference decreased to about 50% in the mixed supply of the two salts, which is attributable to Donnan exclusion. $CoCl_2$-complexed membrane considerably increased the flux, and a low pressure-driven separation in the range of 10～20 kg/cm² was found to be effective for the separation of the each salt from the mixed supply.

Poly-Schiff bases were derived from 2,6-pyridinedicarboxaldehyde and five different diamines under refluxing conditions in a high yield. The polymer from hexamethylenediamine was the only soluble one and was found to form membranes from its blend with PS hybrid or S derivative, favorably along with a crosslinking agent like ethylene glycol diglycidyl ether.