

Development of Anionic Charged Membrane for Use in Selective Recovery of Trace Amounts of Heavy Metal Ions from Sea Water

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Summary

Certain heavy metal cations are known to form metal chloride complexes in the presence of a large excess of chloride ions such as sea water. These complexes can be selectively extracted into organic solvents containing liquid anion-exchangers. Similar ion-association sorption can be obtained by anion-exchange resins. In this study, the potential of these phenomena for application in membrane separation systems of toxic heavy metal ions from sea water was explored.

Sorption behavior of Cd(II) ion from chloride salt solutions into anion-exchange resin (Amberlite CG-400, Rohm&Hass Co., Ltd.) revealed that Cd(II) ion was sorbed in the form of anionic chloride complex such as CdCl_n^{2-n} . Selective sorption of Cd(II) over other heavy metal ions was observed. This system was utilized for extractive transport of metal chloride complexes through commercially available anion-exchange membrane (Selemion AMV, Asahi Glass Co. Ltd.). Under a large concentration gradient of chloride ions across a membrane, Cd(II) chloride complex was selectively enriched in the aqueous receiving phase in accordance with a preferential sorption of Cd(II) on the anion-exchange membrane. No permeation was recorded for Cu(II), Co(II), Fe(III), Ni(II), Ga(III), and In(III). Thus the present system was proved to be effective for selective recovery of Cd(II) from chloride salt solution despite of its low permeation flux.

To enhance permeation selectivity and efficiency, novel hybridized cationic polymer membranes containing trioctylmethylammonium chloride (TOMAC) as a carrier and *o*-nitrophenyloctylether (NPOE) as a plasticizer were developed. The membrane materials used were poly(vinylchloride) (PVC), cellulose acetate (CA), and cellulose triacetate (CTA). An influence of these polymers and membrane composition upon permeation selectivity and efficiency of metal chloride complexes was demonstrated. The stable and selective permeation of Cd(II) chloride complex was observed for the membrane composed of CTA/TOMAC/NPOE (1:2:2 wt%). This membrane was found to exhibit a superior separation selectivity and efficiency to the conventional anion-exchange membranes.