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ENRICHMENT OF ORGANIC SOLUTES WITH HYDROPHOBIC POLYMER MEMBRANE

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Dilute aqueous solutions of aromatic hydrocarbons were permeated through a fluorocarbon polymer membrane under a pressure gradient. Some organic solutes were enriched about two fold and there was a peak in the relationship between enrichment factors and hydrophobicities of the solutes.

It is well known that heavy metal ions or organic solutes are enriched with liquid membranes.[1,2] Polymer membranes also enrich solutes under a pressure gradient in some cases, such as enrichment of phenol with a cellulose acetate membrane.[3] But in many cases, polymer membranes do reject inorganic and organic solutes, which is called reverse osmosis. The authors enriched solutes through a polymer membrane with a novel method, that is, an enrichment of complexed heavy metal ions with a chelating agent through a hydrophobic polymer membrane under a pressure gradient.[4,5] In the method, organic chelating agents were also enriched with heavy metal ions. In this paper, hydrophobic organic solutes were permeated through a hydrophobic membrane under a pressure gradient in order to achieve the enrichment with the membrane.

The hydrophobic membrane used in this study was a fluorocarbon polymer membrane prepared by coating Teflon FEP-120 dispersion on a fluorocarbon membrane filter and then melting as reported previously.[6] Aromatic hydrocarbons were used as organic solutes and their 10^{-4} mol dm^{-3} aqueous solutions were permeated through the membrane under a pressure gradient with a reverse osmosis apparatus. The solute concentrations of the permeated solution and the feed solution were determined by TOC and UV measurements. The permeation data were described with the enrichment factor, which is (concentration of permeated solution)/(concentration of feed solution).

The pressure dependences of the factor and the flux of benzene are shown in Fig. 1. Benzene is enriched with this hydrophobic membrane and the lower the pressure, the higher the factor. The solute flux of benzene does not depend strongly on operating pressure. Benzene must be partitioned and enriched on the hydrophobic membrane surface and permeates under a pressure gradient as the case of permeation of complexed metal ions.[5] The factor of benzene decreased with

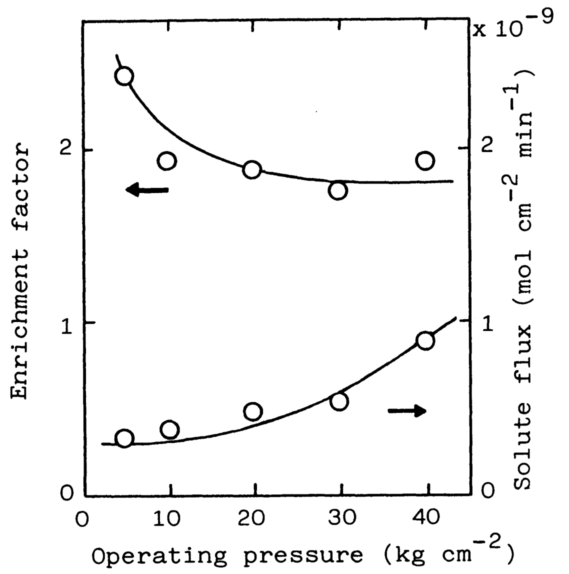

Fig. 1. Enrichment factor and solute flux vs. operating pressure.
Feed soln. : aqueous soln. of 10^{-4} mol dm^{-3} of benzene.

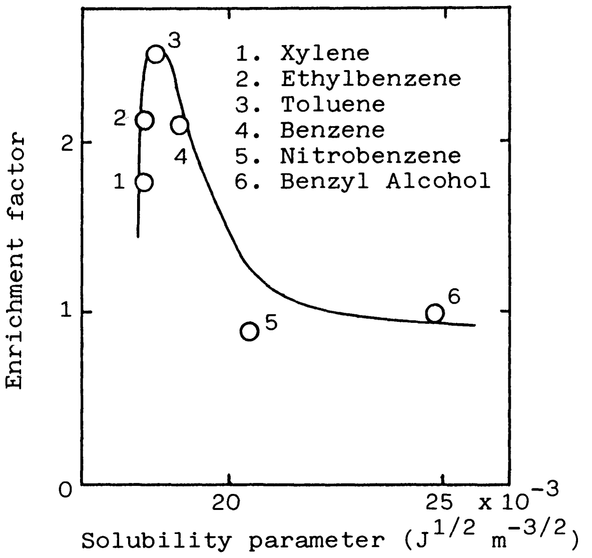

Fig. 2. Enrichment factor vs. solubility parameter.
Feed soln. : aqueous soln. of 10^{-4} mol dm^{-3} aromatic hydrocarbons.
Operating pressure : 10 kg cm^{-2}.

increasing the concentration and the factor became 1.0 at 10^{-3} mol dm^{-3}.

Dilute aqueous solutions of some aromatic hydrocarbons were permeated. The enrichment factors are shown in Fig. 2 against the solubility parameter as the indication of hydrophobicity of organic solute. The factor of hydrophobic solute is high but there is a peak in the relationship between the factor and the parameter. The solute whose hydrophobicity is very strong must be difficult to move in the membrane for the strong interaction with the membrane.

In conclusion, hydrophilic solutes were rejected with the hydrophobic membrane for the strong interaction between solute and water but hydrophobic solutes were found to be enriched with it.

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