SUPPORTED LIQUID MEMBRANE EXTRACTION OF W(VI) IONS USING TRI-N-OCTYLAMINE AS CARRIER

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Study of the extraction of W(VI) ions using supported liquid membrane has been carried out. The carrier used for this metal ion transport, is tri-n-octylamine (TOA) dissolved in xylene. The liquid was supported in microporous polypropylene film. The parameters studied are effect of carrier concentration in the membrane, acid concentrations in the feed solution, concentration of stripping agent on transport of W(VI) ions and of temperature on the transport properties of these supported liquid membranes. The optimum conditions of transport for these metal ions determined are, TOA concentration, 0.66 mol m⁻³ (TOA); HF concentration in the feed solution, 0.01 mol m⁻³ and concentration of NaOH used as stripping agent 2.5 mol m⁻³. The maximum flux and permeability determined under optimum conditions are 3.06 × 10⁻⁵ mol m⁻² s⁻¹ and 8.44 × 10⁻¹¹ mol m⁻³ s⁻¹ at 25±2 °C and 4.21 × 10⁻⁵ mol m⁻² s⁻¹ and 11.55 × 10⁻¹¹ mol m⁻³ s⁻¹ at 65 °C, respectively. The diffusion coefficients for the metal ion carrier complex in the membrane have also been determined. Under the optimum conditions the value for the metal ion carrier complex is 0.14 × 10⁻¹¹ mol m² s⁻¹. Mechanism of transport and the complex formed in the presence of HF have also been discussed. The transport process involves two carrier amine molecules and two protons.

Introduction

Tungsten, being a constituent element in many alloys, especially for creating hardness and resistance to corrosion by many chemicals, is a very important element. Extraction chemistry from aqueous solutions is important to separate it from other metal ions of interest. Solvent extraction study of tungsten(VI) from acid solutions has been performed by some workers. As the tungstates are generally less stable in mineral acid, there are very few references in literature. Some work has been done by DE et al., on extraction of W from HCl with tri-n-butyl phosphate¹ and PALANT et al.² with trialkylamines from aqueous solutions at pH 2, and SATO et al.³ on extraction of W(VI) in the presence of HCl. They added tartaric acid to prevent precipitation of tungstates. In the present investigation, HF was used to...
prevent the formation of such precipitates. No work on transport of W(VI) ions through supported liquid membranes, using tri-n-octylamine appears to have been done especially in the presence of HF in the feed solution. The present investigation was performed to reveal the effect of the following factors on the flux and permeability of tungsten ions through the TOA-xylene based liquid membrane supported in polypropylene microporous films: (1) concentration variation of tri-n-octylamine in the membrane, (2) HF concentration in the feed solution, and (3) NaOH concentration in the stripping phase.

Effect of temperature was also studied for the same purpose to judge the performance of the membrane studied, with respect to flux and permeability of the liquid membrane described above.

**Experimental**

**Liquid membrane cell**

The cell was fabricated from Perspex material. It consisted of two feed and product solution compartments with stirrers. A membrane of effective area of 12.56 cm² fixed in between these two half cells, could separate the feed and stripping solutions. More details about the cell are given in Reference 4.

**Membrane**

The carrier-cum-diluent was supported in Celgard 2400 film of porosity 38%, pore size 0.02 μm and thickness of 25 μm by soaking the film in the required concentration carrier solution for more than 24 hours.

**Flux measurement**

The feed and stripping solutions were filled in their respective cell compartments with membrane in its position. The solutions were kept agitated with stirrers at a speed greater than 1500 rpm to avoid concentration polarization at the membrane interfaces. Samples from the feed solution were taken after regular time intervals and analyzed spectrophotometrically using the technique derived from Reference 5.

**Solvent extraction**

Equal volumes of known tungsten(VI) solution with given HF concentration and organic TOA in diluent solutions were shaken for 20 minutes in separatory funnels and allowed to stand for one hour. The aqueous layer after separation was analyzed...