A process intensified technique of liquid membrane employed in in-house hollow fiber contactor

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ABSTRACT

Facilitated transport through liquid membrane is advantageous over conventional processes for separation of valuable metals such as uranium from lean streams. Dispersion liquid membrane in hollow fiber contactor has the advantage of simultaneous extraction and stripping, continuous replenishment of organic phase immobilized in pores of polymeric membrane and fast disengagement of loaded dispersion after the mass transport operation. In liquid membrane based transport process, diffusion path length inside the wetted pore is important in deciding the rate of extraction. Diffusion path length is related to the fraction of the pore length wetted by the organic liquid membrane phase. Hence, estimation of fraction of the pore length wetted by the organic phase is beneficial for design and scale up of this process. In the present work, a mathematical model has been developed for determining the rate of transport through the membrane and the extent of extraction through the contactor. A novel approach for estimation of fraction of the pore length wetted by the organic membrane phase has been suggested through developed model. This estimation is also helpful to get an idea of the stability of liquid membrane phase to the given polymeric membrane. The data has been generated for extraction of uranium from nitrate medium in counter current once-through mode using hollow fiber dispersion liquid membrane. Water-in-oil dispersion of 1 M NaHCO3 in dodecane, containing 30% v/v Tri-n-butyl phosphate (TBP), is used as extractant. Using polypropylene contactor, uranium extraction of 98% has been achieved in single pass of the feed solution. The model is validated for contactors made of lumens of different materials viz. polysulfone and polypropylene. For polysulfone lumen, the model estimates the fraction of the pore length wetted by the organic membrane phase as 40%. Similarly, estimation has been made for polypropylene lumen and the entire pore length has been found wetted by the organic membrane phase. The model has also been found beneficial for prediction of the performance of polysulfone and polypropylene hollow fiber contactors regarding their scale up.

Keywords: Modelling; Hollowfiber; Uranium; Membrane; Scale up

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