Optimization of hexavalent chromium removal by emulsion liquid membrane (ELM) using sunflower oil as eco-friendly solvent

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Received 8 June 2016; Accepted 2 December 2016

ABSTRACT

The focus of this study is the extraction of hexavalent chromium (Cr(VI)) from wastewater using emulsion liquid membrane (ELM) in order to contribute to sustainable design by replacing the common synthetic organic solvents to a bio-based solvent. The membrane phase consisted of sunflower oil as solvent and two non-ionic surfactants (Span 80 and Tween 80) as emulsifiers. Tri-n-octylphosphine oxide (TOPO) was used as carrier and Na₂CO₃ aqueous solution (0.5 mol/L) as stripping phase. The extraction of hexavalent chromium by using ELMs with sunflower oil as green solvent was modeled and optimized. The influence of several factors was studied: the volume fraction of the internal aqueous phase (X₁), initial concentration of hexavalent chromium [Cr(VI)] (X₂), and the percentage of carrier concentration (X₃). A full 2³ factorial design was performed to study the influence on the yield of the extraction process of Cr(VI); it provided important information regarding the optimum level of each variable along with its interactions with other variables and their effects on yield. Characterization of the primary water-in-oil (W₁/O) and double emulsions (ELM) are also reported. Results showed that the use of a vegetable solvent in ELMs formulation is a good alternative to petroleum organic solvents reaching Cr(VI) removal efficiency values up to 87.43% using 4% of TOPO at an optimal pH of 1.

Keywords: Chromium; Extraction; Emulsion liquid membrane; Factorial design; Eco-friendly solvent; Sunflower oil

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