



Extraction of plutonium (IV) from aqueous nitrate solutions into ligand modified micellar phase (LMMP) of Tergitol 15-S-9 with tri-octylphosphine oxide and separation by ultrafiltration

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ABSTRACT

Pressure-driven membrane-based ultrafiltration (UF) techniques have definite use in the effluent treatment process. One of the promising applications of UF is the extraction of solute into a surfactant micellar pseudo-phase and its removal by filtering through suitable semi-permeable membrane. Extraction of Plutonium (IV) from nitric acid solutions using nonionic polyethylene glycol ether, Tergitol 15-S-9 (Tergitol) surfactant with trioctylphosphine oxide (TOPO) was investigated under different experimental conditions. For the separation of surfactant micelles, polyethersulfone membranes with nominal molecular weight cut-offs (NMWCO), 3, 5, and 10 kDa were used in the batch and stirred cell UF unit. The effects of NMWCO of the membrane and feed solution conditions, such as the concentration of surfactant, organic ligand TOPO, and ionic concentrations on the efficiency of the removal of Pu (IV) were studied. More than 90% recovery of Pu(IV) could be achieved using membrane of NMWCO 3 kDa from aqueous solution contained 0.42 mM Pu with 1–3 M HNO₃, 85.6 mM Tergitol, and 3.8 mM TOPO. The selectivity for the separation of plutonium was investigated by observing rejection of some commonly associated metal ions from nitric acid solutions of three different concentrations. The rejection of Cs(I) was negligible, whereas maximum 54% of Zr, 10% Ce(III) and Eu(III) and 7% of Ru(III) were rejected along with 90% of plutonium from the aqueous solution.

Keywords: Extraction; Micellar enhanced ultrafiltration; Plutonium; Tri-octylphosphine oxide; Tergitol 15-S-9

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