World Academy of Science, Engineering and Technology
International Journal of Nuclear and Quantum Engineering
Vol:10, No:05, 2016

A Method for Solid-Liquid Separation of Cs+ from Radioactive Waste by Using Ionic Liquids and Extractants

Authors : J. W. Choi, S. Y. Cho, H. J. Lee, W. Z. Oh, S. J. Choi

Abstract : Ionic liquids (ILs), which is alternative to conventional organic solvent, were used for extraction of Cs ions. ILs, as useful environment friendly green solvents, have been recently applied as replacement for traditional volatile organic compounds (VOCs) in liquid/liquid extraction of heavy metal ions as well as organic and inorganic species and pollutants. Thus, Ionic liquids were used for extraction of Cs ions from the liquid radioactive waste. In most cases, Cs ions present in radioactive wastes in very low concentration, approximately less than 1ppm. Therefore, unlike established extraction system the required amount of ILs as extractant is comparatively very small. This extraction method involves cation exchange mechanism in which Cs ion transfers to the organic phase and binds to one crown ether by chelation in exchange of single ILs cation, IL_cation+, transfer to the aqueous phase. In this extraction system showed solid-liquid separation in which the Ionic liquid 1-ethyl-3-methylimidazolium bis(trifluoromethylsulfonly)imide (C2mimTf2N) and the crown ether Dicyclohexano-18-crown-6 (DCH18C6) both were used here in very little amount as solvent and as extractant, respectively. 30 mM of CsNO3 was used as simulated waste solution cesium ions. Generally, in liquid-liquid extraction, the molar ratio of CE:Cs+:ILs was 1:5~10:>100, while our applied molar ratio of CE:Cs+:ILs was 1:2:1~10. The quantity of CE and Cs ions were fixed to 0.6 and 1.2 mmol, respectively. The phenomenon of precipitation showed two kinds of separation: solid-liquid separation in the ratio of 1:2:1 and 1:2:2; solid-liquid-liquid separation (3 phase) in the ratio of 1:2:5 and 1:2:10. In the last system, 3 phases were precipitate-ionic liquids-aqueous. The precipitate was verified to consist of Cs+, DCH18C6, Tf2N- based on the cation exchange mechanism. We analyzed precipitate using scanning electron microscopy with X-ray microanalysis (SEM-EDS), an elemental analyser, Fourier transform infrared spectroscopy (FT-IR) and differential scanning calorimetry (DSC). The experimental results showed an easy extraction method and confirmed the composition of solid precipitate. We also obtained information that complex formation ratio of Cs+ to DCH18C6 is 0.88:1 regardless of C2mimTf2N quantities.

Keywords : extraction, precipitation, solid-liquid seperation, ionic liquid, precipitate
Conference Title : ICNST 2016 : International Conference on Nuclear Science and Technology
Conference Location : Tokyo, Japan
Conference Dates : May 26-27, 2016