EXPLORATION OF A NOVEL SOFT DONOR EXTRACTANT FOR PRECIOUS METAL RECOVERY IN SPENT NUCLEAR FUEL AND ELECTRONIC WASTE REPROCESSING

Brian Gullekson[a], Alena Paulenova[a], P. Zalupski[b]
[a]Oregon State University, Corvallis, OR, USA
[b]Idaho National Laboratory, Idaho Falls, ID, USA

Abstract

Spent nuclear fuel reprocessing streams and electronic waste present a viable, and potentially more abundant than in nature, source of precious metals [1]. Solvent extraction with soft electron donor ligands has been shown to preferentially extract softer Lewis acid metals over harder electron acceptors as dictated by HSAB theory [2]. Thiolating oxygen sites on organic ligands is an effective method of creating softer electron donor ligands due to the lower electronegativity of sulfur. Several studies have been performed that show that thiolated ligands either more preferentially extract trivalent actinides over lanthanides, or can be used to isolate precious metals (Ag, Au, etc.) from mixed waste streams.[3],[4]

In this study, a novel ligand, bis-(dibutanethiolthiophosphonato)methane (bDBTPM)was synthesized in an attempt to recover noble metals from both spent nuclear fuel and electronic waste. The ligand is synthesized in a two step reaction, first reacting butyl mercaptan with a chlorinated diphosphineto create a thiophosphonite, followed by a second thiolating reaction to create a thiophosphonate. This reaction was confirmed by both ^{1}H and ^{31}P NMR spectrometry. Following this synthesis, lab scale solvent extraction experiments were performed with several precious metals in aqueous nitric acid solutions to determine their extractability into an organic phase of bDBTPM in n-dodecane. Preliminary results indicate that this ligand is effective at extracting precious metals at lower acid concentrations, possibly indicating its use as an extractant for use in post-PUREX waste reprocessing streams or in a solvent extraction scheme to reprocess electronic components dissolved in an aqueous phase.

References

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