Investigation of metal ion extraction and aggregate formation combining acidic and neutral organophosphorous reagents

A. D. Braatz*, T. Anderson, R. Ellis, M. Antonio and M. Nilsson
***Department of Chemical Engineering and Materials Science, University of California, Irvine**

Abstract

Advanced nuclear fuel cycles are dependent on successful chemical separation of the various elements present in the used fuel. Numerous extraction systems have been developed for the recovery and separation of the various metal ions present in the used fuel. In these solvent extraction systems for the purification of spent nuclear material, aggregation phenomena can interfere with the efficiencies of the processes and decrease the successfulness of the separation. The predictability of these phenomena have been challenging due to the lack of a fundamental understanding of the mechanism that drives these aggregate formations. To investigate the aggregation more closely, tri-n-butyl phosphate (TBP) and dibutyl phosphonic acid (HDBP) in n-dodecane were chosen as the organic phase to be contacted with an aqueous phase containing a single metal ion from the lanthanide series in either 2M or 0.2M nitric acid. The extraction of lanthanum and dysprosium from nitrate solutions at various metal ion concentrations between 10^{-4} M and 10^{-2} M was investigated. Third phase was observed in dysprosium samples of high metal ion concentration though only slight clouding was observed in lanthanum solutions at the same concentrations and conditions. Distribution ratios of metal ions, water uptake, nitrate concentration, and acid concentration were measured to help determine physicochemical properties of the investigated system. Possible explanations of effects and future direction of this project will be presented. Separate studies of the X-ray scattering behavior of these solutions will also be presented.