RadChem 2010



Contribution ID: 191

Type: Verbal

Cobalt bis(dicarbollide) ions with covalently bonded TODGA-like substituents for actinide and lanthanide extractions

Monday, 19 April 2010 10:30 (15 minutes)

The partitioning and transmutation of long-lived nuclides such as minor actinides from high liquid waste (HLW) issued from nuclear fuel reprocessing is a method how to reduce the long-term environmental burder of HLW. In recent years, several HLW partitioning processes using different extractant agents have been developed. Among them, the tridentate ligands like N,N,N',N'-tetraoctyl diglycolamide (TODGA) are one of the most promising extractants for the recovery of actinides and lanthanides in the nuclear fuel treatment. In this work, the recently developed extractants based on cobalt bis(dicarbollide) ion(1-), [(1,2-C2B9H11)2-3-Co)]- (COSAN) functionalized with TODGA like substituents were evaluated for extraction of trivalent actinides and lanthanides from acidic waste solutions. The extractants under study differed in substitution of the amide nitrogen (e.g. by butyl-, octyl-, terc-octyl-, dodecyl-, benzyl- groups) and the mode of attachment of two cobalt bis(dicarbollide) anions (with or without spacer) to diglycolyl acid platform by amidic bonds. It was found, the compounds with longer diethyleneglycol connectors between COSAN cage and diglycolamide group extracted trivalent lanthanides and actinides very effectively even from highly acidic nitric acid solutions. Additionally, the extraction efficiency of such derivates was significantly higher than that of comparable organic TODGA molecules without COSANs. The most perspective compound from this series corresponds to the formula X-[(8-CH2-CH2O)2-1,2-C2B9H10)(1',2'-C2B9H11)-3,3'-Co]2, where central amidic unit X corresponds to [(n-C8H17-NCOCH2)2O]. We will be demonstrate here, this extractant enables good extraction of trivalent lanthanides and actinides from majority of fission products presented in the simulated PUREX feed. Trivalent radionuclides can be effectively stripped using complexants. This extractant will be further studied for possible technological applications.

We thank for partial support from Grant Agency of the Czech Republic (Project No. 104/09/0668), Radioactive Waste Repository Authority (Project 2007/006/Šumb and 2009/002/Šu), and Research Plan AV0Z40320502 from AS CR.

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Session Classification: Chemistry of Nuclear Fuel Cycle, Radiochemical Problems in Nuclear Waste Management 1

Track Classification: Chemistry of Nuclear Fuel Cycle, Radiochemical Problems in Nuclear Waste Management