Andrey A Naumov et al., J Nucl Ene Sci Power Generat Technol 2017, 6:4
DOI: 10.4172/2325-9809-C1-006

conferenceseries.com SciTechnol

2nd International Conference on

NUCLEAR CHEMISTRY

November 15-16, 2017 | Las Vegas, USA

Concentrating of fission ^{99}Mo from very low enriched uranium by extraction with higher hydroxamic acids solutions in alcohols C_8-C_{10}

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Extraction of molybdenum, uranium, and certain fission products from nitric acid solutions with 0.2% solutions of higher hydroxamic acids (HA) in alcohols poorly soluble in water has been studied for ^{99}Mo concentrate production from solutions of enriched U targets, including those of very low enrichment (3% ^{235}U dioxide). The process chemistry of Mo has been supposed for both steps of Mo interphase transfer. Mo extraction by the solvent containing HA, namely caprinohydroxamic acid (CHA), is a slow process limited by first-order reaction in aqueous phase. The slope of D_{Mo} on its aqueous con-centration indicates on apparent coordination number ~ 3 (or more ex-actly, ~2,7 due to Mo partial dimerization in the solvent phase), D Mo rising with the length of alcohol alkyl radical.. One alcohol molecule might enter into the Mo complex with HA. Mo backwashing has been performed by interphase autocatalytic thermo-chemical HA oxidizing destruction with 5 mol/L HNO_3 at 95 oC in combination with Mo complexing in aqueous phase by a salt-free reagents. Alkaline scrubbing has been chosen for final regeneration of the solvent base. The final rig trial included (see Fig.) dissolution of U-Al model or real targets in 8 mol/L HNO_3 containing 0.2 g/L Hg and 0.2 g/L HF at 95oC, allowing further radioiodine and ruthenium compounds air strip-ping. Batch extraction process of Mo recovery was carried out after cooling of the feed using 27 mmol/L caprinohydroxamic acid in 20% n-decanol with Isopar-M in 3 steps – extraction, scrubbing and back-washing - in the vessels of decreasing volume according to the concen-trating factor. The simulate feed contained, mol/L : HNO_3 – 1,2; Al – 1,2; Fe – $5\cdot10^{-3}$; U – 0,11; Hg – $1\cdot10^{-3}$, ^{239}Pu –$1{,}4\cdot10^{-4}$, Mo – $3{,}2\cdot10^{-5}$, as well as 15 MBq/L ^{99}Mo, 5,2 MBq/L ^{125}I and 4,1 MBq/L ^{239}Np. The achieved concentrating factor was 180 in total, including 18 at extraction and 10 at backwashing at 90oC. Total process duration was 2 h. Decontamination factors were ~ $1.5\bullet10^6$ from U, ~ 850 from ^{125}I, > 10^5 from ^{239}Pu, > 10^6 from 239Np, > 10^6 from Al, $4.6\cdot10^4$ from Fe, ~ $2\bullet10^4$ from Hg. The compact extraction flowsheet and simple equipment are proposed. Final Mo decontamination could be performed by sorption and/or by sublimation. The method could be assumed as an interlocutory decision between HEU irradiation and that one of high purity Mo even isotopes (^{98}Mo and ^{100}Mo).

Biography

Andrey A. Naumov is working in the laboratory of spent nuclear fuel reprocessing of the Khlopin Radium Institute (St-Petersnurg, Russia). He is a member of the scientific team which have dealt with investigation, development and testing of modern extraction for aqueous processing of irradiated materials of different kind. His main scientific interest now is to study the extraction of molybdenum-99 from solutions of irradiated uranium targets using higher hydroxamic acids, applicating for PhD in radiochemistry.

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