Desalination and Water Treatment
www.deswater.com

doi: 10.1080/19443994.2013.848655

52 (2014) 514–525
January

Taylor & Francis
Taylor & Francis Group

Removal of ruthenium from high-level radioactive liquid waste generated during reprocessing of spent fuel

Khushboo Singh[a]*, N.L. Sonar[a], T.P. Valsala[a], Y. Kulkarni[a], Tessy Vincent[b], Amar Kumar[b]

[a]*Waste Immobilization Plant, Nuclear Recycle Board, Bhabha Atomic Research Centre, Tarapur 401502, India*
Email: sona.khushboo705@gmail.com
[b]*Process Development Division, Nuclear Recycle Group, Bhabha Atomic Research Centre, Trombay, Mumbai 400085, India*

Received 16 April 2012; Accepted 2 September 2013

ABSTRACT

Radio-ruthenium (Ru) due to its existence in the form of complexes with varied oxidation state, larger fission yield and relatively long half life is an extremely troublesome nuclide during reprocessing and subsequent waste management. In the process of the concentration of high-level waste (HLW), containing many nitrates of fission products and nitric acid, Ru is oxidised to volatile tetroxide RuO_4, which is reduced to its dioxide (RuO_2) at the inner surface of the equipment and is deposited there. As a result, the radiation dose of the plant equipments keeps increasing. A process was developed for the separation of Ru from HLW stream by volatilisation using $KMnO_4$ (potassium permanganate) and O_3 (ozone) as oxidising agent and its subsequent trapping on adsorbent material polyether ether ketone pellets. Various parameters like acidity, Ru concentration, temperature, time period of reaction and type of adsorbent were studied. The sorption behaviour was examined with various isotherms like Langmuir, Freundlich and Dubinin–Raduskevich isotherms. Thermodynamics parameters were also evaluated. The results indicated that maximum volatilisation of Ru occurred in the case of $KMnO_4$ (98%) as compared to O_3 (53%) at low acid concentration (2 M).

Keywords: Ruthenium (Ru); Simulated high-level liquid waste (SHLLW); Polyether ether ketone (PEEK)

*Corresponding author.

Presented at the DAE—BRNS Biennial Symposium on Emerging Trends in Separation Science and Technology (SESTEC 2012) Mumbai, India, 27 February–1 March 2012