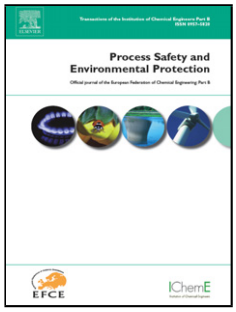

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PII: S0957-5820(17)30061-7
DOI: http://dx.doi.org/doi:10.1016/j.psep.2017.02.019
Reference: PSEP 986

To appear in: *Process Safety and Environment Protection*

Received date: 21-7-2016
Revised date: 14-2-2017
Accepted date: 23-2-2017

Please cite this article as: Aslani, Mahmoud A.A., Celik, Fatih, Yusan, Sabriye, Kutahyali Aslani, Ceren, An Assessment of the Adsorption of Thorium onto Styrene-divinylbenzen Based Resin: Optimization using Central Composite Design and Thermodynamic parameters.Process Safety and Environment Protection http://dx.doi.org/10.1016/j.psep.2017.02.019

An Assessment of the Adsorption of Thorium onto Styrene-divinylbenzen Based Resin: Optimization using Central Composite Design and Thermodynamic parameters

Mahmoud A. A. ASLANI*, Fatih Celik, Sabriye YUSAN, Ceren KUTAHYALI ASLANI

Ege University, Institute of Nuclear Sciences, Department of Nuclear Technology,
35100, Bornova – Izmir – TURKEY
*mahmoud.aslani@ege.edu.tr

Abstract

Adsorption of thorium on styrene-divinylbenzen based resin was investigated to obtain the optimum adsorption conditions by using the Central Composite Design (CCD). This study was performed in 30 runs of experiments as a function of pH, thorium concentration, contact time and temperature. Adsorption performance of styrene-divinylbenzen based resin was observed higher than 98%. It was observed that the optimum adsorption of thorium using styrene-divinylbenzen based resin can be successfully predicted statistically by CCD. In addition, sorption isotherm models such as Langmuir, Freundlich and Dubinin-Radushkevich were applied and adsorption of Th (IV) was described most precisely by the Langmuir isotherm which has the highest R^2 (0.99) value. Thermodynamic parameters showed that the adsorption is an exothermic and spontaneous physical process. The results of this study reveal that this type of synthetic resin can be used as an effective sorbent material for the removal of Th (IV) ions from weakly aqueous solutions in the field of remediation and nuclear wastewater treatment.

Keywords

Adsorption, RSM, CCD, Lewatit S1468, Th^{4+}

1. Introduction

The natural radionuclides such as thorium, which is one of the first actinides known, are trapped in the earth's crust. Because of their long half lives, ^{228}Th ($t_{½}$ = 1.913 y), ^{230}Th ($t_{½}$ = 8.0 x 10^4 y), and ^{232}Th ($t_{½}$ =1.41 x 10^{10} y), which are all alpha-particle emitters, pose long-term health risks and are therefore environmentally important. These radionuclides can be released into the atmosphere by human technology. For instance, burning of fossil fuel is the most significant cause for the direct atmospheric release of pre-existing natural radioactivity (radionuclides from uranium and thorium series) [1]. On the other hand, a variety of systems and processes such as nuclear weapons fabrication and testing, nuclear fuel cycle processes, radioisotope production and application, and nuclear accidents may introduce radioactivity