Contribution ID: **577** Type: **Verbal**

Remediation of Radioiodine from aqueous used nuclear fuel (UNF) waste streams by Lewatit A365 and Purolite S985

Thursday, 17 May 2018 11:00 (15 minutes)

Some nuclear accidents and nuclear fuel treatment (such as reprocessing) can release radioactive iodine isotopes, principally 129I and 131I, into gaseous streams and aqueous solutions. Iodine-131 raises concerns in nuclear accidents due to its high activity and the potential for uptake into the human body but does not pose a long-term disposal risk due to its short half-life (t1/2 = 8.04 d). Iodine-129 raises concerns due to its extremely long half-life (t1/2 = 1.57 × 107 y) and high mobility in most geological environments. During aqueous reprocessing of used nuclear fuel (UNF), iodine partitions between the various gas streams and the various aqueous phases, and iodine can be released to varying degrees in almost every process within the facility. Subsequently, a more efficient method of capturing and immobilizing this iodine from various waste streams before disposal or discharge is required. Current research is looking at aqueous scrubbing of radioiodine from acidic conditions due to compatibility with aqueous based back end processes of UNF reprocessing. This research looks at the effectiveness of two commercially available anion exchange resins for aqueous iodide uptake under a variety of conditions that may be present in reprocessing. Lewatit A365 and Purolite S985 have previously never been considered for iodide uptake, therefore our study aims to determine the suitability of these resins for their industrial implementation.
pH-dependence, isotherm, kinetic and column simulation data has been obtained, allowing for a detailed comparison of performance between the two resins, using iodide ISE analysis. Purolite S985 was found to display greater uptake capacity than Lewatit A365 under all experimental conditions tested, with Langmuir model-fitting demonstrating a maximum uptake capacity of 548.9 mg g-1 in comparison to Lewatit's 435.9 mg g-1. Uptake capacities when compared to commercial applications such as silver mordenite and silver-nitrate impregnated silica and alumina are considerably greater, suggesting these ion-exchange resins could be a superior alternative. Furthermore, our studies have found that addition of iodine enhances iodide uptake by each resin which could dramatically improve uptake where both species are present such as in UNF streams.

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Session Classification: SEP 3

Track Classification: Separation Methods, Speciation