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Polyamine Functionalised Ion Exchange Resins: Synthesis, Characterisation and Uranyl Uptake

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Abstract

A series of linear polyamine functionalised weak base anion exchange resins have been synthesised using the Merrifield resin and characterised using infra-red spectroscopy, thermogravimetry, elemental analysis and solid state ^{13}C nuclear magnetic resonance spectroscopy. Uptake behaviour towards uranium (as uranyl) from sulfuric acid media has been assessed as a function of pH and sulfate concentration, with comparison to a commercially available weak base anion exchange resin, Purolite S985. Synthetic polyamine resins were seen to outperform the commercial resin at industrially relevant uranyl concentrations, with a trend of increased uptake being seen with increasing polyamine chain length. Uranium loading isotherm studies have been performed and fit with the Langmuir and Dubinin-Radushkevich isotherm models, with a maximum loading capacity observed being 269.50 mg g^{-1} for the longest polyamine chain studied. Extended X-ray absorption fine structure experiments have been used to determine uranium coordination environment on the resin surface, showing a $[UO_2(SO_4)_3]^{4-}$ species. This coordination knowledge was employed to develop an extraction mechanism and derive an isotherm model based on the law of mass action.

Keywords; Uranium, polyamine, ion exchange, EXAFS, isotherm models