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Attachment of APTES ((3-aminopropyl)triethoxysilane) to silica for sorption and selective removal of radionickel from solution

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The main aim of this research is to design and develop a novel class of selective sorbents or sequestrating agents for various actinides, fission products, heavy metals and groundwater contaminants using a bespoke modular design of solid-supported polymers and containment-specific ligand groups.
Our current research has seen us attach the ligand known as APTES straight to the surface of silica gel (mean particle size; ca. 70 μm) and high surface area fumed silica (mean particle size; ca. 0.007 μm).
By utilising two different silica types, the authors have been able to investigate the efficiency of ligand attachment to different types of silica. Following successful sequestration of inactive transition metals including cobalt, nickel, copper and zinc, we have extended our research by using the radioactive isotope of nickel-63.
Using a range of concentrations from 2.5 ppm to 80 ppm, the silica attached APTES has successfully sequestrated Ni-63. To make the investigation more realistic and be able to relate it to a real case scenario, competitive ions (in this case sodium and calcium) were added to further the study. It has been shown that the nickel sequestration is not as affected by the addition of these ions as one might expect. Sequestration is still observed at a similar level to deionised water.
Rd's for the sequestration of Ni-63 from deionised water range from 4 x 104 ml/g to 1.2 x 107 ml/g compared to 5.3 x 104 ml/g to 7.9 x 105 ml/g for competitive calcium in solution and 1.2 x 105 ml/g to 7.3 x 106 ml/g for competitive sodium sequestration. Isotherms have also been produced across a pH range from 5.01 to 6.80 before addition of the material, to a final pH of 6.90 to 9.49 depending on the original concentration and competitive ions in solution.

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