**Actinide Colloid Formation and Stability in Alkaline Conditions: Implications for Effluent Treatment.**

Globally, nuclear fuel ponds are used for storage of spent nuclear fuels. In the UK, we have a number of old pond facilities at the Sellafield nuclear facility which require clean-up over the next decades (Figure 1). The Sellafield ponds contain alkaline, effluents with significant radioactive loadings and management of the effluents is essential to timely decommissioning of the ponds (www.sellafield.com). The pond effluents are treated by neutralisation, filtration and ion exchange processes prior to discharge of low level effluents to the environment under authorisation. Building on past work from our group (Bots et al., 2014; Smith et al., 2014), recent highly novel work on these systems has examined the potential for radionuclide bearing colloid formation in representative waste waters from the legacy ponds and silos. We have identified that nanoparticulate uranium bearing colloids are stable across a range of pond chemistry regimes (Figure 2), and that strontium (including the radioactive isotope strontium-90) may be associated with these nanoparticulate colloids under some conditions. This has provided new insights into the structure and stability of these highly novel nanoparticulate phases in alkaline conditions.

**Figure 1. Sellafield Legacy Nuclear Fuel Pond www.gov.uk/government/publications**

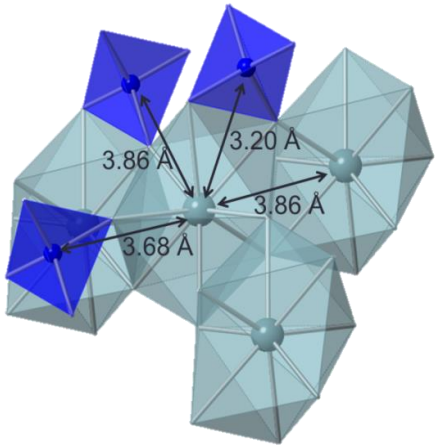


**Figure 2. Molecular Structure of Uranium Colloid.**

This PhD project will continue to develop our highly innovative research based on treatment of alkaline effluents. The key aim will be to characterise the nanoparticle chemistry, structure and stability in the presence of key radionuclides, explore the reaction of the radionuclide bearing nanoparticles with mineral phases present within the ponds, and explore the impacts of a more varied effluent chemistry on colloid stability and therefore effluent treatment. Overall, the project will provide essential information on radionuclide speciation and fate in these complex systems which will directly inform the pond decommissioning process, a project of high national importance. More generally, the presence of radionuclide colloids in alkaline conditions has high relevance in a range of settings including radioactive waste management.

**Training:** This industrially sponsored PhD project will be based in the School of Earth & Environmental Sciences at The University of Manchester. The project will be experimental in scope, and the successful candidates will join a significant ongoing research effort in the nuclear environment and waste area in the group. The project will be based at The University of Manchester and run in collaboration with Sellafield Ltd. and the National Nuclear Laboratory. Currently, the group has over 20 PhD researchers training across the nuclear environmental area and all of our

nuclear PhD graduates have gained employment in academia / industry / regulation. The researcher will also benefit from the excellent facilities within the Williamson Research Centre for Molecular Environmental Science for radiochemical, chemical, mineralogical and colloidal characterisation of samples. Students will also have access to advanced facilities available within The University of Manchester (e.g. electron microscopy, X-ray photo electron spectroscopy, mass spectrometry) as well as national and international facilities where we can analyse radioactive samples such as the Diamond Light Source (http://www.diamond.ac.uk). Finally, the students will work closely with industrial supervisors within the National Nuclear Laboratory and Sellafield to ensure their research is focussed on real site challenges.

**Specification:** This project is experimental in scope and the successful candidates should have a strong background in the Chemical and Environmental Sciences (BSc / Masters in Chemistry, Environmental Chemistry, Geochemistry, Geology or similar). If you require further details about the project, please contact the supervisors, Prof. Katherine Morris (kath.morris@manchester.ac.uk) and/or Prof. Sam Shaw (sam.shaw@manchester.ac.uk). Applications can be made through The University of Manchester site http://www.manchester.ac.uk/study/postgraduate-research/admissions/

**References:**

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