The Effects of Colloidal Silica-Based Grouts on Sr and Cs Geochemistry

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During Australia's short-lived nuclear energy research program, low-level radioactive wastes were disposed between 1960 – 1968 in unlined trenches in low permeability clays at a site now known as the Little Forest Legacy Site (LFLS) in New South Wales, Australia. These trenches contain complex wastes, including radioactive contaminants, beryllium, steel, and organic materials, and were backfilled with soil materials [1]. Radioactive contaminants identified in historical records include relatively short-lived fission products (e.g. Sr-90, Cs-137) and long-lived actinides (e.g. Pu, U and Th) [1]. At the LFLS, traces of radionuclides (e.g. Tritium, Cs, Sr, Pu) have been detected in the vicinity of the disposal trenches [2, 3]; thus a long-term management strategy is required. In-situ immobilization of radioactive toxic wastes is being considered to reduce possible migration of contaminants. Colloidal silica-based grouts have beneficial properties to immobilize radioactive wastes [4, 5], such as low-toxicity, low viscosity, low permeability, and high level of control over gelling (through varying the accelerant (e.g. NaCl, $CaCl_2$) and its concentration [5]). However, the effects of colloidal silica-based grouts on the geochemistry, speciation and fate of radionuclides present in soils and wastes are largely unknown. Here, we present results from adsorption and leaching experiments using trace concentrations of Cs-137 and Sr-85 combined with Sr and Cs XAS in analogous experiments with elevated concentrations. Such detailed studies of the effects of colloidal silica-based grouts on the geochemistry of Sr and Cs provide evidence that utilizing such grouts enhances radionuclide retention in addition to providing hydraulic containment of the legacy wastes.

References

[1] Payne, T.E., Background Report on the Little Forest Burial Ground Legacy Waste Site. 2012, ANSTO. [2] Payne, T.E., et al., Environ. Sci. Technol, 2013. 47(23): p. 13284-13293. [3] Cendón, D.I., et al.,. Aust. J. Earth. Sci., 2015. 62(1): p. 123-141. [4] Hakem, N., et al., Radiochim. Acta., 2004. 92(7): p. 419-432. [5] Pedrotti, M., et al., Tunn. Undergr. Sp. Tech., 2017. 70: p. 105-113.