Decomissionable concrete? Adsorption of radionuclides by removable bio-mineralised hydroxyapatite layers

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Decomissioning of concrete infrastructure at nuclear sites after years of use can be problematic and dangerous due to high levels of radioactivity, penetration of contamination into concrete and potentially large volumes of contaminated material. The depth of contamination within concrete ranges from mm to cm and contain many radioactive isotopes types such as C, U, Pu, Sr and Cs. Before decommissioning, concrete structures must be surface decontaminated to minimize waste volumes and reduce hazard. Techniques normally applied involve mechanical scabbing/scraping and high pressure blasting of concrete to remove layers of contamination. These techniques are expensive, unsafe for workers, and risk the spread of radioactive contamination.

In addressing the above issues, this project aims to develop a novel decommissionable concrete tailored for safe, rapid decommissioning with minimal waste. Previous work in our group has shown that under certain conditions, bacteria can make bio-mineralized hydroxyapatite (HAp) which form layers as surfaces on cement [1]. The Ca from the HAp can substitute for other cations and we hypothesize that this mechanism would be relevant for radioactive isotopes such as Sr^{2+} and Cs^{+} and UO_2^{2+}, by bonding to PO_4^{3-}. These HAp layers can be engineered for easy removal at the end of life.

Our poster presents promising results of the first stage in developing the adsorptive layer of hydroxyapatite (HAp) and show its powerful adsorptive properties for ions such as Sr^{2+} and Cs^{+} with promise for UO_2^{2+}.

[1] Turner, R.J., J.C. Renshaw, and A. Hamilton (2017), *ACS Applied Materials & Interfaces* 9, 31401-31410.