Contribution ID: **1024** Type: **Invited**

Activated biopolymer hydrogel composites for strontium remediation - a mechanistic study

Thursday, 19 May 2022 08:30 (20 minutes)

Engineered biopolymers have received a great deal of interest for environmental remediation of radionuclides in recent years. Composites derived from alginate, chitin or activated biochars
exhibit promising uptake capacities for common and problematic radionuclides such as strontium, cesium and uranium due to a wide range of surface functionality, extensive multiscale porosity, and excellent environmental compatibility. They also lend themselves well to a wide range of directed modification and functionalisation via organic chemical modification, metal doping or physical/structural changes.

Traditional inorganic zeolites for radionuclide remediation possess a number of drawbacks which can drastically limit their efficacy in many environmentally relevant scenarios, as is highlighted by continuing challenges at the Fukushima Daiichi site. These include reduced performance in seawater, in acidic media and rapid fouling by dissolved organic matter. Synthetic zeolites can be costly and introduce technical handling challenges as fine particulate matter. Inorganic ion-exchange media can be bulky and expensive to dispose of.

Biopolymers are well suited to address these deficiencies in remediation technologies and compliment the use of inorganic ion-exchangers. Unlike ion-exchange resins, the carbonaceous nature and large pore volume of biopolymers means that post-processing volume reduction ratios of up to 1000 are possible by compaction or ashing. Keeping final waste inventories to a minimum volume is in line with key decommissioning principles and representing savings in long term storage costs. Synthesis of monolithic composites such as biochar-alginate hydrogel beads are trivial to separate post uptake and do not suffer significant performance issues at low pH. Biopolymers are cheap, sustainable and readily available, and their use in this context is compatible with in-situ methods such as Monitored Natural Attenuation. Lacking however, are in-depth fundamental studies which unravel the binding mechanisms in such novel materials. Without which, optimisation and making a safety case for this class of materials as a remediation technology will be difficult.
We aim to address these shortcomings by 1. Developing functionalisation regimes that not only nullify physicochemical variability but also enhance the number of binding sites and binding affinity; judicious choice of activation protocol also allows for tunability of the adsorbent in response to specific remediation requirements or local environmental conditions 2. Creation of activated monolithic biopolymer hydrogel composites, making recovery of spent materials trivial compared with fine particulate adsorbents and 3. Present mechanistic EXAFS data which highlights the inner sphere-type binding of strontium adsorbed to the biopolymer hydrogel.

Primary author: FOSTER, Stella (University of Leeds)

Co-authors: Dr RAMANAN , Nitya (Diamond Light Source); Prof. HANSON, Bruce (University of Leeds); Dr MISHRA, Bhoopesh (Illinois Institute of Technology)

Presenter: FOSTER, Stella (University of Leeds)

Session Classification: Nuclear Fuel Cycle

Track Classification: Chemistry of Nuclear Fuel Cycle, Radiochemical Problems in Nuclear Waste Management