[Form 2 (to be reported to Committee on Countermeasures for Contaminated Water Treatment and to be disclosed to public)

Technology Information	
Area	2
Title	Nano-composite filters for the removal of fission products from contaminated water
Submitted by	Interface Analysis Centre, University of Bristol

1. Overview of Technologies (features, specification, functions, owners, etc.)

Iron nano-particles (INPs) have already been shown to easily remove particular radionuclides from water (e.g. uranium and plutonium) at incredibly efficient rates. For example, INPs can reduce the level of uranium from 50μmL^{-1} to near 0 μmL^{-1} within 1 hour. Recent initial tests by the University of Bristol have also shown success for removing caesium from water using INPs and therefore it can be logically assumed strontium and other fission products could also be remediated.

Furthermore, we believe INPs have potential for tritium (^{3}H or T) removal by acting as an ion-exchange material. Based on previous studies, it can be assumed that the ^{3}H within the water will exchange with the ^{1}H from the FeOOH produced by the aqueous corrosion of the INPs. Simple tests can be done to prove this by substituting the ^{3}H with ^{2}H (deuterium or D).

For practical applications, our research is also developing a water filter where the INPs are incorporated onto/into a bulk, porous substrate material. The resultant nano-composite filter displays the advantageous reactive properties of the nano-particles but also the mechanical, structural properties of the substrate, allowing for it to be easily placed within filtration systems as an end-of-pipe solution.

2. Notes (Please provide following information if possible.)

- Technology readiness level (including cases of application, not limited to nuclear industry, time line for application)

Technology readiness level 3 – two fabrication methods and initial prototypes has been developed but further investigation and improvements need to be made, followed by thorough testing.

We would suggest a short 3-4 month research project to assess feasibility of tritium uptake by FeOOH, produced by the corrosion product of INPs in water. Experiments would involve placing INPs in a sealed solution containing 50% H_2O and 50% D_2O. Measuring the changes in ratio of the hydrogen isotopes within both the gas and liquid phases will indicate whether the isotope exchange has taken place - if the ^{2}H is being exchanged into the solid phase of the iron corrosion product then there will be a measurable reduction in ^{2}H.

- Challenges

The key challenge will be up-scaling the manufacturing method. The secondary fabrication method (involving jet-sprays) could be the most promising for large scale production as established infrastructure for painting cars could be utilised.

- Others (referential information on patent if any)

We have a patent [GB1111951.8] related to the fabrication of nano-filters for water treatment.

【Areas of Technologies Requested】

(1) Accumulation of contaminated water (Storage Tanks, etc.)
(2) Treatment of contaminated water (Tritium, etc.)
(3) Removal of radioactive materials from the seawater in the harbor
(4) Management of contaminated water inside the buildings
(5) Management measures to block groundwater from flowing into the site
(6) Understanding the groundwater flow