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Novel approach for the extraction and immobilization of radioactive cesium from contaminated fly ash with nanometallic Ca/CaO methanol suspension

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In Japan, the major concern on the radioactive cesium (^{134}Cs and ^{137}Cs) deposition and its contamination due to the emission from the Fukushima Daiichi nuclear power plant showed up after a massive quake on March 11, 2011. By the end of March 2012, ash containing 100,000 to 140,000 becquerels per kilogram (Bq kg^{-1}) of (^{134}Csand ^{137}Cs) was recorded. High levels of ^{134}Cs and ^{137}Cs are also present in incineration ash from normal garbage. The volume of radioactive cesium contaminated ash in the northern part of Japan is growing at 360 t/d. During and after 30 years it takes for ^{137}Cs to decay by half, each time it rains, ^{134}Cs and ^{137}Cs deposited will be washed down to where people live. For the entire ecosystem, ^{134}Cs and ^{137}Cs are being accumulated in the environment. Temporary disposal sites for incinerated ash containing ^{134}Cs and ^{137}Cs are rapidly filling up. No alternative landfills are available. Therefore, the^{134}Cs and ^{137}Cs removal and immobilization in contaminated fly ash are recognized as important problems to be solved using suitable technologies.

Recently the impacts of nanotechnology are increasingly evident in the field of environmental studies and treatment. Treatment and remediation has seemingly experienced the most growth in recent years. In terms of site remediation, the development and deployment of nanotechnology for contaminant destruction has already taken place. Present study, first time we conducted to determine the capability of nanometallic Ca/CaO methanol suspension to extract and immobilize ^{134}Cs and ^{137}Cs in contaminated fly ash. Simultaneous high cesium extraction and immobilization were achieved using methanol/nanometallic Ca/CaO methanol suspension in a synthetically prepared stable cesium (^{133}Cs) contaminated fly ash sample. For actual radioactive cesium contaminated fly ash samples obtained for Fukushima, Japan, after with nanometallic Ca/CaO methanol suspension extraction, total ^{134}Cs and ^{137}Cs concentrations in fly ash was much lower, 3,583 Bq kg^{-1} than the Japanese Ministry of the environment regulatory limit of 8,000 Bq kg^{-1}, which allows the ash to be buried in landfills. Scanning electron microscopy with electron dispersive spectroscopy (SEM-EDS) revealed that the mass percent of ^{133}Cs detectable on the fly ash surface was decreased 100% after nanometallic Ca/CaO methanol suspension extraction, perhaps because of its agglomeration with the Ca/CaO hydration product matrix. The most probable mechanisms for enhanced cesium removal and immobilization capacity with nanometallic Ca/CaO methanol suspension extraction are portrayed schematically in (Fig. 1). These results highlight the potential of nanometallic Ca/CaO methanol suspension as a unique amendment for remediation of ^{134}Cs and ^{137}Cs in contaminated fly ash.

Biography

Srinivasa Reddy Mallampati is a Postdoctoral Research Fellow in Department of Environmental Sciences at Prefectural University of Hiroshima, Japan. His research work focused on the "synthesis and application of nano-size metallic calcium and iron dispersion for detoxification of multi-pollutants containing radioactive cesium, heavy metals and POPs in contaminated soil". He has been awarded with JSPS Postdoctoral Research Fellowship during 2007-2009. He did his Ph.D. work at CSMCRI, one of the National Laboratories of India (CSIR). He is the author of more than 25 papers in reputed journals. He has also presented papers at several international conferences and they have been enthusiastically received. Recently, he got Young Scientist Award from American Academy of Sciences, Houston, TX. USA.

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