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Decontamination of radionuclides using γ-Fe2O$_3$ as a Nanosorbent

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The release of radioactive waste into the environment and the disposal of conditioned waste is a major environmental concern which demands the improvement in the remediation processes [1]. Due to the advancements in Nanotechnology, novel and simple nanoparticles have been proved very efficient worldwide, in the radioactive waste treatment processes [2]. These nanoparticles prove to be an excellent nanosorbents owing to its very high surface area and other size dependent properties [3].

In the present study, nanocrystalline γ-Fe2O$_3$ was synthesized by gel-combustion method. Gel combustion method [4, 5] is the most facile method of synthesis of nanocrystalline oxides. Fuel deficient composition of ferric nitrate (oxidant) and malonyl dihydrazide (fuel) were mixed well in de-ionised water and heated at temperature $\sim$ 300 °C. The smouldering combustion took place resulting in formation of γ-Fe2O$_3$ which further calcined at 500 °C to remove undesirable impurities. The prepared powder further characterized by various techniques such as X-ray diffractometer, transmission electron microscopy, BET technique and zeta potential measurements. The crystallite size of γ-Fe2O$_3$ was found to be 11 nm. TEM images showed that the grain size obtained was in agreement with the XRD report.

Sorption study have been carried out using tracer technique for batch equilibration method at room temperature and atmospheric pressure. A known amount of sorbent (γ-Fe2O$_3$) was mixed with 10 mL of solution containing radiotracer and 1mg/mL solution of carrier. Various parameters such as contact time, pH, amount of sorbent, concentration, temperature, agitation speed were optimized, determination of sorption capacity and interference study was also conducted. The activity is measured by using single channel NaI(Tl) well type gamma ray spectrometer. γ-Fe2O$_3$ was found to be an efficient and cost effective sorbent for the decontamination of heavy radionuclides such as Cs-137, Sr-90, Cd-115m, Cr-51, Hg-203, etc. from low level waste and water effluent.

References:
1. Hamasaki T., Nakamichi N., Teruya K., Shirahata S., Removal Efficiency of Radioactive Cesium and Iodine Ions by a Flow-Type Apparatus Designed for Electrochemically Reduced Water Production, PLoS One. 2014; 9(7): e102218.
2. Gehrke I., Geiser A., Somborn-Schulz A., Innovations in nanotechnology for water treatment, Nanotechnol Sci Appl. 2015; 8: 1–17.
3. Galina Lujanienė G., Šemčuk S., Kulakauskaitė I., Mažeika K., Valiulis D., Juškėnas R., Tautkus S., Sorption of radionuclides and metals to graphene oxide and magnetic graphene oxide, Journal of Radioanalytical and Nuclear Chemistry, 2016;307:3, 2267–2275
4. Patil K.C., Hegde M.S., Rattan T., Aruna S.T., Chemistry of Nanocrystalline Oxide Materials Combustion Synthesis, Properties and Applications, world Scientific Publ. 2008.
5. Thakur, J., Dutta, D. P., Bagla, H. and Tyagi, A. K., Effect of Host Structure and Concentration on the Luminescence of Eu3+ and Tb3+ in Borate Phosphors., J. Am. Ceram. Soc., 2012, 95: 696–704.