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Long term immobilization of Cs-137 by transformation of titanium ferrocyanide to lithium titanate

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Radioactive waste contains a variety of radionuclides and arises in a variety of physical and chemical forms. In Poland, the amount of activity and waste volume of liquid wastes are relatively small, mostly from operation of research reactor. Despite of the low level radioactivity involved, there are many significant hazards that could arise as a result of inadequate management. Treatment of liquid wastes is needed to produce a waste product suitable for long term storage and disposal. Our idea of immobilization of the 137Cs radionuclide in the matrix of TiO2 is based on the initial sorption of 137Cs on titanium ferrocyanide (TCF) and then converting TCF to the TiO2aq by hydroxide solution and calcination of the product to ceramic.
We showed that the TCF is a very effective sorbent for 137Cs. In the column experiments we did not observed any breakthrough of the column after passing 10000 bed volumes of the saline solution spiked with 137Cs . After adsorption of the 137Cs on TCF hydroxide solutions were passed through a column and degree of transformation of TCF to TiO2 and leakage from the column was examined. Hydroxides used were as follows : LiOH , NaOH , KOH , and (CH3)4NOH.

The obtained results indicate that all hydroxides studied convert, in 100 percent, the black TCF to the white TiO2aq. However, when using NaOH and KOH competing influence of the cations K+ and Na+ causes leakage of 137Cs from formed TiO2 aq. Much better results have been obtained using tetraalkylammonium hydroxide and particularly lithium hydroxide. Competitions from bigger tetraalkylammonium cations and hydrated Li+ on sorption of small hydrated Cs+ cation is negligible. Collected samples of the titanium oxide with adsorbed 137Cs were next calcined at 900oC and the leaching of radionuclides has been studied.

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