

9th World Congress on

MATERIALS SCIENCE AND ENGINEERING

June 12-14, 2017 Rome, Italy

Effect of binder on adsorption of cesium on silica gel containing embedded phosphotungstic acid

Aleksy Vasiliev, Iuliia Little and Kenneth Seaton
East Tennessee State University, USA

Statement of the Problem: Radioactive isotopes ^{134}Cs and ^{137}Cs are among the most hazardous contaminants that can be released into the environment by accidents at nuclear power plants (e.g. the Fukushima accident) or small incidents, which may occur during fissile materials processing. Currently, the development of materials that can adsorb Cs^+ selectively in the presence of Na^+ and K^+ is a challenging problem. While other hazardous isotopes, e.g., ^{60}Co or ^{90}Sr , can be separated easily due to the insolubility of many of their salts, most compounds of cesium are soluble and highly mobile in aqueous media. The objective of this work is the synthesis and study of superacidic adsorbents for removal of Cs^+ ions from contaminated waters.

Method: The active ingredient of the adsorbents was synthesized by co-condensation of tetraethoxysilane with phosphotungstic acid by the sol-gel method. Its formulations with $\gamma\text{-Al}_2\text{O}_3$, kaolin and charcoal were prepared with 10-50 wt% of the binders. Their granulating was conducted by tableting at the pressure of 7 metric tons and the separation of 1-2 mm fraction. All adsorbents were characterized by FT-IR spectroscopy, porosimetry, SEM, DLS and thermoanalysis.

Results: The obtained silica gel with embedded phosphotungstic acid had a mesoporous structure with a significant fraction of micropores. The adsorbent was present mostly in the form of nanoparticles, however, part of the material agglomerated. It demonstrated a high adsorption capacity towards cesium. Comparison of its formulations with different binders demonstrated their effectiveness in adsorption at much higher mechanical strength. Kinetics of the adsorption was studied. A significant advantage of H-PTA/ SiO_2 is its stability against leaching.

Conclusion & Significance: A hybrid functionalized material containing phosphotungstic acid embedded into a silica network was successfully synthesized and studied. The obtained data could be used in the development of an adsorbent for the removal of radioactive cesium from nuclear wastes or contaminated water.

Biography

Aleksy Vasiliev has completed his PhD from the Institute of Bioorganic Chemistry and Petrochemistry in Ukraine. His main field of expertise is materials chemistry, in particular, chemistry of mesoporous and microporous materials. He continued his professional career in the National Technological University in Argentina, and further moved to Rutgers University. Currently, he is working as an Associate Professor in East Tennessee State University.

vasiliev@etsu.edu

Notes: