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New Adsorbents from $Ti(OPr^n)_4$ by the Sol-Gel Process: Synthesis, Characterization and Application for Removing Some Heavy Metal Ions from Aqueous Solution

Funda SAYILKAN, Hikmet SAYILKAN
Department of Science, Faculty of Education, İnönü University,
44069, Malatya-TURKEY
e-mail: hsayilkan@inonu.edu.tr
Sema ERDEMOĞLU, Şadiye ŞENER
Department of Chemistry, Faculty of Arts and Sciences, İnönü University,
44069, Malatya-TURKEY
Murat AKARSU
Institut für Neue Materialien, D-66123, Saarbrücken-GERMANY

Abstract: New adsorbents were synthesized by the sol-gel process from the product of a hydrolysis reaction and its coated form of titanium(IV)-n-propoxide for removing some heavy metal ions from aqueous solution. Titanium(IV)-n-propoxide was uncatalyst hydrolyzed with different amounts of water at room temperature and was found to react in a 1:1.6 ratio (mole of Ti:mole of H_2O). It was found that the condensation following the hydrolysis reaction was alcohol condensation. The hydrolysis-condensation product was characterized in detail by GC, Karl-Fischer coulometric titrator, NIR-spectroscopy, FT-IR spectroscopy, TG-DTA and elemental analysis. The hydrolysis-condensation product of titanium(IV)-n-propoxide was calcinated at 900 °C after drying at 100 °C and some of this product was coated with hydrolyzed NH_2-functional silanes [3-(2-aminoethylamino)ethylamino)propyl-trimethoxy silane] (Amino-1), and [3-(2-aminoethylamino)propylmethyldimetoxysilane] (Amino-2), separately. Adsorption capacities of uncoated and NH_2-functional silane coated hydrolysis-condensation products for Fe^{3+} , Cu^{2+} and Pb^{2+} ions in aqueous solution were investigated by FAAS. It was observed that the extent of adsorption was influenced significantly by the type and concentrations of coating materials, e.g., Amino-1 coated adsorbent prepared in methyl alcohol as 50% (w/w) and 100% (without methyl alcohol) adsorbed 90.67% and 100% of Fe^{3+} , respectively, while the uncoated form adsorbed only 5%. The adsorption isotherm was determined and the data were analyzed according to the Freundlich model.

Key Words: Sol-gel process, adsorption, adsorbent, waste water, heavy metals, coating

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