

Turkish Journal of Chemistry

Turkish Journal

of

Chemistry

Synthesis, Characterization and Applications of Sol-Gel Derived Zirconium Oxide Adsorbent Powder: Removal from Aqueous Solution of Phenol and p-Chlorophenol

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
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Abstract: Adsorbent powders were prepared from the uncatalysed hydrolysis-condensation reactions of different complexes that were synthesized by the reactions of $Zr(OPr^n)_4$ with different chelating ligands (such as allylacetic acid [AAH], vinylacetic acid [VAH] and citraconic acid [CAH]). The complex products were characterized by FT-IR, 1H -NMR and ^{13}C -NMR spectra. The maximum combination ratios of AAH/ $Zr(OPr^n)_4$, VAH/ $Zr(OPr^n)_4$ and CAH/ $Zr(OPr^n)_4$ were 1.7, 0.9 and 1.3, respectively. The hydrolysis-condensation products of these complexes were calcinated at 900 °C and half of them were coated with 3-glycidyoxypropyltrimethoxysilane (GLYMO). The surface area and average pore diameter of the powders were estimated by the analysis of adsorption/desorption BET isotherm data. The adsorption capacities of these powders for aqueous phenol and p-chlorophenol were calculated following spectrophotometric determination. Phenol and p-chlorophenol adsorption on all of the GLYMO-coated adsorbents were satisfactory, e.g., the adsorbent obtained from the hydrolyzed, calcinated and GLYMO-coated form of $Zr(OPr^n)_{2.3}(AA)_{1.7}$ adsorbed 63% of phenol while the uncoated form adsorbed only 10%. The adsorption isotherm has been determined and data have been analyzed according to the Freundlich model.

Key Words: adsorbent, adsorption, coating, sol-gel process, zirconium alkoxides.

Turk. J. Chem., **27**, (2003), 477-486.

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