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BOOK OF ABSTRACTS

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SiO_2 and TiO_2-Hybrid Material for Removal of As(V) and Pb(II) Ions from Aqueous Solution

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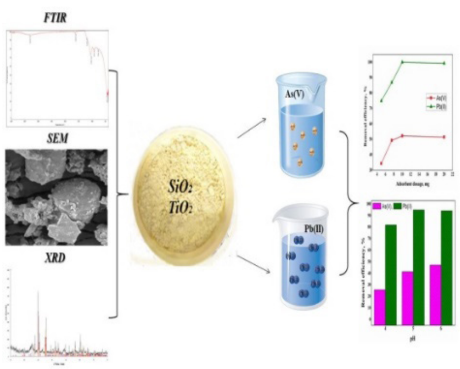

The aim of this research was to investigate As(V) and Pb(II) adsorption behaviour onto mineral heterostructures based on the mixture of Si and Ti-oxides (MHO). Heavy metals are discharged into water bodies from various industries which cause environmental pollution and public health problems due to their toxicity, persistence, high solubility, and mobility [1]. The conventional methods of heavy metal decontamination include chemical precipitation, ion exchange, membrane separation and reverse osmosis [2]. However, the adsorption process for heavy metals removal has been investigated as a cost-effective method, usually easy to manage, maintain and consolidate within the entire wastewater treatment plant.

The metal-oxide heterostructures with a high surface area and specific affinity for heavy metals adsorption from aqueous solutions have demonstrated a promising performance in practical engineering applications [3]. The most common hybrid adsorbents are consisted of metal-oxides combinations such as: iron oxides (maghemite: γ-Fe_2O_3, hematite: α-Fe_2O_3, magnetite: Fe_3O_4, goethite: α-FeOOH), manganese oxide (α-MnO_2), zinc oxide (ZnO), titanium oxide (TiO_2), aluminum oxide (γ-Al_2O_3), magnesium oxide (MgO) and cerium oxide (CeO_2) [4-6].

In this study, synthesized SiO_2 and TiO_2-hybrid material for removal of As(V) and Pb(II) ions from aqueous solution was investigated. The adsorption experiment was conducted in a batch system, using the initial concentrations of 100 µg L^{-1}, at appropriate pH_i for selected ions ($pH_{Pb(II)}$=5 and $pH_{As(V)}$=6). The experimental optimization was performed by varying the parameters such as the mass of the adsorbent and pH of initial ion solution. The maximum removal efficiency of Pb(II) and As(V) was 99,8 and 52.2 %, respectively (experimental conditions: m_{ads}=10 mg, V=10 mL, t=24 h and T=25 °C).

The characterization of MHO adsorbent was carried out using the following techniques: X-ray diffraction (XRD), gas adsorption/desorption isotherms (BET), scanning electron microscopy (SEM) and the Fourier-transform infrared spectroscopy (FTIR). XRD patterns of the MHO sample have shown that the main contribution originates from the diopside phase, $CaMgSi_2O_6$ (84.0 wt. %), while the other oxide-contributions comprised of a hexagonal structure of titanium oxides (anatase and rutile, in total 2.2 wt. %), and iron (titanium) oxides (hematite and titanomagnetite, in total 12.2 wt. %). The FTIR was used to analyze the functional groups present in MHO and recorded numerous vibrations and stretching of functional groups (dominantly Si-O-Si, Si-O-Al and Si-O-Ti bonds), which confirmed that the synthesized material consists of mineral oxides. The SEM analysis indicates a large number of uneven thin forms of nanoplatelets which is complementary confirmed by increased porosity and large surface size (S_{BET} = 271.7 m^2 g^{-1}).

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