

2nd International Conference and Expo on **Separation Techniques**

September 26-28, 2016 Valencia, Spain

Removal of divalent heavy-metal ions from aqueous solutions by adsorption process with titanium dioxide nanowires

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The key objective of this work was to investigate kinetics and adsorption capacities of divalent metal ions (Cu²⁺, Pb²⁺, Cd²⁺) from water on TiO₂ nanowires at pH 3 and 7. Brunauer-Emmett-Teller (BET) analysis showed that the surface area of the TiO₂ nanowires was 115,9 m²g⁻¹. The point of zero charge (pHpzc) was 4.8. Adsorption experiments were performed using the conventional batch technique at room temperature (25±2 °C). The background solution was 0.01 M CaCl₂ in deionized water. Initial concentrations of heavy metal ions were in the range 0.05-5 mg L⁻¹. The amount of adsorbent corresponded to a sample/solution ratio that resulted in 20-80% uptake of given metal ion. The samples were agitated on horizontal shaker for 30 h. The time to reach adsorption equilibrium was obtained from a kinetic study performed over 72 h. The adsorption kinetics of divalent metal ions on TiO₂ nanowires was investigated using pseudo-first order, pseudo-second order and intraparticle diffusion models. Adsorption of metal ions was controlled by chemisorption which was supported by the suitability of the pseudo-second order model. Intraparticle diffusion model data showed that diffusion cannot be considered as the limiting step of adsorption. The equilibrium adsorption data were modeled using Freundlich and Langmuir adsorption isotherms which both showed good agreement with experimental data. The highest removal efficiency of heavy metals was observed at pH=7, except in the case of Pb which has been removed better at pH=3. Adsorption affinities increased in the following order: PbpH3>CdpH7>PbpH7>CdpH3>CupH7>CupH3.

Biography

Snezana Maletic is an Associate Professor and the Chair of Chemical Technology and Environmental Protection, University of Novi Sad, Faculty of Sciences. She has completed her PhD in Chemistry from University of Novi Sad, Faculty of Sciences, Department of Chemistry, Biochemistry and Environmental Protection in 2010 and BSc in Chemistry from University of Novi Sad Faculty of Sciences, Department of Chemistry in 2003. Her research interests include environmental protection, chemical technology, remediation of contaminated water, soil and sediment, bioavailability of inorganic/organic pollutants in sediments/soils investigation and adsorption of inorganic pollutants on nanomaterials. She is Head of the laboratory for the analysis of environmental samples accredited according to ISO 17025 protocols.

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