Physico-chemical nanomaterials science

Nano-sized oxides of different compositions as adsorbents for hazardous substances removal from aqueous solutions and wastewaters

M. Wiśniewska[1*], M. Wawrzkiewicz[2], A. Wołowicz[2], O. Goncharuk[3]

[1] Maria Curie-Sklodowska University, Faculty of Chemistry, Department of Radiochemistry and Colloid Chemistry, M. Curie-Sklodowska Sq. 3, 20-031 Lublin, Poland, E-mail: [*]wisniewska@hektor.umcs.lublin.pl
[2] Maria Curie Sklodowska University, Faculty of Chemistry, Department of Inorganic Chemistry, M. Curie-Sklodowska Sq. 2, 20-031 Lublin, Poland
[3]National Academy of Science of Ukraine, O. O. Chuiko Institute of Surface Chemistry, 17 General Naumov Str., 03164 Kiev, Ukraine

Due to industrialization and urbanization processes large quantities of effluents containing hazardous substances are discharged into the environment. Not only inorganic contaminants such as heavy metals e.g. Cd, Cr, Cu, Ni, As, Pb, and Zn, but also organic compounds like phenol (and its salts), polyalcohols, polyacids, azo dyes (and other macromolecular compounds) as well as many others are generated by metallurgical, engineering, mining, electroplating, nuclear, chemical, textile, petroleum, plastic, and cellulose industries etc. Many of them are known to be toxic or carcinogenic. Thus removal of such hazardous substances is of crucial importance to protect the human and the environment. Several techniques have been used to remove organic and inorganic impurities from industrial wastewaters. Recently increasing attention has been focused on adsorption techniques using metal and semi-metal oxide sorbents such as aluminum oxide, iron oxide, titanium oxide, manganese oxide, zirconium oxide and silica oxide. The nano-sized metal, semi-metal and mixed oxides are classified as the promising sorbents because of their large surface areas and pore sizes as well as mechanical and thermal stability.

The literature review concerning removal of the above mentioned contaminants using nano-sized oxide adsorbents was made. The adsorption parameters which affect removal efficiency, i.e. concentration, phase contact time as well as equilibrium and thermodynamic aspects were taken into account. Moreover, the possibilities of nano-sized oxide adsorbents reuse and desorption effectiveness were pointed out. Additionally, heavy metal ions e.g. Co(II), Ni(II), azo dyes and polymers adsorption by mixed oxides were compared with other adsorbents.

Acknowledgement The research leading to these results has received funding from the People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme FP7/2007-2013/ under REA grant agreement n°PIRSES-GA-2013-612484.