HABILITATION THESIS

New materials used for arsenic removal from water

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A. SUMMARY

Present habilitation thesis is structured in two different parts, and was written based on 31 research papers and one national patent. I am the leading author of 17 out of these 31 papers and the coauthor of 14. From these 31 papers 18 are indexed in Thompson Reuters, 12 are indexed in different other international data bases, and one is a book chapter published by an international book publisher.

The first part of habilitation thesis is briefly presenting my main professional, scientific, and academically achievements from the moment I defended my PhD thesis (2002) until now. During this period I worked into the chemical engineering and also in environmental protection areas.

In this chapter are firstly presented the main aspects regarding the arsenic content into the worldwide natural waters as also in our country, natural and antropic arsenic sources and also the effects of his presence onto the human health, emphasizing all personal contributions. All these studies were focused on arsenic presence in West Romania ground waters, which represent a real problem. High risks associated with consumption of arsenic contaminated water made me identify new extraction materials and processes. New arsenic eliminating strategies emerged.

Because current technology used for arsenic removal processes are quite expensive and generate too much waste and byproducts, we focused on obtaining, describing and testing new environmental friendly materials, technologies and methods. Clean technologies, such as the adsorption would recover or eliminate the arsenic from waters.

This thesis contains also the scientifically results of the research & development project IDEI, which I coordinated, called „Integrated concept of arsenic containg waters depollution through oxidic materials adsorption, followed by immobilization of process waste material into the vitreous matrix", project code 925/2009 – 2011.

During project implementation a new system for arsenic removal was developed using cheap adsorbent material, with high affinity for arsenic ions and also with high adsorption capacity. For this purpose were tested materials containing iron oxide

prepared using different methods (thermal decomposition, combustion), and also a hot dip galvanization processes waste mud with high content of iron.

Afterwards new modern materials (commercial and synthesized polymers) were used, chemically modified by functionalization with pendant groups containing iron ions.

Were studied two different polymers from Amberlite XAD series – Amberlite XAD 7, and Amberlite XAD 8, and also one ions exchange resin – Amberlite IR 120-(Na). All these materials were functionalized by impregnation with di-(2-ethylhexyl) phosphoric acid (DEHPA), tri n octylphosphine oxide (TOPO), triphenylphosphine oxide (TPPO), and loaded with iron ions.

Another set of studies was focused onto the preparation of some chelating polymers containing some amino-phosphinic or amino-phosphonic groups loaded with iron ions.

Last set of studies was focused in functionalization of synthesized styrene-divinylbenzene polymer grafted with phosphonium quaternary groups with crown ethers such as dibenzo-18 crown 6 ether (dibenzo-18-coroană-6-eter) loaded after that with iron ions.

Taking into account the capacity of crown ethers to make complex with metallic ions, including here the arsenic ions, was studied the possibility to use this compounds as extractants on inorganic supports such as silica and florisil, loaded after that with iron ions.

Material impregnation was realized mainly using static regime, and only in few cases impregnation was produced using a dynamic regime.

After functionalization and iron ions loading, all produced materials were characterized using: scanning electron microscopy (SEM), X-Ray photoelectrons dispersion (EDX), Fourier transform infrared spectroscopy (FT-IR), X-Ray diffraction (XRD), thermal analysis, Brunauer, Emmett and Teller specific surface area (BET), specific for each used material.

In order to establish the adsorption properties for each new material, and also to establish the adsorption mechanism thermodynamic, kinetic and equilibrium studies were performed using synthetic and also real waters.

Exhausted inorganic materials due to arsenic removal were immobilized in vitreous matrix used to produce decorative glazes. Organic materials used for arsenic removal were regenerated and reused for several times.

Based on experimental studies can conclude that all studied material have good adsorption properties, and can be used for arsenic retention from waters in dynamic or also in static regime. Adsorption process is better described by the pseudo-second order kinetic model, is spontaneous, endotherm, and has a physical or chemical nature. Also, it was revealed that the contact surface and also the presence of iron ions present a high importance into the arsenic adsorption on studied materials.

In the second part of habilitation thesis are presented the further objectives regarding didactic career, research, and also further development of academic career.

Present habilitation thesis contains 306 references.