Geophysical Research Abstracts
Vol. 15, EGU2013-12025, 2013
EGU General Assembly 2013

Optimizing the application of magnetic nanoparticles in Cr(VI) removal

Konstantinos Simeonidis (1), Efthymia Kaprara (2), Manassis Mitrakas (2), Magdalini Tziomaki (1), Mavroidis Angelakeris (3), Georgios Vourlias (3), and Nikolaos Andritsos (1)

(1) University of Thessaly, Mechanical Engineering, 38343 Volos, Greece (ksime@physics.auth.gr, +302310998032), (2) Analytical Chemistry Laboratory, Department of Chemical Engineering, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece, (3) Department of Physics, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece

The presence of heavy metals in aqueous systems is an intense health and environmental problem as implied by their harmful effects on human and other life forms. Among them, chromium is considered as an acutely hazardous compound contaminating the surface water from industrial wastes or entering the groundwater, the major source of drinking water, by leaching of chromite rocks. Chromium occurs in two stable oxidation states, Cr(III) and Cr(VI), with the hexavalent form being much more soluble and mobile in water having the ability to enter easily into living tissues or cells and thus become more toxic. Despite the established risks from Cr(VI)-containing water consumption and the increasing number of incidents, the E.U. tolerance limit for total chromium in potable water still stands at 50 μg/L. However, in the last years a worldwide debate concerning the establishment of a separate and very strict limit for the hexavalent form takes place. In practice, Cr(VI) is usually removed from water by various methods such as chemical coagulation/filtration, ion exchange, reverse osmosis and adsorption. Adsorption is considered as the simplest method which may become very effective if the process is facilitated by the incorporation of a Cr(VI) to Cr(III) reduction stage. This work studies the potential of using magnetic nanoparticles as adsorbing agents for Cr(VI) removal at the concentration levels met in contaminated drinking water. A variety of nanoparticles consisting of ferrites MFe_2O_4 (M=Fe, Co, Ni, Cu, Mn, Mg, Zn) were prepared by precipitating the corresponding bivalent or trivalent sulfate salts under controlled acidity and temperature. Electron microscopy and X-ray diffraction techniques were used to verify their crystal structure and determine the morphological characteristics. The mean particle size of the samples was found in the range 10-50 nm. Batch Cr(VI) removal tests were performed in aqueous nanoparticles dispersions showing the efficiency of ferrite nanoparticles to reduce Cr(VI) concentration below the regulation limit. The removal capacity is maximized for Fe_3O_4 nanoparticles due to the high reducing potential of the Fe^{2+} cations. Furthermore, their applicability was tested in a pilot-scale magnetic separator for the continuous flow removal of nanoparticles after water treatment that takes advantage of the magnetic properties.

Acknowledgment

This work was implemented within the framework of the Action «Supporting Postdoctoral Researchers» of the Operational Program "Education and Lifelong Learning" (Action's Beneficiary: General Secretariat for Research and Technology), and is co-financed by the European Social Fund (ESF) and the Greek State.