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Modified clay sorbents for wastewater treatment and immobilization of heavy metals in soils

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Soil and groundwater pollution with heavy metals is the result of both, anthropogenic and natural processes in the environment. Anthropogenic influence in great extent appears from industry, mining, treatment of metal ores and waste incineration. Contamination of soil and water can be induced by diffuse sources such as applications of agrochemicals and fertilizers in agriculture, air pollution from industry and transport, and by point sources, e.g., wastewater streams, runoff from dump sites and factories. Treatment processes used for metal removal from polluted soil and water include methodologies based on chemical precipitation, ion exchange, carbon adsorption, membrane filtration, adsorption and co-precipitation. Optimal removal of heavy metal ions from aqueous medium can be achieved by adsorption process which is considered as one of the most effective methods due to its cost-effectiveness and high efficiency. Immobilization of metals in contaminated soil also can be done with different adsorbents as the in situ technology. Use of natural and modified clay can be developed as one of the solutions in immobilization of lead, zinc, copper and other elements in polluted sites. Within the present study clay samples of different geological genesis were modified with sodium and calcium chlorides, iron oxyhydroxides and ammonium dihydrogen phosphate in variable proportions of Ca/P equimolar ratio to test and compare immobilization efficiency of metals by sorption and batch leaching tests. Sorption capacity for raw clay samples was considered as relatively lower referring to the modified species of the same clay type. In addition, clay samples were tested for powder X-ray difractometry, cation exchange, surface area properties, elemental composition, as well as scanning electron microscopy pictures of clay sample surface structures were obtained. Modified clay sorbents were tested for sorption of lead as monocontaminant and for complex contamination of heavy metals. The highest sorption capacity was observed for clay modified with hydroxyapatite and calcium salts. Sorption capacity increased with a rise of temperature; the best pH value for sorption was 5. Immobilization of metals in soil, as well as industrial wastewater treatment can be accomplished by using sorbents on modified clay basis.