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Environmental Remediation and Sorption of Metal Cations Using Aluminum Pillared Nano-Bentonite

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The release of heavy metal cations into the environment is a potential threat to water and soil quality. Some clay minerals play an important role, as physical and chemical barriers, for the isolation of metal-rich wastes and to adsorb heavy metals as well as to avoid their environmental dispersion. In the present study, the bentonitic clay (southeast El-Hammam City, Egypt) was subjected to pillaring using hydroxyl-aluminum solution. The XRD patterns of the Aluminum Pillared Nano-Bentonite (APNB) showed severe alteration of the crystal structure after pillaring. Poly metal solutions with different metal concentrations of Cu, Co, Ni, Zn, Cd and Pb (0.001, 0.005 and 0.01 moles), and pH (1, 2.5, 5 and 6) were subjected to treatment by the APNB. The removal process is very rapid and spontaneous and the contact time may be short (several minutes) for most adsorption to occur. The criterion for environmental remediation of APNB is less stringent and a short contact time is sufficient. The rate of Cu2+, Zn2+, Co2+, Cd2+, Ni2+ and Pb2+sorption remained higher or equal to the CEC. The sorption of metal ions by APNB are complex and probably involve several mechanisms. In general, APNB can be used to immobilize Cu2+, Zn2+, Co2+, Cd2+, Ni2+ and Pb2+ to any extent. For each metal ion, the most effective immobilization occurs over a particular pH around 5. According to the experimental data obtained, the uptake amount of the studied cations by APNB increased with increasing solution pH, sorbent dose and contact time. The preference of the APNB adsorption for heavy metal ions that are through the cation exchange processes decreases in the order: Cu2+>Zn2+>Co2+>Cd2+ >Ni2+ >Pb2+.
Keywords: Bentonitic clay, Egypt, Aluminum Pillared Nano-Bentonite, heavy metal, environmental remediation