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MOBILIZATION OF METALS AND METALLOIDS FROM CONTAMINATED SOIL AND READSORPTION ON SYNTHESIZED ZEOLITES AND ZEOLITE-FLY ASH MIXTURES

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EXTENDED ABSTRACT

The current research investigates the possible effect of a treated fly ash so as to act as a synthesized zeolite on remediating soil polluted with a variety of heavy metals and metalloids including As, Pb, Cu, Zn, Fe and Mn. In particular, 6 types of 'treated material' were produced by hydrothermal treatment of a calcareous fly ash derived from Lignite-Fired Power Plants (Ptolemais and Megalopolis Stations, Greece): four with excess of sodium hydroxide in a solid/liquid ratios of 25 and 50g L^{-1} ($SZ_{25}P$, $SZ_{50}P$ and $SZ_{25}M$, $SZ_{50}M$) and two with excess of fly ash in a solid/liquid ratio of 100g L^{-1} ($SZ_{100}P$, $SZ_{100}M$). Soil samples were obtained from a former mining site (nowadays used as a Technological and Cultural Park) at the city of Lavrion, Greece and pollution referred mainly to slags, sulfur containing waste, smelting waste and low grade lead concentrates. Metal and metalloid concentrations were found to be extremely high, posing significant hazards for both human health and the ecosystem. Except from chemical analysis, soil samples were subjected to X-Ray Diffraction and Thermo-gravimetric Analysis along with the determination of their major physicochemical characteristics, for specifying the different metal formations in soil. Mobilization and transfer of metals to the retention agents was undertaken using HCl aq 1M and Na_2EDTA 0.1M. A kinetic study was conducted and results illustrated that HCl 1M was more effective for intermediate mixing times (up to 4h) while the optimum mixing time for pollutants mobilization under Na_2EDTA 0.1M was determined mainly by the type of soil pollution. Retention experiments were carried out using different soil/additive ratios and the performance of untreated fly ash in combination with zeolites was also examined. Results showed a satisfactory retention with respect to Cu, selective for Fe, Pb and Zn, while rather poor retention was observed for Mn and As. For purposes of comparison with existing materials, the retention of metals and metalloids was examined for a natural zeolite (NZ) too. Results were comparable, while for many substances, synthesized materials were proved more effective for soil decontamination. The type of the waste treated and especially, the different metal formations in contaminated soil, found to be of major importance for the effectiveness of the overall process, since both mobilization and retention varied significantly for the same substances coming from different soil samples. Another important factor found to be the soil-solvent-additive interaction and the pH of the final liquid and solid products.

Keywords: Lavrion, soil, metals, arsenic, soil washing, synthesized zeolite, metal retention