Immobilization of Heavy Metals in Polluted Soils by the Addition of Zeolitic Material Synthesized from Coal Fly Ash

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ABSTRACT

The use of zeolitic material synthesized from coal fly ash for the immobilization of pollutants in contaminated soils was investigated in experimental fields at the Doñana toxic spill (South of Spain). This area was flooded with a high heavy metal pyrite slurry in April 1998. Although reclamation activities were carried out very fast, a residual pyrite slurry mixed with soil accounted for relatively high leachable levels of potentially toxic elements such as Zn, Pb, As, Cu, Sb, Co, Tl, and Cd.

Phyto-remediation strategies were adopted for the final recovery of the polluted soils, and the immobilization of metals was necessary to avoid leaching processes and the consequent ground water pollution.

To this end, 3.5 tonnes of high NaP1 zeolitic material was synthesized from the Teruel and Narcea coal fly ashes in a 10 m^3 reactor at CLARIANT SA facilities using modified conditions from Querol et al. (1999).

This zeolitic material was applied using different doses (from 15 to 54 tonnes per hectare) to 8 different experimental fields. The zeolitic material was manually applied by mixing the powder with the soil. One of the fields were maintained without zeolite addition to compare the reduction of the metal leaching with the other fields. Sampling was carried out one and two years after the zeolite addition.

The preliminary results show that the application of the zeolitic material considerably decreases the leaching of elements such as Cd, Co, Cu, Ni, and Zn. Although the reduction of the leachable proportion is mainly due to the ion exchange, the precipitation of insoluble phases (as a consequence of the pH rise from 3.3 to 7.6 due to the zeolite addition) also contribute to immobilize the pollutants.

Relatively high immobilization rates were obtained with low doses of zeolite (15 tonnes/ha soil) during two years. If a rapid immobilization is required (one year), it may be obtained by adding larger zeolite doses (up to 54 tonnes/ ha).