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Synthesis of zeolites from coal fly ash by hydrothermal process with salt and distilled water. Potential utilization to the reduce amount of heavy metals in contaminated areas

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Coal fly ash is the most abundant coal combustion by-product. Some of it is used in concrete and cement manufacturing but more than half of it finds no applications and is disposed of in landfills. The huge production of fly ash creates serious concerns regarding its disposal and several investigations have been carried out in order to try to exploit this waste material. An area where fly ash has been gaining ground in the last few years is in the synthesis of zeolites. This is possible because the main component of fly ash is amorphous aluminosilicate glass which represents the mainly reactive phase. Synthetic zeolites are known for their ability to act as catalysts, to absorb liquids and gases and to exchange ions.

In the present study four samples of coal fly ash from an Italian thermoelectric power plant were used to synthesize zeolite X and P by hydrothermal activation after fusion pre-treatment with NaOH. Experiments were performed at different temperatures (30-35-40-45-60-90 ˚C) with time of incubations of four days using both salt water and distilled water during hydrothermal process. Chemical characterization of fly ash for major constituents and trace elements was performed, respectively, by X-ray fluorescence (XRF) and ICP-MS analysis after acid sample dissolution. Products have been characterized by XRD, SEM-EDS and FT-IR. Ion-exchange capacity (CEC) for NH_4^+,Co^{2+}, Cr^{6+}, Ni^{2+}, Pb^{2+} and Zn^{2+} were determined for the material obtained.

The experiments demonstrate that zeolites can be synthesized at low temperature using both salt water and distilled water. The ion-exchange capacities of the treated fly ash

in the forms of zeolite X and P indicate that they may be potentially useful to reduce both the amount and mobility of metals.

Zeolitization at low temperature represents a concrete potential application to obtain industrial products from waste material in an economically advantageous way. Moreover, interesting results regarding salt water suggest its potential use in resolving the problem of high water volume needed for the synthesis of zeolites at plant scale.