Utilization of South African Fly Ash to Treat Acid Coal Mine Drainage, and High Quality Zeolite Synthesis from the Solids Produced

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ABSTRACT

South African (SA) coal mining creates huge volumes of sulphate-rich, pollutant-laden acid mine drainage (AMD). SA law requires costly treatment before AMD discharge. Electricity generation produces >20Mt/annum of fly ash (FA) for which there is little large-scale application within SA (typically 5% is utilized), the remainder being disposed in FA dams or heaps. For logistical reasons, coal-fired power stations are sited near to the mines that supply them.

The alkalinity in FA (primarily present as CaO) has been utilized in this study to neutralize AMD. The two waste products were reacted together and produced much cleaner water, broadly comparable to lime or limestone treated AMD, with end pH controlled at anything up to 12. This 'co-disposal' procedure worked best for treating high TDS AMD. Sulphate removal rates were up to 90%, Fe, Al and heavy metal removal were often total depending on the final pH, and EC was seen to drop to a minimum at pH ~10. Treated AMD concentrations for a number of species (e.g. As, B, W and Mo) were seen to increase at high pH, normal for these elements.

The solids remaining after co-disposal of FA and AMD were often suitable raw materials for the synthesis of zeolites via NaOH fusion. High quality, high yield, clean phase (XRD analyses) zeolites formed included zeolite Y (faujasite), zeolite A and sodalite. These zeolites have widespread potential application in water treatment or as catalysts. N_2-BET analyses indicated that some faujasite samples had surface areas in excess of 500 m^2/g.