

Leaching and Toxicity Behavior of Ashes from Circulating Fluidised Bed Combustion

George Skodras^{1,2,3}, Panagiotis Grammelis³, Maria Prokopidou¹, and George P. Sakellariopoulos^{1,2}

¹Chemical Process Engineering Laboratory, Dept. of Chemical Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece; ²Laboratory of Energy and Environmental Processes, Chemical Process Engineering Research Institute, Thessaloniki, Greece; ³Institute for Solid Fuels Technology and Applications, Ptolemais, Greece

KEYWORDS: Solid residues; CFBC; ICP-AES; TCLP; Microtox test

ABSTRACT

Modern power plants are designed to fulfill the increased requirements for high efficiency and enhanced environmental performance in terms of reduced fuel needs, quantities of solid by-products and emitted pollutants, especially concerning CO₂ decrease. Within the last years, attention has been focused on the development of clean coal technologies, based on the pulverized coal fired once-through boiler technology and the Circulating Fluidised Bed Combustion (CFBC) systems. The environmental problems provoked from those wastes due to their toxic trace element contents necessitate their detailed characterisation.

Two different coal types, a South African and a Colombian one, were used in a series of experimental trials. Three different combustion tests per fuel were carried out in a CFBC installation of 1.2 MWth and the behavior of the produced ashes was investigated. Fly and bottom ash samples were characterised in terms of powder X-ray diffraction (XRD), particle size distribution, scanning electron microscopy (SEM-EDS), heavy metal concentration (ICP-AES), leachability (EPA Method 1311 - TCLP) and ecotoxicity (Microtox[®]). According to the results, the toxic trace elements are preferentially concentrated in the fly ash particles, and mostly in the samples collected from the baghouse filter, since they presented the smaller particles size and thus the larger specific surfaces. However, the chemical analysis of the ash leachates showed that are acceptable for safe disposal, since none of them exceeds the maximum EPA limits. Additionally, the Microtox toxicity test proved that the baghouse filter ash leachates, which presented the higher heavy metals concentrations due to their low particle sizes, caused the higher toxic effects on the bacteria.

Submitted for consideration in the 2007 World of Coal Ash Conference, May 7-10, 2007.