

# Coal Fly-Ash Utilisation in Greece

D. Karangelos<sup>1</sup>, M. Anagnostakis<sup>1</sup>, E. Hinis<sup>1</sup>, G. Skodras<sup>2,3,4</sup>, P. Grammelis<sup>2,5</sup>, E. Kakaras<sup>2,5</sup>

<sup>1</sup>Nuclear Engineering Section, Mechanical Engineering Dept., National Technical University of Athens, Athens, Greece, <sup>2</sup>Institute for Solid Fuels Technology and Applications / Centre for Research & Technology Hellas, Ptolemais, Greece, <sup>3</sup>Laboratory of Solid Fuels and Environment, Chemical Process Engineering Research Institute, Thessaloniki, Greece, <sup>4</sup>Chemical Process Engineering Lab, Aristotle University of Thessaloniki, Thessaloniki, Greece, <sup>5</sup>Laboratory of Steam Boilers and Thermal Plants, Mechanical Engineering Dept.,

KEYWORDS: Brown coal, PF ash, heavy metals, radioactivity.

## ABSTRACT

Significant economic and environmental problems coming from the disposal of coal ash have led to the implementation of various alternative uses, in which combustion residues are considered as value-added products. In Greece, a large quantity of fly-ash is the inevitable by-product of Greek brown coal burning, due to its high ash content. In this paper, the main characteristics of fly-ash from Greek coal-fired boilers are presented in relation to its exploitation potential. Both fuel and fly-ash samples were collected and analysed according to the ASTM Standards. Apart from the typical analyses (proximate, ultimate, ash analysis and calorific value), an ICP-AES spectrometer was used for the analysis of heavy metals in the ash. Experimental measurements in order to determine the radioactivity content of raw fuel and the fly-ash were carried out as well.

The ashes from the Greek brown coal are classified in type C, e.g. into class with high proportion of CaO, due to the fact that compounds of sulphur – calcium – aluminates are predominant. The total annual fly-ash production for the last two years was about  $10 \times 10^6$  tons, of which  $7.6 \times 10^6$  tons are produced in northern part of Greece (Ptolemais) and  $2.4 \times 10^6$  tons in southern part of Greece (Megalopolis). Ptolemais fly-ash is rich in calcium compounds, while Megalopolis fly-ash contains more pyrite. Increased heavy metal concentrations are observed in the fly-ash samples of Greek coal. Greek fly-ash appears to have not only pozzolanic but also hydraulic behaviour. Furthermore, Greek fly-ash, depending on its origin, may have relatively high natural radioactivity content, reaching in the case of Megalopolis fly-ash  $1 \text{ kBq kg}^{-1}$  of  $^{226}\text{Ra}$ . Fly-ash is mostly used in Greece in cement industry replacing cement clinker and aiming to the production of special types of Portland cements. However, a more aggressive utilization strategy should be developed, since low quantities of the total produced fly-ash is currently further utilized.

Submitted for consideration in the 2005 World of Coal Ash, April 11-15, 2005, Lexington, Kentucky, USA.