The Application of Advanced Mineralogical Techniques to Coal Combustion By-product Characterisation

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ABSTRACT

Quantitative X-ray diffractometry and automated electron beam image analysis have been successfully used to evaluate the nature, mode of occurrence, distribution and relative abundance of the different crystalline phases (minerals) and amorphous (glassy) phase occurring in a range of coal combustion by-products., The automated electron beam image analysis was performed using a QEMSCAN system, an SEM equipped with four integrated energy dispersive X-ray detectors that rapidly acquire X-ray data from numerous individual points in polished sections of the sample. The software then uses the spectral data to identify the mineral or other phase represented at each point in the analysis, drawing on an internal database of known mineral compositions. Such an approach provides comprehensive information on the constitution, morphology, grain size, distribution and phase associations for several thousand particles in an ash sample.

In this study, the abundance and average chemical composition of the amorphous or glassy components have been determined using quantitative X-ray diffraction, including tests based on different preparation and processing techniques. QEMSCAN was used to map the form and distribution of mineral phases and characterise the variation in glass composition for a range of ash materials. The calculated average chemical composition of the glassy phase provides information that can be related to particle density and surface area as well as ash behaviour in different utilisation processes. The relative abundances of the different crystalline components and the inferred chemical composition of the amorphous fraction can also be related to the mineral matter in the feed coal.

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