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CHARACTERISTICS OF HEAT TRANSFORMED ORGANIC MATTER IN COAL WASTES – PRELIMINARY STUDY

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Coal wastes are produced at various stages during coal exploitation. They contain mineral matter and organic matter (3-30 wt%; Skarżyńska, 1995) occurring in the form of lenses, laminae and dispersed particles of various sizes. The oxidation of organic matter deposited on coal waste banks is a potential influence on self-heating of the wastes and, as a consequence, on the formation of numerous toxic compounds that might be emitted to the atmosphere and/or result in contamination of waters and soils. In this context, the character of the organic matter involved (maceral compostion) and the duration and degree of heating are critical factors.

The aim of this preliminary work is to examine the extent and scope of the oxidation alterations using geochemical and petrographic methods and to assess whether chemical composition and commonly applied biomarker parameters can be used to characterize them.

From over 130 samples of collected from the coal-waste dump at Chwałowice Coal Mine (Upper Silesia, Poland), 15 representative samples were selected from various macroscopically distinguished units within the waste bank. The samples differ in colour and structure. Some with pale reddish and pale yellowish colours are hard and solid. These were formed during the thermal transformation of shales. Other samples are of grayish black to black in colour and are transformed coal muds.

Petrographic analyses carried out on particulate pellets involved the evaluation of the contents of all three maceral groups, mineral matter and coke. The petrographic composition of each sample was determined at 500 points and random reflectance measurements were made at 100 points using an Axioplan II optical microscope at a magnification of 500X. Geochemical analysis involved ultrasonic solvent extraction of powdered samples and the analysis of the total extracts by gas chromatography–mass spectrometry (GC–MS). About 50 g of sample (grain size <0.2 mm) were extracted in dichloromethane for approximately 20 min in an ultrasonic bath. The extracts were not separated into compound groups because of the very low extractability of most of the samples. An Agilent Techn. gas chromatograph with a DB-35 column (60 m×0.25 mm i.d.), coated with a 0.25 μm stationary phase film coupled with a mass spectrometer was used. The experimental heating program was as follows: 50°C (isothermal for 2 min) followed by heating up to 175°C at 10°C/min, to 225°C at 6°C/min

and, finally, to 300°C at 4°C/min. The final temperature (300°C) was held for 20min. The carrier gas was He. The mass spectrometer was operated in the EI (70eV) and scanned from 50-650 da. All compounds were identified using mass spectra, comparison of peak retention times with those of standard compounds, interpretation of MS fragmentation patterns and literature data. Several biomarker parameters of thermal maturity and depositional environment were used (Peters *et al.* 2005). Geochemical parameters were calculated using peak areas acquired in the manual integration mode.

The content of macerals differs from a few to over 90%. The most abundant maceral group that undergoes weathering at an early stage is vitrinite. Weathered particles are characterised by irregular cracks and some by a pale gray colour. Other maceral groups (liptinite and inertnite) occur in lesser quantity. Coke with a yellowish colour and high reflectivity, usually occurs as massive particles (with low or nil porosity) and detritus. Porous coke particles are rare. Organic matter present in the coal muds is usually unaltered or slightly altered and mixed with small quantities of coke. In contrast, wastes with a reddish colour contain significantly lower amounts of organic matter. In this case, the organic matter is typically coke; particle alteration is at most slight.

Extracted organic matter falls into three main categories (groups) in terms of chemical properties. The first group shows features characteristic of unaltered organic material (coal or coaly shales and mud) with biomarker parameters indicative of thermal maturity in the range of middle catagenesis. The samples are, in some cases, slightly weathered and/or water-washed – and probably also biodegraded. The second group comprises organic material showing increased thermal maturity reflected in changes in the distribution of both aromatic and aliphatic compounds; variations are probably related to distance from a fire zone. The third group, characterised by very low extract yields, comprises burnt out wastes in which any organic matter remaining is composed of coke. The extracts from these show compositions typical of pyrolysates. This organic matter was produced in a different temperature regime within the fire-affected waste dump. The pyrolysates were likely formed during a dump fire, evaporated and precipitated on the mineral matter after cooling occurred.

REFERENCES

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