

## Composition of fly ash from co-combustion of bio-mass with coal in power plant

W. WILCZYŃSKA-MICHALIK<sup>1\*</sup>, R. GASEK<sup>1</sup>, J. DAŃKO<sup>2</sup>  
AND M. MICHALIK<sup>3</sup>

<sup>1</sup>Institute of Geography, Pedagogical University, 30-084  
Krakow, ul. Podchorazych 2, Poland

(\*correspondence: wmichali@ap.krakow.pl)

<sup>2</sup>Elektrociepłownia KRAKOW S.A., 31-587 Krakow,  
Ciepłownicza 1

<sup>3</sup>Institute of Geological Sciences, Jagiellonian University, 30-  
063 Kraków, ul. Oleandry 2a, Poland

Co-combustion of bio-mass and coal in power plants gives important environmental advantages but also influences combustion process and properties of fly ash and slag.

Fly ash is composed of mullite, quartz, leucite, CaO, MgO and amorphous matter. SiO<sub>2</sub>/Al<sub>2</sub>O<sub>3</sub> ratio varies between 2.0 and 2.6. Fe<sub>2</sub>O<sub>3</sub>, MgO, CaO content varies between 7.4 and 8.5; 4.2 and 4.4 and 4.4; 6.8 and 7.2 wt.%. LOI varies between 5 and 9 wt.%, coal content is between 3.9 and 7.5 wt% and sulphur content is ca. 0.5 wt.%. Trace elements contents are similar to those of fly ash produced during coal combustion. The content of water-soluble substances is relatively high comparing with fly ash obtained from coal combustion.

Grain size of fly ash particles varies from below 1 µm up to ca. 50 µm. Spherical particles dominate but the content of other forms is relatively high in comparison with fly ash obtained from coal combustion. Spheres are black, brown or yellowish in transmitting light microscopy. Most spheres are composed of aluminosilicate of various composition, Fe rich components, and Fe, Mg, Ca rich oxides. Spherical particles are often empty inside, with porous walls and inhomogeneous in chemical composition. Glassy spheres are often composed of two chemical varieties: Si-rich small droplets dispersed inside Si-Al component with K and Fe.

Irregular vesicular particles with aluminosilicate composition, unburnt coal fragments are relatively common. Quartz grains up to 50 µm in size are also present.

Comparison of fly ash from co-combustion and coal combustion indicates that significantly higher CaO content in ash obtained in co-combustion process is the most important difference. CaO content determined in chemical analysis and identification of CaO in XRD suggest potential risk of too high content of free CaO for several applications of fly ash.

## Discrimination between monsoon-driven eolian, fluvial and turbiditic supply in the northern Arabian Sea

D. WILHELMS-DICK<sup>1\*</sup>, T. HANEUBUTH<sup>1</sup>, C. VOGT<sup>1</sup>,  
U. RÖHL<sup>2</sup>, T. WESTERHOLD<sup>2</sup>, V. LUKIES<sup>2</sup>  
AND S. KASTEN<sup>3</sup>

<sup>1</sup>Bremen University, Postfach 330 440, 28334 Bremen,  
Germany (\*correspondence: wilhelms@uni-bremen.de)

<sup>2</sup>Marum, Postfach 330 440, 28334 Bremen, Germany

<sup>3</sup>Alfred Wegener Institute for Polar and Marine Research,  
Postfach 120161, 27515 Bremerhaven, Germany <sup>3</sup> Bremen  
University

To study short-lasting variability in the Arabian Monsoon intensity, laminated sediments from the Arabian Sea oxygen minimum zone (OMZ, 200-1200m) offer a high-resolution climate archive [1]. Previous investigations have demonstrated that three independent proxies (varve thickness, stable oxygen isotope ratios of planktic foraminifera, and inorganic geochemical composition) together reflect the monsoon-driven 'moisture history' [2]. The frequencies of turbidites and varve thickness often occur as multiples of the basic tidal cycles [3].

So far, high-resolution analysis of laminated sediments have mainly been performed in the northeastern Arabian Sea, which are not remarkably influenced by turbidites.

In contrast to these studies, a 5.3 m long sediment core from the northern Arabian Sea (GeoB12309-5: 24:52.3°N; 62:59.9°E, 960 m water depth), covering a suggested time period of about 1600 years, includes a succession of turbidites, deciphered by radiography. We assume that these can be used as climatic signals in addition to the intensive varve layering.

XRF core scanning shows highly varying signals only within the upper 1.6 m, which might be explained with a recent expansion of the OMZ. Further, major elements reflect mainly terrigenous sources. ICP-MS and laser ablation-ICP-MS techniques will be used for (i) calibration of the XRF data, (ii) to elaborate advantages and disadvantages of all three methods, and (iii) to calculate enrichment factors of single elements to define source regions from deposited material.

The obtained elemental signatures will be used (i) to investigate monsoonal intensity via known and new proxies, and (ii) to perform frequency analysis of element signatures, varve thickness and turbidites to discriminate whether these signals formed in relation to monsoonal or tidal variations.

[1] Von Rad *et al.* (1999) *Quat. Res.* **51**, 39-53. [2] Lückge *et al.* (2001) *Palaeogeogr. Palaeoclimatol. Palaeoecol.* **167**, 273-286. [3] Berger & Von Rad (2002) *Glob. Planet. Change* **34**, 313-325.