Characterization of particulate matter in Kraków, Poland.

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Keywords: aerosols, Poland, benzo(a)pyrene, Hg(p).
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Airborne particulate matter poses a significant problem in South Poland. Kraków is classified at the eighth place among 575 most PM2.5-polluted cities and at the 145th place among 1100 most PM10-polluted cities listed in the WHO ranking (WHO, 2013). According to its basin location the city often suffers under temperature inversion causing high pollution periods. Continuous air quality monitoring and several studies conducted already in the region showed that residential solid fuel combustion and traffic have a dominant influence on particulate matter burden (e.g., Larsen *et al*., 2007), being responsible for increased concentration of toxic and noxious chemicals. However, the available information is not persuasive enough to become a catalyst for efficient policies reducing the emissions and lowering the human exposure to hazardous substances.

The current study combines two sampling campaigns (February 2011 – PM10 and February 2013 – PM10 and PM2.5). Particulate matter was collected in the centre of Krakow (Aleja Mickiewicza, AGH, University of Science and Technology) with low volume samplers operated with daily (24h) intervals. Quartz fibre filters (Pall, 47mm) were used for sampling, field blanks were collected.

Particulate matter mass was measured gravimetrically under stable humidity and temperature conditions. Circular aliquots were punched out of the filters in order to conduct chemical analyses. Analytes and the respective aerosol sources are listed in Table 1.

Table 1. Characteristic sources their chemical fingerprints and analytical methods.

Source	Component group	Method
Combustion	EC, OC	Thermal-optical
RWC, BA	Saccharides	HPAE PAD
SA	Inorganic anions	HPAE CD
SA	Inorganic cations	HPCE CD
Combustion	PAHs	GC-MS
Combustion, Industry	Selected elements	XRF
Combustion, Industry	Particulate Hg	CV-AAS

RWC = residential wood combustion, BA = biological aerosol, SA = secondary aerosol, EC = elemental carbon, OC = organic carbon, PAHs = polycyclic aromatic hydrocarbons

The aim of the study is to chemically characterize PM10 and PM2.5 as well as to quantify aerosol sources being locally relevant. The comparison of two winter periods will help to assess the pollutants which were not reduced over a period of two years.

The source apportionment method used for Kraków is based on the macro-tracer model derived in Austria (Puxbaum *et al*., 2005). This model is taking advantage of the existence of source specific compounds and stability of their relations in emission and ambient air.

The winter PM10 concentrations observed during the sampling period in winter 2011 exceeded constantly the admissible threshold of 50 µg/m³. The similar trend is expected for 2013, as no powerful reduction measures have been applied in the city since that time.

In 2011 the highest mass contribution was found for carbonaceous aerosols (50%), followed by inorganic secondary aerosols (30%). Levoglucosan (anhydrous saccharide used to assess residential wood burning impact) concentrations did not exceed 1% of PM10. Analysed PAHs contributed only 0.1% to PM10 mass, but benzo(a)pyrene (BaP) concentrations were around 10 ng/m³ (being 10 times higher than the annual limit value). Residential coal combustion is expected to be the most prominent BaP source.

This work is an ongoing cooperation between Vienna University of Technology and AGH University of Science and Technology, Kraków. We acknowledge the work of students of both institutions involved in the study. Work was financially supported by the International Atomic Energy Agency (project RER/1/008), the Polish Ministry of Science and Higher Education grants for Scientific Research and KICCoalGas “Development of a Coal Gasification Technology for High Efficiency Fuel and Power Production”.

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