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Benzo(a)pyrene emitted during small-scale wood burning

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Benzo(a)pyrene (BaP) - a marker for the carcinogenic risk of polycyclic aromatic hydrocarbons (PAHs), is formed during inefficient combustion. Transportation and domestic combustion of solid fuels, including biomass, are known to be its major emission sources. The European Council has established in Document 2004/107/EC that the ambient concentration of BaP, starting from 31.12.2012, should not exceed 1 ng m^{-3} for the total content in the PM_{10} fraction averaged over a calendar year.

In Austria, the concentration threshold of BaP has been until now often violated, due to high share of biomass burning emissions in atmospheric pollution burden (e.g., report by Bauer et al., 2008).

The following experiment is part of a study characterizing wood burning particles from domestic sources in Austria and describes the BaP emissions.

We present the emission rates of PM_{10} and particulate PAHs from burning of the major wood species grown in eight Mid-European countries. The logwood tests were performed with modern small-scale (<10kW) logwood- and pellet stoves. PM_{10} was sampled on quartz fibre filters, over the whole combustion cycle (2 or 3 loadings). Particle-bound PAHs were determined, after extraction of combined samples, with GC-MS system (HP 5890 + HP 5973). The details are given in Schmidl et al. (2011) and Kistler et al. (2012).

BaP emission from four chimney stoves varied strongly (3-45 μg MJ^{-1}) among fuels and stove types. The variation of the emission rates from different combustion tests is explained with a multiple linear regression model including EC (a further oxidation product) and the burn rate as input variables. This indicates that the increased BaP emission rates are related to high burn rates (hot and air starved conditions), and may occur temporarily during very efficient burning cycles, which are characteristic for modern stoves.

These findings pose a question if the modern combustion technology is able to ensure a significant decrease of BaP levels in small “wood-burning-communities”. Therefore we calculate and discuss BaP emission ratios in relation to PM_{10} in order to estimate the ambient wood-burning BaP concentration.

References

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