Characterization of Particulate Matter from Biomass combustion using Fluorescence Microscopy analysis

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This study is a part of the INTERREG research project BIOCOMBUST (Gieré *et al.*, 2013-2015) that explores and communicates the impact of particulate emissions from biomass combustion on air quality and health in the Upper Rhine region. The expected results will provide a basis for technical and economic applications, which eventually will lead to an improvement of both environmental and living conditions. In addition, the results will give an important boost to the sustainable expansion of the biomass industry and to the use of the associated ashes as secondary raw materials for the cement industry.

Biomass burning is more and more considered to be a good alternative to fossil fuel scarcity. Nevertheless, this energy recovery emits an aerosol that contains particles with very low diameters below 1 µm. In order to have a better understanding of their effects on global environment and health, Particulate matter have to be collected and characterized. Fluorescence microscopy is a relatively cheap and fast method to achieve characterization of dust from biomass burning.

Firstly, a quick overview of sampling procedures used in order to separate dust from the aerosol will be developed. The household boilers sampled have several nominal outputs: 40 kW, 400 kW, 3.8 MW, 8MW, 17.3 MW that combusted wood chips and miscanthus (an energy crop). The dust samples were collected either with flue gas treatment devices (Multicyclone, Bag House filter, Electrostatic Precipitator) or with a DEKATI DGI impactor ($PM_{2.5}$). Bulk dust and dried dust collected from smoke treatment devices was studied using Malvern laser granulometer.

Secondly, fluorescence spectroscopy was applied to two dust samples, which were collected in a multicyclone and resulted from combustion of miscanthus and wood chips. The collected particles were mounted between a standard slide and a coverslip. On a confocal microscope equipped for fluorescence spectroscopy, 32 images were acquired on the same field of observation corresponding to different fluorescent emission wavelengths (excitation at 405 nm; emission from 413.9 nm to 689.8 nm with steps of 8.9 nm). The ImageJ software (Schneider *et al.*, 2012) was used to analyse single-particle and whole-sample fluorescence spectra. These plots are related to fluorescence of some components (Carletti *et al.*, 2010).

These results allow the choice of the set of filters and then wide-field fluorescence microscopy can be useful to characterize dust. On the same field of observation, white light collected and processed images allowed us to define the equivalent surface of particles. Meanwhile, on fluorescence images the surface and the fluorescence intensity were quantified. Both the percentages and densities of fluorescence (per particle surface) were measured. To ensure dust sample representativeness many fields per sample were collected.

Subsequently, twelve different samples resulting from biomass combustion were investigated using this protocol. All of the dust samples collected were analysed using this method. In order to make sense of this information on fluorescence, it will be attempted to correlate the measurements to chemical components of dust: PolyAromatic Hydrocarbons (PAH), Humic-Like Substances (HULIS) and non-combusted matter.

An attempt to analyse soot from diesel burning using fluorescence microscopy revealed no fluorescence detected using this method. As the method was applied to several samples of dust from biomass burning, with several nominal outputs, it could be a fast way to discriminate Particulate matter from biomass burning and diesel burning in a random aerosol.

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