THERMOGRAPHIC CHARACTERISATION OF DIFFERENT SOOT TYPES

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Large amounts of soot particles are emitted into the atmosphere mainly from incomplete combustion of biomass and fossil fuel. Since soot is the most strongly absorbing aerosol in the atmosphere it has a direct climatic impact and affects photochemical reaction rates. Furthermore it offers a large surface area for the interaction with trace gases and may cause health effects. Although atmospheric soot has substantial impact on various fields it is still not well defined. Most methods characterise soot-containing aerosol either by its light absorbing properties as black carbon (BC), by its volatility as organic carbon (OC, high volatility) and elemental carbon (EC, low volatility), or combinations of both. These terms are operationally defined by the analysis method and the results depend on the analysis method applied. Intercomparison of soot data from different laboratories is complicated furthermore since many different soot sources with different characteristics are used. The aim of this study is to compare the soot sources currently used in our laboratory with one analysis method.
For the following soot types the total (TC), elemental, and organic carbon content was determined by thermographic analysis of quartz filter samples according to German VDI 2465(2) (VDI, 1999): (a) Diesel soot from a turbo Diesel engine (TDI, 1.9l, 66kW, VW) operated under various loads and with mineral Diesel fuel as well as colza oil methyl ester (Biodiesel) as fuel, (b) Soot from a spark discharge generator (GfG 1000, Palas), and (c) soot generated with a standard propane burner (CAST, Jing-CAST Technology) in a diffusion flame at various carbon to oxygen (C/O) ratios. The VDI 2465(2) method classifies the carbon volatilized from a heated soot sample in three fractions: OC1 (350°C in helium), OC2 (650°C in helium), EC (650°C in oxygen). Particle number concentrations and size distributions were measured with condensation particle counters (3022A, TSI) and scanning mobility particle sizer (3071, TSI).
Figure 1 shows the highest EC content for propane burner soot (C/O = 0.29) and its decrease from spark generated soot, Diesel soot (medium load), Biodiesel soot, to CAST soot (C/O = 0.44 and 1.0). This paper will discuss the soot composition for different loads and fuels of the Diesel engine and the dependence of particle size and composition on the operating conditions of the propane burner.

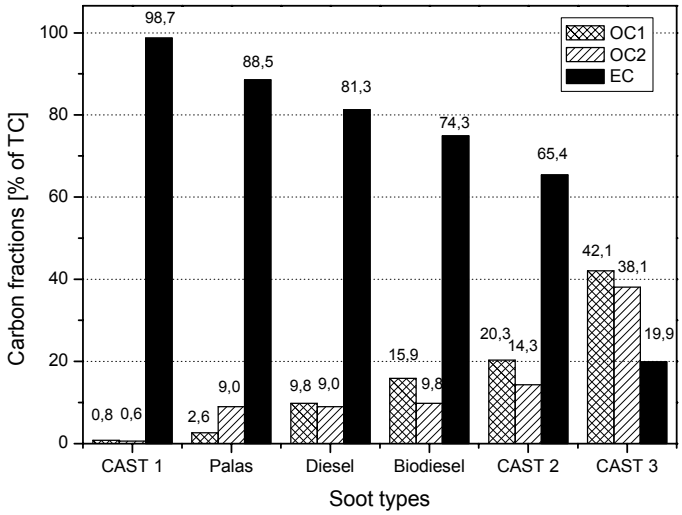

Figure 1. Comparison of the composition of propane burner soot (CAST 1-3; C/O: 0.29, 0.44, 1.0), spark generated soot (Palas) and soot from a Diesel engine (Diesel and Biodiesel).

VDI (1999) Measurement of Soot (Ambient Air) – Thermographic Determination of Elemental Carbon After Thermal Desorption of Organic Carbon. VDI/DIN-Handbuch Reinhaltung der Luft, Band 4, VDI 2465 Part 2, Beuth, Berlin.