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Characterization of emissions from fireplace and wood stove combustion of three Mediterranean tree species

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Biomass burning is an important source of atmospheric particulate matter and gases. It is considered to have large impact on both climate and air quality. Particle emission characteristics, in terms of size distribution and emission factors, have high relevance when the impact of biomass burning is assessed. Wood is commonly used in residential combustion for heating, but its combustion results in the emission of high levels of toxic air pollutants. Biomass burning in residential heating is identified as a major source of atmospheric pollution, especially in rural sites in Europe, mainly in winter. However, the available emission factors were obtained for American biofuels, uncommon in Europe. In order to accurately assess the contribution of wood burning and evaluate its impacts, it is desirable to use available regional data.

In the Centre for Environmental and Marine Studies (University of Aveiro, Portugal) a set of tests was carried out to determine the gas, aerosol size distribution, and chemical composition of PM10 emitted from the combustion in a fireplace and a wood stove. Three types of biomass were burned in the laboratory: Pinus pinaster, Eucalyptus globulus and Quercus suber, typical species of the Mediterranean area. The wood was cut into logs of 30-40 cm in length with a total biomass burned during each cycle of around 1.8 kg. Burning cycles took around 45 min.

The gas sampling was carried out in the exhaust ducts of both combustion systems. Particles were collected under isokinetic conditions in the dilution tunnel that was directly coupled to the chimney. PM10 was collected on quartz filters using a low volume sampler. Size distribution and number concentration of the particles generated during the burning process were continuously monitored in the dilution tunnel using a laser spectrometer (Passive Cavity Aerosol Spectrometer Probe, PMS, Model PCASP-X). This optical counter measures the size distribution of particles with nominal optical diameters of between 0.1 and 10 micrometers in 31 discrete channels. Thanks to the dilution sampling, the rapid cooling and dilution that occurs when exhaust mixes with the atmosphere is simulated.

During each sampling cycle, the concentrations of CO2 and CO were determined using a non-dispersive infrared analyser; an automatic analyser with flame-ionisation detector was used for total volatile hydrocarbons determination. Filters were analyzed by a thermal-optical transmission technique in order to determine the carbonaceous content (elemental and organic carbon) and water-soluble inorganic ions were determined using ion chromatography.

This study represents a step towards a better characterisation of emission profiles of wood species growing in the Mediterranean region in order to improve emission inventory development and contribute to source apportionment.

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