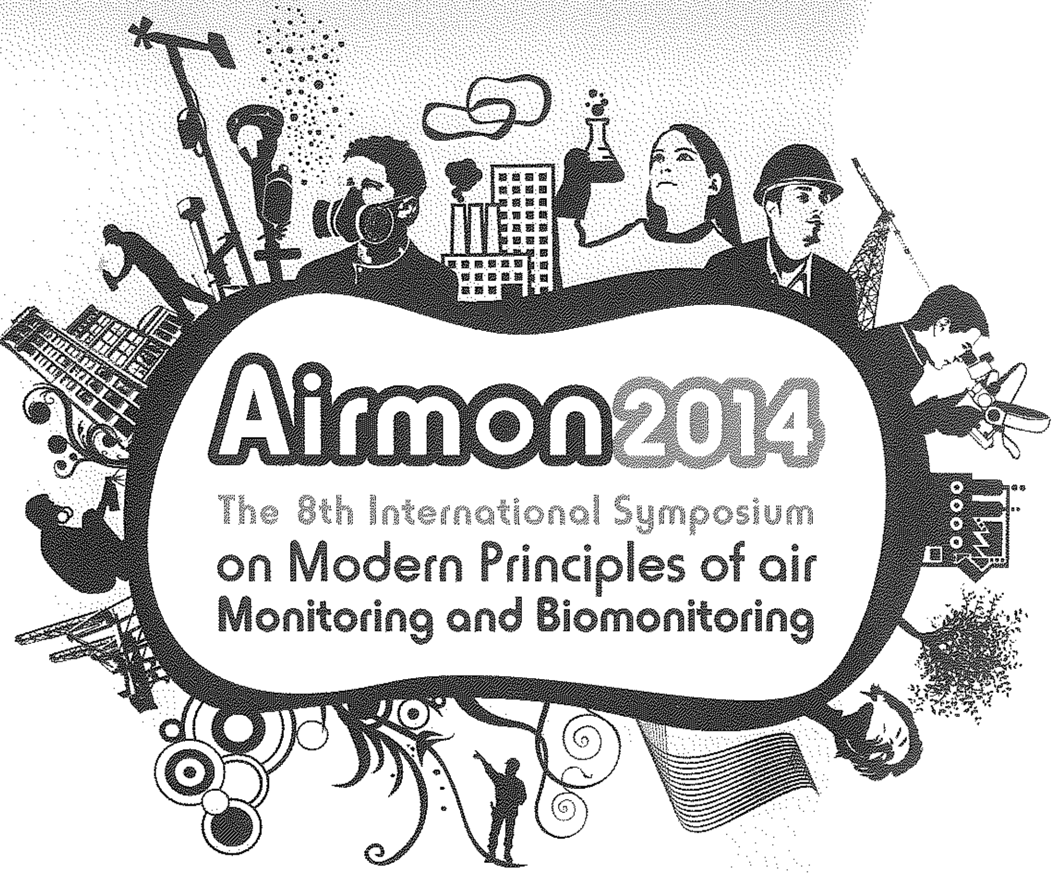

Airmon 2014

The 8th International Symposium on Modern Principles of air Monitoring and Biomonitoring

15-19 June 2014

Marseille, France

Hotel Mercure Euro Centre

Abstracts

Influence of operating conditions on composition of particulate matter emissions from residential combustion

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Currently, most developed countries suffer from a heavy dependence on fossil fuels. In this context, there have been environmental policies that encourage the use of biomass as a renewable energy source (Khan *et al.*, 2009; Saidur *et al.*, 2011). Despite the recognised advantages of the use of biomass, residential wood combustion for heat production has been pointed out as a major source of fine particle emissions (Borrego *et al.*, 2010; Gonçalves *et al.*, 2012), especially during winter-time. The airborne particles arising from residential combustion have harmful effects on public health (Nevalainen & Pekkanen, 1998) and cause disturbances in atmospheric chemistry and climate (Calvo *et al.*, 2013; Pöschl, 2005). Taking into account the impact of these emissions and the need for compliance with legal norms, a rigorous quantification and characterisation of emissions from this sector is necessary. Several studies have shown that emissions from the residential wood combustion are highly variable (Alves *et al.*, 2011; Gonçalves *et al.*, 2010; Tissari *et al.*, 2008; Johansson *et al.*, 2004). The types of appliances, wood fuel and operational practices have a great influence on emissions from this sector.

The aim of this study was to experimentally quantify and characterise the emissions of particulate matter (PM_{10}) resulting from combustion in a typical Portuguese woodstove with variations in fuel (pine and beech), and operational conditions. The variables evaluated were ignition technique (upside down and bottom up lighting), fuel load and, in the case of high load, split and non-split logs.

The highest PM_{10} emission factor was observed for the operation with reduced load for both woods. The top-down method of lighting can decrease the PM_{10} emission factor to less than half when compared with the traditional technique. Quantitative analysis of the carbonaceous material showed that the mass of particles emitted was mainly composed of organic carbon (OC), while elemental carbon (EC) represented a minor mass fraction. The OC content of PM_{10} was higher when loading a lower amount of wood (59%), in the case of beech, or when increasing wood loads (58%), in the case of pine. The top-down method of lighting contributed to substantial mass fractions of EC in PM_{10}, corresponding to 25 and 33% for pine and beech, respectively.

The major organic components of smoke particles from biomass burning are monosaccharide derivatives from the breakdown of cellulose and hemicelluloses, such as levoglucosan, a specific marker for wood combustion in ambient PM samples, which is usually the most abundant organic compound. Average mass concentrations in PM_{10} ranged from 1.8 to 11.2% for beech and from 1.5 to 10.9% for pine wood smoke, which are in general agreement with levoglucosan contents of 0.2 to 17% found for Portuguese woods (Gonçalves *et al.*, 2010) and 0.1 to 15.1% obtained for Alpine species (Schmidl *et al.*, 2008). The highest mass concentrations in PM_{10} have been recorded for the operation with the reduced load for both woods.

Acknowledgement: This work was supported by EC through the "Testing and development of air quality mitigation measures in Southern Europe" (AIRUSE), 11/ENV/ES/000584 LIFE project.

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