# Secondary measures to reduce particulate and gaseous emissions from residential biomass combustion

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The emissions from domestic biomass combustion are highly technology-dependent. In Europe, traditional woodstoves are very common and a high diversity of designs with different performances and emissions can be found. In Portugal, national statistics show that traditional stoves and closed fireplaces represent almost half of the total number of appliances in use (Gonçalves *et al*., 2012). Particle precipitation devices and catalytic converters are already available on the market for residential combustion systems, being especially attractive for old systems, which have high particulate and gaseous emissions. However, detailed studies concerning the efficiency of these devices in different combustion systems are scarce. In this study, pollution control devices were tested in two different combustion systems in order to observe the emission reduction potential.

A manual and batch operated woodstove and an automatic pellet stove were selected for the combustion experiments. Two types of firewood, pine and eucalypt, were used as fuel in the manual stove. Two types of pellets (type I-certified pellets and type II- non-certified pellets) were selected for the experiments in the automatic stove. Particulate matter ($PM_{10}$) sampling was carried out in a dilution tunnel under isokinetic conditions with a TCR TECORA. The flue gas composition was determined using an online Fourier Transform Infrared Gas analyser (Gasmet, CX4000). A catalytic converter (CAT) and an electrostatic precipitator (EP) have been applied to the flue gases.

For most cases, these tests could not document any significant reduction of $PM_{10}$ mass emissions. In the case of EPs, possible particle formation due to condensation of organic compounds, which result from poor burnout conditions, may contribute to particle formation downstream the charging electrode. Significant differences in conductivity have been previously found for salts, soot, and condensable organic compounds (Nussbaumer and Lauber, 2010). Thus, depollution of flue gas from traditional residential combustion equipment is problematic, because of incomplete combustions and high emission of condensables. Although a catalytic converter is designed to clean the flue gas, most of the chemical compounds in wood smoke are only combustible at high temperatures which are hardly achieved in small-scale traditional appliances. In addition, ash/soot clogging and creosote fouling may take place on the surface of the catalyst.

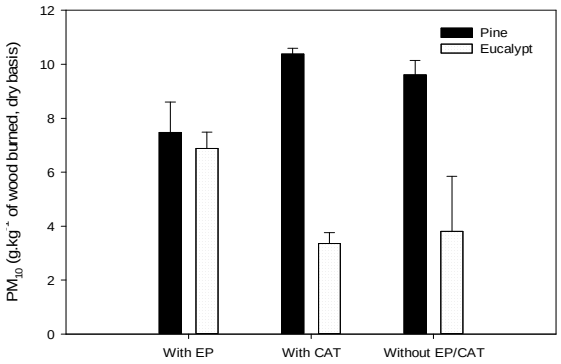


Figure 1. $PM_{10}$ emission factors for the combustion in the woodstove with or without passage of the flue gas through a pollution control device.

Although without effectiveness in removing particles, most of the gaseous pollutants in the flue gas of a pellet stove undergo a decrease in their concentrations. Due to lower flue gas temperatures, these reductions are not observed in the exhaust of a traditional woodstove.

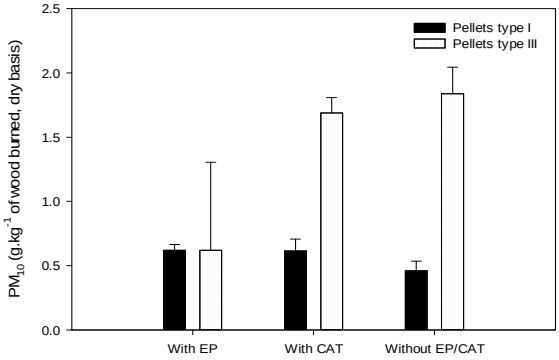


Figure 2. $PM_{10}$ emission factors for the combustion in a pellet stove with or without passage of the flue gas through a pollution control device.

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Nussbaumer and Lauber (2010) *Proc. 18th European Biomass Conference and Exhibition*. Lyon, France.

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