

Hybrid filter performance in residual biomass combustion PM emissions control

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CLEANBIOM research project aims to investigate the sustainability of medium scale biomass combustion plants for power and heat production and their upgrade for fulfilling new legislation (EU, 2015). A series of experiments has been conducted in a semi-industrial scale plant. Very little research work has been done so far on the application of hybrid filters (HF) to biomass combustion (Aragon, 2015; Sanz, 2012).

Facility and method

The facility consists of a bubbling fluidized bed combustion plant (1 MW nominal output) and a HF that integrates electrostatic precipitation (ESP) (dry, wire-plate) and fabric filter (BF) modules. Different combustion operating conditions were tested firing olive prune chips, sieved and non-sieved. Gas to cloth ratio and ESP voltage were varied during the tests.

Pseudo isokinetic aerosol sampling was undertaken both upstream and downstream of the HF. The aerosol sample was past through a cyclon and then collected on 47mm filter for mass concentration determination. In addition, a low pressure cascade impactor was used to assess mass size distribution. Also, CNC and DMA were used for determination of number concentration and size distribution.

After each test day the hoppers of ESP and BF modules were emptied and the ashes were weighted. Secondary voltage and current was periodically recorded during each test.

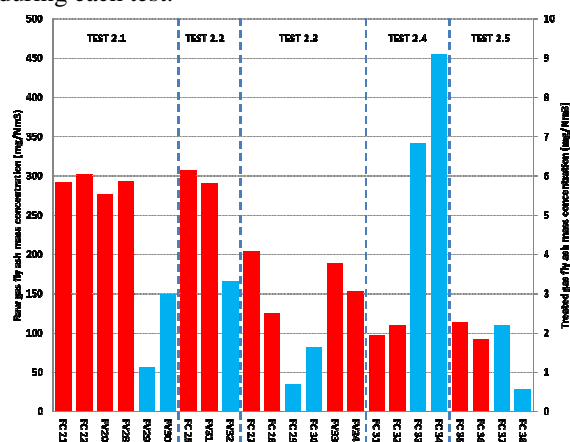


Figure 1. Fly ash mass concentration in raw (red) and treated (blue) gas.

Results

Fly ash size distribution varied with operating conditions, higher concentration being produced when burning non-sieved fuel (tests 2.1 and 2.2). The HF reaches high efficiencies in all studied conditions (92.0-99.5%) (figure 1) with very low pressure drop, inspite of raw gas fly ash featuring a large proportion of fine particles (50%) (figure 2).

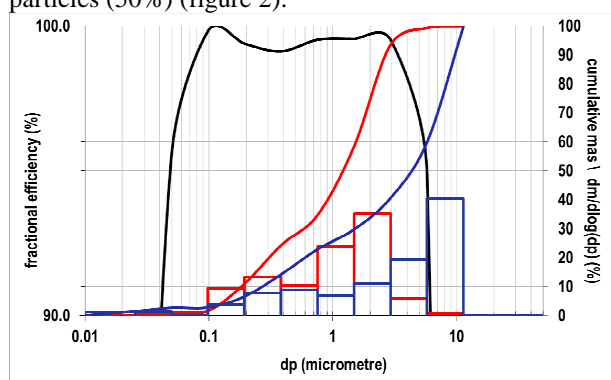


Figure 2. Raw (red), treated (blue) gas mass size distribution and fractional efficiency (black) in Test2.3.

Fractional collection efficiency shows a minimum at 0.4 μm , in agreement with filtration theory and bibliography (Nussbaumer, 2010).

Mass size distribution in treated gas was dominated by few very large particles collected on the first stage of the impactor.

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