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Supplement of

Primary particle emissions and atmospheric secondary aerosol formation potential from a large-scale wood-pellet-fired heating plant

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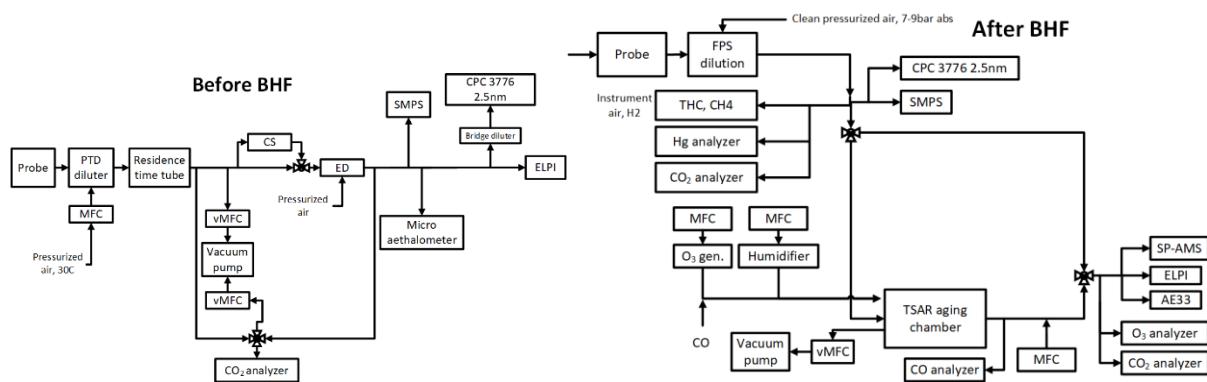
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Figure S1. The measurement setup used (a) before bag-house filters (BHFs) and (b) after BHFs. The measurement setup (a) used to measure black carbon (BC, measured with MAAP and micro-aethalometer), total particle number concentration (CPC), and particle size distributions (SMPS, ELPI) from an online sample taken from the flue gas duct before the BHFs. The PTD stands for porous tube type diluter, CS for catalytic stripper, ED for ejector diluter, and (v)MFC for (vacuum) mass flow controller. The measurement setup (b) used to measure BC (AE33), total particle number concentration (CPC), particle number size distributions (SMPS, ELPI), and chemical composition of the particles (SP-AMS) from an online sample taken from flue gas after the BHFs. The TSAR aging chamber allowed us to study the artificial atmospheric aging of the flue gas. FPS stands for fine particle sampler, THC for total hydrocarbons, and (v)MFC for (vacuum) mass flow controller.
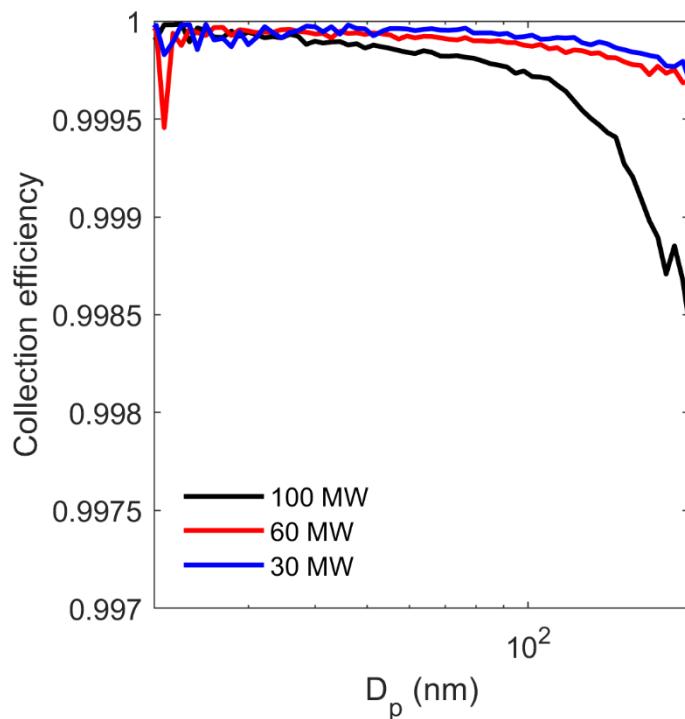

Figure S2. Particle collection efficiency of the BHF as a function of particle size (20-200 nm), calculated from the SMPS data acquired before and after the BHF.

Table S1. The characteristics of the pellets used during the experiment. Analysis of the pellets were made in the Eurofins laboratory. Further details can be found in Niemelä et al. 2022.

	Pellet 1	Pellet 2
Moisture (%)	6.6	6.9
Ash (550 °C) (%)	0.9	0.4
Volatiles (%)	84.1	85.1
Effective calorific value (MJ/kg)	18.58	19.08
Carbon (%)	50.1	50.9
Hydrogen (%)	5.9	6.0
Nitrogen (%)	0.24	0.17
Oxygen (%, calculated)	42.8	42.6
Ca (mg/kg)	2500	790
Mg (mg/kg)	250	140
Na (mg/kg)	57	53
K (mg/kg)	1000	410
P (mg/kg)	150	34
S (mg/kg)	150	48
Fe (mg/kg)	47	11
Al (mg/kg)	63	12
Si (mg/kg)	350	31
Ti (mg/kg)	3.5	<1
Mn (mg/kg)	27	76
Ba (mg/kg)	11	12
Cr (mg/kg)	<1	<1
Cu (mg/kg)	1.4	1.5
Ni (mg/kg)	<1	<1
Zn (mg/kg)	17	8.9
Pb (mg/kg)	<10	<10
V (mg/kg)	<1	<1
F (%)	<0.001	<0.001
Cl (%)	0.005	0.002

Table S2. The median diameters of the particle number size distributions measured by ELPI (D_a) and SMPS (D_p) and the effective density of the particles at three different load conditions.

	D_a (nm)	D_p (nm)	ρ_{eff} (g/cm^3)
100MW	136	75	2.13
60MW	159	79	2.48
30MW	193	96	2.55

References

Niemelä, N. P., Mylläri, F., Kuittinen, N., Aurela, M., Helin, A., Kuula, J., Teinilä, K., Nikka, M., Vainio, O., Arffman, A., Lintusaari, H., Timonen, H., Rönkkö, T., Joronen, T. Experimental and numerical analysis of fine particle and soot formation in a modern 100 MW pulverized biomass heating plant, Combustion and Flame, 240, 2022, 111960, https://doi.org/10.1016/j.combustflame.2021.111960.