Green Week 2013
Low emission wood combustion: Swiss experience
Emissions de PM10 combustion [t/a]

Condensation de COVNM = formation de PM10
8'300 t

11'000 t

Total combustion
6'100 t

Chauffages au bois
4'200 t

Ch. b. <50 kW
Particle Types in different combustion regimes

- Soot
- Salt
- COC ('Tar')

Graph showing CO emissions against excess air ratio for different combustion regimes.

[Nussbaumer, Energy & Fuels 2003, 17]
Ignition from the top: Optimised start

Only dry untreated wood
Boiler: 2-stage Combustion with forced downdraft

Wood: $\text{C}_n\text{H}_m\text{O}_q$

$\text{CO}, \text{H}_2, \text{C}_x\text{H}_y$

$\text{CO}_2, \text{N}_2$

$+ \text{Air } \lambda < 1$

$\text{O}_2 + \text{N}_2$

$\text{CO}_2, \text{H}_2\text{O}, \text{N}_2$

$+ \text{Air } \lambda > 1$

$\text{O}_2 + \text{N}_2$
Emission factors wood combustion (mgPM/MJ)

![Graph showing emission factors for different types of wood combustion equipment.]
Conclusions 1

• Only dry untreated wood, as well as good operation and ignition practice;
• Crucial for existing wood stoves and boilers;
• Heat accumulation tank required to avoid part-load operation with increased emissions;
• Restrict biomass open fires, which release high emissions without energy use;
• In any case prohibit private waste incineration.
Conclusions 2

• Wood stoves design should be developed that avoid improper operation like overfilling or reducing the air inlet, resulting in smoldering conditions;

• Secondary measures might be considered, like small ElectroStaticPrecipitator;

• To better cover heat demand 2-staged log wood boilers or automatic pellet stoves might be enforced;
Conclusions 3

• Improved wood boilers include a two-stage combustion with forced ventilation prior to the hot combustion chamber should be applied to enable good mixing and less dependance on the ambient air temperature and wind;

• For residential wood combustion, strictly native and well dried wood is applicable.
• More information on www.bafu.admin.ch/air

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Pellet boiler with automatic ignition
Additional information

Small scale ESP:

Oekotube