

Small Wood fired Appliances: Emission Reduction by combined Methods

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Small wood fired appliances:

Common names: wood stoves, tiled stoves, fireplaces

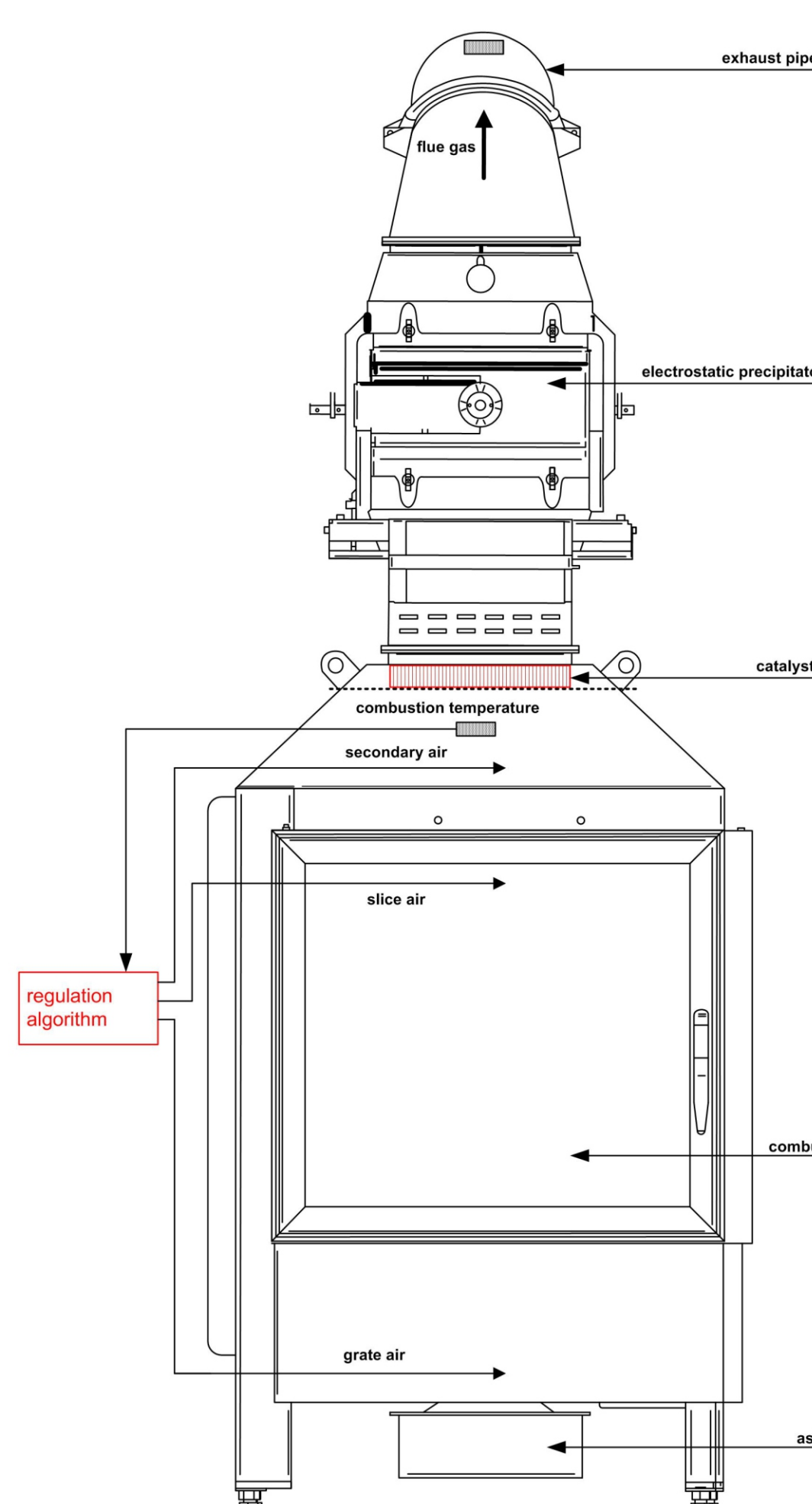
Standardisation: room heaters, inset appliances, inserts

Intended use: living room heating and decoration

Typical features: manually fed with batches of cord wood, natural chimney draught, manually controlled by user, operation without electric power

Background:

Small wood fired appliances such as stoves or fireplace are known to contribute significantly to the PM₁₀ concentration in ambient air of many industrialized countries. Due to the manual operation of these appliances, user behaviour has an important effect on their combustion performance. Therefore technical improvements aim at both, technical optimisation of the combustion technology and reduction of the user influence. In this study a standard fireplace insert was equipped with an automatic combustion air control, that avoids user errors regarding the air setting, an electrostatic precipitator for reduction of particle emissions and a catalyst for improvement of gaseous emissions.



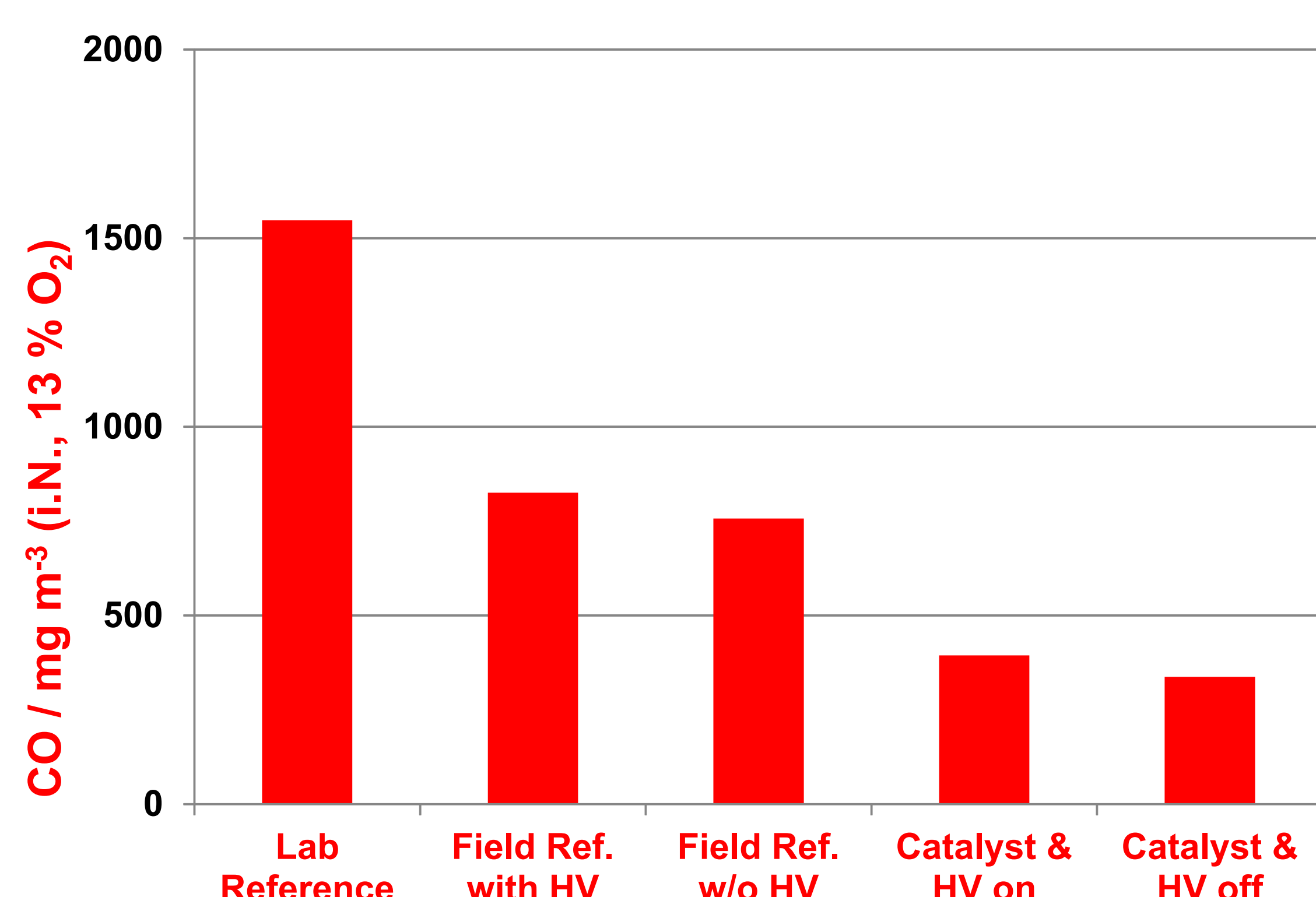
Project:

Period: 2011 to 2014, Field tests from 2012 to 2014

Laboratory tests: unmodified appliance as reference

Field tests: optimisation and testing of different configurations, validation of final setup gas analyser Eheim VISIT 02S, Sick Maihak Sidor, particle mass by HF according to VDI 2066, particle number TSI CPC 3781

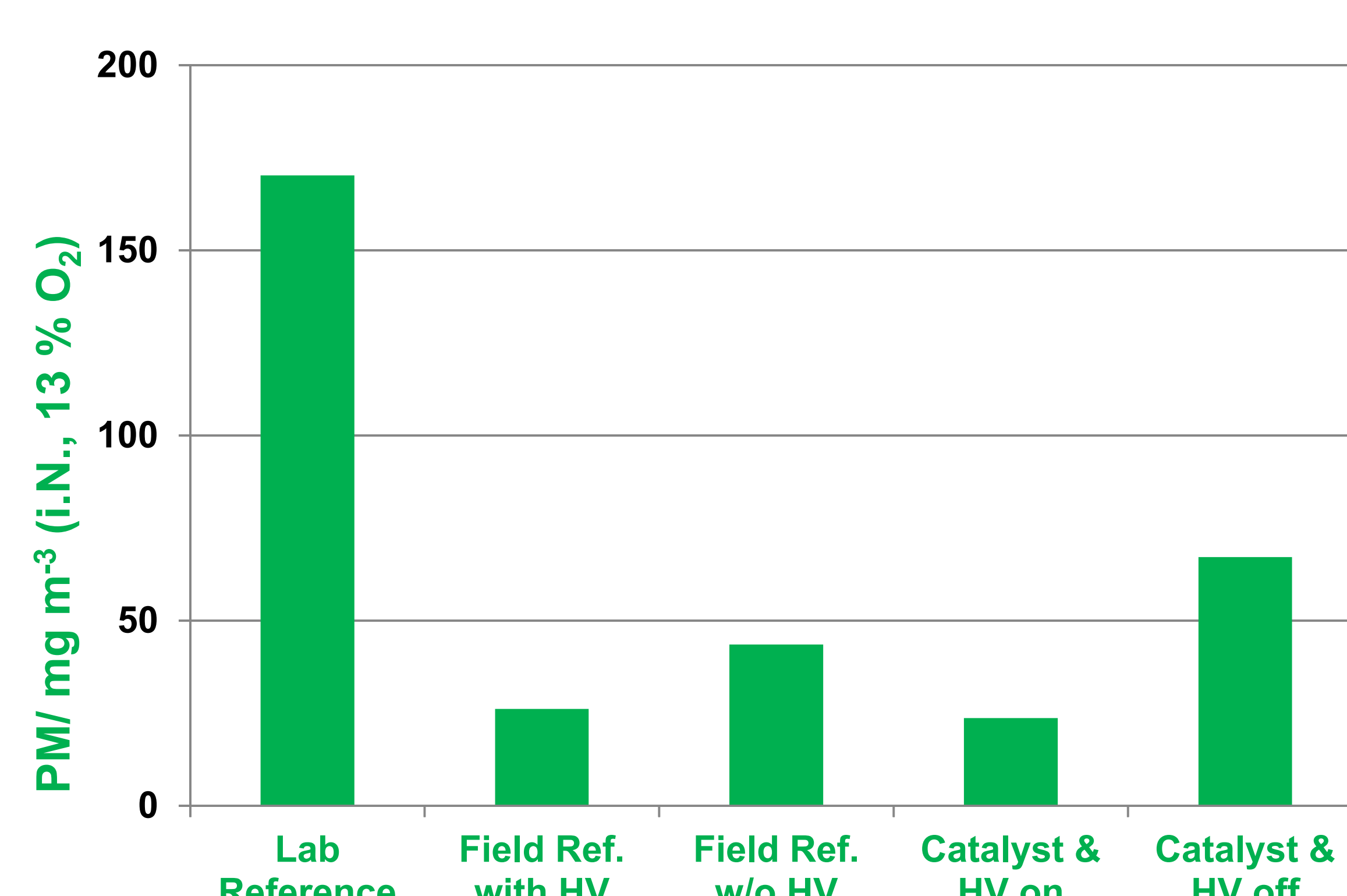
Emission reduction compared to reference:
CO ~70%, particulates ~80%



above: setup for final field tests: fireplace insert with ESP, catalyst and automatic air control

left: CO emission of original fireplace insert (lab reference) compared to field test result with ESP on/off and with/without catalyst

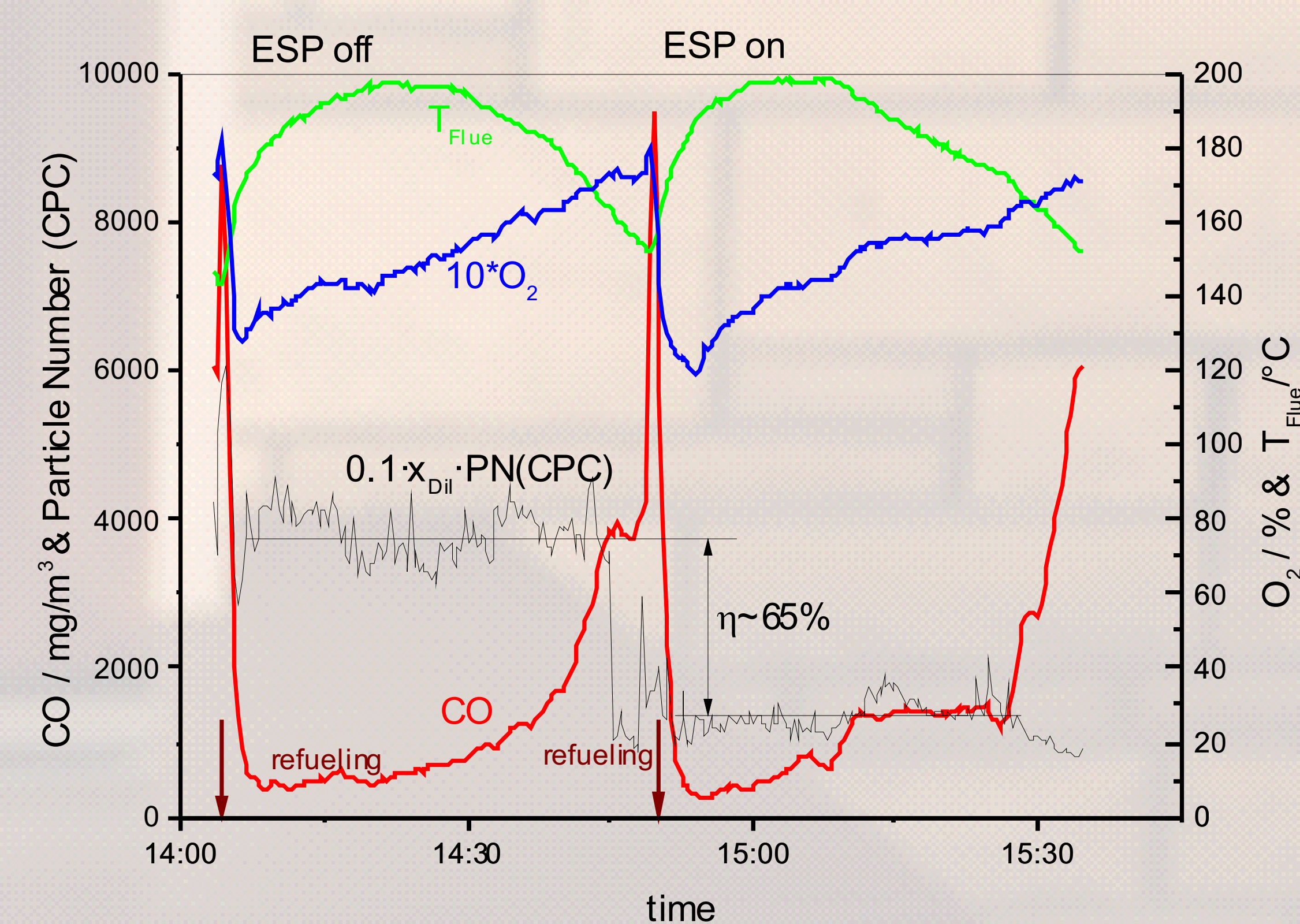
right: CO emission of original fireplace insert (lab reference) compared to field test result with ESP on/off and with/without catalyst



Conclusion

A conventional fireplace insert has been equipped with a catalyst, an electrostatic precipitator and a conventional automatic combustion air control. For this combination fitness for use has been demonstrated for an extended period of field tests under realistic operation conditions in the field. A significant reduction of CO and particle emissions has been demonstrated by field tests.

below right: typical during field test run showing flue gas temperature (green), oxygen concentration (blue), CO concentration (red) and particle number concentration (black) for one combustion cycle with HV of ESP off and one cycle with HV on.



Acknowledgements

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