

Effect of an oxidizing catalyst on PAH emissions at firewood combustion

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Introduction:

Catalysts have been shown to be an effective measure especially against CO and OGC emissions from biomass combustion. So far the impact of oxidative catalysis on toxic PAHs in the flue gas is not clarified.

Methodology:

A highly effective metallic Pt/Pd catalyst (*EnviCat® LongLife Plus*) was tested for its effect on PAH emissions from a log wood stove. The tests were conducted with a special test device (Fig. 1). Flue gas passes either the catalyst or a uniform dummy without catalytic layer. PAH sampling was conducted by filtration of diluted flue gas with quartz fiber filters. The filters were analyzed for 19 different PAHs including all 16 EPA PAHs. Moreover CO, OGC and PM emissions were determined. Discontinuous measurements (PM and PAH) were conducted in batches 1, 3, 5 and 7.

Results:

A clear reduction of CO (-88%) and OGC (-39%) according to a previous work¹ was confirmed.

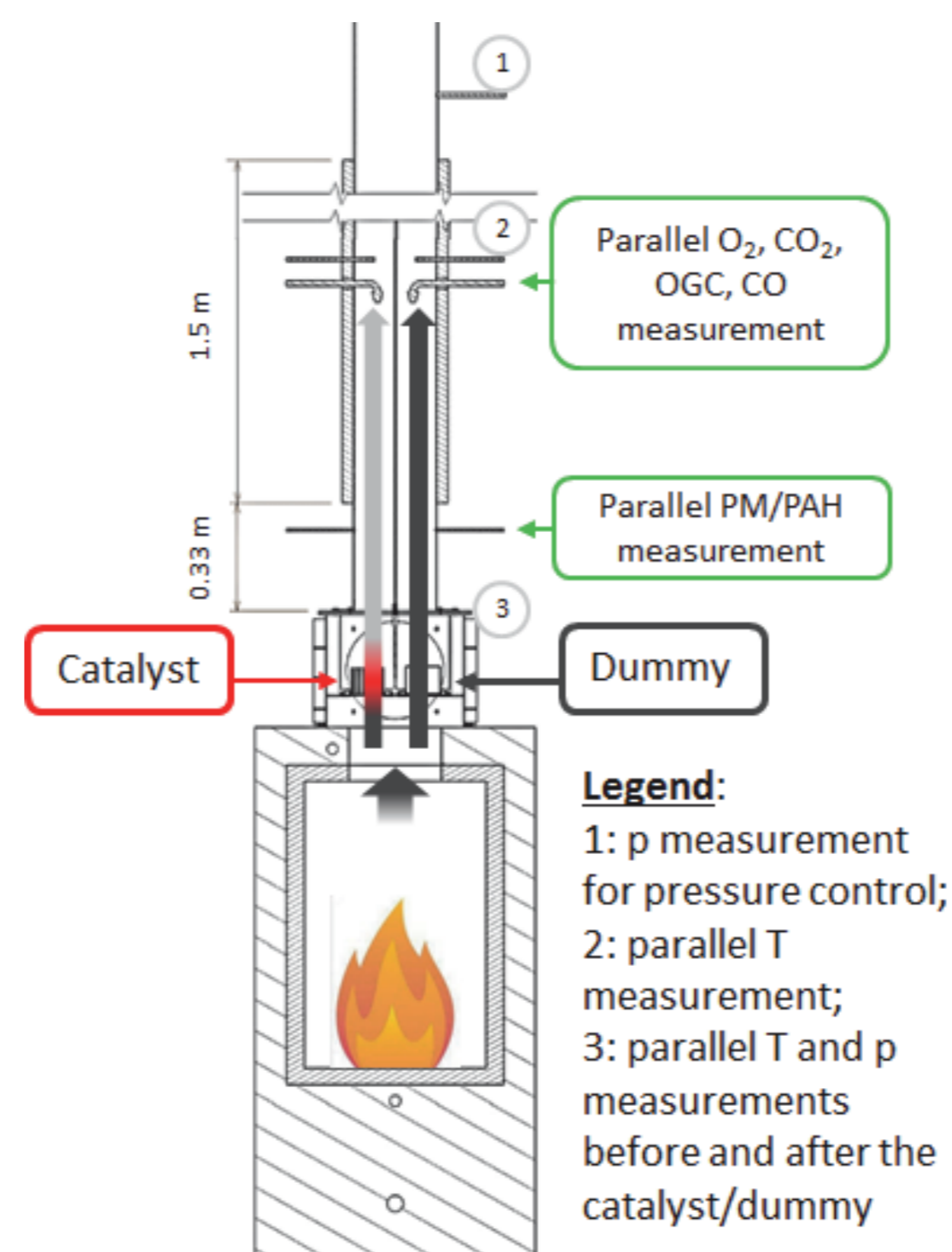


Fig. 1: DemoCat test device

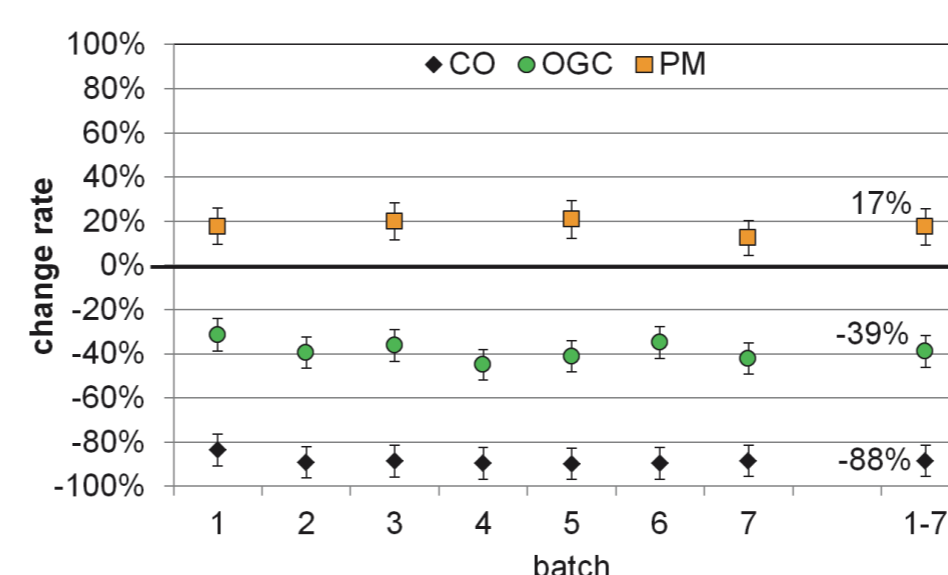


Fig. 2: Change rates of CO, OGC and PM emissions. Error bars indicate measurement uncertainties.

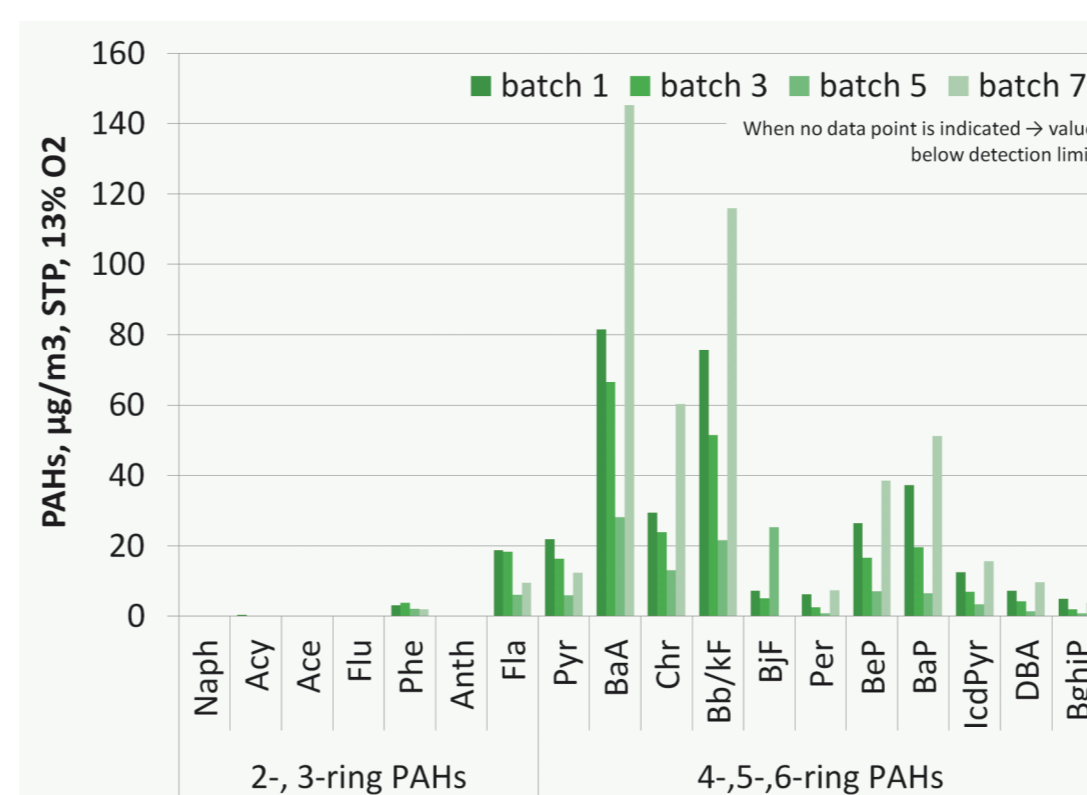


Fig. 3: PAH concentrations without catalytic treatment (from dummy side)

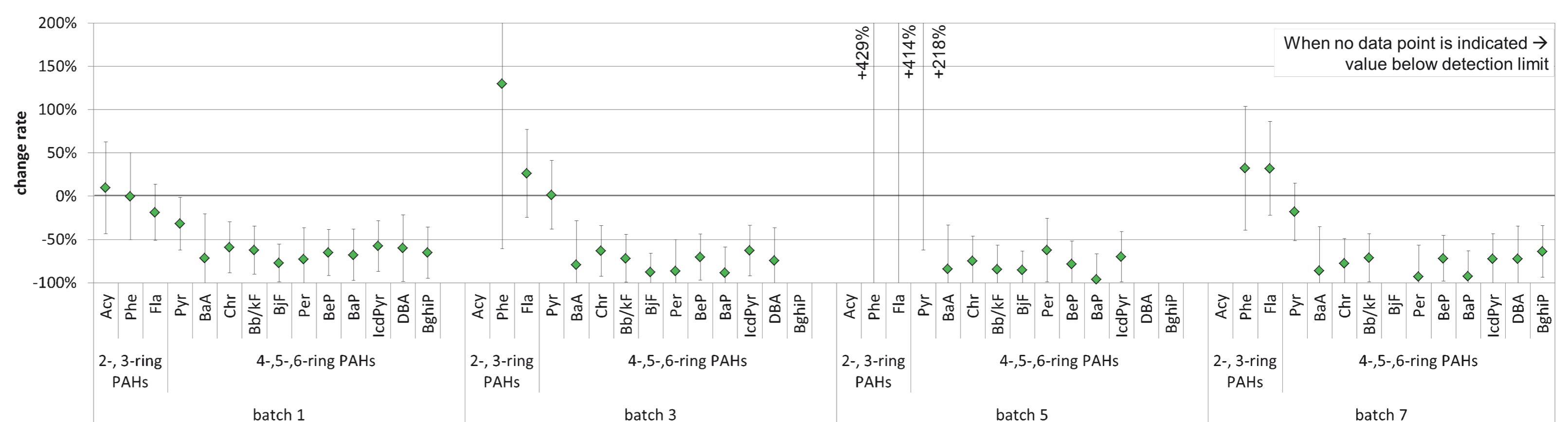


Fig. 4: Change rates of determined PAHs. Error bars indicate measurement uncertainties.

PM which was sampled in diluted flue gas increased by 17% after catalytic treatment (Fig. 2).

In the untreated flue gas 4-ring PAHs were dominant among all determined PAHs (Fig. 3). Many low molecular weight PAHs (2- and 3- ring PAHs) were below the detection limits. The sum of the determined PAHs decreased by more than 60% by catalytic treatment. High molecular weight PAHs (4- to 6-ring PAHs) decreased mostly by more than 75% and low molecular weight PAHs seem to increase (Fig. 4).

Conclusions:

- PAHs and especially high molecular weight PAHs, among which are the more toxic PAHs, are distinctly reduced. Toxicity of flue gas arising from EPA PAHs can be reduced by the metallic *EnviCat® LongLife Plus* catalyst.

- At sampling at near atmospheric conditions PM concentrations increased after catalytic treatment. To achieve an effective reduction of CO, OGC, PAHs as well as of PM, catalysts should be combined with fabric filters or electrostatic precipitators, which are more suitable for the reduction of particle emissions.

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¹ Reichert, G., Schmidl, C., Haslinger, W., Stressler, H., Sturmlechner, R., Schwabl, M., Wöhler, M., Hochenauer, C., 2018. Catalytic efficiency of oxidizing honeycomb catalysts integrated in firewood stoves evaluated by a novel measuring methodology under real-life operating conditions. *Renew. Energy* 117, 300–313. <https://doi.org/10.1016/j.renene.2017.10.065>

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