

On-site estimation of secondary organic aerosol production potential from wood burning appliances

A. Keller¹, J. C. Corbin², A. A. Mensah², B. Sierau², H. Burtscher¹

¹Institute for Aerosol and Sensor Technology, University of Applied Sciences Northwestern-Switzerland, 5210 Windisch, Switzerland

²Institute for Atmospheric and Climate Science, ETH Zurich, 8092 Zurich, Switzerland

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Presenting author email: alejandro.keller@fhnw.ch

Organic aerosol (OA) can be the dominant component of ambient particulate matter (Szidat *et al.*, 2007). However, not all OA is present at the emission point. An important fraction, called secondary organic aerosol (SOA), forms after emitted organic gaseous carbon (OGC) undergoes atmospheric chemistry in a process that can take hours or even days to complete. Small combustion installations (SCI) that burn solid fuel produce important amounts of SOA (Grieshop *et al.*, 2009; Heringa *et al.*, 2011). Their SOA production potential depends, among other things, upon the type of technology and the operating conditions.

SOA is, thus, an important fraction of atmospheric PM that should be considered in emission control legislation. This poses a challenge for air quality regulatory agencies. Smog chamber experiments, for instance, are hardly appropriate for type approval testing or as a standard system for emissions control. We have tested a more compact solution: a continuous-flow reactor-tube with a residence time of only a few seconds. We will show that this setup is enough to oxidize OGC emissions from SCI and transform them into SOA, resulting in a SOA production potential between 0.01 and 1.28 g/Kg-CO₂ (Keller and Burtscher, 2012). These values depend upon the combustion phase and are comparable to previous published data from smog-chamber experiments. Changes in the dilution of the sample, tested up to a factor of 1:8, do not seem to influence the results. Field measurements show that larger automatic installations (e.g. boilers > 70kW) can achieve a very good combustion with no measurable OGC emissions and have, accordingly, no measurable SOA production potential either.

We will also present data from the chemical analysis of the resulting SOA by means of an Aerodyne aerosol mass spectrometer (AMS) run by ETH Zurich. This instrument shows that conditioning the emissions in our UV reactor results in a highly oxidized OA. The oxidation degree is higher than previously published data from field campaigns or smog chamber experiments (see, e.g., figure 1). This difference does not come into conflict with the purpose of our reactor. We do not want to predict an ambient outcome, which is influenced by atmospheric conditions and the contribution of other local sources. Instead, we want to provide a system that can estimate the maximum SOA production potential of wood burning appliances.

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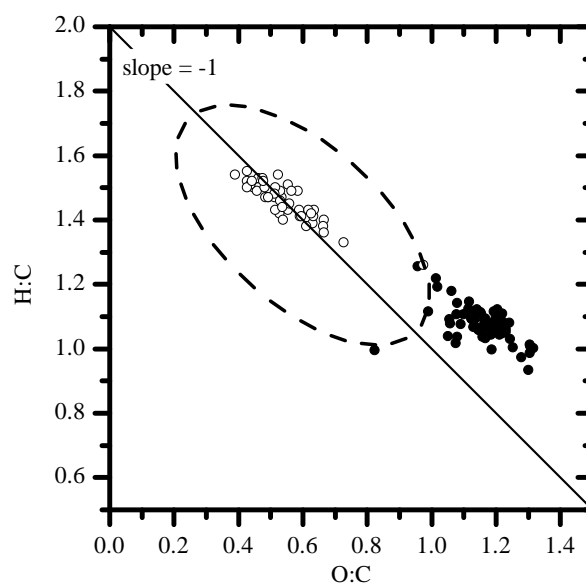


Figure 1: Van Krevelen diagrams of the elemental ratios of organic aerosol emitted during the warm combustion cycles of a log-wood stove measured by AMS run by ETH Zurich. Open circles represent the raw emissions whereas solid circles represent the result of conditioning these emissions in the UV reactor tube. The dashed ellipse shows the area comprising ambient data from the MILAGRO C-130 aircraft campaign over and near Mexico City (Heald *et al.*, 2010).

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