

Characterization of secondary organic aerosol from ozonolysis of β -pinene

Ågot K. Watne, Eva U. Emanuelsson, Anna Lutz, Evert Ljungström and Mattias Hallquist

Department of Chemistry and Molecular Biology, University of Gothenburg, Gothenburg, Sweden

Keywords: Aerosol Chemistry, Flow Reactor, Volatility, Terpenes

Presenting author email: agot.watne@chem.gu.se

A large fraction of the atmospheric aerosol contains organics. Particulate organics can be formed in the atmosphere through oxidation of gaseous precursors to secondary organic aerosol (SOA). The processes of formation of SOA are currently not well understood. In order to predict and represent SOA influence on for instance cloud formation and climate, an accurate description of formation and properties of SOA is needed (Hallquist *et al.*, 2009).

The effects of humidity, temperature and radical chemistry on the SOA formed from the ozonolysis of β -pinene were studied in Gothenburg Flow Reactor for Oxidation Studies at low Temperatures (G-FROST). G-FROST is a laminar flow reactor where SOA can be formed under well-controlled conditions (Figure 1). Through the flow reactor there is a continuous laminar flow. This creates a stable aerosol output and imposed changes to the chemistry can be monitored and analyzed.



Figure 1: Schematic of G-FROST.

The relative humidity (RH) was varied in experiments conducted at 288 K and at 298 K for three different β -pinene concentrations: low, intermediate and high. In addition, the effect of using 2-butanol or cyclohexane as OH-scavenger was studied. In all experiments, the RH was changed in four steps aiming at 12, 15, 30 and 50 %. Figure 2 shows an example of an experiment.

In addition to the number and mass of SOA produced, thermal properties of the aerosol were characterized using a Volatility Tandem Differential Mobility Analyser (VTDMA). The VTDMA provides several aspects of thermal properties. An example is volume fraction remaining at 383K, VFR(383K), which is a general measure of volatility.

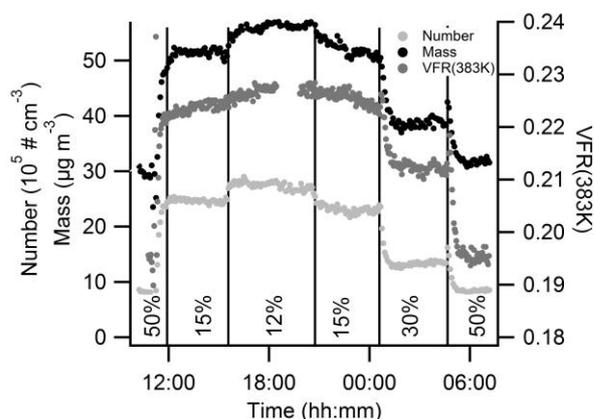


Figure 2: Change in particle number, mass concentration and VFR(383K) in with stepwise change in RH.

As can be seen in Figure 2, the SOA formed from ozonolysis of β -pinene shows a negative RH dependence. This was valid for all experiments and is the opposite RH dependence of what has been observed from the ozonolysis of α -pinene (e.g. Jonsson *et al.*, 2008).

Regarding the thermal properties, several aspects were revealed. It was demonstrated that thermal properties of the SOA did change for the different conditions (e.g. temperature, RH and use of scavenger). For instance, as shown in Figure 2, the SOA got more volatile with increasing RH. This was observed as an decrease in VFR(383K) at higher RH and was valid in all experiments. These features can be linked to the changes in chemical mechanism affecting SOA number and mass (Emanuelsson *et al.*, 2013).

The results from this study suggest inclusion of new chemistry in atmospheric chemical models in order to cover relevant atmospheric changes in humidity, temperature and oxidant levels that affect SOA formation and properties.

The research presented is a contribution to the Swedish strategic research area Modelling the Regional and Global Earth system, MERGE. This work was supported by Formas (214-2010-1756) and the Swedish Research Council (80475101).

Emanuelsson *et al.*, (2013), *manuscript submitted to Journal of Physical Chemistry*

Hallquist *et al.*, (2009) *Atmospheric Chemistry and Physics*, 9, 5155-523

Jonsson *et al.*, (2008) *Environmental Science and Technology*, 42, 5938-5944