4.048 Oxidation flow reactors (OFRs) to study secondary aerosol formation: overview of recent field and modeling studies.

Presenting Author:
Jose-Luis Jimenez, Univ. of Colorado-Boulder, jlj.colorado@gmail.com

Co-Authors:
Brett Palm, Univ. of Colorado-Boulder
Zhe Peng, Univ. of Colorado-Boulder
Weiwei Hu, Univ. of Colorado-Boulder
Amber Ortega, Univ. of Colorado-Boulder
Rui Li, Univ. of Colorado-Boulder
Pedro Campuzano-Jost, Univ. of Colorado-Boulder
Douglas Day, Univ. of Colorado-Boulder
Harald Stark, Univ. of Colorado-Boulder
Brune William, Penn State Univ
de Gouw Joost, NOAA CSD
Schroder Jason , Univ. of Colorado-Boulder

Abstract:

OFRs allow studying SOA formation and aging in both laboratory and field experiments. The concentration of an oxidant (OH, O_3, or NO_3) can be increased, leading to hours–months of equivalent atmospheric oxidation during the several-minute residence time. Typically, more SOA formation is observed from nighttime than daytime air. Measured ambient VOCs cannot explain the observed SOA formation, suggesting that typically unmeasured S/IVOCs (possibly VOC oxidation products or direct emissions) are important ambient SOA precursors. A kinetic model is used to study OFR chemistry. OHexposure (OH_{exp}) can be estimated within a factor of ~3 using model-derived equations, and verified using VOC decay measurements. OH_{exp} is strongly dependent on external OH reactivity, which may cause significant OH suppression in some circumstances (e.g., lab/source studies with high precursor concentrations). UV photolysis and O atoms are typically minor reaction pathways, except under high OH suppression. Low-volatility organic gases (LVOCs) fate is dependent on particle condensational sink. For the range of particle condensational sink at a remote pine forest, ~60% of produced LVOCs were predicted to condense onto aerosols for an OH_{exp} of ~1 day, with the remainder lost to walls. Similar to chamber wall loss corrections, a correction is needed to relate OFR sampling to the atmosphere, where condensation onto aerosols is the dominant LVOC fate. At high OH_{exp} (>20 days) in an OFR, LVOCs are predicted to be oxidized many times, leading to formation of volatile fragmentation products that no longer form SOA. Changes to preexisting OA at high OH_{exp} are a result of heterogeneous oxidation. The fate of RO_2 and NO_x is being investigated with the model. SOA yields specific to OFR oxidation were investigated using standard addition of individual VOCs into ambient air, and were consistent with laboratory large chamber yields.