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The effect of organic aerosol material on aerosol reactivity towards ozone

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After aerosol particles are formed or emitted into the atmosphere, heterogeneous reactions with gaseous oxidants cause them to "age". Aging can change aerosol properties, such as the hygroscopicity, which is an important parameter in how the particles scatter radiation and form clouds. Conversely, heterogeneous reactions on aerosol particles play a significant role in the cycles of various atmospheric trace gases.

Organic compounds, a large part of the total global aerosol matter, can exist in liquid or amorphous (semi)solid physical phases. Different groups have shown that reactions with ozone (O_3) can be limited by bulk diffusion in organic aerosol, particularly in viscous, (semi)solid materials, and that organic coatings alter the surface interactions between gas and aerosol particles. *We aim to better understand and quantify how the viscosity and phase of organic aerosol matter affect gas-particle interactions.*

We have chosen the reaction of O_3 with particles composed of a potassium iodide (KI) core and a variable organic coating as a model system. The reaction is studied in an aerosol flow reactor that consists of a laminar flow tube and a movable, axial injector for the injection of O_3. The aerosol-containing air is inserted at the tube's top. The interaction length (and therefore time), between the particles and the O_3 can be varied by moving the injector. Alternatively, the production of aerosol particles can be modulated. The remaining O_3 concentration is monitored from the bottom of the tube and particle concentrations are measured simultaneously, which allows us to calculate the reactive uptake coefficient γ.

We performed exploratory experiments with internally mixed KI and polyethylene glycol (PEG) particles at the University of Washington (UW) in a setup with a residence time around 50 s. Aerosol particles were generated in an atomizer from solutions with varying concentrations of KI and PEG and inserted into the flow tube after they were diluted and humidified and excess flow was ventilated. It proved necessary to separate the particles before the O_3 monitor to prevent interference with the optical O_3 detection method. Unfortunately, large O_3 losses occurred on the used filter, which limited the accuracy of the γ-determinations. Nevertheless, it was found that already a small amount of added PEG considerably reduced the observed γ. Other aerosol separation methods are currently being investigated for the follow-up experiments in Kuopio.