Volatility of Primary Organic Aerosols Emitted from Light Duty Gasoline Vehicles

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Volatility measurements of Primary Organic Aerosol (POA) emitted from light duty gasoline vehicles (LDGV) were made at atmospherically relevant concentrations under conditions where the relative humidity and black carbon concentration of the dilution air were varied. The mass fraction of POA remaining in the condensed phase was measured under 3 temperature perturbations (+25, +50, +75°C) using a High-Resolution Aerosol Mass Spectrometer (HR-AMS) and traditional thermo-optical techniques at all experimental conditions. A thermo-denuder model based on fitted volatility distributions was used to interpret the measurements.

Results indicate that the median response of all volatility experiments can be explained with a single-component thermo-denuder model fitted to a volatility distribution similar to motor oil, but the fit of this model to all data is relatively weak (R^2=0.52). A thermo-denuder model based on two components has much stronger fit to the data (R^2=0.94). The volatility distributions of the two components are approximately equivalent to semi-volatile motor oil and a non-volatile source of POA thought to be fuel combustion products. Measurements across a fleet of 8 representative gasoline-powered vehicles show that half of the vehicles had POA emissions composed primarily of motor oil and half of the vehicles had POA emissions composed primarily of fuel combustion products. These results imply that POA emitted from motor vehicles is not completely semi-volatile and will not completely evaporate in the atmosphere. A comparison to previous experiments explains this conclusion relative to contradictory results from other published studies.