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Effect of SO2 concentration on SOA formation in a photorreactor from a mixture of anthropogenic hydrocarbons and HONO

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Sulfur dioxide (SO2) is an important urban atmospheric pollutant, mainly produced by the combustion of fossil fuels containing sulfur. In the atmosphere, SO2 can react with OH radicals to form sulfuric acid, which can condense to form acidic aerosol. Sulfuric acid particles act as an acid catalyst for some heterogeneous carbonyl reactions like hydration, polymerization or acetals formation, which may lead to a large increase on SOA mass.
In order to evaluate the effect of the SO2 concentration on SOA formation, 3 experiments were performed during the campaign carried out by CIEMAT on the EUPHORE facility (CEAM, Valencia, Spain) during June- July 2008. The objective of the campaign was to evaluate the effect of different experimental conditions on SOA formation from the photooxidation of some anthropogenic and biogenic VOCs using HONO as oxidant. Experiment on 6/17/08 was selected as base case (no SO2 was introduced) and experiments 6/26/08 and 7/1/08 were selected as high SO2 (2600 ug/m3) and low SO2 (60 ug/m3) concentration experiments respectively. In the three experiments a mixture of toluene, 1,3,5-TMB (trimethylbenzene), o-xylene and octane was selected as the parent VOCs.
Single and coupled to mass spectroscopy gas cromatography (GC and GC/MS), as well as high performance liquid chromatography (HPLC) and Fourier transform infrared spectroscopy (FTIR) were used to measure the initial VOCs and oxidant concentrations decay and the formation of gas phase oxidation products through the experiments. Aerosol size distribution and concentration were measured with SMPS (scanning mobility particle sizer) and TEOM (tapered element oscillating monitor) respectively. In addition, analysis of the organic and inorganic aerosol content was also performed via filter sampling followed by GC/MS and ionic chromatography (for organic and inrganic content respectively).
Comparing the filters collected in the three experiments, clearly the largest mass aerosol formation is observed in experiment 6/26/08, which is in concordance with the higher total and organic aerosol concentrations measured by TEOM during the whole experiment. Highest total and organic aerosol yields were also observed in this experiment, as well as maximum aerosol particle sizes and densities measured by SMPS, suggesting that aerosol formation and growth are enhanced by the presence of high concentrations of SO2. On the other hand, SMPS analysis of experiment 7/1/08 showed a similar behaviour to the base case, while the aerosol yields and TEOM profiles were slighty lower, possibly due to the difference in the initial concentrations in the two experiments, which are difficult to be exactly reproduced.