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Effect of OH Scavenger and Humidity on Secondary Organic Aerosol Formation from the Reaction of 2-Methylstyrene with Ozone

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The formation of secondary organic aerosol (SOA) from the gas-phase reaction of ozone with terpenes has been studied intensively over the last 10 years. However, very little attention has been given to unsaturated aromatic compounds such as styrene and methylstyrene. In this work a series of atmospheric simulation chamber experiments has been performed to determine the yield of SOA produced from the ozonolysis of 2-methylstyrene and its dependence on the initial hydrocarbon concentration, type of OH scavenger and relative humidity.

The effect of the initial hydrocarbon concentration was investigated under dry conditions and in the presence of OH scavenger using ozone concentrations of 600ppb and 1 ppm. The SOA yield was found to vary from 7 % to 42 % for starting concentrations in the range 450-3000 ppb and in particular was found to be dependent on the amount of 2-methylstyrene reacted. Experiments were also performed using other OH radical scavengers; 2-butanol and CO. The SOA yields ranged from 0.05 % (450 ppb of 2-methylstyrene, 600 ppb of ozone, 2-butanol as OH scavenger, RH $<$ 2%) to around 50% (3 ppm of 2-methylstyrene, 600 ppb of ozone, CO as OH scavenger, RH $<$ 2%). The yields obtained when cyclohexane was used as the scavenger were very similar to those obtained in experiments performed in the absence of a scavenger. However, SOA yields were higher when CO was used as the scavenger and lower for

experiments involving 2-butanol. These results are in agreement with studies on the effect of scavenger type on SOA yields produced during the ozonolysis of cyclohexene (CO$>$2-butanol $\cong$ no scavenger $>$cyclohexane)[1] and β-pinene (cyclohexane $\cong$no scavenger $>$ 1-butanol)[2]. It seems that the main role of the scavenger is to influence the production of HO_2 radicals and thus affect the efficiency of peroxide formation via RO_2 + HO_2 reactions.

The yield of SOA was found to decrease gradually as the humidity was increased in the chamber. For example, during a series of replicate experiments with the initial hydrocarbon concentration at 1 ppm in the presence of cyclohexane as scavenger, the aerosol yield decreased from 0.18% to 0.12% when the relative humidity was varied from $<$2% to 75%.

References:

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