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Particle formation from toluene by OH-induced photochemical transformation employing a wide range of OH level

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The formation of particles from toluene was determined in a 200 l Teflon bag (FEP 200A), serving as a smog chamber by employing a solar simulator consisting of 16 fluorescent lamps (Osram Eversun Super, 80 W each). Photochemical degradation of methyl nitrite was used as precursor of OH radicals at in initial levels ranging from 0.1 to 500 ppm. The photolytic lifetime of methyl nitrite was on the order of a few min, and the level of OH reached a steady state rapidly, leading to initial levels of OH between 5 E 6 cm-3 and 2.2 E 9 cm-3 (depending in an almost linear fashion on the initial level of methyl nitrite). A simultaneous consumption of toluene (initial level 1 ppm) and formation of ozone (up to 1 ppm) occurred under these conditions, consuming toluene completely and forming particles (monitored by a differential mobility analyser and a CNC). Within less than half an hour, number densities in excess of 1 E 5 cm-3 are reached, which then decrease in an almost exponential fashion. The size distribution becomes fairly monodisperse very soon, and the particle volume is observed to be directly proportional to the toluene consumed. Assuming a mass density of 1.4 g/cm3 of the particles, the particle mass yield is observed to reach a limit of $>$75% of the toluene consumed. This value is much higher than values reported in the literature. Although it may comprise transformation products of methyl nitrite at those high levels (such as organic nitrates and nitric acid), it is a hint at the polymerisation reaction via olefinic oxidation products of toluene which become more efficient at higher oxidation rates. The mass yield is observed to be constant with time (except for a very minor decrease by deposition) and to increase from final values of about 10% at 0.1 ppm methyl nitrite to 78% at 167 ppm of methyl nitrite. It is confirmed

to be as high as 77% at 167 ppm of methyl nitrite from 0.2 ppm of toluene and 73% at 500 ppm of methyl nitrite from 1 ppm of toluene. Since both OH and ozone were present as active species during the degradation and the mass yields increase with both species, more experiments are required to confirm this preliminary result, to elucidate the mechanism of particle formation and to differentiate the contributions as a function of the active species separately.