

Characterization of aerosol and cloud water at a mountain site during WACS 2010: Secondary organic aerosol formation through oxidative cloud processing

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Supplementary material:

A simple model below was used to estimate the steady state OH concentration in our photo-oxidation experiments of aerosol filter extracts and cloud water. The differential equations were solved by POLYMATH.

Reaction	Rate constant	References
$\text{H}_2\text{O}_2 + h\nu \rightarrow 2\text{OH}$	$k_1 = 6.9 \times 10^{-4} \text{ s}^{-1}$	This study
$\text{OH} + \text{H}_2\text{O}_2 \rightarrow \text{HO}_2 + \text{H}_2\text{O}$	$k_2 = 2.7 \times 10^7 \text{ M}^{-1}\text{s}^{-1}$	Tan et al. (2009)
$\text{HO}_2 + \text{H}_2\text{O}_2 \rightarrow \text{OH} + \text{H}_2\text{O} + \text{O}_2$	$k_3 = 3.7 \text{ M}^{-1}\text{s}^{-1}$	Tan et al. (2009)
$\text{HO}_2 + \text{HO}_2 \rightarrow \text{H}_2\text{O}_2 + \text{O}_2$	$k_4 = 8.5 \times 10^5 \text{ M}^{-1}\text{s}^{-1}$	Tan et al. (2009)
$\text{OH} + \text{HO}_2 \rightarrow \text{H}_2\text{O} + \text{O}_2$	$k_5 = 7.1 \times 10^9 \text{ M}^{-1}\text{s}^{-1}$	Tan et al. (2009)
$\text{Org} + \text{OH} \rightarrow \text{OxOrg}$	$k_6 = 1 \times 10^8 \text{ M}^{-1}\text{s}^{-1}$	

Org = Organics, OxOrg = Oxidized organics, $[\text{H}_2\text{O}_2]_0 = 70 \text{ mM}$, $[\text{Org}]_0 = 10^{-5} \text{ M}$

The photolysis rate constant, k_1 , was determined as below:

$$k_1 = I \times q_{(\text{H}_2\text{O}_2)} \times \sigma_{(\text{H}_2\text{O}_2)}$$

where $I = \text{Photo flux of our UV lamp} \approx 6.9 \times 10^{15} \text{ photons cm}^{-2} \text{ s}^{-1}$

$q_{(\text{H}_2\text{O}_2)} = \text{quantum yield of OH radical at 254 nm (molecules photon}^{-1}) = 2$

$\sigma_{(\text{H}_2\text{O}_2)} = \text{Cross section of H}_2\text{O}_2 \text{ at 254 nm (cm}^2 \text{ molecule}^{-1}) \approx 1 \times 10^{-19}$

References:

Tan, Y., Perri, M. J., Seitzinger, S. P. and Turpin, B. J.: Effects of Precursor Concentration and Acidic Sulfate in Aqueous Glyoxal-OH Radical Oxidation and Implications for Secondary Organic Aerosol, *Environ. Sci. Technol.*, 43, 8105-8112, 2009.