

Table 1. Physical loss of methyl salicylate (MeSA) under different experiment conditions: dry without SOA, dry with SOA, humid without SOA and humid with SOA.

[MeSA] ₀ (ppbv)	[O ₃] ₀ (ppbv)	[limonene] ₀ (ppbv)	Exp. Numbers	RH (%)	SOA		loss rate (s ⁻¹)		
					Number (10 ⁴ #/cm ³)	Mass (μg/cm ³)	k'	methyl salicylate	SF ₆
25-48			2	<1	~0	~0	Total loss	1.58×10 ⁻⁵ ± 1.6×10 ⁻⁷	
							Wall loss in dry conditions	(1.0 ± 0.1)×10⁻⁶	
9-34	32-34	137-163	3	<1	6.4±4.4	36.5±14.4	Total loss	1.62×10 ⁻⁵ ± 1.2×10 ⁻⁷	
							loss on SOA in dry conditions	(0.4 ± 0.1)×10⁻⁶	
22-40			2	48-59	~0	~0	Total loss	1.96×10 ⁻⁵ ± 1.6×10 ⁻⁷	1.48×10 ⁻⁵ ± 6.5×10 ⁻⁸
							Wall loss in humid conditions	(4.8 ± 0.1)×10⁻⁶	
22-36	32-34	137-163	2	40-62	7.2±4.6	36.0±14.4	Total loss	2.17×10 ⁻⁵ ± 1.1×10 ⁻⁷	
							loss on SOA in humid condition	(2.1 ± 0.1)×10⁻⁶	

Table 2. Summary of the Results from the Relative Rate Study for Reaction of OH/Cl/NO₃ with methyl salicylate at 296 ± 2K.

Radical	[methyl salicylate] ₀ 10 ¹¹ molecule cm ⁻³	References	k _{ref} (cm ³ molecule ⁻¹ s ⁻¹) ^d	no. of experiments	$\frac{k}{k_{ref}} \pm 2\sigma$ ^a	k ± 2σ (cm ³ molecule ⁻¹ s ⁻¹) ^b
OH	1.84-4.61	methyl ethyl ketone	(1.05 ± 0.21) × 10 ⁻¹²	2	2.718 ± 0.093	(2.85 ± 0.58) × 10 ⁻¹²
		toluene	(5.60 ± 1.46) × 10 ⁻¹²	2	0.675 ± 0.012	(3.78 ± 0.98) × 10 ⁻¹²
		di-n-butyl ether	(2.80 ± 0.42) × 10 ⁻¹¹	3	0.118 ± 0.005	(3.30 ± 0.51) × 10 ⁻¹²
		Average ^c				(3.20 ± 0.46) × 10 ⁻¹²
Cl	1.86-4.09	Chloroacetone	(1.90 ± 0.49) × 10 ⁻¹³	3	0.797 ± 0.038	(1.51 ± 0.40) × 10 ⁻¹²
		ethyl formate	(1.02 ± 0.20) × 10 ⁻¹⁵	3	0.173 ± 0.009	(1.76 ± 0.37) × 10 ⁻¹²
		Average ^c				(1.65 ± 0.44) × 10 ⁻¹²
NO ₃	1.98-19.8	acetaldehyde	(2.70 ± 1.08) × 10 ⁻¹⁵	2	1.816 ± 0.052	(4.90 ± 1.97) × 10 ⁻¹⁵
		benzaldehyde	(4.00 ± 1.60) × 10 ⁻¹⁵	3	0.944 ± 0.009	(3.78 ± 1.51) × 10 ⁻¹⁵
		Average ^c				(4.19 ± 0.92) × 10 ⁻¹⁵
O ₃	1.55-14.5	3,3,3,-trifluoropropene	(3.50 ± 1.02) × 10 ⁻¹⁹	2	0.951 ± 0.504	(3.33 ± 2.01) × 10 ⁻¹⁹

^a the error of $\frac{k}{k_{ref}}$ was estimated in three steps in this work: (1) 2 times of standard deviation was calculated in the least-squares fit of Figure 3 ; (2)

weighted average and error of repeated sampling was calculated using Eq.2 and Eq.3 (SI) ; (3) the final error of $\frac{k}{k_{ref}}$ was multiplied 2.353/2.9 as the Student *t*-distribution contribution due to the limited number of measurements (3 and 2, respectively).

^b The quoted error was calculated from Eq. S1 in SI.

^c The weighted averaged calculated from Eq. S2 and Eq. S3.

^d Reference compound rate coefficients were taken from the recent evaluated database of McGillen et al., 2020.

Table 3. Summary of rate constants and estimated atmospheric lifetimes of methyl salicylate with respect to their reactions with OH, NO₃, O₃, Cl and photolysis and deposition on the SOA and ground surface.

	rate constants (cm ³ molecule ⁻¹ s ⁻¹) ^a	Loss/deposition rate (m s ⁻¹)	Global life time (days)
OH	(3.20±0.46)×10 ⁻¹²		7.2 ^g
NO ₃	(4.19±0.92)×10 ⁻¹⁵		11.0 ^g
Cl	(1.65±0.44)×10 ⁻¹²		701 ^g
ozone	(3.33±2.01)×10 ⁻¹⁹		50 ^g
photolysis		(2.7±2.4)×10 ⁻⁶	-
Ground surface		0.8 -4.0×10 ⁻⁶ ^b	145 ^d /694 ^c
SOA surface		0.3 -1.8×10 ⁻³ ^b	1-30 ^f / 4-190 ^e

^a values obtained in this work.

^b deposition rate from dry (<1%) to humid (~40-60%) conditions.

^{c,d} $\frac{S_a}{V}$ is ca. 0.02 m⁻¹ and deposition rate of dry (<1%)^c or humid (~40 to 60%)^d conditions.

^{e,f} $\frac{S_a}{V}$ is 10⁻⁴ - 10⁻³ m⁻¹ and deposition rate of dry (<1%)^e or humid (~40 to 60%)^f conditions.

^g global OH, NO₃, Cl and ozone concentration is: [OH]= 1 × 10⁶ molecule cm⁻³ (Spivakovsky et al., 2000), [NO₃]=5 × 10⁸ molecule cm⁻³ (Atkinson, 1991), [ozone]= 7 × 10¹¹ molecule cm⁻³ (Monks et al., 2009) and [Cl]= 1 × 10⁴ molecule cm⁻³ (Wingenter et al., 1996)