Overall KLa of a Volatile Compound from the Oxygen KLa (Two-Film)

Overall mass transfer coefficient KLa of a volatile organic compound from the measured oxygen KLa, diffusivity ratio, Henry's constant and gas-to-liquid film ratio.

Input parameters

Unit system: SI

Parameter	Value	Unit
Oxygen KLa of the device	0.003000	1/s
Liquid diffusivity of the compound	9.1000e-10	m²/s
Liquid diffusivity of oxygen	2.0600e-09	m²/s
Dimensionless Henry's constant of the compound	0.42000	
Gas to liquid film coefficient ratio (surface aerators 40–200)	150.00	

Calculated results

Parameter	Value	Unit
Liquid-film scaling	0.66464	
Liquid-film share of resistance	98.438	%
Overall KLa of the compound	0.001963	1/s
Time for 90 % removal in a batch	19.552	min

Notes for this case

• Penetration theory (k_l ∝ √D) for the liquid film and two-film resistances in series; oxygen is liquid-film controlled. Compounds with small H are increasingly gas-film controlled.

Formula and method

$$K_L a_{(c)} = K_{L,O_2} a \left(\frac{D_{l,c}}{D_{l,O_2}} \right)^{1/2} \left(1 + \frac{1}{H k_g / k_l} \right)^{-1}$$

Variables

$K_{L,O_2} a$	Oxygen KLa of the device	1/s
$D_{l,c}$	Liquid diffusivity of the compound	m²/s
D_{l,O_2}	Liquid diffusivity of oxygen	m²/s
H	Dimensionless Henry's constant of the compound	-
k_g / k_l	Gas to liquid film coefficient ratio (surface aerators 40–200)	-
$\sqrt{D_c / D_{O_2}}$	Liquid-film scaling	-
$(1 + 1/(H k_g/k_l))^{-1}$	Liquid-film share of resistance	-
$K_L a$	Overall KLa of the compound	1/s
t_{90}	Time for 90 % removal in a batch	s

Method and standards

Two-film theory with penetration-theory scaling.

Assumptions and limits

- Same device and hydrodynamics for both compounds.

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/environmental/drinking-water/two-film-kla-from-oxygen

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.