Orthokinetic (Macroscale) Flocculation Time for Particle Reduction

Floc volume fraction, first-order orthokinetic flocculation rate constant and the time to reduce the particle count by a chosen fraction at a given G.

Input parameters

Unit system: SI

Parameter	Value	Unit
Particle diameter	5.0000	µm
Initial particle count per mL	1,000,000	
Velocity gradient	40.000	1/s
Collision efficiency	50.000	%
Fraction of particles to remain	10.000	%

Calculated results

Parameter	Value	Unit
Floc volume fraction	6.5450e-05	
First-order rate constant	0.10000	1/min
Time required	23.026	min
Gt required	55,262	

Notes for this case

- Smoluchowski orthokinetic flocculation of equal spheres with a constant floc volume fraction, giving first-order kinetics; real flocs are fractal and break up, so use for comparisons and trends.

Formula and method

$$\Phi = \frac{\pi d^3 n_0}{6}, \quad k = \frac{4\alpha\Phi G}{\pi}, \quad t = \frac{-\ln(n/n_0)}{k}$$

Variables

d	Particle diameter	m
n_0	Initial particle count per mL	-
G	Velocity gradient	1/s
α	Collision efficiency	-
n/n_0	Fraction of particles to remain	-
Φ	Floc volume fraction	-
k	First-order rate constant	1/s
t	Time required	s
Gt	Gt required	-

Method and standards

Smoluchowski orthokinetic rate written as first-order kinetics.

Assumptions and limits

- Monodisperse spheres, laminar shear, no floc breakup.

Report details

Report reference	FCC-6BNK-6J5P (the same inputs always give the same reference)
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Calculator	Orthokinetic (Macroscale) Flocculation Time for Particle Reduction
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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/flocculation-orthokinetic-time

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.