Particle Terminal (Settling) Velocity

Terminal settling velocity of a spherical particle in a gas or liquid, by the Haider–Levenspiel drag correlation, with Reynolds number, drag coefficient and the Stokes value.

Method: Haider and Levenspiel (1989); Powder Technology 58; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Particle diameter	100.00	µm
Particle density	2,500.0	kg/m³
Fluid density	1.2000	kg/m³
Fluid dynamic viscosity	1.8000e-05	Pa·s

Calculated results

Parameter	Value	Unit
Terminal velocity	0.53597	m/s
Particle Reynolds number	3.5732	
Drag coefficient	9.4781	
Stokes-law velocity (valid for Re below about 0.3)	0.75632	m/s

Notes for this case

- Single smooth sphere in still fluid; irregular particles settle more slowly, and crowding (hindered settling) slows them further.

Formula and method

$$C_D\,Re^2 = \frac{4 g d_p^3 \rho_f (\rho_p - \rho_f)}{3\mu^2}$$

$$C_D = \frac{24}{Re}\left(1 + 0.1806\,Re^{0.6459}\right) + \frac{0.4251}{1 + 6880.95/Re}$$

$$v_t = \frac{Re\,\mu}{\rho_f d_p}, \quad v_{St} = \frac{g d_p^2 (\rho_p - \rho_f)}{18\mu}$$

Variables

d_p	particle diameter	m
ρ_p	particle density	kg/m³
ρ_f	fluid density	kg/m³
μ	fluid dynamic viscosity	Pa·s
g	standard gravity	m/s²
v_t	terminal velocity	m/s
Re	particle Reynolds number	-
C_D	drag coefficient	-
v_{St}	Stokes-law velocity	m/s

Method and standards

At terminal velocity weight less buoyancy equals drag. The product C_D Re² depends only on the particle and fluid, so Re is found from it with the Haider–Levenspiel (1989) sphere correlation, valid up to Re 2.6×10⁵, and the velocity follows. The Stokes value is shown for comparison.

Assumptions and limits

- Single smooth sphere in still, unbounded fluid; sphericity is not an input, and irregular particles settle more slowly than the value shown.
- No hindered settling (dilute suspension).
- Re up to 2.6×10^{5}.

References

- Haider and Levenspiel (1989)
- Powder Technology 58
- eq. 6
- Stokes' law

Report details

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

This calculator online

https://calc.firecad.com/mechanical/fluid-mechanics/particle-terminal-velocity

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Reopens the calculator with the inputs of this report.