Gravity Settling Chamber: Efficiency and Cut Size

Stokes settling velocity of a particle, collection efficiency of a gravity settling chamber in laminar flow, and the smallest particle collected completely.

Method: Laminar settling chamber model (de Nevers, Air Pollution Control Engineering, 2nd ed. (McGraw-Hill, 2000), ch. 9)

Input parameters

Unit system: SI

Parameter	Value	Unit
Gas flow	18,000	m³/h
Chamber length	10.000	m
Chamber width	4.0000	m
Particle diameter	50.000	µm
Particle density	2,000.0	kg/m³
Gas viscosity	1.8500e-05	Pa·s
Gas density (for the Reynolds check) 1.2 kg/m³ for air at 20 °C; about 0.6 for flue gas at 300 °C.	1.2000	kg/m³

Calculated results

Parameter	Value	Unit
Settling velocity	0.14725	m/s
Collection efficiency for d_p	100.00	%
Smallest particle collected completely	46.068	µm
Particle Reynolds number (check < 1)	0.47756	

Notes for this case

- Plug-flow (laminar) model η = v_tLW/Q. Settling chambers are only useful for coarse particles (above about 50 µm) as pre-cleaners.

Formula and method

$$v_t = \frac{g\rho_p d_p^2}{18\mu}, \quad \eta = \frac{v_t L W}{Q}, \quad d_{100} = \sqrt{\frac{18\mu Q}{g\rho_p L W}}, \quad Re_p = \frac{\rho_g v_t d_p}{\mu}$$

Variables

Q	Gas flow	m³/s
L	Chamber length	m
W	Chamber width	m
d_p	Particle diameter	m
ρ_p	Particle density	kg/m³
μ	Gas viscosity	Pa·s
ρ_g	Gas density (for the Reynolds check)	kg/m³
g	Standard gravity, 9.806 65	m/s²
v_t	Settling velocity	m/s
η	Collection efficiency for d_p	-
d_{100}	Smallest particle collected completely	m
Re_p	Particle Reynolds number (check < 1)	-

Method and standards

Stokes law and plug flow.

Assumptions and limits

- Laminar flow; Stokes regime (Re_p below 1; the page warns above it).
- The gas density enters only the Reynolds check; enter the density at the chamber temperature for hot flue gas.

References

• Laminar settling chamber model (de Nevers, Air Pollution Control Engineering, 2nd ed. (McGraw-Hill, 2000), ch. 9)

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/environmental/air-pollution/settling-chamber-efficiency

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.