Pressure Drop Through a Packed Bed (Ergun Equation)

Pressure drop of a fluid flowing through a packed bed of particles from bed depth, particle size, voidage and superficial velocity, by the Ergun equation.

Method: S. Ergun; Fluid flow through packed columns; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Bed depth	1.0000	m
Particle diameter (equivalent sphere)	5.0000	mm
Bed voidage	40.000	%
Sphericity	1.0000	
Superficial velocity (flow / bed area)	0.50000	m/s
Fluid density	1.2000	kg/m³
Fluid viscosity	1.8000e-05	Pa·s

Calculated results

Parameter	Value	Unit
Pressure gradient	1,288.1	Pa/m
Pressure drop over the bed	1.2881	kPa
Viscous term	0.30375	kPa
Inertial term	0.98437	kPa
Particle Reynolds number	277.78	

Notes for this case

- Pressure gradient in Pa per metre. Voidage dominates: a few per cent change in ε moves the result a lot.

Formula and method

$$\frac{\Delta p}{L} = 150\,\frac{\mu(1-\varepsilon)^2 v_s}{\varepsilon^3(\phi_s d_p)^2} + 1.75\,\frac{\rho(1-\varepsilon)v_s^2}{\varepsilon^3\phi_s d_p}$$

Variables

L	Bed depth	m
d_p	Particle diameter (equivalent sphere)	m
$\mathcal{E}$	Bed voidage	-
ϕ_s	Sphericity	-
v_s	Superficial velocity (flow / bed area)	m/s
ρ	Fluid density	kg/m³
μ	Fluid viscosity	Pa·s
$\Delta p/L$	Pressure gradient, in Pa/m	Pa/m
Δp	Pressure drop over the bed	Pa
Δp_v	Viscous term	Pa
Δp_i	Inertial term	Pa
Re_p	Particle Reynolds number	-

Method and standards

Ergun's correlation.

Assumptions and limits

- Randomly packed bed.

References

- S. Ergun
- Fluid flow through packed columns
- Chem. Eng. Prog. 48 (1952) 89

Report details

Report reference	FCC-Z9AY-ZD38 (the same inputs always give the same reference)
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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/mechanical/fluid-mechanics/ergun-packed-bed

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.