Minimum Fluidisation Velocity (Wen and Yu)

Minimum fluidisation velocity of a bubbling or circulating fluidised bed from particle size and density and the gas temperature, by the Wen and Yu correlation.

Method: C.Y. Wen and Y.H. Yu (1966); Air viscosity by Sutherland's law for each gas mixed by Wilke's rule; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Mean particle diameter	0.60000	mm
Particle density	2,600.0	kg/m³
Gas (bed) temperature	850.00	°C
Gas pressure (absolute)	1.0132	bar

Calculated results

Parameter	Value	Unit
Minimum fluidisation velocity	0.12320	m/s
Archimedes number	864.21	
Reynolds number at minimum fluidisation	0.51915	
Gas density (air)	0.31429	kg/m³

Notes for this case

- Air properties are used for the gas; bubbling beds run at a few times U_mf, set by the boiler design.

Formula and method

$$Ar = \frac{d_p^3\,\rho_g(\rho_p - \rho_g)\,g}{\mu^2} \qquad Re_{mf} = \sqrt{33.7^2 + 0.0408\,Ar} - 33.7 \qquad U_{mf} = \frac{Re_{mf}\,\mu}{\rho_g\,d_p}$$

Variables

d_p	mean particle diameter	m
ρ_p	particle density	kg/m³
T	gas temperature	K
p	gas pressure	Pa
U_{mf}	minimum fluidisation velocity	m/s
Ar	Archimedes number	–
Re_{mf}	Reynolds number at U_mf	–
ρ_g	gas density	kg/m³
μ	gas viscosity	Pa·s
g	standard gravity, 9.80665	m/s²

Method and standards

Wen and Yu (1966) correlation; air density by the ideal-gas law and viscosity from FireCAD's Sutherland–Wilke model of dry air.

Assumptions and limits

- Spherical-equivalent particles of one size; air as the fluidising gas (flue gas in a firing bed differs by a few per cent in density and viscosity).
- The fluidisation regime calculator uses Grace's constants (27.2 and 0.0408) instead of Wen and Yu's 33.7 and 0.0408, so it gives a somewhat different U_mf for the same particle; both are published fits.

References

- C.Y. Wen and Y.H. Yu (1966)
- Air viscosity by Sutherland's law for each gas mixed by Wilke's rule
- density by the ideal-gas law

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/boilers-power-plant/fluidised-bed/minimum-fluidisation-velocity

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.