Pneumatic Conveying: Saltation Velocity and Pressure Check (Rizk)

Minimum air velocity to avoid saltation in dilute-phase horizontal pneumatic conveying (Rizk) from loading ratio, particle size and pipe diameter.

Method: Rizk (1973) saltation correlation μ_s = 10^−δ Fr^χ; δ = 1.44d_p + 1.96; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Solids loading ratio (kg solids/kg air)	5.0000	
Particle size	0.50000	mm
Pipe inside diameter	100.00	mm
Safety margin on velocity	20.000	%
Air density in the line	1.6000	kg/m³

Calculated results

Parameter	Value	Unit
Saltation velocity	12.695	m/s
Design pick-up velocity	15.234	m/s
Air mass flow at design velocity	689.15	kg/h
Solids conveyed	3.4457	t/h

Notes for this case

- Rizk's correlation for dilute-phase horizontal flow of fairly uniform particles (about 0.1–5 mm). Use the conveying air calculator for pressure and free-air flow.

Formula and method

$$\mu_s = \frac{1}{10^{\delta}} Fr^{\chi}, \quad Fr = \frac{v_s}{\sqrt{gD}}, \quad \delta = 1.44 d_p + 1.96, \ \chi = 1.1 d_p + 2.5 \ (d_p \text{ mm})$$

Variables

μ_s	Solids loading ratio (kg solids/kg air)	-
d_p	Particle size	m
D	Pipe inside diameter	m
m	Safety margin on velocity	-
ρ_a	Air density in the line	kg/m³
v_s	Saltation velocity	m/s
v_d	Design pick-up velocity	m/s
$\dot{m}_a$	Air mass flow at design velocity	kg/s
$\dot{m}_s$	Solids conveyed	kg/s

Method and standards

Rizk correlation.

Assumptions and limits

- Dilute phase; horizontal.
- Particles of about 0.1–5 mm; outside that range a warning is given and the result is a rough estimate only.

References

- Rizk (1973) saltation correlation μ_s = 10^−δ Fr^χ
- δ = 1.44d_p + 1.96
- χ = 1.1d_p + 2.5 (d_p in mm)
- as given in Klinzing et al.
- Pneumatic Conveying of Solids (2010)

Report details

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Release checks	2 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/material-handling/pneumatic-conveying-saltation

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.