Pneumatic Ash or Fuel Conveying: Air Flow and Velocity

Conveying air mass and free-air flow from the solids rate and the solids loading ratio, and the air velocity in the pipe at the conveying pressure and temperature.

Method: Mass balance with the solids loading ratio; ideal gas with the dry-air molar mass

Input parameters

Unit system: SI

Parameter	Value	Unit
Solids conveyed	10.000	t/h
Solids loading ratio (kg solids per kg air)	10.000	kg/kg
Pipe bore	150.00	mm
Air pressure in the pipe (absolute)	2.0000	bar
Air temperature	50.000	°C

Calculated results

Parameter	Value	Unit
Conveying air	1,000.0	kg/h
Free air at 0 °C, 1 atm (normal; FAD at a 20 °C intake is about 7 % more)	773.80	Nm³/h
Air density in the pipe	2.1562	kg/m³
Air velocity in the pipe	7.2903	m/s

Notes for this case

- Velocity rises along the pipe as pressure falls; check the pick-up velocity at the feed end and wear at the outlet.

Formula and method

$$\dot{m}_a = \frac{\dot{m}_s}{\mu}, \quad \rho_a = \frac{pM}{RT}, \quad v = \frac{\dot{m}_a}{\rho_a \pi d^2/4}$$

Variables

$\dot{m}_s$	Solids conveyed	kg/s
μ	Solids loading ratio (kg solids per kg air)	kg/kg
d	Pipe bore	m
p	Air pressure in the pipe (absolute)	Pa
T	Air temperature	K
$\dot{m}_a$	Conveying air	kg/s
$\dot{V}_n$	Free air (0 °C, 1 atm)	Nm³/s
ρ_a	Air density in the pipe	kg/m³
v	Air velocity in the pipe	m/s

Method and standards

Mass balance with the solids loading ratio; air density by the ideal-gas law with the dry-air molar mass; free air at 0 °C and 101.325 kPa from the normal molar volume.

Assumptions and limits

- Air only (solids volume ignored).
- The free air is at 0 °C and 1 atm. Compressor makers quote free air delivery (FAD) at intake conditions: at 20 °C it is 293.15/273.15, about 7 % more; size the compressor on that.
- The velocity is not checked against the pick-up or saltation velocity of the material: take it from the conveyor maker or test data.

References

- Mass balance with the solids loading ratio; ideal gas with the dry-air molar mass

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/boilers-power-plant/fuel-ash-handling/pneumatic-conveying-air

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Reopens the calculator with the inputs of this report.