Slurry Minimum Transport Velocity (Durand and Spells)

Minimum velocity to keep a settling slurry from forming a deposit (Durand), velocity for full symmetric suspension (Spells) and the matching flow.

Method: Perry's Chemical Engineers' Handbook; 9th ed. (McGraw-Hill, 2019); ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Pipe inside diameter	154.10	mm
Solid density	2,650.0	kg/m³
Liquid density	998.00	kg/m³
Solids volume fraction	15.000	%
Durand factor F_L (1.5 conservative)	1.5000	
Particle size (85 % by mass smaller)	0.50000	mm
Liquid viscosity	1.0000	cP

Calculated results

Parameter	Value	Unit
Slurry density	1,245.8	kg/m³
Minimum transport (deposition) velocity	3.3551	m/s
Flow at the minimum velocity	225.27	m³/h
Velocity for symmetric suspension (Spells)	5.2181	m/s

Notes for this case

- Design above V_M2 with a margin; typical settling-slurry velocities are 1–4 m/s (Perry's). Above V_M2, pressure drop is about 25 % above that of a uniform fluid of the slurry density.

Formula and method

$$V_{M2} = F_L\sqrt{2gD(s-1)}, \quad V_{M1}^2 = 0.075\left(\frac{DV_{M1}\rho_M}{\mu}\right)^{0.775} gD_S(s-1), \quad s = \frac{\rho_S}{\rho_L}$$

Variables

D	Pipe inside diameter	m
ρ_S	Solid density	kg/m³
ρ_L	Liquid density	kg/m³
C_S	Solids volume fraction	-
F_L	Durand factor F_L (1.5 conservative)	-
D_S	Particle size (85 % by mass smaller)	m
μ	Liquid viscosity	Pa·s
ρ_M	Slurry density	kg/m³
V_{M2}	Minimum transport (deposition) velocity	m/s
Q_{min}	Flow at the minimum velocity	m³/s
V_{M1}	Velocity for symmetric suspension (Spells)	m/s

Method and standards

Durand and Spells correlations.

Assumptions and limits

- Settling slurries in horizontal pipes.
- The two velocities answer different questions: V_M2 (Durand) is the limit below which a stationary deposit forms; V_M1 (Spells) is the velocity for full, symmetric suspension. They can differ widely (in the fly-ash preset Spells gives 1.39 m/s and Durand 2.45 m/s). Design above V_M2 with a margin; where V_M1 is the larger, run near it only if a fully suspended profile is needed, since wear rises with velocity.

References

- Perry's Chemical Engineers' Handbook
- 9th ed. (McGraw-Hill, 2019)
- sec. 6
- Eqs. (6-150) (Durand) and (6-152) (Spells)

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/fluid-mechanics/slurry-transport-velocity

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.