CFB Gas–Solid Slip Velocity and Suspension Density

Gas–solid slip velocity in a fast bed from superficial gas velocity, solids flux and voidage (Basu Eq. 2.25), with the suspension density and solids velocity.

Method: Basu; Circulating Fluidized Bed Boilers: Design; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Superficial gas velocity	5.5000	m/s
Solids flux	20.000	kg/(m²·s)
Local voidage	98.000	%
Particle density	2,500.0	kg/m³

Calculated results

Parameter	Value	Unit
Interstitial gas velocity	5.6122	m/s
Solids velocity	0.40000	m/s
Slip velocity	5.2122	m/s
Suspension density	50.000	kg/m³

Notes for this case

- In the core the slip is of the order of the particle terminal velocity; near the wall solids may fall against the gas.

Formula and method

$$U_{slip} = \frac{U}{\varepsilon} - \frac{G_s}{(1-\varepsilon)\rho_p}, \quad \rho_{susp} = \rho_p(1-\varepsilon)$$

Variables

U	Superficial gas velocity	m/s
G_s	Solids flux	kg/(m²·s)
$\mathcal{E}$	Local voidage	-
ρ_p	Particle density	kg/m³
U/ε	Interstitial gas velocity	m/s
U_s	Solids velocity	m/s
U_{slip}	Slip velocity	m/s
ρ_{susp}	Suspension density	kg/m³

Method and standards

Basu's Eq. (2.25).

Assumptions and limits

- Cross-section averages.
- A warning is given when the solids velocity exceeds U/ε (negative slip): the inputs are inconsistent with up-flow.

References

- Basu
- Circulating Fluidized Bed Boilers: Design
- Operation and Maintenance (Springer, 2015)
- ch. 2
- Eq. (2.25)

Report details

Report reference	FCC-C71D-A6Y1 (the same inputs always give the same reference)
Generated	17 November 2026, 19:46 UTC
Calculator	CFB Gas–Solid Slip Velocity and Suspension Density
Method last reviewed	13 November 2026
Software release	FireCAD Calc, release of 17 November 2026
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/boilers-power-plant/fluidised-bed/cfb-slip-velocity

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.