CFB Furnace Cross-Section: Grate Heat Release and Velocity

Grate heat release from superficial velocity and excess air (3.3 U_0/EAC MW/m², Basu Eq. 4.21) and the furnace cross-section for a heat input.

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Heat input (HHV)	300.00	MW
Superficial velocity referred to 300 K	1.6000	m/s
Excess air coefficient (1.2 = 20 % excess)	1.2000	
Combustion air volume flow at 300 K (for the check; 0 = none)	342,000	m³/h

Calculated results

Parameter	Value	Unit
Grate heat release rate	4.4000	MW/m²
Furnace cross-section	68.182	m²
Velocity at 300 K from the gas flow	1.3933	m/s

Notes for this case

- U_0 is referred to 300 K; at a typical 850 °C furnace temperature the actual velocity is about 6.0 m/s (×3.7, before the gas volume added by combustion).
- The constant 3.3 MW/m² per m/s is for average fossil fuels; biomass and high-moisture fuels release a different heat per unit of air.
- The velocity from the gas flow (1.39 m/s) differs from U_0 (1.60 m/s) by more than 10 %: check the gas flow, the excess air or U_0.

Formula and method

$$q_A = \frac{3.3 U_0}{EAC}\ \mathrm{MW/m^2}, \quad A = \frac{Q}{q_A}, \quad U_{check} = \frac{\dot{V}_{300}}{A}$$

Variables

Q	Heat input (HHV)	W
U_0	Superficial velocity referred to 300 K	m/s
EAC	Excess air coefficient (1.2 = 20 % excess)	-
$\dot{V}_{300}$	Combustion air volume flow at 300 K (for the check)	m³/s
q_A	Grate heat release rate	W/m²
A	Furnace cross-section	m²
U_{check}	Velocity at 300 K from the gas flow	m/s

Method and standards

Basu's Eq. (4.21).

Assumptions and limits

- Average fossil fuels: about 3.3 MW per m² for each m/s of air at 300 K. Biomass and wet fuels differ.
- Eq. (4.21) is in terms of the air velocity, so the check uses the combustion air flow at 300 K, not the flue gas flow.
- The check velocity is shown only when a gas flow is entered; a warning appears when it differs from U_0 by more than 10 %.

References

- Basu
- Circulating Fluidized Bed Boilers: Design
- Operation and Maintenance (Springer, 2015)

- ch. 4
- Eq. (4.21) (Waters 1975)

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/boilers-power-plant/fluidised-bed/cfb-grate-heat-release

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.