CFB Furnace Membrane Wall Area and Heat Absorbed

Projected and actual membrane wall area of a CFB furnace, wall temperature by Basu's rule and the heat the walls absorb (Basu Eqs. 6.14–6.17).

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Furnace width	15.000	m
Furnace breadth (depth)	8.0000	m
Water-cooled height	30.000	m
Tube outer diameter	63.500	mm
Tube pitch	88.900	mm
Heat transfer coefficient on the projected area	180.00	W/(m²·K)
Bed temperature	850.00	°C
Saturation temperature at drum pressure	320.00	°C

Calculated results

Parameter	Value	Unit
Actual-to-projected area ratio	1.4077	
Projected wall area	1,380.0	m²
Actual heat-transfer area	1,942.6	m²
Wall temperature (T_sat + 25 °C)	345.00	°C
Heat absorbed by the walls	125.44	MW

Notes for this case

- Basu also takes superheater and reheater metal at steam temperature + 50 °C (Eq. 10.2); refractory-lined lower walls absorb little and are left out of L.

Formula and method

$$A_x = \frac{\pi D/2 + p - D}{p}, \quad A_w = 2(W+B)L, \quad A_{actual} = A_x A_w, \quad Q_w = A_w U_h (T_b - T_{wall}), \quad T_{wall} = T_{sat} + 25\ \mathrm{K}$$

Variables

W	Furnace width	m
B	Furnace breadth (depth)	m
L	Water-cooled height	m
D	Tube outer diameter	m
p	Tube pitch	m
U_h	Heat transfer coefficient on the projected area	W/(m²·K)
T_b	Bed temperature	K
T_{sat}	Saturation temperature at drum pressure	K
A_x	Actual-to-projected area ratio	-
A_w	Projected wall area	m²
A_{actual}	Actual heat-transfer area	m²
T_{wall}	Wall temperature (T_sat + 25 °C)	K
Q_w	Heat absorbed by the walls	W

Method and standards

Basu's design equations.

Assumptions and limits

- Roof and exit areas taken as equal (Basu).
- One average coefficient and bed temperature over the whole water-cooled height. In a CFB the coefficient falls strongly with suspension density up the furnace; use a height-averaged U_h or split the furnace into zones.
- T_{sat} is entered directly; take it at the drum pressure from the saturation calculator.

References

- Basu
- Circulating Fluidized Bed Boilers: Design
- Operation and Maintenance (Springer, 2015)
- ch. 6
- Eqs. (6.14)–(6.17) and ch. 10
- Eq. (10.1) (evaporator wall at T_sat + 25 °C)

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-furnace-wall-heat-absorption

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.