Fluidised-Bed Start-Up: Fuel to Heat the Bed

Fuel oil or gas to heat the bed material (and refractory) from cold to the solid-fuel ignition temperature with start-up burners of a given efficiency and time.

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Bed material	150,000	kg
Bed specific heat	0.84000	kJ/(kg·K)
Refractory heated	100,000	kg
Refractory specific heat	1.0000	kJ/(kg·K)
Initial temperature	30.000	°C
Ignition temperature for coal	600.00	°C
Start-up burner heat transfer efficiency	50.000	%
Start-up fuel LHV	42.000	MJ/kg
Heating time	6.0000	h

Calculated results

Parameter	Value	Unit
Heat to the bed and refractory	128.82	GJ
Start-up fuel	6.1343	t
Average fuel rate	1,022.4	kg/h

Notes for this case

- Refractory heat-up rates are limited by the refractory maker's curve; that often sets the start-up time.

Formula and method

$$Q = (M_b c_b + M_r c_r)(T_2 - T_1), \quad M_f = \frac{Q}{\eta_b LHV}, \quad \dot{M}_f = \frac{M_f}{t}$$

Variables

M_b	Bed material	kg
c_b	Bed specific heat	J/(kg·K)
M_r	Refractory heated	kg
c_r	Refractory specific heat	J/(kg·K)
T_1	Initial temperature	K
T_2	Ignition temperature for coal	K
η_b	Start-up burner heat transfer efficiency	-
LHV	Start-up fuel LHV	J/kg
t	Heating time	s
Q	Heat to the bed and refractory	J
M_f	Start-up fuel	kg
$\dot{M}_f$	Average fuel rate	kg/s

Method and standards

Sensible heat balance.

Assumptions and limits

- Uniform final temperature: the bed and the refractory are both taken to reach the ignition temperature.
- Heat taken by the water walls, drum water and steam during the heat-up is not counted separately; it is folded into the burner heat transfer efficiency you enter.

References

- Basu
- Circulating Fluidized Bed Boilers: Design
- Operation and Maintenance (Springer, 2015)
- ch. 11 (start-up: bed heated by start-up burners to coal ignition temperature)
- Sensible heat balance

Report details

Report reference	FCC-QQ25-YTWB (the same inputs always give the same reference)
Generated	17 November 2026, 19:46 UTC
Calculator	Fluidised-Bed Start-Up: Fuel to Heat the Bed
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/startup-bed-heating-fuel

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.