Coal Devolatilisation: Time for a Fraction of Volatiles

Time to release a fraction of a coal particle's volatiles (La Nauze shrinking core) and the devolatilisation–combustion time t_v = a dᵖ (Basu Eqs. 4.3–4.4).

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Fraction of volatiles released	90.000	%
Time for complete devolatilisation	30.000	s
Pillai constant a (s per mm^p)	5.0000	
Exponent p	1.0000	
Coal particle diameter	6.0000	mm

Calculated results

Parameter	Value	Unit
Time to release the fraction x	16.610	s
Devolatilisation and volatile combustion time	30.000	s

Notes for this case

- Both τ_C and a must come from tests on the coal at the bed temperature and particle size of interest; the two times are separate correlations and are not linked to each other.

Formula and method

$$\frac{t}{\tau_C} = 1 - 3(1-x)^{2/3} + 2(1-x), \quad t_v = a\, d_v^{\,p} \ (d_v \text{ in mm})$$

Variables

x	Fraction of volatiles released	-
τ_C	Time for complete devolatilisation	s
a	Pillai constant a (s per mm^p)	-
p	Exponent p	-
d_v	Coal particle diameter	m
t	Time to release the fraction x	s
t_v	Devolatilisation and volatile combustion time	s

Method and standards

Shrinking-core relation and Pillai's empirical fit.

Assumptions and limits

- Constants from tests. The calculator does not scale them: τ_C grows roughly with the square of particle size and a falls steeply with temperature (about $T^{-3.8}$), so enter values measured at your size and bed temperature.
- The two outputs come from separate correlations: t from the τ_C you enter and t_v from a, p and d_v. They are not linked and can disagree.

References

- Basu
- Circulating Fluidized Bed Boilers: Design
- Operation and Maintenance (Springer, 2015)
- ch. 4
- Eqs. (4.3) (La Nauze 1985) and (4.4) (Pillai 1981)

Report details

Report reference	FCC-16MV-1HQF (the same inputs always give the same reference)
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Calculator	Coal Devolatilisation: Time for a Fraction of Volatiles
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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/coal-devolatilisation-time

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.