Falling-Rate Drying Time (Linear Rate)

Drying time in the falling-rate period when the rate falls linearly from the critical moisture to zero at equilibrium moisture (Perry's sec. 12).

Method: Perry's Chemical Engineers' Handbook; 9th ed. (McGraw-Hill, 2019); ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Dry solids	500.00	kg
Drying surface	25.000	m²
Critical moisture (dry basis)	0.30000	kg/kg
Final moisture (dry basis)	0.050000	kg/kg
Equilibrium moisture (dry basis)	0.020000	kg/kg
Constant drying rate	1.8000	kg/(m²·h)

Calculated results

Parameter	Value	Unit
Falling-rate drying time	6.9490	h
Rate at the end	0.19286	kg/(m²·h)

Formula and method

$$t_f = \frac{m_s (X_c - X^*)}{A N_c} \ln \frac{X_c - X^*}{X_2 - X^*}$$

Variables

m_s	Dry solids	kg
A	Drying surface	m²
X_c	Critical moisture (dry basis)	kg/kg
X_2	Final moisture (dry basis)	kg/kg
X^*	Equilibrium moisture (dry basis)	kg/kg
N_c	Constant drying rate	kg/(m²·s)
t_f	Falling-rate drying time	s
N_2	Rate at the end	kg/(m²·s)

Method and standards

Integration of a rate linear in free moisture.

Assumptions and limits

- Linear falling rate.

References

- Perry's Chemical Engineers' Handbook
- 9th ed. (McGraw-Hill, 2019)
- sec. 12 (drying): falling-rate period with rate proportional to free moisture

Report details

Report reference	FCC-DSVY-MKFM (the same inputs always give the same reference)
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Calculator	Falling-Rate Drying Time (Linear Rate)
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/chemical/unit-operations/falling-rate-drying-time

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.