Timber Kiln Drying: Water Removed and Energy per m³

Water removed and heat used to kiln-dry a charge of timber from its volume, basic density and moisture contents, with the energy per cubic metre.

Method: Energy balance of timber kiln drying

Input parameters

Unit system: SI

Parameter	Value	Unit
Timber volume (green)	50.000	m³
Basic density (oven-dry mass per green volume)	550.00	kg/m³
Initial moisture (dry basis)	60.000	%
Final moisture (dry basis)	12.000	%
Specific heat of oven-dry wood	1.4000	kJ/(kg·K)
Heating of the charge from ambient to kiln temperature	50.000	K
Heat to evaporate wood moisture (including sorption)	2,600.0	kJ/kg
Kiln efficiency (venting and structure losses)	50.000	%

Calculated results

Parameter	Value	Unit
Oven-dry wood mass	27.500	t
Water removed	13,200	kg
Heat supplied	79.397	GJ
Heat per m³ of timber	441.09	kWh
Heat per kg of water	6.0149	MJ/kg

Notes for this case

• Timber moisture is stated on a dry basis, so the water removed is the oven-dry mass (volume × basic density) times the drop in moisture content. Heat goes to warming the wood and its water, evaporating the water (slightly more than free water below fibre saturation because of sorption heat) and to vent and structure losses, lumped here in the kiln efficiency. Conventional kilns use about 3–6 MJ per kg of water; vented heat recovery or dehumidification kilns use less.

Formula and method

$$m_w = V\rho_b(M_0 - M_1), \quad Q = \frac{m_w\lambda + V\rho_b(c_w + c_{water}M_0)\Delta T}{\eta}$$

Variables

V	Timber volume (green)	m³
ρ_b	Basic density (oven-dry mass per green volume)	kg/m³
M_0	Initial moisture (dry basis)	-
M_1	Final moisture (dry basis)	-
c_w	Specific heat of oven-dry wood	J/(kg·K)
ΔT	Heating of the charge from ambient to kiln temperature	K
λ	Heat to evaporate wood moisture (including sorption)	J/kg
η	Kiln efficiency (venting and structure losses)	-
m_d	Oven-dry wood mass	kg
m_w	Water removed	kg

Q	Heat supplied	J
Q/V	Heat per m³ of timber	J
Q/m_w	Heat per kg of water	J/kg

Method and standards

Timber kiln.

Assumptions and limits

- Single heat-up; lumped losses.

References

Energy balance of timber kiln drying

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/chemical/drying/timber-kiln-drying-energy

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.