Phase-Change Material (PCM) Thermal Storage Capacity

Heat stored in a phase-change material heated through its melting point, its volume and energy density, compared with water over the same range.

Method: Sensible and latent heat balance

Input parameters

Unit system: SI

Parameter	Value	Unit
PCM mass	1,000.0	kg
Start temperature	20.000	°C
End temperature	60.000	°C
Melting temperature	50.000	°C
Specific heat of the solid	2.0000	kJ/(kg·K)
Specific heat of the liquid	2.2000	kJ/(kg·K)
Latent heat of fusion	200.00	kJ/kg
Mean density	850.00	kg/m³

Calculated results

Parameter	Value	Unit
Sensible heat (solid and liquid)	22.778	kWh
Latent heat	55.556	kWh
Total heat stored	78.333	kWh
PCM volume	1.1765	m³
Energy density (kWh per m³)	66.583	
Ratio to the same volume of water over the same range	1.4316	

Notes for this case

• Q = m[c_s(T_m − T₁) + L + c_l(T₂ − T_m)] when the range spans the melting point; sensible only otherwise. Water reference: 1,000 kg/m³ and 4,186 J/(kg·K). PCMs pay off when the useful temperature swing is small; heat transfer into the solid is usually the design limit.

Formula and method

$$Q = m\left[c_s(T_m - T_1) + L + c_l(T_2 - T_m)\right], \quad \frac{Q}{Q_{water}} = \frac{Q}{\rho_w c_w V(T_2 - T_1)}$$

Variables

m	PCM mass	kg
T_1	Start temperature	K
T_2	End temperature	K
T_m	Melting temperature	K
c_s	Specific heat of the solid	J/(kg·K)
c_l	Specific heat of the liquid	J/(kg·K)
L	Latent heat of fusion	J/kg
ρ	Mean density	kg/m³
Q_s	Sensible heat (solid and liquid)	J

Q_L	Latent heat	J
Q	Total heat stored	J
V	PCM volume	m³
Q/V	Energy density (kWh per m³)	-
Q/Q_{water}	Ratio to the same volume of water over the same range	-

Method and standards

Latent heat storage.

Assumptions and limits

- Sharp melting point; constant properties.

References

Sensible and latent heat balance

Report details

Report reference	FCC-M0ST-88D7 (the same inputs always give the same reference)
Generated	23 November 2026, 17:35 UTC
Calculator	Phase-Change Material (PCM) Thermal Storage Capacity
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
Release checks	3 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/environmental/hydrogen-fuel-cells/pcm-latent-heat-storage

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.