Molten Salt Thermal Storage Mass, Volume and Tank Size

Salt mass, volume and two-tank size of a molten salt store for a concentrating solar plant from the electricity to store and the tank temperatures.

Method: Sensible heat storage energy balance

Input parameters

Unit system: SI

Parameter	Value	Unit
Electrical energy to deliver from storage	1,000.0	MWh
Power cycle efficiency (1 for heat delivered as heat)	40.000	%
Hot tank temperature	565.00	°C
Cold tank temperature	290.00	°C
Salt mean specific heat (solar salt about 1,500)	1.5000	kJ/(kg·K)
Salt mean density (solar salt about 1,800–1,900)	1,850.0	kg/m³
Tank volume margin (heel and freeboard)	1.1000	
Tank liquid height	12.000	m

Calculated results

Parameter	Value	Unit
Thermal energy stored	2,500.0	MWh
Salt mass	21,818	t
Salt volume	11,794	m³
Volume of each tank with margin	12,973	m³
Tank diameter for the height entered	37.101	m
Storage density (kWh thermal per m³ of salt)	211.98	

Notes for this case

• Q = E_e/η, m = Q/(c_pΔT); each tank holds the full inventory in a two-tank system. Solar salt (60 % $NaNO_3$, 40 % KNO_3) freezes near 220 °C and degrades above about 600 °C.

Formula and method

$$Q = \frac{E_e}{\eta}, \quad m = \frac{Q}{c_p(T_h - T_c)}, \quad D_t = \sqrt{\frac{4fV}{\pi H}}$$

Variables

E_e	Electrical energy to deliver from storage	J
η	Power cycle efficiency (1 for heat delivered as heat)	-
T_h	Hot tank temperature	K
T_c	Cold tank temperature	K
c_p	Salt mean specific heat (solar salt about 1,500)	J/(kg·K)
ρ	Salt mean density (solar salt about 1,800–1,900)	kg/m³
f	Tank volume margin (heel and freeboard)	-
H	Tank liquid height	m
Q	Thermal energy stored	J
m	Salt mass	kg

V	Salt volume	m³
V_t	Volume of each tank with margin	m³
D_t	Tank diameter for the height entered	m
e	Storage density (kWh thermal per m³ of salt)	-

Method and standards

Sensible storage sizing.

Assumptions and limits

- Constant c_p; perfect stratification between tanks.

References

Sensible heat storage energy balance

Report details

Report reference	FCC-6004-X84S (the same inputs always give the same reference)
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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/solar-thermal/molten-salt-thermal-storage

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.