Anaerobic Digester Heat Requirement and Cool-down

Heat to warm the sludge feed and to make up losses through wall, floor and roof of a cylindrical digester, and the temperature drop if heating stops for a day.

Input parameters

Unit system: SI

Parameter	Value	Unit
Sludge feed	40,000	kg/d
Sludge specific heat	4.2000	kJ/(kg·K)
Digester temperature	37.000	°C
Incoming sludge temperature	18.000	°C
Diameter	15.000	m
Side water depth	8.0000	m
Depth at the centre (cone floor)	10.000	m
Wall coefficient	0.50000	W/(m²·K)
Earth or air next to the wall	10.000	°C
Floor coefficient	1.2000	W/(m²·K)
Earth below the floor	12.000	°C
Roof coefficient	0.80000	W/(m²·K)
Air above the roof	5.0000	°C
Sludge density	1,000.0	kg/m³

Calculated results

Parameter	Value	Unit
Sludge heating	36.944	kW
Wall loss	5.0894	kW
Floor loss	5.4867	kW
Roof loss	4.5239	kW
Heat exchanger duty	52.044	kW
Daily heat	4.4966	GJ
Digester volume	1,531.5	m³
Temperature drop in 24 h without heat	0.69906	K

Notes for this case

- The floor is a cone of the given centre depth; the roof is taken as flat.

Formula and method

$$q_s = \dot{m} c_p (T_d - T_s), \quad q = UA\,\Delta T\ (\text{wall},\ \text{floor},\ \text{roof}), \quad \Delta T_{24h} = \frac{Q_d}{\rho V c_p}$$

Variables

$\dot{m}$	Sludge feed	kg/s
c_p	Sludge specific heat	J/(kg·K)
T_d	Digester temperature	K

T_s	Incoming sludge temperature	K
D	Diameter	m
h_s	Side water depth	m
h_m	Depth at the centre (cone floor)	m
U_w	Wall coefficient	W/(m²·K)
T_{ew}	Earth or air next to the wall	K
U_f	Floor coefficient	W/(m²·K)
T_{ef}	Earth below the floor	K
U_r	Roof coefficient	W/(m²·K)
T_a	Air above the roof	K
ρ	Sludge density	kg/m³
q_s	Sludge heating	W
q_w	Wall loss	W
q_f	Floor loss	W
q_r	Roof loss	W
q	Heat exchanger duty	W
Q_d	Daily heat	J
V	Digester volume	m³
ΔT	Temperature drop in 24 h without heat	K

Method and standards

Digester heat balance.

Assumptions and limits

- Steady losses; radiation included in U.

Report details

Report reference	FCC-CCZC-Q36Z (the same inputs always give the same reference)
Generated	23 November 2026, 17:50 UTC
Calculator	Anaerobic Digester Heat Requirement and Cool-down
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/wastewater/digester-heating-requirement

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.