CIP Heating: Energy and Time to Heat Detergent

Energy and steam to heat CIP detergent and rinse tanks, and the time to heat with a given heater duty, for one cleaning cycle.

Method: Mass and energy balances (definitions); solution specific heat taken as 4.0 kJ/(kg·K)

Input parameters

Unit system: SI

Parameter	Value	Unit
Tank solution volume	5.0000	m³
Solution density	1,030.0	kg/m³
Initial temperature	15.000	°C
Cleaning temperature	75.000	°C
Heater duty	200.00	kW
Cycles per day	3.0000	
Steam latent heat	2,130.0	kJ/kg

Calculated results

Parameter	Value	Unit
Energy per cycle	343.33	kWh
Heating time	103.00	min
Steam per cycle	580.28	kg
Steam per day	1,740.8	kg

Notes for this case

- Recovering and reusing hot detergent (instead of single-use) cuts CIP heat by more than half.

Formula and method

$$E = V\rho c(T_2 - T_1), \quad t = \frac{E}{\dot{Q}}, \quad m_s = \frac{E}{h_{fg}}$$

Variables

V	Tank solution volume	m³
ρ	Solution density	kg/m³
T_1	Initial temperature	K
T_2	Cleaning temperature	K
$\dot{Q}$	Heater duty	W
n	Cycles per day	-
h_{fg}	Steam latent heat	J/kg
E	Energy per cycle	J
t	Heating time	s
m_s	Steam per cycle	kg
m_d	Steam per day	kg

Method and standards

Sensible heat with c = 4.0 kJ/(kg·K).

Assumptions and limits

- No heat loss during heating.

References

- Mass and energy balances (definitions); solution specific heat taken as 4.0 kJ/(kg·K)

Report details

Report reference	FCC-PR0Z-6KH9 (the same inputs always give the same reference)
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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/food-dairy/cip-heating-energy

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.