Massecuite Crystalliser Cooling Duty and Water

Heat removed to cool massecuite in a crystalliser and the cooling-water flow, from massecuite flow, specific heat, temperatures and water rise.

Method: Energy balance Q = ṁ c_p ΔT; water c_p 4.1868 kJ/kg K

Input parameters

Unit system: SI

Parameter	Value	Unit
Massecuite flow	10.000	t/h
Massecuite specific heat	1.9000	kJ/(kg·K)
Massecuite in	70.000	°C
Massecuite out	40.000	°C
Cooling-water temperature rise	8.0000	K

Calculated results

Parameter	Value	Unit
Heat removed	158.33	kW
Cooling water	17.018	t/h

Notes for this case

- The heat of crystallisation is small and neglected; cool slowly to avoid false grain.

Formula and method

$$\dot{Q} = \dot{m}_m c_p (T_1 - T_2), \quad \dot{m}_w = \frac{\dot{Q}}{c_w \Delta T_w}$$

Variables

$\dot{m}_m$	Massecuite flow	kg/s
c_p	Massecuite specific heat	J/(kg·K)
T_1	Massecuite in	K
T_2	Massecuite out	K
ΔT_w	Cooling-water temperature rise	K
$\dot{Q}$	Heat removed	W
$\dot{m}_w$	Cooling water	kg/s

Method and standards

Energy balance.

Assumptions and limits

- Steady flow.
- The heat of crystallisation is neglected (it is small against the sensible heat).
- The cooling-water inlet temperature is not an input, so the approach is not checked: the water must enter colder than the massecuite outlet temperature, by a margin that the crystalliser design sets.

References

- Energy balance Q = ṁ c_p ΔT; water c_p 4.1868 kJ/kg K

Report details

Report reference	FCC-48H8-8YAJ (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/sugar-ethanol/pan-boiling/crystalliser-cooling-duty

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.