Mash Cooling Duty and Cooling Water

Heat to remove when cooling liquefied mash to fermentation temperature, and the cooling water flow for a water temperature rise, by a sensible heat balance.

Method: Sensible heat balance Q = ṁ c_p ΔT (definition); Jacques; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Mash flow	60.000	t/h
Mash specific heat	3.8000	kJ/(kg·K)
Mash in (after liquefaction)	85.000	°C
Mash out (to fermenters)	32.000	°C
Cooling water temperature rise	8.0000	K

Calculated results

Parameter	Value	Unit
Cooling duty	3,356.7	kW
Cooling water	360.78	t/h

Notes for this case

- Recover the first part of this heat into incoming slurry or process water before using cooling-tower water.

Formula and method

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

Variables

$\dot{m}$	Mash flow	kg/s
c_p	Mash specific heat	J/(kg·K)
T_1	Mash in (after liquefaction)	K
T_2	Mash out (to fermenters)	K
ΔT_w	Cooling water temperature rise	K
Q	Cooling duty	W
$\dot{m}_w$	Cooling water	kg/s
c_w	Specific heat of water 4 186.8	J/(kg·K)

Method and standards

Sensible heat balance; water c_w = 4.1868 kJ/(kg·K).

Assumptions and limits

- No phase change.

References

- Sensible heat balance Q = ṁ c_p ΔT (definition)
- Jacques
- Lyons and Kelsall (eds.)
- The Alcohol Textbook
- 4th ed. (2003)
- ch. 2: liquefaction at 80–90 °C
- fermentation set near 32 °C

Report details

Report reference	FCC-X1G0-23M0 (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/ethanol/mash-cooling-duty

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.