Water-Cooled Crystalliser Surface and Water (Hugot)

Cooling surface and water of a water-cooled (Werkspoor type) crystalliser from massecuite flow and massecuite and water temperatures (Hugot 34.15–34.17).

Method: Hugot; Handbook of Cane Sugar Engineering; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Massecuite flow	25.000	m³/h
Massecuite density	1,500.0	kg/m³
Massecuite specific heat	1.6747	kJ/(kg·K)
Allowance factor Hugot: 1.15–1.20 (Tromp 1.4).	1.1500	
Heat-transfer coefficient Hugot: A 40–60, B 35–50, C 25 kcal/(m²·h·°C).	69.780	W/(m²·K)
Massecuite in	70.000	°C
Massecuite out	40.000	°C
Water in	25.000	°C
Water out	50.000	°C

Calculated results

Parameter	Value	Unit
Heat removed	601.85	kW
Cooling surface	496.25	m²
Cooling water	20,700	kg/h
Water per kg massecuite (without allowance)	0.48000	

Notes for this case

- Hugot's example: 25 m³/h of A massecuite cooled 70 → 40 °C by water 25 → 50 °C needs about 495 m² and 20 700 kg/h of water.

Formula and method

$$\dot{Q} = \alpha V d c (T_0 - T), \quad S = \frac{\dot{Q}}{k\,\Delta T_{lm}}, \quad \Delta T_{lm} = \frac{(T_0 - t) - (T - t_0)}{\ln \frac{T_0 - t}{T - t_0}}, \quad W = \frac{\dot{Q}}{c_w (t - t_0)}$$

Variables

V	Massecuite flow	m³/s
d	Massecuite density	kg/m³
c	Massecuite specific heat	J/(kg·K)
α	Allowance factor	-
k	Heat-transfer coefficient	W/(m²·K)
T_0	Massecuite in	K
T	Massecuite out	K
t_0	Water in	K
t	Water out	K
$\dot{Q}$	Heat removed	W

S	Cooling surface	m²
W	Cooling water	kg/s
w	Water per kg massecuite (without allowance)	-

Method and standards

Hugot's counter-current heat balance.

Assumptions and limits

- Counter-current flow; constant properties.
- The water ratio w excludes the allowance while the water flow W includes it.
- The cooling rate of the massecuite (false grain risk) is not checked.

References

• Hugot
• Handbook of Cane Sugar Engineering
• 3rd ed. (Elsevier, 1986)
• ch. 34
• water-cooled crystallisers
• eqns 34.15–34.17 and example
• pp. 739–744

Report details

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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/water-cooled-crystalliser-surface

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.