Diffuser Heating Steam (Hugot)

Steam to heat prepared cane and imbibition water to diffusion temperature, with Hugot's specific heat of prepared cane (p. 397) and IF97 latent heat of the steam.

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Crushing rate	250.00	t/h
Water in cane	72.000	%
Cane temperature	30.000	°C
Imbibition water per unit cane	30.000	%
Imbibition water temperature	50.000	°C
Diffusion temperature Hugot: 65–75 °C (Saturne 75–80).	75.000	°C
Heating steam pressure (absolute)	1.2000	bar
Heat losses	5.0000	%

Calculated results

Parameter	Value	Unit
Specific heat of prepared cane 0.25 + 0.81h	3.4884	kJ/(kg·K)
Heat duty	13,771	kW
Steam	22.094	t/h
Steam per tonne cane	88.377	kg/t

Notes for this case

- Hugot: de Smet cane diffusers take about 94 kg steam per tonne cane, bagasse diffusers about 45, including the recirculation heaters.

Formula and method

$$c_c = 0.25 + 0.81h \ \text{kcal/(kg°C)}, \quad \dot{Q} = \frac{A[c_c \max(0, T - t_c) + W c_w \max(0, T - t_w)]}{1 - k_l}, \quad \dot{m}_s = \frac{\dot{Q}}{h_{fg}(p_s)}$$

Variables

A	Crushing rate	kg/s
h	Water in cane	-
t_c	Cane temperature	K
W	Imbibition water per unit cane	-
t_w	Imbibition water temperature	K
T	Diffusion temperature	K
p_s	Heating steam pressure (absolute)	Pa
k_l	Heat losses	-
c_c	Specific heat of prepared cane 0.25 + 0.81h	J/(kg·K)
$\dot{Q}$	Heat duty	W
$\dot{m}_s$	Steam	kg/s
$\dot{m}_s/A$	Steam per tonne cane	kg/kg
c_w	Specific heat of water, 1 kcal/(kg·°C)	J/(kg·K)

h_{fg}	Latent heat of the steam at p_s (IAPWS-IF97)	J/kg

Method and standards

Heat balance with Hugot's specific heat of cane.

Assumptions and limits

- Steady state; condensate leaves saturated: indirect heating, only the latent heat counted. With direct steam injection the condensate also cools to T and gives more heat per kg, so less steam is needed. Superheat of the steam is not counted.
- A stream already hotter than T is given zero duty, with a note.

References

• Hugot
• Handbook of Cane Sugar Engineering
• 3rd ed. (Elsevier, 1986)
• ch. 23
• specific heat of prepared cane (p. 397) and steam figures (pp. 373–380)
• Latent heat from IAPWS-IF97

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/diffusion/diffuser-heating-steam

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.