Juice Heater Velocity and Pressure Drop (Hugot)

Juice velocity, head loss and pressure drop through a multi-pass juice heater from flow, tubes per pass, passes, tube length and friction (Hugot 30.20–30.22).

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Juice flow	100.00	m³/h
Tube inside diameter	31.000	mm
Tubes per pass	19.000	
Number of passes	12.000	
Tube length	3.7000	m
Friction factor Hugot: smooth 0.016–0.020; scaled 0.025–0.100; 0.05 at the end of a week.	0.050000	
Juice density	1,050.0	kg/m³

Calculated results

Parameter	Value	Unit
Juice velocity	1.9370	m/s
Head loss	14.044	m
Pressure drop	144.61	kPa

Notes for this case

- The 3D added to each tube length covers the losses in the heads; Hugot's coefficient 0.0025 is λ/(2g) for λ = 0.05.

Formula and method

$$U = \frac{\dot{V}}{z\pi D^2/4}, \quad J = \frac{\lambda U^2}{2g} n \left(\frac{l}{D} + 3\right), \quad \Delta p = \rho_J g J$$

Variables

$\dot{V}$	Juice flow	m³/s
D	Tube inside diameter	m
z	Tubes per pass	-
n	Number of passes	-
l	Tube length	m
λ	Friction factor	-
ρ_J	Juice density	kg/m³
U	Juice velocity	m/s
J	Head loss	m
Δp	Pressure drop	Pa
g	Standard gravity, 9.806 65	m/s²

Method and standards

Darcy loss per pass with Hugot's allowance for the heads.

Assumptions and limits

- Turbulent flow; λ from experience.

References

• Hugot
• Handbook of Cane Sugar Engineering
• 3rd ed. (Elsevier, 1986)
• ch. 30
• eqns 30.20–30.22 and example
• pp. 458–462

Report details

Report reference	FCC-65B5-N6WD (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/clarification/juice-heater-pressure-drop

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.