Juice Heater Tube Velocity and Reynolds Number

Juice velocity and Reynolds number in the tubes of a multi-pass juice heater from the flow, juice density and viscosity, tube bore and tubes per pass.

Method: Continuity v = ṁ/(ρ n π d²/4); Re = ρ v d/μ

Input parameters

Unit system: SI

Parameter	Value	Unit
Juice flow	260.00	t/h
Juice density	1,060.0	kg/m³
Juice viscosity	6.0000e-04	Pa·s
Tube inside diameter	41.000	mm
Tubes per pass	30.000	

Calculated results

Parameter	Value	Unit
Juice velocity in the tubes	1.7202	m/s
Reynolds number	124,602	

Notes for this case

- Juice heaters are usually run at 1.5–2 m/s (Hugot) to limit scaling.

Formula and method

$$v = \frac{\dot{m}_j}{\rho\, n\, \pi d_i^2/4}, \quad Re = \frac{\rho v d_i}{\mu}$$

Variables

$\dot{m}_j$	Juice flow	kg/s
ρ	Juice density	kg/m³
μ	Juice viscosity	Pa·s
d_i	Tube inside diameter	m
n	Tubes per pass	-
v	Juice velocity in the tubes	m/s
Re	Reynolds number	-

Method and standards

Continuity.

Assumptions and limits

- Full tubes.
- A note compares the velocity with the usual 1.5–2 m/s, the same band as the juice heater coefficient and pressure drop calculators.

References

- Continuity v = ṁ/(ρ n π d²/4); Re = ρ v d/μ

Report details

Report reference	FCC-48CW-1EBP (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-tube-velocity

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.