# Juice, Syrup and Molasses Pipe Flow (Hugot)

Velocity, Reynolds number, friction factor (Hugot eqns 45.10–45.13) and head loss of a sugar product in a pipe, with impure-solution viscosity from purity (45.9).

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

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Flow | 5.0000 | L/s |
| Pipe inside diameter | 40.000 | mm |
| Pipe length | 20.000 | m |
| Kinematic viscosity of the pure solution<br>Hugot Table 45.1 (pure sucrose); measure for impure products where possible. | 1.1000e-06 | m²/s |
| Purity | 100.00 | % |
| Density | 1,080.0 | kg/m³ |
| Pipe | Smooth | |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Kinematic viscosity of the product | 1.1000e-06 | m²/s |
| Velocity | 3.9789 | m/s |
| Reynolds number | 144,686 | |
| Friction factor | 0.016424 | |
| Head loss per metre | 0.33143 | |
| Head loss | 6.6287 | m |
| Pressure drop | 70.205 | kPa |

**Notes for this case**

- Hugot's normal velocities (m/s, suction/delivery): water 1–1.25/1.25–2.5; juice 1–1.2/1.2–2; syrup 0.5–1/0.75–1.25; molasses 0.25–0.5/0.5–0.75; massecuite 0.1–0.2/0.15–0.3.

## Formula and method

$$U = \frac{4Q}{\pi D^2}, \quad R = \frac{UD}{\nu}, \quad \lambda = \frac{64}{R}\ (R < 2320), \quad \lambda = \frac{1}{\sqrt[4]{100R}}\ (R < 10^5), \quad \lambda = 0.0032 + \frac{0.221}{R^{0.237}}$$

$$\lambda = 0.01\left(\frac{A}{D}\right)^{0.314}\ (\text{rough pipes},\ R > 10^5), \quad j = \frac{\lambda}{D}\frac{U^2}{2g}$$

$$\nu = \frac{\nu_0}{p}\ (\text{impure solution, Hugot eqn 45.9})$$

### Variables

| | | |
|---|---|---|
| $Q$ | Flow | m³/s |
| $D$ | Pipe inside diameter | m |
| $L$ | Pipe length | m |
| $\nu_0$ | Kinematic viscosity of the pure solution | m²/s |
| $p$ | Purity | - |

| | | |
|---|---|---|
| $\rho$ | Density | kg/m³ |
| $\mathrm{pipe}$ | Pipe | - |
| $\nu$ | Kinematic viscosity of the product | m²/s |
| $U$ | Velocity | m/s |
| $R$ | Reynolds number | - |
| $\lambda$ | Friction factor | - |
| $j$ | Head loss per metre | - |
| $J$ | Head loss | m |
| $\Delta p$ | Pressure drop | Pa |

### Method and standards

Hugot's flow formulae.

### Assumptions and limits

- Newtonian flow; massecuites are not Newtonian.
- Rough pipes: Hugot's rough law (45.13) holds at very high Reynolds numbers ($10^5$–$10^6$, by roughness). Below $10^5$ the page uses the smooth law and shows the rough value in a note; the true value lies between them.
- A is Hugot's roughness coefficient "having the dimension of length" (1.5, 2.5 and 5 m as printed), not a physical roughness height.

### References

- Hugot
- Handbook of Cane Sugar Engineering
- 3rd ed. (Elsevier, 1986)
- ch. 45
- eqns 45.1–45.13 and Table 45.2
- pp. 1115–1123

## Report details

| | |
|---|---|
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| Release checks | 3 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/steam-power/sugar-product-pipe-flow

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.