Jet Condenser Approach and Outlet Water

Approach of a multi-jet condenser by Hugot (eqn 40.47) from air, vacuum and water flow, the outlet water temperature and the water pressure.

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Air to remove Hugot: 10, 15 and 20 kg/h for normal minimum, average and high air.	15.000	kg/h
Barometric pressure	101.33	kPa
Vacuum	66.000	cmHg
Injection water	800.00	m³/h

Calculated results

Parameter	Value	Unit
Approach	7.8000	K
Vapour temperature	51.549	°C
Outlet water temperature	43.748	°C
Water pressure needed (0.1 m per kg/h of air)	1.5000	m

Notes for this case

- Hugot's formula is for multi-jet condensers handling up to about 2 000 m³/h; the approach grows quickly with air and with vacuum.

Formula and method

$$H_{76} = 76 - \frac{p_a - H}{1333.224\ \mathrm{Pa/cmHg}}, \quad App = 0.3(10+R)\frac{79-H_{76}}{76-H_{76}}\cdot\frac{4000-Q_1}{4000}\ \ [^\circ C;\ R\ \mathrm{kg/h};\ H\ \mathrm{cmHg};\ Q_1\ \mathrm{m^3/h}]$$

Variables

R	Air to remove	kg/s
p_a	Barometric pressure	Pa
H	Vacuum	Pa
H_{76}	Equivalent vacuum referred to a 76 cmHg barometer	cmHg
Q_1	Injection water	m³/s
App	Approach	K
t_v	Vapour temperature	K
t_2	Outlet water temperature	K
h_w	Water pressure needed (0.1 m per kg/h of air)	m

Method and standards

Hugot's empirical formula.

Assumptions and limits

- Multi-jet condensers, normal water.
- Hugot's vacuum is referred to a 76 cmHg barometer, so the vacuum you enter (against your barometer) is turned into the absolute pressure and then into the equivalent vacuum H_{76} at 76 cm. At sea level the two are the same.
- In the formula R is in kg/h, H in cmHg and Q_1 in m³/h, although the Variables table gives SI units; the page converts.
- The injection water temperature is not an input, so the outlet temperature t_2 is not checked against it; with high air loads it can come out unrealistically low.

References

• Hugot
• Handbook of Cane Sugar Engineering
• 3rd ed. (Elsevier, 1986)
• ch. 40
• jet condensers
• eqn 40.47 and Table 40.21
• pp. 897–900
• Saturation temperature from IAPWS-IF97

Report details

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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/vacuum-water/jet-condenser-approach

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.