Thermocompressor Entrainment (Truffault)

Entrainment ratio of a steam-jet thermocompressor by Truffault's formula (Hugot eqns 32.18–32.19) from motive, suction and discharge pressures, and the steam saving.

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Motive steam pressure (absolute)	25.000	kg/cm²
Discharge (mixture) pressure (absolute)	2.0300	kg/cm²
Suction (aspirated vapour) pressure (absolute)	1.5000	kg/cm²
Efficiency factor μ/μ₀	0.95000	
Motive steam	5,000.0	kg/h
Number of effects of the evaporator	4.0000	

Calculated results

Parameter	Value	Unit
Saturation temperature at discharge	120.07	°C
Saturation temperature at suction	110.77	°C
Theoretical entrainment	1.9076	
Entrainment ratio	1.8122	
Vapour aspirated	9,061.1	kg/h
Steam saving μq/n	2,265.3	kg/h

Notes for this case

- Hugot: keep the compression to 10 °C or less of saturation temperature and use thermocompression on the first effect or pre-evaporator only.

Formula and method

$$(\mu_0+1)^2=\frac{80}{t_m-t_0}\left[\log\frac{P}{p_m}-0.01(t_0-100)\right],\quad \mu=k\mu_0\ (k\approx 0.95),\quad e=\frac{\mu q}{n}$$

Variables

P	Motive steam pressure (absolute)	Pa
p_m	Discharge (mixture) pressure (absolute)	Pa
p_0	Suction (aspirated vapour) pressure (absolute)	Pa
k	Efficiency factor μ/μ₀	-
q	Motive steam	kg/s
n	Number of effects of the evaporator	-
t_m	Saturation temperature at discharge	K
t_0	Saturation temperature at suction	K
μ_0	Theoretical entrainment	-
μ	Entrainment ratio	-
y	Vapour aspirated	kg/s
e	Steam saving μq/n	kg/s

Method and standards

Truffault's formula as given by Hugot (t in °C).

Assumptions and limits

- Dry saturated motive steam.
- Truffault's formula is empirical; its range of validity is not stated with it here. A compression above Hugot's 10 °C of saturation temperature is flagged.

References

• Hugot
• Handbook of Cane Sugar Engineering
• 3rd ed. (Elsevier, 1986)
• ch. 32
• thermo-compression
• eqns 32.17–32.19 and 32.27–32.30
• pp. 556–565
• Saturation temperatures 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/evaporation/thermocompressor-entrainment

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Reopens the calculator with the inputs of this report.