MVR Evaporator: Compressor Power from Temperature Lift

Pressure ratio and power of a mechanical vapour recompression (MVR) compressor from the vapour flow, its saturation temperature, the lift and the efficiency (IF97).

Method: Isentropic compression of saturated steam with IAPWS-IF97 (saturation pressures, entropy and enthalpy)

Input parameters

Unit system: SI

Parameter	Value	Unit
Vapour compressed	10.000	t/h
Saturation temperature of the vapour	90.000	°C
Saturation temperature lift	10.000	K
Isentropic efficiency	78.000	%

Calculated results

Parameter	Value	Unit
Suction pressure	70.182	kPa
Discharge pressure	101.42	kPa
Pressure ratio	1.4451	
Compressor shaft power	226.99	kW
Energy per tonne of vapour	22.699	kWh/t

Notes for this case

- The lift must cover the boiling-point elevation plus the heat-transfer ΔT; high-solids liquors need more lift.
- Shaft power only: add mechanical, gearbox and motor losses for the electrical demand.

Formula and method

$$p_i = p_{sat}(T_i), \quad w = \frac{h(p_2, s_1) - h_1}{\eta_s}, \quad P = \dot{m}_v w$$

Variables

$\dot{m}_v$	Vapour compressed	kg/s
T_1	Saturation temperature of the vapour	K
ΔT	Saturation temperature lift	K
η_s	Isentropic efficiency	-
p_1	Suction pressure	Pa
p_2	Discharge pressure	Pa
p_2/p_1	Pressure ratio	-
P	Compressor shaft power	W
e	Energy per tonne of vapour	J/kg

Method and standards

IF97 isentropic compression.

Assumptions and limits

- Saturated suction vapour at T_1. Vapour from a boiling liquor is in fact superheated by the boiling-point elevation; the lift entered must include that elevation.
- Shaft power from the isentropic efficiency only; mechanical, gearbox and motor losses are extra.

References

- Isentropic compression of saturated steam with IAPWS-IF97 (saturation pressures, entropy and enthalpy)

Report details

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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/spent-wash-zld/mvr-compressor-power

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.