Minimum Work to Separate an Ideal Mixture

Thermodynamic minimum work to separate a binary ideal mixture into pure products at constant temperature, per mole and for a feed rate (−RT Σ x ln x).

Method: Ideal-solution Gibbs energy of mixing: ΔG_mix = RT Σ x ln x (definition)

Input parameters

Unit system: SI

Parameter	Value	Unit
Mole fraction of component 1	50.000	%
Temperature	25.000	°C
Feed	100.00	kmol/h

Calculated results

Parameter	Value	Unit
Minimum work per mole of feed	1.7183	kJ/mol
Minimum power	47.730	kW

Notes for this case

- Real columns use 10–100 times this work as heat: the minimum shows how much room there is for heat integration.

Formula and method

$$W_{min} = -RT_0 \left[x_1 \ln x_1 + (1 - x_1) \ln(1 - x_1)\right]$$

Variables

x_1	Mole fraction of component 1	-
T_0	Temperature	K
F	Feed	mol/s
W_{min}	Minimum work per mole of feed	J/mol
$\dot{W}_{min}$	Minimum power	W
R	Gas constant 8.314 462 618	J/(mol·K)

Method and standards

Ideal-solution Gibbs energy of mixing.

Assumptions and limits

- Ideal solution; pure products; isothermal.

References

- Ideal-solution Gibbs energy of mixing: ΔG_mix = RT Σ x ln x (definition)

Report details

Report reference	FCC-PXPF-N0N3 (the same inputs always give the same reference)
Generated	17 November 2026, 19:44 UTC
Calculator	Minimum Work to Separate an Ideal Mixture
Method last reviewed	13 November 2026
Software release	FireCAD Calc, release of 17 November 2026
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/chemical/separation/minimum-work-separation

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.