Ethanol–Water Isothermal Flash at 1 atm

Vapour fraction and liquid and vapour strengths when an ethanol–water feed is heated to a temperature between its bubble and dew points near 1 atm (Wilson).

Method: Ethanol–water VLE at about 1 atm: Wilson equation (Perry's Chemical Engineers' Handbook, 9th ed., sec. 4) with energies 399 and 933 cal/mol fitted to FireCAD ethanol–water x–y–T data at 101.325 kPa; ethanol vapour pressure Perry's 9th ed. Table 2-8; water IAPWS-IF97; Checked against Gmehling and Onken; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Feed strength entered as	% vol at 20 °C	
Feed strength	30.000	%
Flash temperature	90.000	°C
Pressure Model fitted at 1 atm; use 0.9–1.2 atm.	101.33	kPa

Calculated results

Parameter	Value	Unit
Feed mole fraction	11.318	%
Liquid mole fraction	5.1689	%
Vapour mole fraction	33.637	%
Vapour fraction (molar)	21.602	%
Liquid strength	15.172	%
Condensed vapour strength	64.318	%

Formula and method

$$T_b(x_1) = T, \quad y_1 = y^*(x_1), \quad \frac{V}{F} = \frac{z_1 - x_1}{y_1 - x_1}$$

Variables

basis	Feed strength entered as	-
s_F	Feed strength	-
T	Flash temperature	K
P	Pressure	Pa
z_1	Feed mole fraction	-
x_1	Liquid mole fraction	-
y_1	Vapour mole fraction	-
V/F	Vapour fraction (molar)	-
q_x	Liquid strength	-
q_y	Condensed vapour strength	-

Method and standards

Equilibrium at the flash temperature with the lever rule.

Assumptions and limits

- Wilson energies fitted at 1 atm; 0.9–1.2 atm only.
- Binary ethanol–water; congeners and dissolved solids ignored.

References

- Ethanol–water VLE at about 1 atm: Wilson equation (Perry's Chemical Engineers' Handbook, 9th ed., sec. 4) with energies 399 and 933 cal/mol fitted to FireCAD ethanol–water x–y–T data at 101.325 kPa; ethanol vapour pressure Perry's 9th ed. Table 2-8; water IAPWS-IF97
- Checked against Gmehling and Onken
- DECHEMA Chemistry Data Series vol. I/1
- as quoted in Perry's 9th ed. sec. 13 (simple batch distillation example)

Report details

Report reference	FCC-8X2E-S2H9 (the same inputs always give the same reference)
Generated	17 November 2026, 19:46 UTC
Calculator	Ethanol–Water Isothermal Flash at 1 atm
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/sugar-ethanol/ethanol-distillation/ethanol-water-flash

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.