Simple Batch (Rayleigh) Distillation, Constant α

Moles left in the still, distillate collected and its average composition when a binary charge is boiled from x_i to x_f, by the Rayleigh equation, constant α.

Method: Perry's Chemical Engineers' Handbook; 9th ed. (McGraw-Hill, 2019); ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Charge	0.10000	kmol
Initial mole fraction (light)	50.000	%
Final mole fraction in the still	20.000	%
Relative volatility	2.5000	

Calculated results

Parameter	Value	Unit
Left in the still	0.024803	kmol
Distillate collected	0.075197	kmol
Average distillate mole fraction	59.895	%
Light component recovered	90.079	%

Formula and method

$$\ln\frac{H_i}{H_f}=\frac{1}{\alpha-1}\left[\ln\frac{x_i}{x_f}+\alpha\ln\frac{1-x_f}{1-x_i}\right],\quad \bar{x}_D=\frac{H_i x_i-H_f x_f}{H_i-H_f}$$

Variables

H_i	Charge	mol
x_i	Initial mole fraction (light)	-
x_f	Final mole fraction in the still	-
α	Relative volatility	-
H_f	Left in the still	mol
D	Distillate collected	mol
$\bar{x}_D$	Average distillate mole fraction	-
η	Light component recovered	-

Method and standards

Rayleigh equation integrated for constant α.

Assumptions and limits

- Constant α; no reflux; one stage.
- The distillate composition and recovery do not depend on the charge size; with a zero charge the amounts are zero.

References

• Perry's Chemical Engineers' Handbook
• 9th ed. (McGraw-Hill, 2019)
• sec. 13 (distillation)
• Eqs. (13-124) to (13-126)

Report details

Report reference	FCC-QQ97-1EGS (the same inputs always give the same reference)
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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/chemical/separation/rayleigh-batch-distillation-alpha

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.