Absorber Theoretical Stages (Kremser Equation)

Number of theoretical stages of a counter-current absorber with a straight equilibrium line (y = mx) from the gas inlet and outlet and liquid inlet, by Kremser.

Method: Kremser (1930) equation for counter-current stages with constant absorption factor A = L/(mG)

Input parameters

Unit system: SI

Parameter	Value	Unit
Solute in the gas entering (mole fraction)	2.0000	%
Solute in the gas leaving	0.10000	%
Solute in the liquid entering	0	%
Equilibrium slope y = mx	1.2000	
Liquid-to-gas molar ratio	1.8000	

Calculated results

Parameter	Value	Unit
Absorption factor L/(mG)	1.5000	
Theoretical stages	4.9139	
Fraction of solute absorbed	95.000	%

Notes for this case

- Dilute systems with straight operating and equilibrium lines; round the stages up and divide by the tray efficiency.

Formula and method

$$N = \frac{\ln\left[\frac{y_{in} - m x_{in}}{y_{out} - m x_{in}}\left(1 - \frac{1}{A}\right) + \frac{1}{A}\right]}{\ln A}, \quad A = \frac{L}{mG}$$

Variables

y_{in}	Solute in the gas entering (mole fraction)	-
y_{out}	Solute in the gas leaving	-
x_{in}	Solute in the liquid entering	-
m	Equilibrium slope y = mx	-
L/G	Liquid-to-gas molar ratio	-
A	Absorption factor L/(mG)	-
N	Theoretical stages	-
ϕ	Fraction of solute absorbed	-

Method and standards

Kremser.

Assumptions and limits

- Dilute, isothermal, straight lines.
- For A within 10^{-6} of 1 the linear A = 1 form is used, which avoids a loss of precision in the general formula.

References

- Kremser (1930) equation for counter-current stages with constant absorption factor A = L/(mG)

Report details

Report reference	FCC-3BDD-PSPF (the same inputs always give the same reference)
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Release checks	3 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/kremser-absorber-stages

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.