Isothermal Flash: Vapour Fraction by Rachford–Rice

Vapour fraction and liquid and vapour compositions of an isothermal flash of up to four components from the feed composition and K-values (Rachford–Rice).

Method: Rachford and Rice (1952) equation Σ z_i(K_i − 1)/(1 + V(K_i − 1)) = 0

Input parameters

Unit system: SI

Parameter	Value	Unit
Component 1: feed mole fraction	30.000	%
Component 1: K-value y/x At the flash temperature and pressure, from a K chart, Raoult (p_sat/p) or a simulator.	3.0000	
Component 2: feed mole fraction	30.000	%
Component 2: K-value y/x At the flash temperature and pressure, from a K chart, Raoult (p_sat/p) or a simulator.	1.2000	
Component 3: feed mole fraction	40.000	%
Component 3: K-value y/x At the flash temperature and pressure, from a K chart, Raoult (p_sat/p) or a simulator.	0.30000	
Component 4: feed mole fraction	0	%
Component 4: K-value y/x At the flash temperature and pressure, from a K chart, Raoult (p_sat/p) or a simulator.	1.0000	

Calculated results

Parameter	Value	Unit
Vapour fraction	40.000	%
Component 1: liquid mole fraction	16.667	%
Component 1: vapour mole fraction	50.000	%
Component 2: liquid mole fraction	27.778	%
Component 2: vapour mole fraction	33.333	%
Component 3: liquid mole fraction	55.556	%
Component 3: vapour mole fraction	16.667	%
Component 4: liquid mole fraction	0	%
Component 4: vapour mole fraction	0	%

Formula and method

$$\sum_i \frac{z_i(K_i-1)}{1+\frac{V}{F}(K_i-1)} = 0, \quad x_i = \frac{z_i}{1+\frac{V}{F}(K_i-1)}, \quad y_i = K_i x_i$$

Variables

z_1	Component 1: feed mole fraction	-
K_1	Component 1: K-value y/x	-
z_2	Component 2: feed mole fraction	-
K_2	Component 2: K-value y/x	-
z_3	Component 3: feed mole fraction	-

K_3	Component 3: K-value y/x	-
z_4	Component 4: feed mole fraction	-
K_4	Component 4: K-value y/x	-
V/F	Vapour fraction	-
x_1	Component 1: liquid mole fraction	-
y_1	Component 1: vapour mole fraction	-
x_2	Component 2: liquid mole fraction	-
y_2	Component 2: vapour mole fraction	-
x_3	Component 3: liquid mole fraction	-
y_3	Component 3: vapour mole fraction	-
x_4	Component 4: liquid mole fraction	-
y_4	Component 4: vapour mole fraction	-

Method and standards

Rachford–Rice.

Assumptions and limits

- Constant K at the flash conditions.
- For an all-liquid or all-vapour result the other phase's fractions are incipient values (K z or z/K), not normalised; they do not add to 1.

References

- Rachford and Rice (1952) equation Σ z_i(K_i − 1)/(1 + V(K_i − 1)) = 0

Report details

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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/rachford-rice-flash

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Reopens the calculator with the inputs of this report.