Van Winkle Plate Efficiency Correlation (Murphree EMV)

Murphree vapour efficiency of a sieve or bubble-cap tray from surface tension, liquid properties, vapour velocity, weir height and free area by Van Winkle.

Input parameters

Unit system: SI

Parameter	Value	Unit
Liquid surface tension	15.000	mN/m
Liquid viscosity	0.20000	mPa·s
Liquid density	600.00	kg/m³
Vapour density	15.000	kg/m³
Liquid diffusivity of the light key	6.0000e-09	m²/s
Superficial vapour velocity	1.0000	m/s
Weir height	50.000	mm
Fractional free area (hole area / column area)	10.000	%

Calculated results

Parameter	Value	Unit
Surface tension number	75.000	
Liquid Schmidt number	55.556	
Reynolds number	37,500	
Murphree vapour efficiency	81.229	%

Notes for this case

• Van Winkle et al. (1972) fitted binary-system data for sieve and bubble-cap trays; it gives point-to-tray efficiencies of the right order for preliminary design. Values above 1 can occur with long flow paths.

Formula and method

$$E_{mV} = 0.07\, Dg^{0.14}\, Sc_L^{0.25}\, Re^{0.08}$$

$$Dg = \frac{\sigma_L}{\mu_L u_v}, \quad Sc_L = \frac{\mu_L}{\rho_L D_{LK}}, \quad Re = \frac{h_w u_v \rho_v}{\mu_L (FA)}$$

Variables

σ_L	Liquid surface tension	N/m
μ_L	Liquid viscosity	Pa·s
ρ_L	Liquid density	kg/m³
ρ_v	Vapour density	kg/m³
D_{LK}	Liquid diffusivity of the light key	m²/s
u_v	Superficial vapour velocity	m/s
h_w	Weir height	m
FA	Fractional free area (hole area / column area)	-
Dg	Surface tension number	-
Sc_L	Liquid Schmidt number	-
Re	Reynolds number	-
E_{mV}	Murphree vapour efficiency	-

Method and standards

Van Winkle's dimensionless efficiency correlation.

Assumptions and limits

- Binary systems within the correlation's data range.

Report details

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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/van-winkle-plate-efficiency

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Reopens the calculator with the inputs of this report.