Evaporation Rate from an Open Tank or Pool

Evaporation rate from an open liquid surface from a mass transfer coefficient, the surface area and the vapour pressure difference (water from IF97 or any liquid).

Method: Film mass transfer N = k_c (C_s − C_∞); C = pM/(RT); water vapour pressure from IAPWS-IF97

Input parameters

Unit system: SI

Parameter	Value	Unit
Liquid	Water (vapour pressure from IAPWS-IF97)	
Liquid surface temperature	50.000	°C
Mass transfer coefficient From a correlation for the air speed over the surface; your figure.	0.005000	m/s
Surface area	20.000	m²
Air relative humidity (water)	60.000	%
Air temperature (water)	30.000	°C
Vapour pressure at the surface (other liquid)	10.000	kPa
Partial pressure in the air (other liquid)	0	kPa
Molar mass (other liquid)	58.080	kg/kmol

Calculated results

Parameter	Value	Unit
Vapour pressure at the surface	12.351	kPa
Partial pressure in the air	2.5480	kPa
Evaporation flux	3.2302e-04	kg/(m²·s)
Evaporation rate	23.258	kg/h

Notes for this case

- Dilute mass transfer (no correction for high vapour pressure); the coefficient sets the accuracy.

Formula and method

$$N = k_c \frac{M}{R}\left(\frac{p_s}{T_s} - \frac{p_\infty}{T_a}\right), \quad \dot{m} = NA$$

Variables

liquid	Liquid	-
T_s	Liquid surface temperature	K
k_c	Mass transfer coefficient	m/s
A	Surface area	m²
φ	Air relative humidity (water)	-
T_a	Air temperature (water)	K
p_v	Vapour pressure at the surface (other liquid)	Pa
p_∞	Partial pressure in the air (other liquid)	Pa
M	Molar mass (other liquid)	kg/kmol
p_s	Vapour pressure at the surface	Pa
N	Evaporation flux	kg/(m²·s)

$\dot{m}$	Evaporation rate	kg/s

Method and standards

Film theory.

Assumptions and limits

- Dilute vapour, steady state.
- For water the air-side concentration is taken at the air temperature; for another liquid the air temperature is not an input and the surface temperature is used for both.
- The mass transfer coefficient is your figure; the result is only as good as it is.

References

- Film mass transfer N = k_c (C_s − C_∞)
- C = pM/(RT); water vapour pressure from IAPWS-IF97

Report details

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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/evaporation-open-tank

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Reopens the calculator with the inputs of this report.