Diluting a Concentrated Acid or Alkali (Mass Balance)

Volumes of concentrated acid or alkali and water to make a dilute solution, by mass balance with the densities of both solutions, since volumes do not add.

Method: Solute mass balance $w_1 m_1 = w_2 m_2$ with solution densities

Input parameters

Unit system: SI

Parameter	Value	Unit
Strength of the concentrated solution (mass fraction)	98.000	%
Density of the concentrated solution From the maker's or a handbook density table.	1,836.0	kg/m³
Strength wanted (mass fraction)	10.000	%
Density of the dilute solution	1,066.0	kg/m³
Volume of dilute solution wanted	1,000.0	L
Water density	998.00	kg/m³

Calculated results

Parameter	Value	Unit
Mass of concentrated solution	108.78	kg
Volume of concentrated solution	59.246	L
Mass of water	957.22	kg
Volume of water	959.14	L

Notes for this case

- Add the concentrated acid or alkali to the water slowly, with stirring and cooling; never water to the concentrate.

Formula and method

$$m_2 = \rho_2 V_2, \quad m_1 = \frac{w_2}{w_1} m_2, \quad m_w = m_2 - m_1$$

Variables

w_1	Strength of the concentrated solution (mass fraction)	-
ρ_1	Density of the concentrated solution	kg/m³
w_2	Strength wanted (mass fraction)	-
ρ_2	Density of the dilute solution	kg/m³
V_2	Volume of dilute solution wanted	m³
ρ_w	Water density	kg/m³
m_1	Mass of concentrated solution	kg
V_1	Volume of concentrated solution	m³
m_w	Mass of water	kg
V_w	Volume of water	m³

Method and standards

Mass balance.

Assumptions and limits

- Densities at the same temperature.

References

- Solute mass balance $w_1 m_1 = w_2 m_2$ with solution densities

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/solutions/acid-dilution-densities

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.