Neutralising Amine Dose for Condensate

Neutralising amine (morpholine, cyclohexylamine, ammonia) feed to neutralise the CO_2 in steam and keep a free amine residual, from steam flow and CO_2 content.

Method: Neutralisation stoichiometry (amine + CO2 + H2O → amine bicarbonate, 1:1); IUPAC 2013 atomic weights

Input parameters

Unit system: SI

Parameter	Value	Unit
Steam flow	10,000	kg/h
CO_2 in the steam	10.000	ppm
Amine	Morpholine	
Free amine residual to keep in the steam	5.0000	ppm
Amine content of the product	40.000	%

Calculated results

Parameter	Value	Unit
Dose in the steam (active)	24.796	ppm
Active amine feed	0.24796	kg/h
Product feed	0.61991	kg/h
Amine to neutralise 1 kg CO_2 (to bicarbonate)	1.9796	kg/kg

Notes for this case

- The amine splits between steam and condensate by its distribution ratio: a far end of the system may need a higher dose than this average.

Formula and method

$$r = \frac{M_{amine}}{M_{CO_2}} \qquad D = CO_2\, r + R \qquad \dot{m}_a = \dot{m}_s\, D \qquad \dot{m}_p = \frac{\dot{m}_a}{w}$$

Variables

$\dot{m}_s$	steam flow	kg/s
CO_2	CO_2 in steam, mass fraction	–
amine	morpholine, cyclohexylamine or ammonia	–
R	free amine residual	–
w	amine content of the product	–
D	dose in the steam	–
$\dot{m}_a$	active amine feed	kg/s
$\dot{m}_p$	product feed	kg/s
r	amine per kg CO_2	kg/kg
M	molar masses from IUPAC atomic weights	kg/kmol

Method and standards

One mole of amine neutralises one mole of CO_2 as bicarbonate; molar masses of morpholine (C_4H_9NO), cyclohexylamine ($C_6H_{13}N$) and ammonia from IUPAC 2013 atomic weights.

Assumptions and limits

- CO_2 given as measured in the steam; bicarbonate neutralisation; distribution between phases not modelled.
- Neutralising to bicarbonate is the minimum. Reaching a target condensate pH (often 8.5–9.2) usually needs more amine than the stoichiometric amount; the free residual you enter is where that margin goes.

References

- Neutralisation stoichiometry (amine + CO2 + H2O → amine bicarbonate, 1:1)
- IUPAC 2013 atomic weights

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/boilers-power-plant/water-treatment/amine-dose

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.