# Hydrated Lime for $SO_2$ and HCl Capture

Hydrated lime for dry or semi-dry acid gas removal from $SO_2$ and HCl loads, removal wanted, stoichiometric ratio and lime purity (1 $Ca(OH)_2$ per $SO_2$, ½ per HCl).

**Method:** Stoichiometry $Ca(OH)_2 + SO_2 \rightarrow CaSO_3 + H_2O$; $Ca(OH)_2 + 2\ HCl \rightarrow CaCl_2 + 2\ H_2O$

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Flue gas flow (dry, normal) | 100,000 | $Nm^3/h$ |
| $SO_2$ at the inlet (dry, at the actual $O_2$, not corrected) | 800.00 | $mg/Nm^3$ |
| HCl at the inlet (dry, at the actual $O_2$, not corrected) | 150.00 | $mg/Nm^3$ |
| $SO_2$ removal | 70.000 | % |
| HCl removal | 90.000 | % |
| Stoichiometric ratio (on the acid gas removed)<br>Moles of $Ca(OH)_2$ fed per stoichiometric mole for the $SO_2$ and HCl removed. Some suppliers quote it on the inlet acid gas instead: convert before entering. | 2.0000 | |
| $Ca(OH)_2$ content of the lime | 92.000 | % |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Stoichiometric $Ca(OH)_2$ | 78.490 | kg/h |
| Commercial hydrated lime | 170.63 | kg/h |

**Notes for this case**

- Dry lime utilisation is low; spray-dryer (semi-dry) systems humidify the gas and need less excess.

## Formula and method

$$\dot{m}_{st} = \left(\eta_{SO_2}\dot{n}_{SO_2} + \frac{1}{2}\eta_{HCl}\dot{n}_{HCl}\right) M_{Ca(OH)_2}, \quad \dot{m} = \frac{SR\,\dot{m}_{st}}{p}$$

### Variables

| | | |
|---|---|---|
| $\dot{V}_n$ | Flue gas flow (dry, normal) | $Nm^3/s$ |
| $c_{SO_2}$ | $SO_2$ at the inlet (dry, actual $O_2$) | $kg/m^3$ |
| $c_{HCl}$ | HCl at the inlet (dry, actual $O_2$) | $kg/m^3$ |
| $\eta_{SO_2}$ | $SO_2$ removal | - |
| $\eta_{HCl}$ | HCl removal | - |
| $SR$ | Stoichiometric ratio on the acid gas removed | - |
| $p$ | $Ca(OH)_2$ content of the lime | - |
| $\dot{m}_{st}$ | Stoichiometric $Ca(OH)_2$ | kg/s |
| $\dot{m}$ | Commercial hydrated lime | kg/s |

### Method and standards

Stoichiometry: 1 mol $Ca(OH)_2$ per mol $SO_2$ and ½ mol per mol HCl removed, with molar masses from IUPAC atomic masses. The stoichiometric ratio multiplies the lime for the acid gas removed, not for the inlet acid gas; supplier figures on the inlet basis must be converted.

### Assumptions and limits

- Dry, normal basis. The concentrations are at the actual $O_2$ of the gas, matching the actual dry flow; values corrected to a reference $O_2$ must be converted back first.

### References

- Stoichiometry $Ca(OH)_2 + SO_2 \rightarrow CaSO_3 + H_2O$; $Ca(OH)_2 + 2\ HCl \rightarrow CaCl_2 + 2\ H_2O$

## Report details

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|---|---|
| Report reference | FCC-2XTF-W2PY (the same inputs always give the same reference) |
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| Calculator | Hydrated Lime for $SO_2$ and HCl Capture |
| Method last reviewed | 13 November 2026 |
| Software release | FireCAD Calc, release of 17 November 2026 |
| 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/boilers-power-plant/emissions-stacks/hydrated-lime-acid-gas

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.