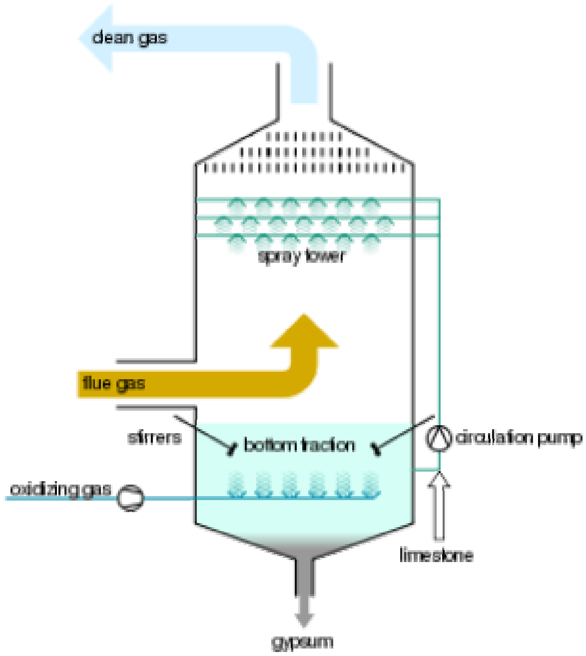
Scrubbing with a basic solid or solution



Schematic design of the absorber of an FGD

SO_2 is an acid gas and thus the typical sorbent slurries or other materials used to remove the SO_2 from the flue gases are alkaline. The reaction taking place in wet scrubbing using a $CaCO_3$ (limestone) slurry produces $CaSO_3$ (calcium sulfite) and can be expressed as:

$$\mathbf{CaCO_3\ (solid) + SO_2\ (gas) \rightarrow CaSO_3\ (solid) + CO_2\ (gas)}$$

When wet scrubbing with a $Ca(OH)_2$ (lime) slurry, the reaction also produces $CaSO_3$ (calcium sulfite) and can be expressed as:

$$\mathbf{Ca(OH)_2\ (solid) + SO_2\ (gas) \rightarrow CaSO_3\ (solid) + H_2O\ (liquid)}$$

When wet scrubbing with a $Mg(OH)_2$ (magnesium hydroxide) slurry, the reaction produces $MgSO_3$ (magnesium sulfite) and can be expressed as:

$$\mathbf{Mg(OH)_2\ (solid) + SO_2\ (gas) \rightarrow MgSO_3\ (solid) + H_2O\ (liquid)}$$

To partially offset the cost of the FGD installation, in some designs, the $CaSO_3$ (calcium sulfite) is further oxidized to produce marketable $CaSO_4 \cdot 2H_2O$ (gypsum). This technique is also known as **forced oxidation**:

$$\mathbf{CaSO_3\ (solid) + H_2O\ (liquid) + \tfrac{1}{2}O_2\ (gas) \rightarrow CaSO_4\ (solid) + H_2O}$$

A natural alkaline usable to absorb SO_2 is seawater. The SO_2 is absorbed in the water, and when oxygen is added reacts to form sulfate ions SO_4- and free H^+. The surplus of H^+ is offset by the carbonates in seawater pushing the carbonate equilibrium to release CO_2 gas:

$$\mathbf{SO_2\ (gas) + H_2O + \tfrac{1}{2}O_2\ (gas) \rightarrow SO_4^{2-}\ (solid) + 2H^+}$$
$$\mathbf{HCO_3^- + H^+ \rightarrow H_2O + CO_2\ (gas)}$$