

Process Design Technical Note

TECHNICAL NOTE SULPHUR TRIOXIDE SCRUBBING

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1.0 Sulphur Trioxide scrubbing

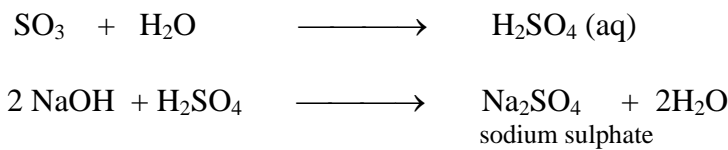
Atomic weight	80.06
Melting point	16.8 °C γ -form
Boiling point	44.8 °C

1.1 Reactions of SO₃

Sulphur trioxide dissolves in water to give sulphuric acid.

In commercial production of sulphuric acid SO₃ is dissolved in concentrated sulphuric acid to give oleum which is then diluted.

Scrubbing sulphur trioxide with caustic soda can be represented chemically as follows:-



1.1.2 Scrubbing

The method selected to scrub SO₃ depends on the quantities involved.

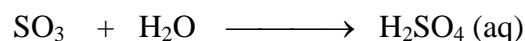
For large volumes scrubbing with concentrated sulphuric acid is preferable. However, the materials handling problems associated with circulating concentrated H₂SO₄ are obvious and best avoided.

For small and trace amounts of SO₃ the choice is between scrubbing with water or alkali.

If there is a use for dilute sulphuric acid, then water can be used.

1.1.3 Heat of Solution

Heats of formation, ΔH_f @25°C	SO ₃ (g)	-94.77	kcal/mole
	H ₂ SO ₄ (aq)	-212.03	
	H ₂ O (l)	-68.32	



$$\begin{aligned} \text{Heat of solution} &= -(-94.77 + (-68.32)) + (-212.03) \\ &= 163.09 - 212.03 \\ &= \underline{-48.94 \text{ kcal}} \end{aligned}$$

i.e. **49 kcal/mole sulphur trioxide** exotherm

1.1 Reactions of SO₃(Cont.)

1.1.4 Solubilities

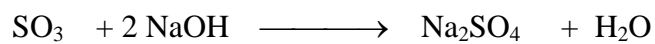
	Solubility in water				
	g/l				
	10°C	20°C	30°C	40°C	50°C
(NH ₄) ₂ SO ₄	730	754	780	810	840
K ₂ SO ₄	92	111	130	148	165
Na ₂ SO ₄				488	467

NaOH is the preferred scrubbing medium with appropriate scrubber liquor changes before blockages can occur due to crystallisation. Ammonia liquor as a scrubbing medium has its own handling problems, but can be used if available.

1.2 Heat of Reaction

1.2.1 NaOH

Heats of formation, ΔH _f @25°C	SO ₃ (g)	-94.77	kcal/mole
	NaOH (aq)	-112.19	
	Na ₂ SO ₄ (aq)	-330.82	
	H ₂ O (l)	-68.32	



$$\begin{aligned} \text{Heat of reaction} &= -(-94.77 + (2 \times -112.19)) + (-330.82 + (-68.32)) \\ &= 319.15 - 399.14 \\ &= \underline{-79.99 \text{ kcal}} \end{aligned}$$

i.e. **80 kcal/mole sulphur trioxide** exotherm