**Topic 12 Sulfur**

**Syllabus**

* The sources of sulfur
* The use of sulfur in the manufacture of sulfuric acid by the contact process.
* The reactions and the conditions used in the contact process
* The properties of dilute sulfuric acid as a typical acid
* The uses of sulfur dioxide as a bleach in the manufacture of wood pulp for paper and as a food preservative (by killing bacteria)

**Sources of sulfur**

Sulfur is found as the element in large underground deposits around the world including in Mexici and the USA. It is also found around volcanos. Sulfur is also found in compounds, it is present in fossil fuels and some metal ores.

**Making sulphuric acid –the contact process**

One of the main uses of sulfur is in the manufacture of sulphuric acid

 **Stages** **Conditions Equation**

Sulfur

H2O(l) + H2S2O7(l) →2H2SO4(aq)

Mix carefully with water

SO3(g) +H2SO4(l) →H2S2O7(l)

Dissolve in concentrated sulfuric acid

2SO2(g) +O2(g) ⇌2SO3(g)

S(s) +O2(g)→SO2(g)

Burn in air

Concentrated sulphuric acid

Sulfur dioxide

Oleum

Sulfur trioxide

Sulfuric acid is a typical acid:

Mixed with more air and passed over vanadium (V) oxide catalyst at 450oC.

**Why the conditions for the equilibrium step?**

**Temperature**

2SO2(g) +O2(g) ⇌2SO3(g)

Forward reaction is exothermic so is favoured by low temperatures.The temperature used is 450oC as below 400oC catalyst doesn’t work and reaction would be too slow

**Pressure**

2SO2(g) +O2(g) ⇌2SO3(g)

3 molecules of gas 2 molecules of gas

High pressure would favour the forward reaction as less gas molecules would reduce the pressure. However the yield is good at atmospheric pressure so high pressure is not needed

**Catalyst**

Vanadium (V) oxide is used. This does not affect the equilibrium position as it effects the forward and reverse reactions equally however it means that equilibrium is reached more quickly.

**Sulfuric acid is a typical acid**

1. Acid + reactive metal → sulfate salt + hydrogen
2. Acid +Base → sulfate salt +water
3. Acid + carbonate → sulfate salt + carbon dioxide +water

**Sulfur dioxide**

An acid gas formed when sulfur is burned in air. It is also formed for the burning of fossil fuels and it is a cause of acid rain

In the manufacture of sulfuric acid

**Uses**

Food preservative in Jams and dried fruit because it stops the growth of bacteria and mold

Treatment of wood pulp in paper making because it acts as a bleach.