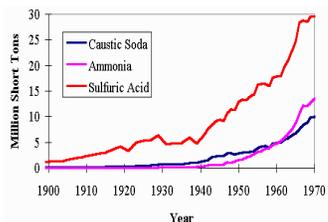# C3.4.12 Why is sulphuric acid so important?

By the end of this lesson you should:

- Describe the uses of sulphuric acid to show its economic importance in producing fertlisers and paints
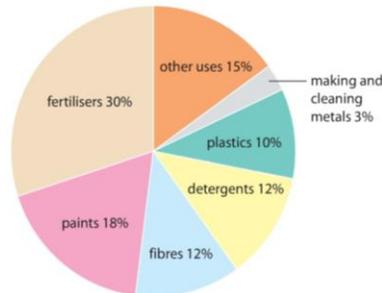
Sulphuric acid

Sulphuric acid, H_2SO_4 is probably the most important chemical produced in the world today - about **170 000 000 tonnes** is produced each year. It is so important because it is the **starting material** for so many other chemicals that each has an important use.

Fertilisers

The manufacture of **fertilisers** uses up 30% of the sulphuric acid produced each year. It is used in two main ways:

- to make **superphosphate fertilisers** from **rock phosphate** (an impure form of **calcium phosphate** – scientists first used coprolites* instead of phosphate rock)
  *fossil that results when human or animal dung is fossilized)

- to make **ammonium sulphate** (a **nitrogen** containing fertiliser)

Plants take in minerals through their **roots** but the plant can only absorb **soluble** compounds. Rock phosphate contains phosphorus in the form of **insoluble calcium phosphate** and so plants cannot utilise it. By reacting the rock with sulphuric acid, the soluble compound **calcium hydrogenphosphate** is produced. This can be absorbed by plants.

$$Ca_3(PO_4)_2 + H_2SO_4 \quad Ca(HPO_4)_2 + CaSO_4$$

Ammonia, NH_3, is an important **nitrogen**-containing compound that occurs naturally and is absorbed by plant roots. However, it is not a convenient substance to handle (since it is a **gas**) and so when it needs to be applied in large quantities it is firstly converted to a **solid** called **ammonium sulphate, $(NH_4)_2SO_4$**

Paints

The main pigment used in **white paints** is called **titanium dioxide TiO_2** It is extracted from an ore called **ilmenite** but this ore contains **iron** compounds as well, **$FeTiO_3$**.
The stages in obtaining the titanium dioxide are:
Ilmenite is reacted with sulphuric acid to produce **iron sulphate**, **$FeSO_4$** and **titanyl sulphate**, **$TiOSO_4$**.
The two compounds are separated
The **titanyl sulphate** is **heated** to a high temperature with **steam** to make titanium dioxide.

Questions

1. List the four main uses of sulphuric acid.
2. Look back at the figure for the amount of sodium hydroxide produced yearly in the world. How many tonnes of sulphuric acid are produced per tonne of sodium hydroxide?
3. Labels on fertilisers often show their NPK ratio. What do the letters stand for?
4. Copy and complete the following word equations:
(a) Calcium phosphate + _____ → _____ + _____
(b) ammonia + sulphuric acid → _____
5. Explain why rock phosphate would not make a good fertiliser.
6. What is the formula of titanium dioxide?
7. What would be the problem with the pigment if there were impurities of iron in the titanium dioxide?
8.Summarise the properties of sulphuric acid by turning the information in the pie-chart into a table or chart, and annotating your bar chart with examples from this page or other sources.

Homework

1. Sulphuric acid is produced in very _____ amounts because it has so many uses. _____ of the sulphuric acid that is produced goes to make _____, such as _____ sulphate and _____ hydrogen phosphate, also known as _____.
Sulphuric acid is also used in the manufacture of white paint, to allow the white pigment _____ dioxide to be separated from impurities of _____ which would discolour the paint.

ammonium   calcium   fertilisers   iron   large   most   superphosphate   titanium

2. Write a formula equation for the reaction in which titanyl sulphate is converted to titanium dioxide.

3. If we do not use chemical fertilisers, how do plants get the nutrients that they need? Give some examples of alternatives that can be used.

4. Some people claim that food grown without chemical fertilisers is healthier for you. Why is it very difficult to test this sort of statement scientifically?

5. The symbol equation for the reaction of sulphuric acid with ilmenite is:
$FeTiO_3 + H_2SO_4 \rightarrow TiOSO_4 + FeSO_4 + H_2O$
Is this equation balanced? Explain your answer. If you think it is not balanced, write out a correctly balanced form of the equation.