AQA C10b Using Resources
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Corrosion

Corrosion is the destruction of materials by chemical reactions.
Rusting is an example of corrosion. Iron rusts. For rusting, you need iron, oxygen and water – you must have all three.
We can prevent corrosion by applying a coating that acts as a barrier, such as greasing or painting. We can also use sacrificial protection (with a more reactive metal, for example galvanising iron with zinc).
Aluminium is quite reactive, but forms an unreactive oxide layer which prevents further corrosion.

Alloys

Alloy	Description
bronze	Alloy of copper and tin
brass	Alloy of copper and zinc
steel	Alloy of iron and other elements. High carbon steel is strong but brittle. Low carbon steel is softer. Stainless steel contains chromium and nickel. It resists corrosion.
aluminium alloys	Low density, and stronger than pure aluminium
gold alloys	Alloys of gold with silver, copper and zinc. The proportion of gold is measured in carats. 24 carat gold is 100% gold. 18 carat gold is 75% gold. 12 carat gold is 50% gold.

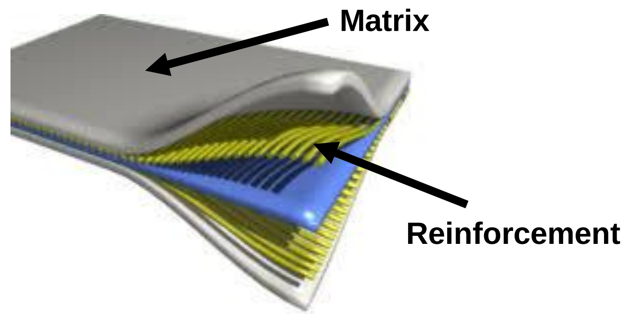
Glass and Ceramics

Clay ceramics are made by shaping wet clay and then heating in a furnace.

Most glass is soda-lime glass. This is made from sand, sodium carbonate and limestone.

Borosilicate glass is made by heating sand with boron trioxide.

Borosilicate glass has a much higher melting point than soda-lime glass

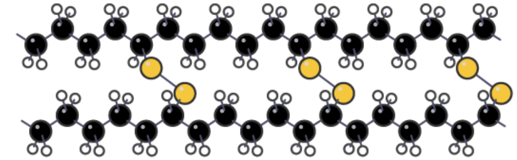


Composite Materials

Composites are made of two materials. They are combined to produce a material with better properties.

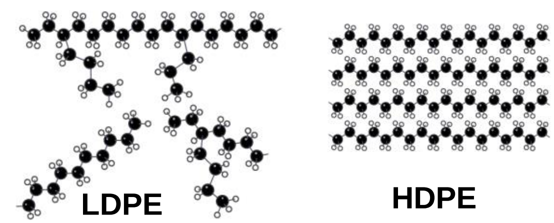
The matrix or binder is made of one material, which surrounds and binds together fibres or fragments of a second material, called the reinforcement.

For example, reinforced concrete is made of steel reinforcement in a concrete matrix, and chipboard is made of wood chips in a resin (glue) matrix.



Polymers and Melting

Some polymers are thermosetting (they do not melt when heated) and some are thermosoftening (they melt when heated).
Thermosetting polymers form **crosslinks** between polymer chains, like in the picture above. These strong bonds prevent the plastic melting.
Thermosoftening polymers are only kept solid by weak intermolecular forces.



Polyethene (LDPE/HDPE)

Polymers have different properties depending on how they are made.

Low density polyethene (LDPE) has a random structure with branching chains. That makes it flexible and useful for carrier bags.

High density polyethene (HDPE) has an ordered structure with lined up straight chains. It is stronger and is useful for pipes and plastic bottles.

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The Haber Process

Ammonia is an important industrial product used to make fertilisers, explosives and dyes. It is manufactured using the Haber process. This involves a reversible reaction between nitrogen and hydrogen:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The reaction can reach a dynamic equilibrium.
We get nitrogen from the air. We get hydrogen from reacting natural gas.
The reaction is carried out using:

- 200 atmospheres of pressure
- 450℃ temperature
- An iron catalyst

The produced ammonia is liquefied and cooled, and the unreacted nitrogen and hydrogen and recycled.

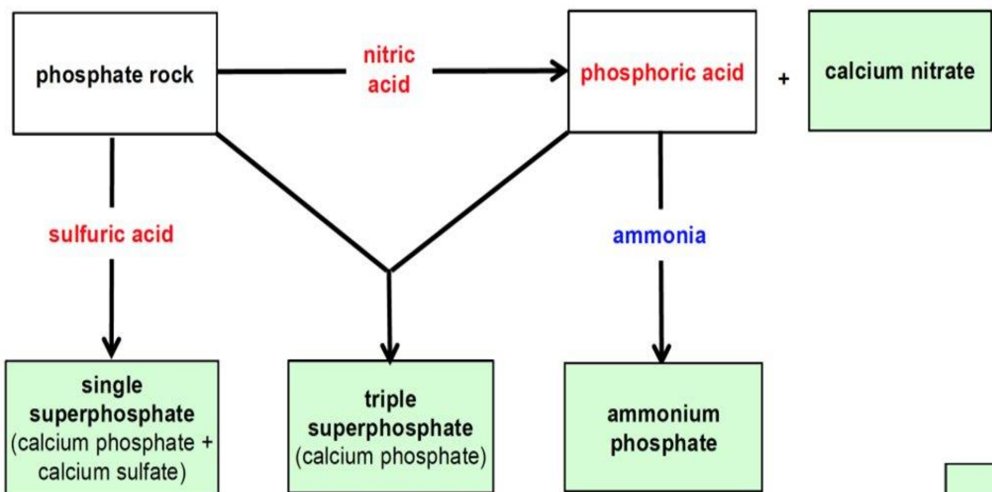
Reaction Conditions *(First, revise the ideas from C8 on rates/equilibria)*

The conditions used in the Haber process are a compromise between <u>rate,</u>, <u>yield</u> and <u>cost</u>.

<u>Pressure</u> Increasing the pressure will cause the equilibrium position to move to the side with the fewest moles of gas, to reduce the pressure.
In the Haber process, if pressure is increased, the equilibrium position moves to the right, so the yield of ammonia increases.
The rate of reaction also increases because the gas molecules are closer together, so successful collisions are more frequent.
However, the energy costs increase when higher pressures are used and the equipment becomes more expensive. Therefore, the choice of pressure is a compromise between yield and cost.

<u>Temperature</u> When the temperature is increased, the position of equilibrium moves in the endothermic direction to reduce the temperature.
In the Haber process, the forwards reaction is exothermic, so the reverse reaction is endothermic.
This means that as the temperature is increased, the position of equilibrium moves to the left, and the yield of ammonia decreases.
Low temperatures maximise the yield of ammonia but reduce the rate of reaction. The temperature chosen is a compromise between yield and rate.

<u>Catalyst</u> A catalyst speeds up the rate of the forward and reverse reactions equally. This increases the rate and has no effect on the yield. It also reduces costs as a catalyst lowers activation energy.



Fertilisers

NPK fertilisers contain compounds of nitrogen (N), phosphorus (P) and potassium (K).
NPK fertilisers are formulations.