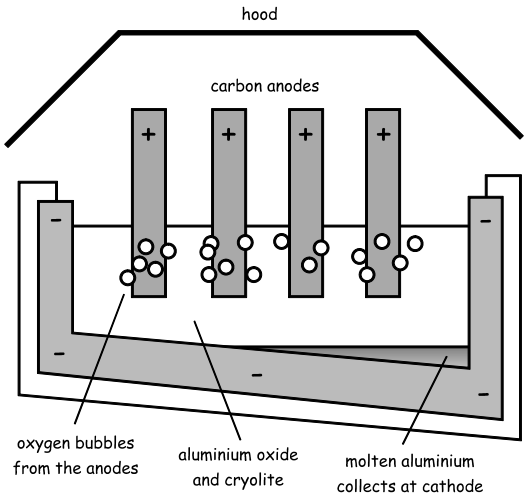
Lesson 7: Siting an aluminium smelter

Using Electrolysis to extract Aluminium

Higher Level

Aluminium ore (bauxite) contains aluminium oxide (containing Al^{3+} and O^{2-} ions). Aluminium is very reactive (it bonds tightly to oxygen), so carbon isn't reactive enough to take the oxygen away from the oxide. Instead we melt the aluminium oxide and then electrolyse it.

Aluminium oxide melts at a high temperature, so we add a substance called “cryolite” which lowers the melting point and saves energy.



The sides and the bottom of a steel tank are lined with carbon. The carbon lining is connected to an electricity supply to make the cathode. The anodes are also made of carbon. They are lowered into the molten mixture of aluminium oxide and cryolite.

Aluminium ions are positive, so they are attracted to the negative cathode where they gain electrons and are discharged. Molten aluminium collects at the bottom of the tank.

$$Al^{3+} + 3e^- \rightarrow Al$$

Oxygen is formed at the carbon anodes as the oxygen atoms lose electrons and pair up to form oxygen gas. The temperature is so high that they react with the anodes to make carbon dioxide.

$$2O^{2-} \rightarrow O_2 + 4e^-$$

$$C + O_2 \rightarrow CO_2$$

Corrosion of the anode is so great that it has to be replaced frequently. This, along with the huge demand for electricity, adds to the cost of the process.