

Metal Ores

Haematite Iron (Fe₂O₃)

Bauxite Aluminium

What are metal ores?

Naturally occurring compounds containing high percentages of specific metals. Desirable metals are extracted from ore.

Methods of Metal Extraction

Depending on a metal's reactivity, different methods of extraction are used.

If the metal is **less reactive than carbon**, then a reduction reaction (involving carbon) is used. This works because the carbon forms compounds more readily, so it 'steals' the oxygen (similar to **displacement** reactions). An example of this is iron, which is extracted using a blast furnace.

If the metal is **more reactive than carbon**, electrolysis must be used, as the metal's compounds are very stable. An example of this is aluminium extraction.

Aluminium Extraction

- Bauxite** is purified to produce pure aluminium oxide (Al₂O₃).
- The aluminium oxide is dissolved in **cryolite** (another aluminium ore). This introduces impurities, reducing the melting temperature of the mixture to 900°C.
- The aluminium oxide is melted.
- When a current is passed through it, the positive Al³⁺ ions are attracted to the **cathode** (negative electrode), where they gain electrons. This is **reduction**.
- The negative O²⁻ electrons are attracted to the **anode** (positive electrode), where they lose electrons and form oxygen or carbon dioxide. This is **oxidation**.

Half equations:



- Electrolysis is possible because the molten aluminium oxide contains free electrons, allowing it to conduct electricity.
- The electrodes are made of graphite because it is a good conductor.
- The anode must be replaced regularly because it wears down through reactions with oxygen.

Iron Extraction

Reducing iron ore to iron:

- Hot air is added to the blast furnace, as this makes the coke burn faster and elevates the temperature to around 1500°C.
- The coke burns and produces carbon dioxide.
 $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
- The carbon dioxide reacts with any unburnt coke.
 $\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$
- The carbon monoxide reduces the iron ore to iron.
 $3\text{CO} + \text{Fe}_2\text{O}_3 \rightarrow 3\text{CO}_2 + 2\text{Fe}$

Purifying the resulting iron:

The main impurity is silicon dioxide (sand).

- Limestone is thermally decomposed into calcium oxide.
 $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$
- Calcium oxide reacts with silicon dioxide to form slag.
 $\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$

- Coke is almost pure carbon.
- Slag is used in road building and fertilisers.