

Electrolytes

These are solutions or molten (melted substances) which conduct electricity. It is the electrolyte which is decomposed (broken-up) into its constituent elements.

All electrolytes are ionic substances that have been dissolved in water or heated up to melt them.

Examples include Copper sulphate solution, sodium chloride solution, molten lead bromide, dilute sulphuric acid and potassium iodide

Non-electrolytes are covalent substances, e.g. pure water, sugar solution, alcohol, petrol.

Electrolysis

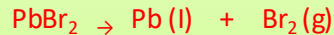
This is when an electric current passes through an electrolyte.

Electrons enter the solution through the negative electrode (cathode), cause a chemical change and leave by the positive electrode (anode).

Molten electrolytes are split into their elements by electrolysis.

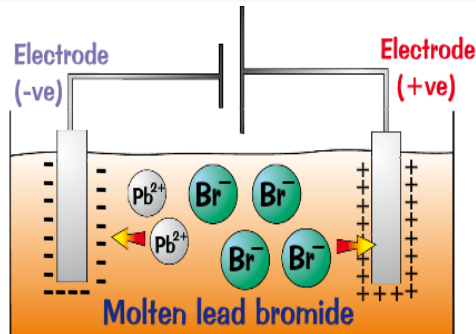
The metal is produced at the cathode (-), while the non-metal is produced at the anode (+)

e.g. Lead Bromide (molten) = Lead (at the cathode) + Bromine (at the anode)



+ve ions are attracted to the **-ve electrode**. Here they **gain electrons** (reduction).

Lead is produced at the **-ve electrode**.



-ve ions are attracted to the **+ve electrode**. Here they **lose electrons** (oxidation).

Bromine is produced at the **+ve electrode**.

Electrolysis foundation

With aqueous electrolytes, the electrolyte is also split up. If the metal is more reactive than hydrogen, then hydrogen from the water is produced at the cathode instead place of the metal.

e.g. Copper chloride (aq) = Copper (at the cathode) + Chlorine (at the anode)

e.g. Sodium chloride (aq) = Hydrogen (at the cathode) + Chlorine (at the anode)

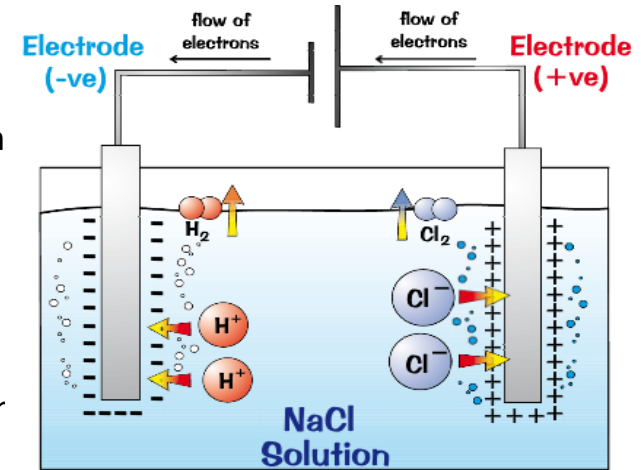
Because positive ions go to the cathode, they are called **Cations**

Because negative ions go to the anode, they are called **Anions**

Change at the electrodes

During electrolysis ion move towards the electrodes.

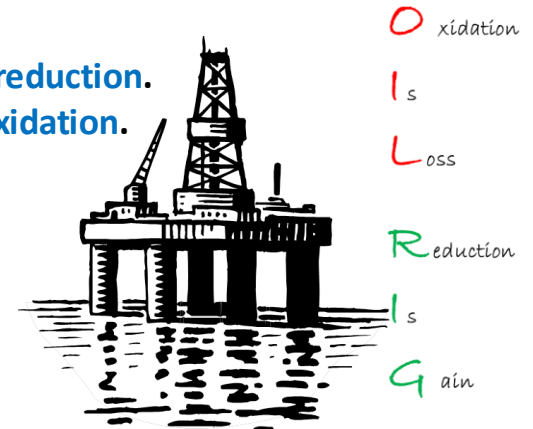
When an ion reaches the electrode they either lose or gain an electron depending or their charge.



Negatively charged ions *lose* electrons to become neutral atoms
Positively charged ions form neutral atoms via *gaining* electrons.

Gaining electrons is called **reduction**.

Losing electrons is called **oxidation**.



Electrolysis of Sodium Chloride Solution

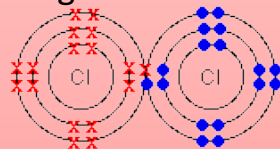
The main ions present in sodium chloride solution are Na^+ and Cl^- , but there are also a few H^+ and OH^- ion present because water is very slightly ionised.

The Na^+ ions and H^+ ions are attracted to the negative cathode. Here the H^+ ions pick up electrons, since hydrogen is less reactive than sodium.

The hydrogen ions gain electrons (**reduction**) to form hydrogen atoms, which then pair up to form hydrogen molecules.



The Cl^- ions are attracted to the positive anode. Here they lose electrons (**oxidisation**) to form chlorine atoms. These atoms pair up to form chlorine molecules. Chlorine gas is given off at the anode.



The products are hydrogen and chlorine, but Na^+ and OH^- ions are left in solution to make sodium hydroxide (NaOH)

Electrodes

Graphite is commonly used as the material for electrodes as it conducts electricity and doesn't take part in the reactions.

Extraction of Aluminium

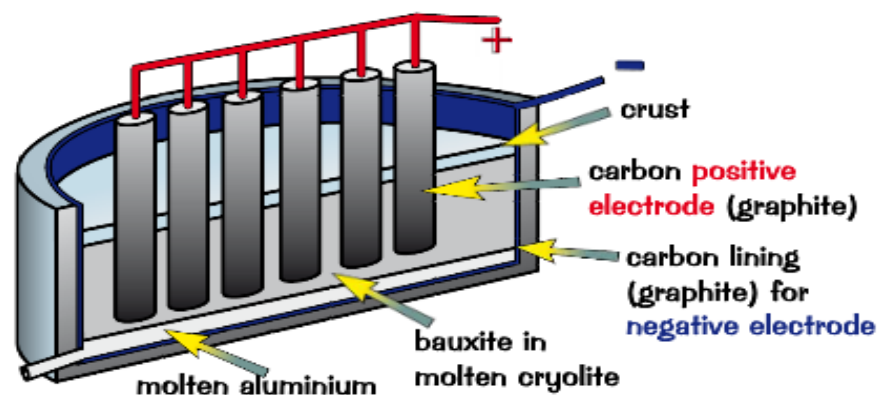
Aluminium is manufactured by the electrolysis of a molten mixture of **aluminium oxide** and **cryolite**.

Cryolite is used to **lower the melting point** of aluminium oxide

Graphite electrodes are used

Aluminium forms at the negative electrode and oxygen at the positive electrode.

The positive electrode is made of carbon, which reacts with the oxygen to produce carbon dioxide. For this reason the anode must be continually replaced as it loses mass.



Keywords

Electrode, a conductor used to establish electrical contact with a circuit. The electrode attached to the negative terminal of a battery is called a negative electrode, or cathode. The electrode attached to the positive terminal of a battery is the positive electrode, or anode.

Electrolysis, the decomposition (break-down) of a compound using an electric current.

Electrolyte, a substance which, when molten or in solution, will conduct an electric current.

Ion, electrically charged particle, formed when an atom or molecule gains or loses electrons.

Ionic compound, an ionic compound occurs when a negative ion (an atom that has gained an electron) joins with a positive ion (an atom that has lost an electron).

Molten, a term used to describe a liquid substance (eg rock, glass or metal) formed by heating a solid.

Oxidation, the gain of oxygen, or loss of electrons, by a substance during a chemical reaction.

Reduction, the loss of oxygen, or gain of electrons, by a substance during a chemical reaction.

Questions

- Ions are free to move when they are?
- Where do ions move to when a current is applied?
- At which electrode is the metal produced?
- What material is used to make the electrodes?
- When is hydrogen produced at the cathode?
- At the cathode what happens to positively charged ions?
- At the anode what happens to negatively charged ions?