Applications of electrolysis

Electrolysis is used commercially to extract reactive metals, such as sodium and aluminium, from their ores.

Electroplating and corrosion protection uses the principle of electrolysis.

Pure metals can be obtained using the process of electorefining.

**Extraction of sodium using the Down’s cell.**

(Please refer to your text for the cell diagram)

In this process, molten sodium chloride and calcium chloride are used. The purpose of calcium chloride is to lower the temperature to prevent sodium chloride from boiling.

At the cathode: \( \text{Na}^+ \) ions are discharged. \( \text{Na}^+(l) + e \rightarrow \text{Na}(l) \)

At the anode: Chlorine is liberated.

\( 2\text{Cl}^-(l) \rightarrow \text{Cl}_2(g) + 2e \)

*NOTE: Steel hood is used to keep the sodium and chlorine apart and to prevent them from reacting.*

**Anodising**

Anodising is a process of producing corrosion-resistant articles by coating. The anode in this cell is an aluminium object and the electrolyte solution is one which can liberate oxygen at the anode, such as dilute sulphuric acid.

At the anode: \( \text{OH}^- \) ions are discharged.

\( 4\text{OH}^-(aq) \rightarrow 2\text{H}_2\text{O}(l) + \text{O}_2(g) + 4e \)

The oxygen liberated at the anode reacts with the aluminium object to form a protective oxide coating of aluminium oxide (\( \text{Al}_2\text{O}_3 \)), which is resistant to corrosion.

**Electroplating**

This is the process of coating an object with a thin layer of another metal by electrolysis. This can be used to prevent corrosion and to make the object more attractive. In this process, the object to be coated is the cathode and the metal to be used for coating (plating) is the anode. For example, to add a nickel plate to an object, a nickel sulphate solution could be used as the electrolyte.

At the cathode: The object or metal to be coated (plated) acts as the cathode. For example, in nickel plating, nickel ions are discharged and deposits on the cathode or object, thereby coating it.

\( \text{Ni}^{2+}(aq) + 2e \rightarrow \text{Ni} (s) \)

At the anode: If the object is to be nickel plated, then the anode must be made of nickel. The nickel will, therefore, dissolve to form nickel ions.
Ni (s) cathode $\rightarrow$ Ni$^{2+}$ (aq) + 2e

*Note: If the object is to be chrome plated or silver plated, then a chromium or silver electrolyte solution is used and the anode is made of chromium or silver.*

**Purification of copper**

The purity of copper can be improved by electrorefining. In this case, the same principle of electroplating or electrodeposition is used.

The electrolyte is a solution containing copper ions, such as copper sulphate. The cathode is a strip of pure copper and the anode is a lump of the impure copper.

At the anode: Copper atoms from the impure copper dissolve to form copper ions. This causes the anode to decrease in size.

\[
\text{Cu(s)} \rightarrow \text{Cu}^{2+} (\text{aq}) + 2e
\]

Impurities fall off the anode and are collected in the cell.

At the cathode: Cu$^{2+}$ ions migrate towards the cathode where they are deposited on the cathode as solid copper.

\[
\text{Cu}^{2+} (\text{aq}) + 2e \rightarrow \text{Cu(s)}
\]

The cathode becomes thicker (increases in size).