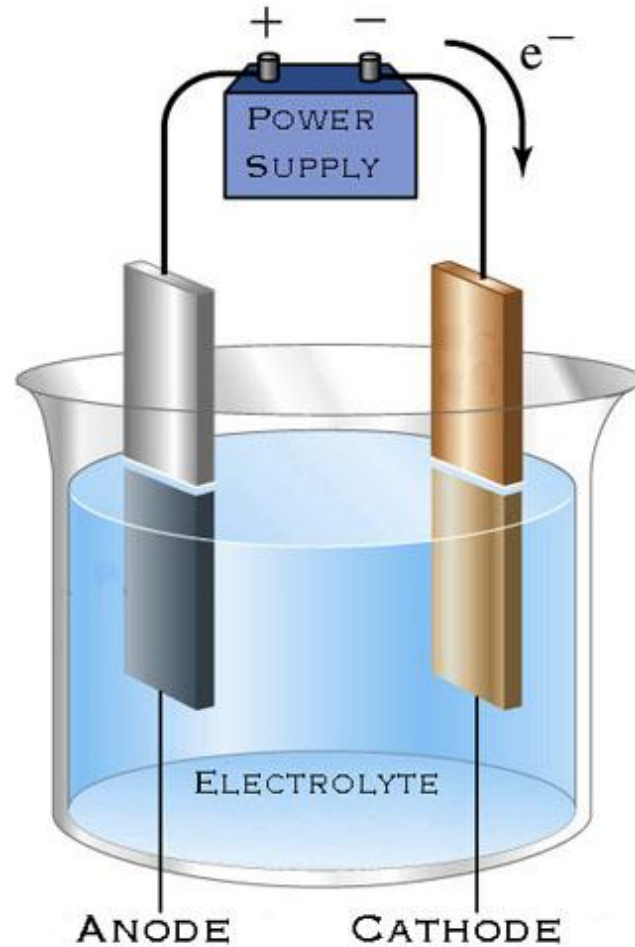


Caustic Soda

Learning Objectives:

- Describe the process of the electrolysis of brine
- Describe the uses of sodium hydroxide

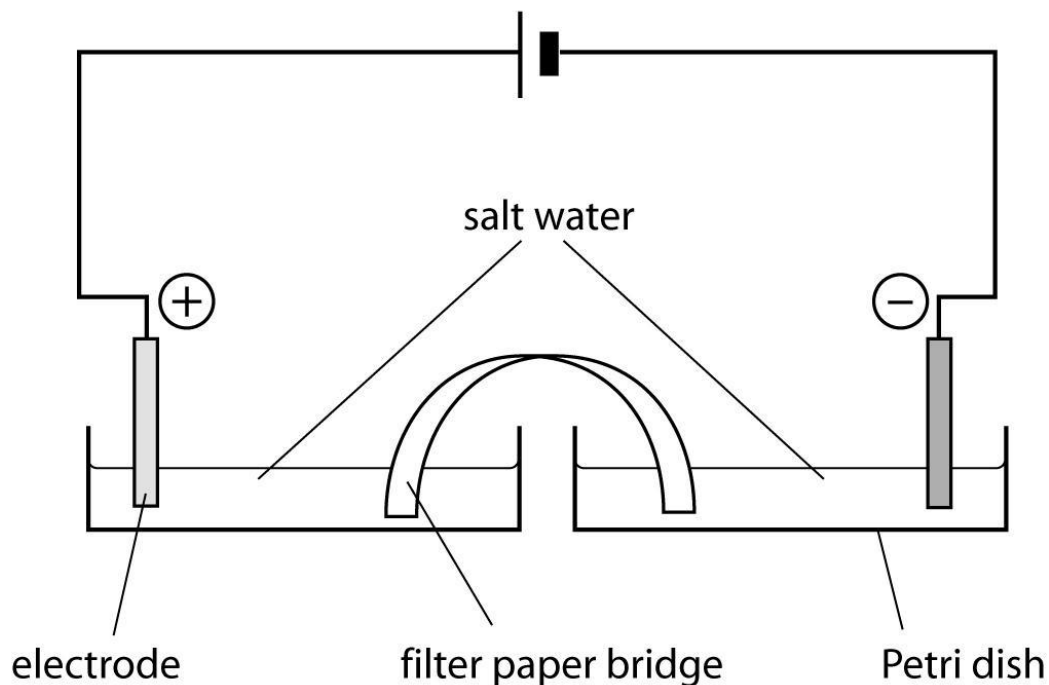
Draw the practical set up you would need for electrolysis



INDUSTRIAL USES OF ELECTROLYSIS

1. To **extract reactive metals** such as ALUMINIUM, sodium, magnesium etc from their compounds. This is EXPENSIVE due to the large amounts of electrical energy needed. Aluminium is extracted from bauxite (Al_2O_3).
2. **Electrolysis of BRINE** (salt solution) to produce
CHLORINE (for disinfectants and plastics) see below
HYDROGEN (for ammonia fertilisers, margarine)
SODIUM HYDROXIDE (for soap and cleaning agents)
3. **Purifying copper**. The copper for wiring etc needs to be more pure than that produced in a blast furnace. see below
Electrolysis is used to convert impure copper to pure copper

Electrolysis of Brine Practical



Chlorine gas will be produced in this experiment. Use a fume cupboard or a well-ventilated laboratory.

Keep the power pack on the lowest setting and turn the power off as soon as you have made your observations.

Questions

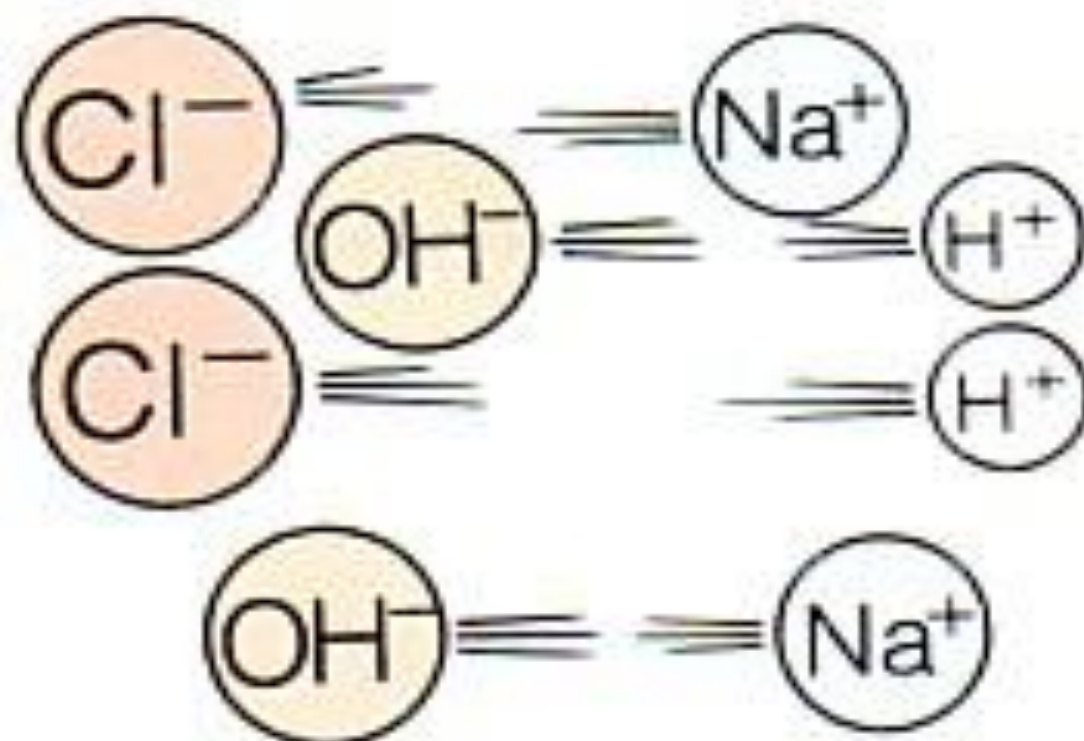
- 1 What did the universal indicator show you about the *type* of substance formed in:
a the anode dish **b** the cathode dish?
- 2 Chlorine gas is given off at the anode. How can you tell?
- 3 Suggest the name of an acid that might be formed in the anode dish.
- 4 Chlorine is an important ingredient in bleach. What observation can you make that shows the bleaching property of chlorine?
- 5 Why would the experiment not have worked without the filter paper between the two dishes?
- 6 What would be the problem with connecting the two dishes up with a piece of metal wire?
- 7 Give the formulae of the two ions found in sodium chloride.
- 8 Which of these ions will be attracted to: **a** the anode **b** the cathode?

Electrolysis of brine

- The NaCl will split into Na^+ ions and Cl^- ions.
- Water splits into H^+ ions and OH^- (hydroxide) ions.
- So what do we think will happen during electrolysis?
- Remember – Na is VERY reactive, it is much more likely to exist as an ion than hydrogen.

anode

cathode



Now let's see what actually
happens

Electrolysis of brine

- The H^+ and Cl^- ions are discharged at the electrodes.

Electrolysis of brine

- **Hydrogen** comes off at the cathode (-)
- $2\text{H}^+_{(\text{aq})} + 2\text{e}^- \longrightarrow \text{H}_{2(\text{g})}$
- Hydrogen is oxidised or reduced?

Electrolysis of brine

- Chlorine comes off at the anode (+)
- $2\text{Cl}_{(\text{aq})} - 2\text{e}^- \longrightarrow \text{Cl}_{2(\text{g})}$
- Chlorine is oxidised or reduced?

Electrolysis of brine

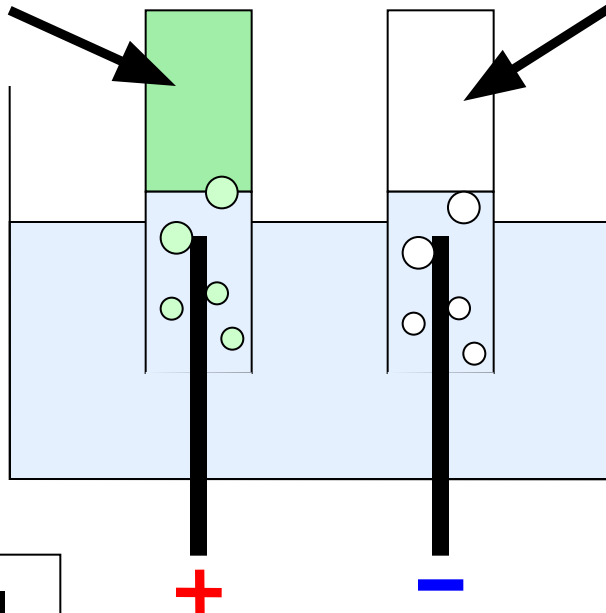
- The Na^+ and OH^- ions stay in solution.
- They join together to form **sodium hydroxide**.
- This is a very important alkali

INDUSTRIAL ELECTROLYSIS OF BRINE

Chlorine gas

Hydrogen gas

BRINE
(NaCl solution)



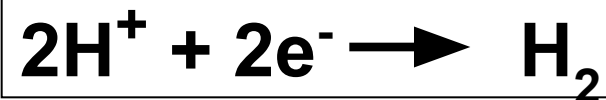
ANODE

OH^- and Cl^-



CATHODE

H^+ and Na^+



*OH^- left in solution
so concentration
grows*

Start: Sodium
chloride solution
(neutral)
End: sodium
hydroxide solution
(alkaline)

*Na^+ left in solution
so concentration
grows*



Industrial chlorine production from electrolysis of brine

Hydrogen



- Used to make margarine (helps to make the oils in the margarine spread on your bread)
- Used as a fuel (already important in space rockets, but may be the fuel of cars after the oil age)



Sodium hydroxide

- Detergents and soap
- Paper



Sodium hydroxide



- Purifying bauxite to extract aluminium
- Rayon and acetate fibres



Chlorine

- Bleach



- Killing bacteria in water



Chlorine



- Solvents (used in dry cleaning)



- Hydrochloric acid (HCl)

Summary

1. What are the 3 products?
2. What they used for?
3. Why do the dishes need to kept separate?