

### ELECTRIC CURRENT

Electric current is an energy that exists due to flow of electrons.

- Symbol 'I'
- Defined as the flow of electric charges.
- Electricity has– heating, magnetic, chemical effects
- Electrical energy can be converted into other forms of energy, like, thermal energy, magnetic energy and chemical energy.
- The particles that carry the charges are the negatively charged particles called electrons.

### ELECTRIC TESTER

- How do we know if a substance is a conductor or an insulator?
- For this purpose we use a device called a tester.
- If the bulb glows, it shows the flow of Current
- If the bulb does not glow, it does not show flow of Current

### CONDUCTION

- Flow of current through a substance.

<b>TYPES</b>	
<b>Conductors</b>	<b>Insulators</b>
Substances, which allow electric current to pass through them.	Substances, which do not allow current to pass through them.
For Ex. Metals, Alloys, Graphite(even though it's a non metal)	E.g. Glass, Plastic, All non-metals except for Graphite are insulators

### Conductivity In Liquids

- Liquids also conduct electricity like solids.

<b>Conducting Liquids</b>	<b>Non-Conducting Liquids</b>
Also called electrolytes	Non- electrolytes
Allows 'I' ( i.e. current ) to pass through them	Does not allow I to pass through them
Ex. All salt solutions, mineral water, acids, bases.	Ex. Distilled water, glucose, kerosene, petrol.

## What Chemical changes are observed when current flows through a conducting material ?

What happens when electricity is passed through a conduction material/ solution?

- There could be glowing of a bulb, buzzer etc.
- Change in the colour of the solution displaying that some new chemicals have been formed.
- Deposits on something
- Formation of bubbles indicating that some gases have been released

So how does conductivity of a liquid help?

It aids certain chemical reactions and hence chemical changes to take place.

Let's take the example of water.

Distilled water does not conduct electricity. But to make it conducting, we add salt, acid or a base to it. After this the water starts conducting electricity through it. That is, it becomes an electrolyte

### ELECTROLYTE

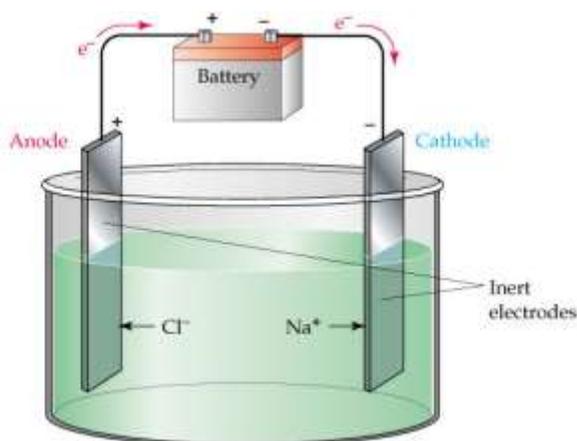
An electrolyte is a substance that produces an electrically conducting solution when dissolved in water. The dissolved electrolyte separates the positive and negative ions, which are called cations and anions respectively.

### CHEMICAL EFFECTS OF CURRENT (I) – ELECTROLYSIS

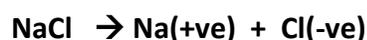
- **Electrolysis** is a process by which electric current is passed through a substance to effect a chemical change. The chemical change is one in which the substance loses or gains an electron (oxidation or reduction). The process is carried out in an electrolytic cell (*q.v.*), an apparatus consisting of positive and negative electrodes held apart and dipped into a solution containing positively and negatively charged ions.

### Electrolysis when Salt( NaCl) is dissolved in Water

When current is passed through a conducting (electrolyte), the following changes are observed:



- The solution in the beaker is conduction ( Salt Solution – Electrolyte )
- **Electrolyte** - A liquid that allows current to pass through it. It dissociates (breaks) itself.
- Chemical changes take place in the beaker
- **Electrolysis** - the occurrence of a chemical change in electrolyte, when current is passed through it.
- **An electrode**- is a small piece of metal or other substance that is used to take an electric current to or from a source of power, a piece of equipment, or a living body.
- **Anode** - Electrode connected to +ve terminal of a battery.
- **Cathode** – Electrode connected to the –ve terminal of a battery.
- **So , Electrode = Anode (+ve) + Cathode (-ve)**
- When current passes through the electrolyte NaCl, it breaks into +ve and
- –ve ions.



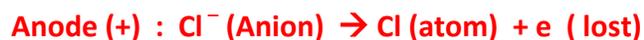
So,

**Na is positive—its called a cation---its electron deficient**

**Cl is negative—its called a anion---its electron rich**

**So, the Anion (-ve ion) will travel to the Anode (+)**

**Here it loses electrons and becomes a neutral atom**



**So, Cation (+ve ion ) will travel to the Cathode (-)**

**Here it gains electrons (e), and becomes a neutral atom.**



- **Electrolytic cell** - The whole arrangement of electrodes, electrolyte, and vessel containing them.

## Applications of Electrolysis –

### a. Electroplating

**b. Electro refining** – Purification of metals obtained from the Earth’s Crust.

**Electrorefining** refers to the process of using electrolysis to increase the purity of a metal extracted from its ore (compound or mixture of compounds from which a metal can be extracted commercially). The anode, positive electrode, is the impure metal to be purified.

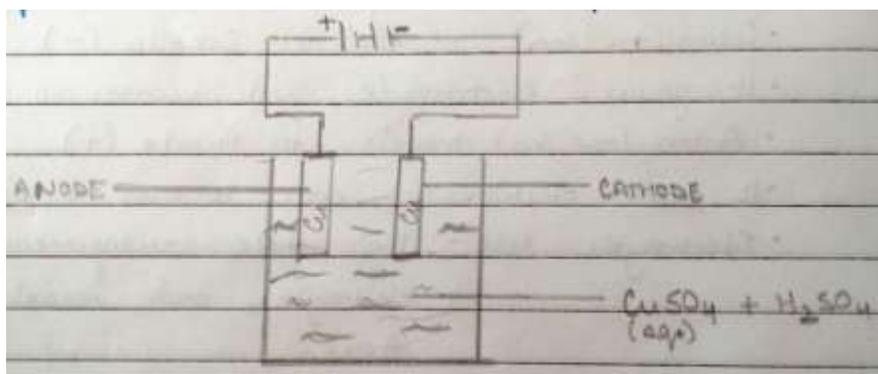
**c. Electrometallurgy** - Is a branch of metallurgy that deals with the application of electric current either for electrolytic deposition or as a source of heat. It is used in the primary attraction of metals from their ores or in refining of metals to make them pure.

## ELECTROPLATING

- A process of depositing a thin layer of metal over another metal, by passing current.
- It is a chemical change
- It is an application of electrolysis.

### Activity:-

- Take Copper Sulphate solution [ $\text{CuSO}_4$  (liquid form)] in a beaker.
- This is a good electrolyte as it will allow the current to flow through it.
- Add a few drops of dilute  $\text{H}_2\text{SO}_4$ . (Reason: Makes electrolyte a better conductor)
- Take 2 Cu plates as the 2 electrodes or else one copper plate and another iron plate.
- If you wish to coat copper on say, iron, then connect the iron plate to the Cathode (i.e. to the negative terminal and make it the cathode).
- So whichever thing on which you want the coating to be done should be made the cathode always.
- Connect the electrodes with a battery using connecting wires
- Dip the electrodes in the  $\text{CuSO}_4$  beaker.



### Observation:-

- A reddish – brown coating of Cu gets deposited on the cathode.
- The anode gets thinner and the cathode gets thicker.

### Reason:-

- On passing of current, the Electrolyte  $\text{CuSO}_4$  breaks into ions.
- It gets broken into  $\text{Cu}^{2+}$  and  $\text{SO}_4^{2-}$  ions.
- The  $\text{Cu}^{2+}$  ions are called Cations and the  $\text{SO}_4^{2-}$  ions are called Anions.
- On passing of the current, the cathode side will gain more electrons.
- Copper ( $\text{Cu}^{2+}$ ) Cations get attracted to the Cathode (-) so that they can gain electrons and get deposited on the cathode.
- Now when these copper ions move to the -ve electrode, then Copper is also getting lost from the Copper Sulphate Solution.

- Since the solution now has only negative Sulphate ions, it will seek to gain 2 positive charges from the Copper Rod.
- So the Copper from the Anode will release its positive ions into the sulphate solution to make it  $\text{CuSO}_4$ , a neutral solution.
- It will release its 2 electrons into the wires which will travel through the wire and make the cathode more and more electron rich.
- So the positive Copper ions from the positive electrode (Anode) will start moving towards the solution in the beaker so that it can join and become a neutral solution.
- Hence the Cu from the solution first gets attracted to the cathode and then the Cu from the anode joins with the  $\text{SO}_4$  ions to form  $\text{CuSO}_4$  again. The Cu in this further goes and gets deposited at the cathode.
- Hence the Anode becomes thinner and thin while the cathode gets thicker and thicker.

### ELECTROPLATING OF DIFFERENT METALS

- The 2 electrodes should be made of different metals.
- Cathode(-) = electrode on which the coating is to be done.
- Anode(+) = electrode whose metal has to be deposited
- Electrolyte = Solution of the metal to be coated, hence, a solution of the anode metal.

e.g. electroplating of Zn over Cu

Zn (Anode)

Cu (Cathode)

Parent metal (Base Metal)

Electrolyte = Zn metal ( salt solution) ( $\text{ZnSO}_4$  /  $\text{ZnCl}_2$  /  $\text{ZnCO}_3$ )

### Reasons for Electroplating

- **Protection** - The parent metal is protected by depositing another metal on top of it.
- **Producing an attractive finish.**  
e.g. – Silver articles are electroplated with gold.  
-- Chromium deposits on iron.

## Applications

- 1. Galvanization** - Coating of Zn on Iron. Iron/Fe bridges and automobiles are protected from corrosion. Iron Bridges are strong but are prone to rusting. Zinc coating protects the iron from getting corroded.
- 2. Silver** – plating for attractive appearance. EPNS → Electroplated Nickel Silver
- 3. Cr (Chromium) plating** – Expensive, shiny, corrosion free, scratch resistant. Hence, Cr coating is done on bathtubs, bath taps, car bumpers, bicycle handlebars, towels rails, etc. These are all Cr plated.
- 4. Ag and Au plating** - Cutlery and Jewelry.
- 5. Sn plating** - Fe ions are coated with Zn, to prevent direct contact between the food and the iron (Fe). Tin cans are thus galvanized. Zn is less reactive than Fe. Thus food is prevented from coming in contact with Fe and getting spoilt. Tin cans are made of galvanized Fe, and are safe for food storage.

