14 Chemical Effects Of Electric Current

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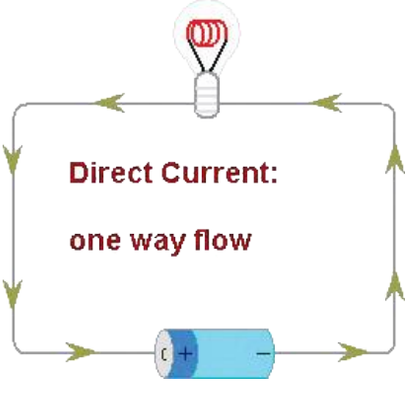
INTRODUCTION

Electricity is very useful in our daily life. Electricity is used to operate fans, different type of machines, trains etc. Two electrodes negative and positive are required for flowing electric current. The continuous flow of electric charges is called electric current. The rate of flowing of charge per second is called intensity or strength of current.

$$\text{Intensity of Electric current} = \frac{\text{Quantity of charge flowing in the conductor}}{\text{Time taken (in second) for flowing}}$$

Flowing charge in electrons, which flows from negative electrode towards positive electrode. But by convention the direction of electric current is assumed from positive electrode (anode) to negative electrode (cathode). Dry cell (torch cell) is used to operate torch, transistor, calculator, remotes etc. Electricity is used to operate mixture, heater, refrigerator, fan, cooler, T.V etc. Electric current is of two types :

1. **Direct Current :** It is a current which flows in one direction only. It is obtained from cell and battery. Direct current is used to operate torch, calculators etc.
2. **Alternating Current :** The current which repeat its direction and magnitude after a certain time period i.e. periodically. The frequency of alternating current is 50 Hz. Its source is alternating current generator. The electric current obtained in houses and factories or industries is alternating current.



Source of Electric Current

There are two main sources of electric current : (i) cell, (ii) generator.

An electric cell is a device which converts chemical energy into electric energy. Cells are of two types :

(i) Primary cell, **(ii)** Secondary cells or accumulator.

Dry cell is used for a continuous flow of electric charge. It is "use and throw" pattern cell. Each cell has two terminals : positive (+) and negative (–). These terminals are connected to each other by a wire. The charge flows in the wire from positive (+) terminal to negative (–) terminal whereas the current in the cell flows from negative (–) to positive (+) terminal. These cells are non-renewable sources of electric energy.

Here we shall describe two primary cells.

1. **Voltaic Cell :** First of all this cell was invented by Alexandro Volta in the year 1796, so it is called voltaic cell. In this cell electrodes are the strips of copper and zinc dipped in dilute sulphuric acid. Sulphuric acid acts as electrolyte. When the two electrodes are connected with a metal (copper) wire and a bulb is installed between the electrodes. The current flows and bulb glows. The negative charge begins to flow from zinc plate to copper plate. This whole process takes place for a few minutes only. Since hydrogen gas is produced due to chemical reaction taking place in the cell. The hydrogen gas reaches the copper and gets deposited there in the form of layer. This layer creates obstacle in the reaction and the reaction stops.

2. **Dry cell :** This cell was invented by a French engineer **George Lechlanche** in 1866. So it is called Lechlanche cell also. A dry cell consists of a cylindrical zinc container, which acts as the negative terminal. The paste of ammonium chloride acts as electrolyte. A carbon rod with a metal cap (usually of brass) is fixed in the centre of the paste. This rod acts as positive terminal. The space between carbon rod and electrolyte is filled with a mixture of magnese dioxide (MNO_2) carbon (coke), graphite. The top of the cell is sealed by a layer of pitch to prevent leakage of cell contents. Mangnese dioxide reacts with the hydrogen, which is produced in cell and thus prevents the accumulation of hydrogen on zinc container.

Secondary cells Accumulators

A cell in which the chemical changes can be reversed by passing an electric current, through it is called a secondary cell. This cell can be recharged and hence can be used again. Because we can put or store electric energy, which can be taken out as and when required to use so these cells are called storage cell or accumulators also.

While we use these cells, the chemical energy is converted into electrical energy and which is charged then electrical energy is converted into chemical energy.

These are of two types :

(a) Lead acid accumulator, **(b)** Nickel -Cadmium base accumulator.

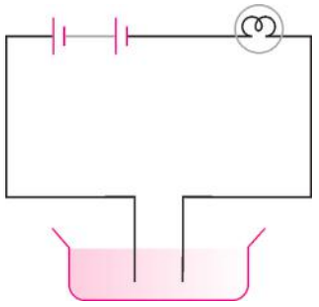
Lead acid accumulator : It is the most commonly used storage cell. It consists of two plates of lead, dipped in dilute Sulphuric acid. The plates act as electrodes and the dil sulphuric acid as electrolyte. When cell is charged, the layer of lead oxide is deposited on positive electrode and lead on negative electrode. When cell is discharged (i.e. used) lead sulphate is deposited on both the electrodes. This cell may be used again and again and are the sources to obtain electric current for a long time.

It is costly and heavy. It has acids so it must be used very carefully. These are used for button start in scooters, motor cycles, car, buses, inverters mainly.

Conductor and Insulator of Electric Current

The substances which allow electric current to pass through them are called **conductors**. On the other hand, the substances which do not allow the electric current to pass through them are called **non-conductors** or **insulators**. We have seen most of the metals copper, aluminium etc. are conductor of electricity whereas rubber, plastic, wood etc. are insulators or bad conductors.

Do Liquids Conduct Electricity ?



We have made tester to test the flow of electric current in solids in previous class. We can use the same tester to test whether a liquid allows to pass electric current through it or not. For this purpose we will use battery in place of the cell. Before using tester we will also check whether it is working or not.

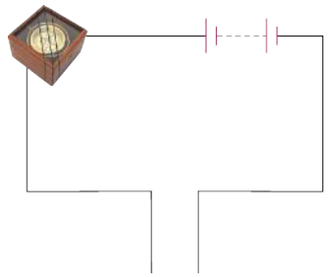
Activity Time

Join the ends of the tester together for a moment. By doing so the circuit of the tester completes and the bulbs should glow. If the bulb does not glow, it means that the tester is not working. There may be several possibilities. The connections may be loose or the bulb is fused or the cells are used up. Check these aspects one by one. Check that all the connections are tight, then change the bulb.

Now check again whether the tester is working or not. If it is not working even now then change the cells. If it works properly then it may be used to test various liquids. A liquid may allow to conduct electric current through it; but it is possible that it may allow the electric current through it as in case of metals. It is possible that the liquid between the two ends of the tester allows the current to pass. Thus, the circuit of the tester becomes complete. But if the bulb does not glow then the current through a circuit may be too weak to glow the bulb.

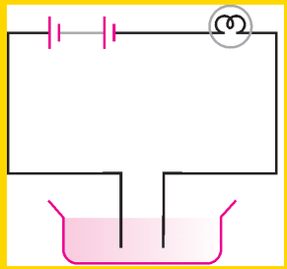
Light emitting diode LED can be used in the tester in place of electric bulb. LED glows even when

a weak electric flows through it. There are two wires attached to a LED. These wires are called leads . One of the wire is slightly longer than the other. While connecting the LED to a circuit the longer wire must always be connected to the positive terminal of the battery and the shorter wire to the negative terminal. We can use some another effect of electric current for this purpose i.e. to make a tester.



Activity Time

Wrap an electric wire few times around a tray, taken from inside of a discarded match box. Place a small compass needle inside it. Now connect one of free end of the wire to the terminals of a battery. Leave the other end of wire free. Take another piece of wire and connect it to the other terminal of the battery. Now bring the two free ends of the two wires in contact of each other for a moment. The compass needle should show a deflection. Your tester with two free ends of the wire is ready. By using this tester, as soon as the two free ends of two tester are dipped in lemon juice, the compass needle must show a deflection. Take out the ends of the tester from the lemon juice, dip them in water and wipe them dry. This activity may be done using other liquids such as tap water, vegetable oil, milk, honey etc.



Take a plastic or rubber cap of used up bottle of soft drink or water, clean it. Pour about one teaspoonful of lemon juice or vinegar in it. Now bring your tester near the cap and dip both of its end in the lemon juice or vinegar. Be careful that the two end must not be at a distance more than 1cm, but on the other hand, they should not touch each other. Does the bulb of tester glow? Do the lemon juice or vinegar allows to conduct electricity through it ? Will you keep the lemon juice or vinegar in the category of conductor or insulator? When the liquid between the two ends of the tester allows to pass electric current through it, the circuit of the tester gets completed. The electric current begins to flow in the circuit and the bulbs glow.

Warning

While testing your tester, bring its free ends in contact with each other only for few moments, otherwise the cells of the battery will be used up very quickly.

S.No.	Liquid	Does the compass need show defect?	Conductor/insulator
1.	Lemon juice	Yes	Conductor
2.	Vinegar		
3.	Tap water		
4.	Vegetable oil		
5.	Milk		
6.	Honey		

From the above table we find that some liquids are conductor and some are insulator of electric current. Infact under certain conditions most of the materials can conduct electricity. Therefore the materials must be classified as good conductors or poor conductors instead of as conductors or insulators.

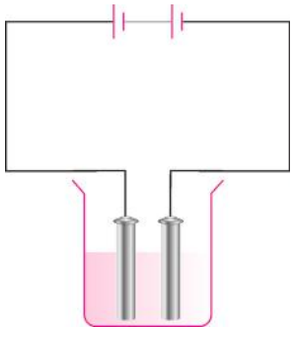
Battery

Some times a device requires more current or voltage than available from a single cell. In such cases we use two or more cells together. Such as in torches, casios, transistors, remotes etc. A **combination** of two or **more cells is called a battery**. Usually the cells are joined in series. In series the negative terminal of one cell is joined to the positive terminal of the next cell.

Activity Time

Take about two tea spoon full of distilled water in a clean and dry plastic or rubber cap of a bottle. Test whether distilled water conducts electricity or not, using your tester. Now take a pinch of common salt, dissolve it in distilled water. We get a solution of common salt. Test its conductivity. You will find that it is a good conductor of electricity. In fact the water, that we get from taps, hand pumps, wells, ponds and other water bodies is not pure. It contains less or more quantity of several salt dissolved in it. So this water is good conductor of electricity. On the other hand, distilled water, being free of salts, is a poor conductor of electricity.

Heating Effects of Electric Current

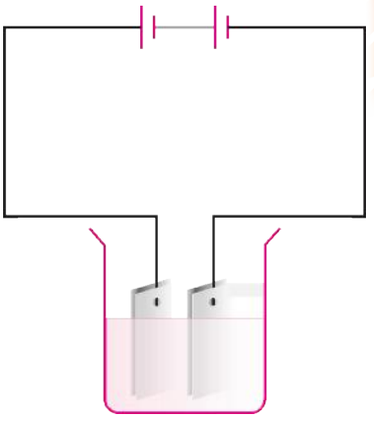


When electric current passes through a substance, then a part of electric energy is transformed into heat energy. This energy is used in heater, geyser, toaster, hair dresser etc. The electric current transforms as light and heat energy. In such appliances there is a filament of nicrome, which can be heated upto a very high temperature. Fuse wires made of an alloy of very low melting points are used in electric circuits. In case the current of excessive intensity passes through the circuits. In case the current of excessive intensity passes through the circuit the fuse wire melts. Consequently the circuit breaks, flow of current stops : the appliances become safe i.e. are not damaged.

Activity Time

Take out the carbon rods from two used up dry cells carefully. Wrap copper wires around metal caps of the carbon after cleaning them with a sand paper and connect them with a battery. We call these two rods electrodes. You may take iron nails about 6cm long, instead of carbon rods. Take a cupful of water in a glass or plastic bowl. Add a few drops of lemon juice or a teaspoonful common salt to the water to make it more conducting. Now immerse the electrodes in this solution. Take care that the metal caps of the carbon rods should remain outside the water. Wait for 3-4 minutes. Observe the electrodes carefully. Are you able to see

gas bubbles near to electrodes? We call the changes taking place in the solution, chemical changes. In the year 1800, a British chemist **William Nicholsen**, had shown that if electrodes were immersed in water and electric current was passed through the water, bubbles of oxygen and hydrogen were produced. The bubbles of oxygen are formed on the electrode connected to positive electrode of the battery and the bubbles of hydrogen on the other electrode.



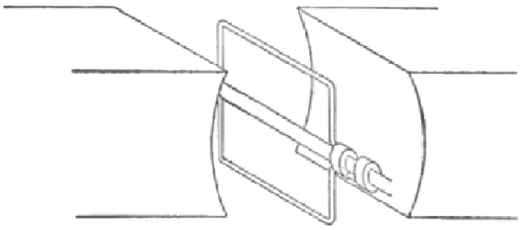
Chemical Effects of Electric Current

On passing electric current through a conducting solution chemical reaction occurs. Due to it, gas bubbles may form on electrodes. Deposits of metals may also be seen on the electrodes. The colour of solution may change. The chemical reaction will depend upon the nature of solution and electrodes used. These are some of the chemical effects of the electric current.

Electro Plating

When we see a brand new bicycle, we find that the rim and wheels of it are very shining. But if these are accidentally scratched, the shiny coating comes off and the surface beneath it does not look so shiny. Some artificial ornaments appear shiny as they are made of gold. It is due to the reason that they have a coating of gold or some other metal over a normal metal. Because of this coating they appear shiny.

Similarly, when an electric current is passed through the copper sulphate solution, copper sulphate dissociates into copper and sulphate. The free copper is attracted towards the electrode connected to the negative terminal of the battery and gets deposited on it. But how the loss of copper from the solution is restored.



From the other electrode, which is made of copper plate, an equal amount of copper gets dissolved in the solution. Thus, the loss of copper from the solution is restored and the process continues. It means that in the process of electro plating copper gets transferred from one electrode to the other.

The process of depositing a layer of any desired metal on another material by means of electricity is called **electroplating**. It is one of the most common applications of chemical effects of electric current.

In present age of time some old materials are polished with a thin layer of desired (having specific properties) metal. It creates good effect on the ordinary material that is polished. Chromium plating is done on many objects such as, some parts of car and bike, bath taps, kitchen gas burners, handle bars of bicycle, wheel rims etc. By doing so the object becomes shiny.

Jewellery makes electroplates silver and gold on cheaper metals. These ornaments have the appearance of silver or gold. But infact these are comparatively less expensive.

In storing food, tin cans are used. These cans are made by electroplating tin on the iron. Tin is less reactive than iron. Thus, the food does not come into contact with iron and is protected from getting spoilt.

Iron is used in bridges and automobiles to make them strong. But iron has a tendency to corrode and rust. Therefore a coating of zinc is deposited on iron to protect it from corrosion and rusting. Electroplating has a great importance in present age.

Know the Keywords :

Electric current : The continuous flow of electric charges is called electric current.

Conductors : The substances which allow electric current to pass through them are called conductors.

Insulators : The substances which do not allow the electric current to pass through them are called insulators.

Battery : A combination of two or more cells is called a battery.

Point to Remember

- The flow of electric charge through a conductor is called electric current.
- The cell was first invented by Volta in year 1796, that cell was named voltaic cell.
- The power of moving charges is called power of electric charge.
- The substances which do not allow the electric current to pass through them are called bad conductor of electricity.
- Some liquids are good conductors and some are bad conductors of electricity.
- Most of the liquid which allow the electricity to conduct through them are the solution of acids, bases and salts.
- The process of depositing a layer of some desired metal on other material by means of electricity is called electroplating.
- Chromium is a shiny and costly material.

EXERCISE TIME

A. Answer the following questions :

1. What is electroplating?
2. Mention some chemical effects of electric current.
3. What are good conductors and bad conductors of electricity?
4. What should be done to protect the metal against corrosion and rusting?
5. Does pure water conduct electricity? If not, what can be done to make it conducting?
6. Describe the process of passing electric current through water with the help of a diagram.
7. Test the conductivity of electric current in lemon juice or vinegar with suitable diagram.
8. Write a short note on electroplating.

9. Prepare a list of objects around you which are electroplating.
10. Mention the differences between primary and secondary cells?

B. Fill in the blanks :

1. Pure water _____ conduct electricity.
2. The salt solution is _____ of electricity.
3. The _____ of metal can be seen on electrode.
4. Some liquids are good conductor of electricity where as others are _____.
5. The process of depositing a layer of desired metal on any other material by means of electric current is called _____.

C. Tick (✓) the correct option :

1. In a conductor, electric charge is called :
   (i) electric current ◯ (ii) magnetic current ◯
   (iii) electric charge ◯ (iv) none of these ◯
2. Voltaic cell was invented in the year of :
   (i) 1776 ◯ (ii) 1796 ◯
   (iii) 1786 ◯ (iv) 1666 ◯
3. Pure water is a :
   (i) good conductor ◯ (ii) poor conductor ◯
   (iii) semi conductor ◯ (iv) none of these ◯
4. Which one of the following is used to strengthen the bridges and automobiles?
   (i) iron ◯ (ii) silver ◯
   (iii) nickel ◯ (iv) steel ◯
5. The process of deposition of a layer of desired metal by electricity is called
   (i) magneto plating ◯ (ii) electro plating ◯
   (iii) chemical reaction ◯ (iv) none of these ◯
6. Which of the following substance is an electrolyte :
   (i) copper ◯ (ii) copper sulphate ◯
   (iii) mercury ◯ (iv) kerosene ◯

Creative Work

- **Draw the diagram of any two devices on the chart paper which generate electric current. Write their names and display in your classroom.**