# 11 CHEMICAL EFFECTS OF ELECTRIC CURRENT

## 11.1

Our elders might have cautioned us against touching an electrical appliance with wet hands. But do you know why it is dangerous to touch an electrical appliance with wet hands?

We know that some solid materials allow electric current to pass through them like copper aluminum, silver etc. On the other hand some solid materials do not allow electric current to pass through them easily like rubber, plastic, wood etc. These materials which allow electric current to pass through them are good conductors of electricity. On the other hand, materials, which do not allow electric current to pass through them easily, are poor conductors of electricity.

You all have seen at your home that conduction of electric current in solid materials is checked by tester, do liquids also allow electric current to pass through them? Let us do an activity to know this -

### Activity 1

Materials required - Plastic or rubber cap or a beaker, vinegar or lemon juice, 2 testers, battery, bulb, two electric wires.

Take a small plastic or rubber cap of discarded bottle and pour one teaspoon of lemon juice or vinegar in it. Connect one tester to the battery and another tester to the bulb with the help of connecting wire as shown in figure 11.1. Now join the other terminal of the battery to the wire connected to the bulb. Bring the ends of the two testers and dip it in lemon juice or vinegar solution. Take care that the ends are not more than 1 cm apart but at the same time do not touch each other.

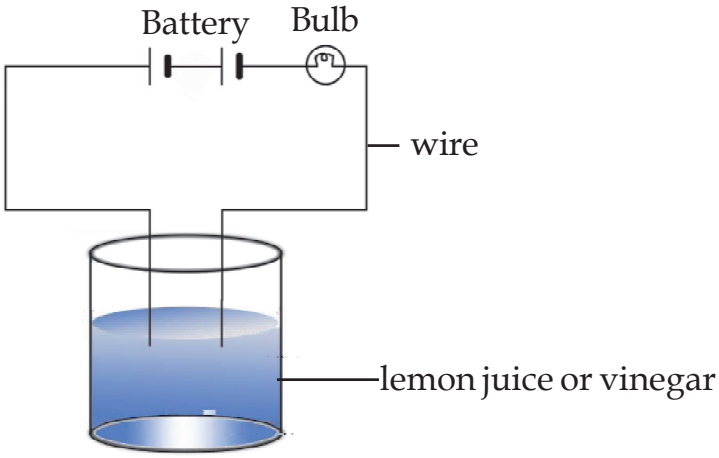



Fig 11.1 Testing of conduction of electricity in lemon juice or vinegar.

Does the bulb of the tester glow? Does lemon juice or vinegar conduct electricity? How would you classify lemon juice or vinegar- a good conductor or a poor conductor? Before doing the activity check whether tester and cell are working properly or not?

Repeat the same activity with other liquids like pure water, milk etc and check whether they are good conductors or poor conductors.

Thus we saw that when the liquid between the two ends of the tester allows the electric current to pass, the circuit of the tester becomes complete. The current flows in the circuit and the bulb glows. And when the liquid like pure water does not allow the electric current to pass, the circuit of the tester is not complete and the bulb does not glow.

In some situations even though the liquid is conducting, the bulb may not glow, what can be the reason? You know that, on passing electricity through the bulb, due to the heating effect of the current, the filament of the bulb gets heated to a high temperature and it starts glowing. However, if the current through the circuit is too weak, the filament does not get heated sufficiently and it does not glow. Let's make another tester which can detect a weak current.

## Activity 2

**Materials required-** Discarded matchbox, small magnetic compass, connecting wire, battery.

Take the tray from inside a discarded matchbox. Place a small magnetic compass, inside it. Now according to the fig. 11.2 wrap an electric wire, a few times around the tray. Now connect one free end of the wire to the terminal of a battery. Leave the other end free. Take another piece of wire and connect it to the other terminal of the battery. Join the free ends of two wires momentarily. Should the compass needle show any deflection?

Due to passing electricity in the circuit path, compass needle shows deflection. Now dip the free ends of the testers in lemon juice, do you find any deflection? Why does this happen? Lemon juice being good conductor passes electricity through itself. Repeat the activity with other liquids like distilled water, vegetable oil etc instead of lemon juice. In each case observe whether the magnetic compass needle shows deflection or not. Record your observations in table 11.1

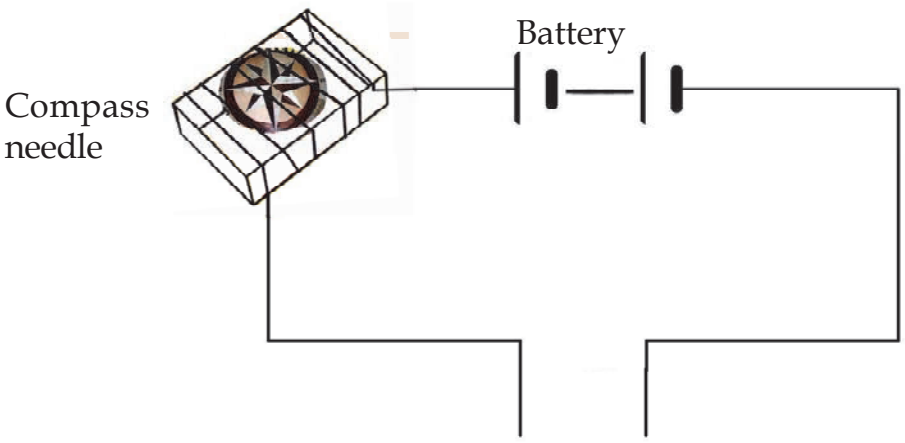



Fig 11.2 Testing of conduction of electricity through the circuit

**TABLE 11.1 Good/Poor conducting liquids**

| S.No. | Material | Compass needle shows deflection yes/no | Good conductor/ Poor conductor |
|---|---|---|---|
| 1. | Lemon Juice | Yes | Good conductor |
| 2. | Distilled Water | ..... | ..... |
| 3. | Tap water | ..... | ..... |
| 4. | Vegetable oil | ..... | ..... |
| 5. | Salt water | ..... | ..... |
| 6. | Honey | ..... | ..... |
| 7. | ..... | ..... | ..... |
| 8. | ..... | ..... | ..... |

Actually, under certain conditions most materials can conduct electricity. That is why it is preferable to classify materials as good conductors and poor conductors instead of classifying as conductors and insulators.

In the above activity we have seen that distilled water does not passes electricity through it but the water that we get from sources such as taps, hand pumps, wells and ponds is not pure. It may contain several salts dissolved in it. Small amount of mineral salts are naturally present in it. This water is thus a good conductor of electricity. On the other hand, distilled water is free of salts and is a poor conductor.

Now you understand that why you are cautioned against touching an electrical appliance with wet hands.

## Activity 3

**Materials required -**Three clean plastic or rubber caps of bottles or beaker, distilled water, vinegar or lemon juice, caustic soda, sugar, 2 testers, connecting wires for the electric circuit path.

Take three clean plastic or rubber caps of bottles. Pour about two teaspoon full of distilled water in each of them. Add a few drops of lemon juice or dilute hydrochloric acid to distilled water in one cap. Now in the second cap containing distilled water, add a few drops of a base such as caustic soda or potassium hydroxide. Add a little sugar to the distilled water in the third cap and dissolve it. Now arrange electric circuit path for the above three caps and test which solutions conduct electricity and which do not. Most liquids that conduct electricity are solutions of acids, bases and salts.

## NOW ANSWER THESE

1. What do you mean by good and poor conductor of electricity?
2. Why distilled water is poor conductor while tap water is good conductor of electricity?

## 11.2 Chemical Effects of Electric Current

Electric current produces some kind of effect when it flows through a conducting solution. What is this effect called? Let's understand this.

Two metal rods are dipped in a conducting solution kept in a beaker, one end of metal rod is connected to the positive terminal of the battery and other rod is connected to the negative terminal. Electric current begins to flow. In this condition the conducting solution dissociates into ions. This effect is called chemical effect of electric current. The passage of an electric current through a conducting solution causes chemical reactions. As a result, bubbles of a gas may be formed on the electrodes. Deposition of metal may be seen at electrodes, Also changes of colour of solution may occur. All these may be seen one at a time or simultaneously. The apparatus mentioned above is called voltameter. The terminal of the voltameter which is connected to the positive terminal of the battery is called anode and the terminal which is connected to the negative terminal of the battery is called cathode. In the external circuit of the voltameter, current flows from anode to cathode but inside the conducting solution current flows from cathode to anode, this process is called electrolysis.

If current is passed through a container of acidic water (water and few drops of sulphuric acid), electrolysis of water takes place and it dissociates into ions (fig 11.3) Bubbles were seen below the two electrodes. Similarly, on passing electricity through salt water, electrolysis takes place with dissociation of sodium and chloride ions. Thus the changes that takes place in the conducting solution is called its chemical effect.

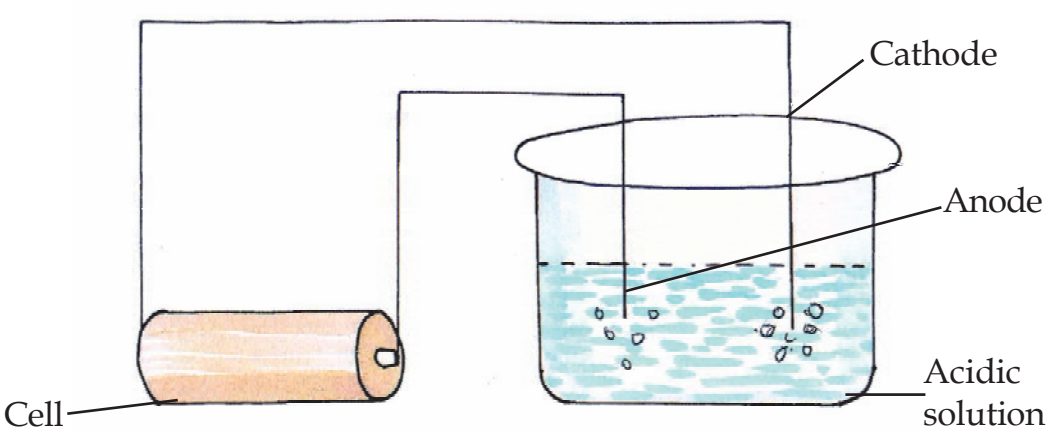



Fig. 11.3 Passing current through water

## 11.3 Electric Conduction through Fruits and Vegetables

### Activity 4

**Materials required** -Potato, sugar, connecting wire for the electric circuit path.

Cut potato into two equal parts and make an electric circuit path according to the fig.11.4 by inserting the copper wires of a tester into it. After few times, you will notice greenish blue spot on the potato around one wire whereas there is no such spot around the other wire, Repeat the activity for 2 to 3 times, you will find that it was always the wire connected to the positive terminal which had a greenish blue spot around it. This shows that electric current passes through the potato and produces chemical effect.

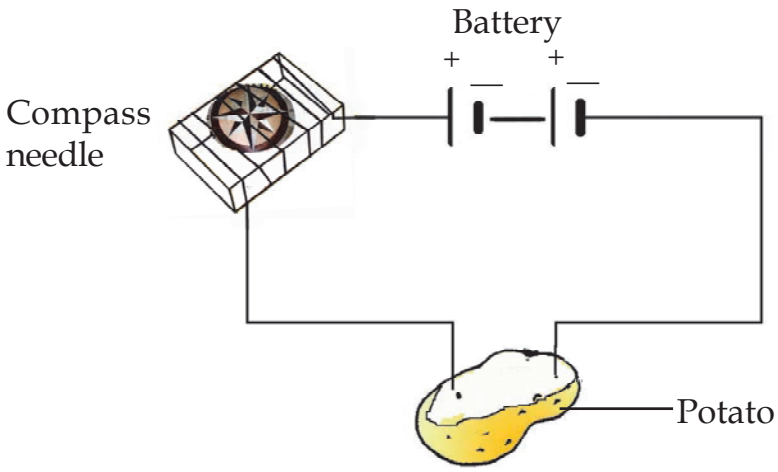



Fig. 11.4 Testing the conduction of a potato

## 11.4 Electroplating

We have to consider few examples to understand electroplating. You know that a brand new bicycle has shiny handle bar and wheel rims. However, if these are accidently scratched, the shiny coating comes off revealing a not so shiny surface beneath. You might have also seen women using ornaments which appear to be made of gold. However, with repeated use, the gold coating wears off, revealing silver or some other metal beneath. Let's try to learn in both the situations, how one metal is coated over another metal.

### Activity5

**Materials required -** Beaker, distilled water, copper sulphate, dilute sulphuric acid, battery, two copper plates,

Take 200 mL of distilled water in a clean and dry beaker, Dissolve two teaspoon full of copper sulphate in it and make a solution. Add a few drops of dilute sulphuric acid to copper sulphate solution to make it more conducting. Clean, copper plates of size 10 cm x 01cm with sand paper. Now rinse them with water and dry them. Connect the copper plates to the terminals of a battery and immerse them in copper sulphate solution. Allow the current to pass for about 15 minutes. Now remove the electrodes from the solution and look at them carefully. Do you find a coating over it? What colour is the coating? Note down the terminal of the battery with which this electrode is connected (fig 11.5)

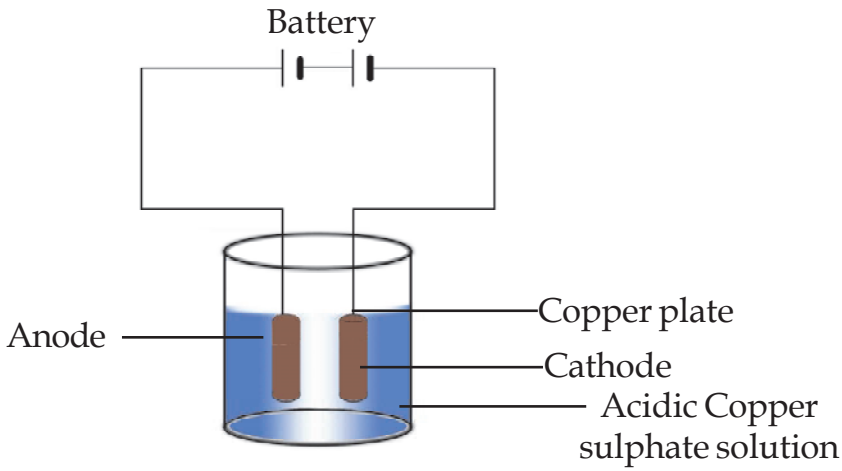



Fig 11.5 A simple circuit showing electroplating

After doing the electroplating activity interchange the electrodes and repeat the activity, what do you observe this time?

When electric current is passed through the copper sulphate solution, copper sulphate dissociates into copper and sulphate. The free copper gets drawn to the electrode connected to the negative terminal of the battery and gets deposited on it. There is a loss of copper from the solution. From the other electrode 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. This process continues until electric current passes through the circuit path. On interchanging the electrodes, copper gets deposited on the other plate.

Thus in the process of electroplating, copper gets transferred from one electrode to the other. In the solution, on passing current, when copper plate is connected with positive terminal of battery and carbon rod is connected with negative terminal of the battery, we get success in obtaining a coating of copper on carbon rod. The process of depositing a layer of any desired metal on another material by means of electricity is called electroplating.

### 11.4.1 Uses of Electroplating

1. Chromium has a shiny appearance. It does not corrode. It resists scratches. However chromium is expensive and it may not be economical to make the whole object out of chromium. So the object is made from a cheaper metal and only a coating of chromium over it is deposited. Thus chromium plating is done on many objects like car parts, bath taps, kitchen gas burners, bicycle handlebars, wheel rims and many others.

2. Jewelers electroplate silver and gold on less expensive metals. These ornaments have the appearance of silver or gold but are much less expensive.

3. Electroplating is used to obtain pure metals from their ores.
4. Electrolysis method is used to get pure metals from their impurities.
5. Tin cans, used for storing food, are made by electroplating tin on to iron. Tin is less reactive than iron. Thus, food does not come into contact with iron and is protected from getting spoilt.
6. Iron is used in bridges and automobiles to provide strength. However, Iron tends to corrode and rust. So, a coating of zinc is deposited on iron to protect it from corrosion and formation of rust.

## NOW ANSWER THESE

1. What do you mean by chemical effect of electric Current?
2. What are the main reasons of doing electroplating?
3. Name some electroplated objects available in your surrounding by mak ing a list.

## 11.5 Electric Cell

We use cell or battery in our daily life to obtain electric current. Some cells are given below.

### 11.5.1 Voltaic cell

At first in 1796 a scientist named Alexandro Voltas of Italy successfully tried to get continuous flow of current. He found that if two plates made of different metals are placed in an acidic solution kept in a glass jar then the electric current flows through the circuit between the two plates (fig 11.6).

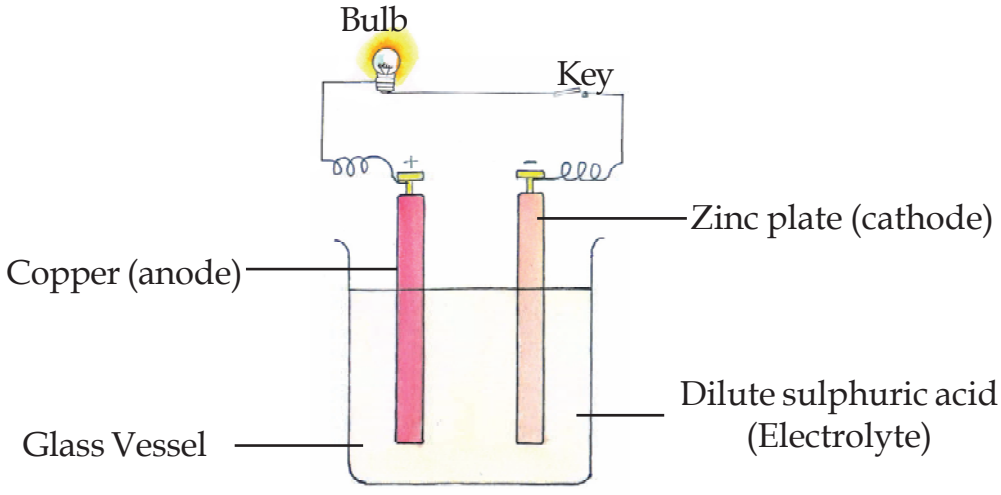


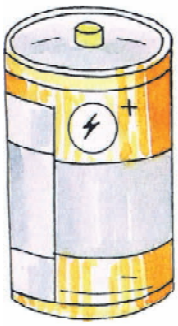

Fig 11.6 Voltaic cell

This source of electric current is called voltaic cell named after its discoverer. In the cell the solution is called electrolyte and the metal plates are called electrodes. The anode and cathode of Voltaic cell are made up of which metals?

## 11.5.2 Dry cell

The cell, used in torch, transistor, radio and many toys is the dry cell. Do you know how it is formed? To know this, take a used or useless cell and remove its outer cardboard or tin cover and try to look inside. You will find that there is a hollow cylindrical plate of zinc which acts as negative electrode.

This is filled with mixture of ammonium chloride (electrolyte), zinc chloride and plaster of paris paste. In the centre, there is a muslin cloth bag filled with mixture of manganese dioxide, ammonium chloride, and zinc chloride and carbon powder with a carbon rod in the centre. The upper part of the carbon rod comes out and is covered by a cap of brass. This carbon rod acts as the positive electrode. The mouth of this cylinder is closed with sealing wax or pitch. A small hole is there in this to allow the gas formed inside to escape (fig 11.7). To get more electric current we attach two or more cells to each other in series. The positive end of one cell is placed on the negative end of the next cell. The series of such cells is called a battery. When the chemical inside the cell is completely exhausted, the passage of electric current stops. Such a cell is called a dead cell. Cut open a longitudinal section of a dry cell and draw its labeled diagram.



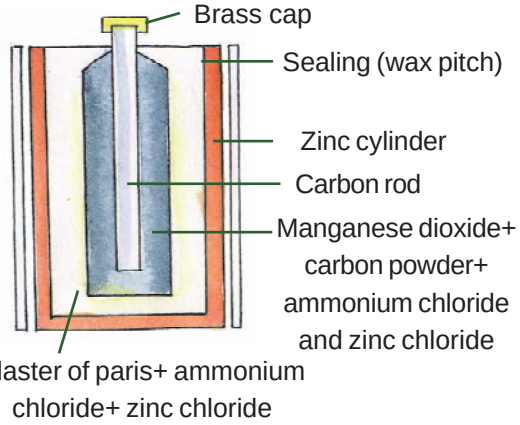



Fig 11.7 Dry cell

## 11.5.3 Button cell

Button cell is a button shaped small dry cell in which there is a zinc or aluminum anode (positive pole), silver oxide or mercury oxide, cathode (negative pole) and the electrolyte is sodium or potassium oxide.

Because button cell is small sized, cheap, long lived and more powerful, it is used in many electronic instruments as calculators, watches hearing aids etc.

## 11.5.4 Solar cell

Solar cell transforms the solar energy falling on it to electrical energy. An ordinary solar cell is made of two layers of silicon. In the lower layer, a very small

quantity of arsenic is mixed. This forms the positive layer. In the upper layer, a small quantity of atoms of boron is mixed. This forms the negative layer. When sunlight falls on this arrangement and electric circuit is connected between the two layers then very weak current flows. To increase the quantity of the current, many solar cells are attached in a series.

**Uses**

1. They are used in watches, calculators, transistors and artificial satellites.

2. It is used for cooking, water heating and for illuminating the street.

## NOW ANSWER THESE

1. Which electrode and electrolyte is used in a simple voltaic cell?

2. What is a solar cell made of?

## WE HAVE LEARNT

- Some liquids are good conductor where as others are poor conductor of electricity.
- Most liquids that conduct/ pass electricity are solutions of acids, bases and salts
- Electricity does not pass through distilled water.
- The passage of an electric current through a conducting liquid causes chemical reaction, the resulting effects is called chemical effect of current.
- The process of depositing a layer of any desired metal on another metal is, called electroplating.

## QUESTION FOR PRACTICE

**1. Tick the correct answer -**

(i) Which of the following is not a good conductor of electricity -

(a) Distilled Water (b) lemon Juice

(c) Salty Water (d) Tap Water

(ii) The electrolyte used in a simple voltaic cell is -

(a) Dilute sulphuric acid (b) Dilute hydrochloric acid

(c) Copper sulphate solution (d) Potassium hydroxide solution.

(iii) The process of depositing a layer of any desired metal on another material by means of electricity is known as -

(a) Electrolysis (b) Electroplating

(c) Chemical reaction (d) Electro refining

(iv) The apparatus used for electrolysis is -

(a) Electric cell (b) Voltameter

(c) Ammeter (d) Magnetic needle

**2. Fill in the blanks -**

(i) Solution of ..... electrolyte is used in simple voltaic cell.

(ii) On passing current through any solution, produces..... effect.

(iii) In solar cell ..... energy is converted into ..... energy.

(iv) Process of coating of expensive metals over cheap metals by voltaic cell is called.....

(v) ..... cells are used in watches, calculator, transistors and artificial satellites.

**3. Answer the following questions -**

1. Does distilled water conduct electricity? If not what can we do to make it a conductor?
2. In case of fire, before the fireman uses the water they shut off the main electrical supply for the area. Explain why they do this?
3. Why zinc is coated with iron?
4. Explain the process of electrolysis?
5. Name the electrolyte, positive terminal and negative terminal of button cell.
6. Write 3 uses of electroplating.