Unit 4

Properties of Water

You know that water is very useful for live elements. Due to this necessity it is said that 'Water is Life.' Water is included in the fundamental needs of living beings. Now, lets us know about water in details.

Make note of some information about water :

(1) Taste _____

(2) Colour _____

(3) Smell _____

At ordinary temperature water is in the liquid form. When it is cooled at 0^{o} C temperature it turns into solid form and we call it ice. Heating it up to 100^{o} C it starts boiling and turns into gaseous form, which we call vapour.

As water absorbs heat slowly and gets heated; also it emits heat slowly and cools down. But metals and soil get heated very fast and they cool down also very fast. Due to this nature of water, on the earth there is not very much big difference between the temperatures of day and night. Also due to this nature of water, water is used in radiators for vehicles.

What is required : Test-tube, pieces of wax, a match-box, a transparent glass, water, pieces of ice, a candle and a tripod stand.

What to do ?

- Taking a few pieces of wax in a test-tube, heat the test-tube with the help of a candle.
- Add some solid pieces of wax in the melted wax in test-tube and then make your observation.

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- Now, put some pieces of ice in a transparent glass of water and observe what happens.

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Why does it happen like this ?

Solid form of water is lighter than the liquid form of water. This is a specific physical property of water.

If water is cooled from 4^{o} C to 0^{o} C, instead of decreasing the volume of water, the volume increases and the density decreases. This is called an irregular expansion or anomalous expansion of water. Due to this nature of water ice floats on water.

In cold regions the top layer of water of ponds and lakes turns into ice, but there is water just below the layer of the ice hence the creatures living in water are able to live in it. This ice layer prevents the heat of the water going away into the atmosphere; hence the creatures under water get the proper temperature. Thus, formation of ice is a blessing for the creatures living under water.

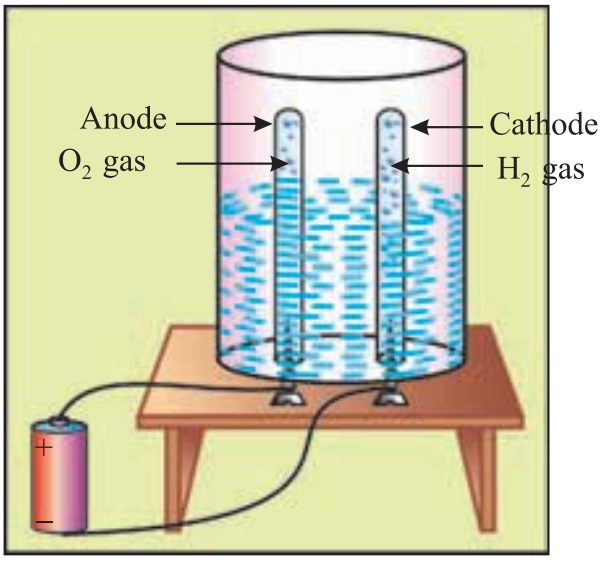
Chemical properties of water :

Electrolysis of water :

What is required ? Half cut plastic jar, two screws, copper wire, two test-tubes, a shell or a six volt battery and dilute sulphuric

What to do ?

- As shown in the figure, making two holes in the bottom of the half cut jar fix two screws in such a way that water does not leak.
- Join the outer ends of the screws with wire to the battery or a shell. We call it a voltmeter. (Even a ready voltmeter can be used.)
- Now fill water in the voltmeter up to the half level.
- Add four or five drops of sulphuric acid in it so that it turns out to be a good conductor of electricity.



Now, fill two test-tubes by water up to the brim and arrange them upside down on the screws in such a way that the water from the test-tubes does not come out. The screw joined with positive end of the battery behaves as positive pole (Anode) and the screw joined with negative end of the battery behaves as negative pole (Cathode). Now, complete the circuit and start electricity. What do you observe in the test-tubes of both the poles ?

There are hydrogen and oxygen in water. Passing electric current in water, hydrogen and oxygen are separated.

Hydrogen gas is inflammable and it burns with cracking sound. But oxygen gas is a supporter of combustion hence it helps things to burn.

After sometime, observe the portion of gas collected on both the test-tubes. On which pole the test-tube contains more gas ?

- When the test-tube on the negative pole is filled half then stop the electric current.
- Now closing the mouth of the test-tube on the negative pole by pressing the thumb against it, remove the test-tube out and turn it with the right side up and keep a lighted match stick in front of it. Observe, what happens ?

It shows that this test-tube contains hydrogen gas in it.

- Similarly remove the test-tube from the positive pole and insert a smoking incense trick (Agarbatti) in it up to the half level. Then observe, what happens ?

In shows that in this test-tube there is oxygen gas.

From this we can say that water is mixture of hydrogen and oxygen. The portion of hydrogen is double than the portion of oxygen in it.

Caution : With voltmeter connect only 6 volt D.C. Battery or a shell. Should not connect it directly to A.C. Current.

Solvent, soluble and solution :

What is required ? Common salt, water, transparent glass and a spoon.

What to do ?

- ☞ Take water in a glass made from glass.
- ☞ Add some common salt in it and go on stirring it with a spoon.
- ☞ You will see that common salt is dissolved in water.

Solvent : A liquid in which a thing dissolves is called a solvent. e.g. Water.

Soluble : A thing which dissolves in a solvent is called soluble. e.g. Salt.

Solution : The mixture of soluble and the solvent is known as solution. e.g. Solution of common salt.

The solution of anything made in water is called water solution. E.g. water solution of common salt.

Sugar dissolves in milk. Here milk is a solvent, sugar is a soluble and sweet milk is a solution.

What is required ? Milk, common salt, sugar, sand, alum, oil, water and a glass made from glass.

What to do ?

- ☞ Take water in a glass made from glass.
- ☞ Now add sugar in it.
- ☞ After that go on stirring it by a spoon.

Make your observation and make a note of it in the following table :

Things dissolving in water	Things not dissolving in water

Soft water and hard water :

Rain water is pure water but some gases dissolve in it from the atmosphere. When this water flows on the soil and through the layers of rock some of the salts dissolve in it and hence it appears to be salty in some of the regions. In this way pure water becomes impure.

In the soil of some of the region the proportion of salts is more and hence in these regions there is more probability of water to be salty. In some of the regions of Gujarat and Rajasthan, having salty water is a big problem.

What is required ? Five test-tubes, a dropper, a beaker, a tripod stand, solution of Aretha powder, distilled water, water from a tube-well, sea-water, water from a river or a lake.

What to do ?

- ☞ Write the names of the sample water on five test-tubes and fill them with the corresponding water.
- ☞ Prepare Aretha solution in a beaker.
- ☞ In each of the test-tubes add five drops of Aretha solution with the help of a dropper. Turn by turn shake all the test-tubes well.
- ☞ Water in which, more foam is formed has less salt in it. Water in which, less foam is formed has more salt in it.
- ☞ Make a note of your observations in the following tables.

No.	Name of the sample water, which forms more foam.	Name of the sample water, which forms less foam.

- Water in which there is less proportion of salt is called soft water.
- Water in which there is more proportion of salt is called hard water.

In our school or at home, to know the proportion of dissolved salts in the water we get, T.D.S. (Total dissolved solid) meter is used. This instrument measures in ppm (parts per million).

0 ppm to 50 ppm	-	Ideal water
51 ppm to 100 ppm	-	Spring water or carbon filtered water.
101 ppm to 200 ppm	-	Normal-tap water.
201 ppm to 400 ppm	-	Hard water
401 ppm to 500 ppm	-	Water containing more salts.
Above 500 ppm	-	Water is harmful to drink.

T.D.S. meter

Different methods to remove hardness of water :

Solar steel

What is required ? A big vessel, a bowl, salt-water, plastic sheet, string and a stone.

What to do ?

- ☞ Keep a bowl in the middle of the vessel.
- ☞ Pour salt-water in the vessel in such a way that the bowl is not immersed in it.
- ☞ Cover the vessel by a plastic sheet and tie it with a string.
- ☞ Put a stone on the plastic in such a way that it is exactly above the bowl.
- ☞ Now, keep this vessel in the sun for two to three hours. After that make your observation.

Taste the water collected in the bowl and mention what is the taste of it :

(Taste original water also)

Now take some water from the bowl and fill it in a test-tube. Fill the other test-tube with the water from the vessel. Add four or five drops of Aretha solution in both the test-tubes and shake them well and then make your observation.

Water collected in the bowl is distilled water, because in that dissolve salts are absent.

There are two types of hardness in water :

(1) **Permanent hardness :** Water in which chlorides of calcium and magnesium and sulphate salts are dissolved and hardness caused due to them is called permanent hardness.

(2) **Temporary hardness :** Water is which bicarbonate salts of calcium and magnesium are dissolved and the hardness caused due to them is called temporary hardness. This type of hardness can be removed by boiling and filtering the water.

Methods of making hard water soft :

- To remove the different salts very much dissolved in hard water, can be done by boiling such water very much. So dissolve salts are converted into undissolved salt.
- Doing this, some of the salts settle down at the bottom and some of the salts float on the top.
- Filtering this water it becomes soft water.
- Adding washing soda or borax powder in the hard water it can be made into soft water.

Water purification :

We receive drinking water from different sources and this water is not very much pure. There are different types of impurities in it. Mainly there are three types of impurities in water :

(1) Non-dissolved impurities

(2) Dissolved impurities

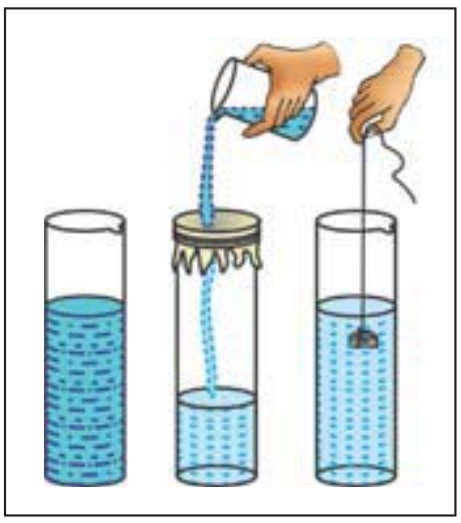
(3) Impurities of microgerms

To verify whether the water we use for drinking is really proper for drinking or not, 'Water and sanitation management organization' (WASMO) sends a kit to some schools and institutions. Water is filled in this instrument according to the given information and it is kept for some time, then it shows colour changes. From this we come to know whether the water is proper for drinking purpose or not.

What is required ? Three beakers, a piece of cotton cloth, dirty water and alum.

What to do ?

- ☞ As shown in the picture, tie a piece of cloth on one of the beakers. Pour dirty water in it. After that take dirty water in the other beaker.
- Now, compare the water collected in both the beakers.
- What difference do you find ?



- Now deep a piece of alum in the filtered water for some time and then remove it out.
- Let the water be kept as it is for half an hour.
- Compare this water with the dirty water of the other beaker.
- What do you see ?

- After this, filter this water in the third beaker.

With this method we can get rid of most of the non-dissolved impurities.

The instrument used for purification of water in the modern era (time) :

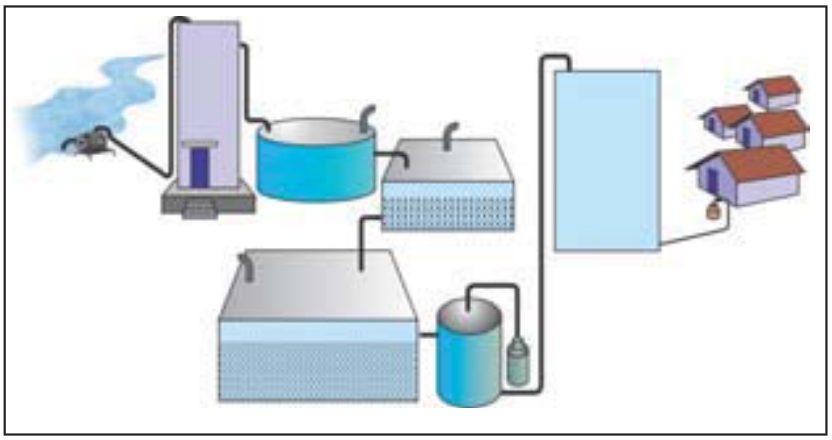
R.O. Plant (Reverse Osmosis Plant) :

The process of separating the dissolved salts from a liquid is known as reverse osmosis. In this plant water is passed through a membrane made of small nets with a very high pressure and the dissolved salts are removed. The surplus water containing all salts is left to go out. Now, the water with no salt in it is allowed to pass through ultraviolet rays and the microgerms are made inactive and the water thus obtained is proper for drinking.

R.O. Plants

Water-purification plants used in big cities :

In big cities water is distributed by the water supply project. This water is obtained from rivers, dams, wells and tube-wells. To purify this water it is passed through different layers.



- For purification of water at the bottom a layer of big stones is made. Above it a layer of small stones is prepared and above this layer a layer of sand is spread. The non-dissolved impurities are left over the layer of sand hence this layer of sand is very often changed after every few days. After this process is completed chlorine gas is passed through the water and it is made germs-free. The water obtained in this way is then supplied from house to house.
- During monsoon to keep the water germsfree the health workers appointed by the health department go from house to house and put chlorine tablets in the water as per the requirement and make the water germsfree.
- Water is made germs free by adding bleaching powder in it.
- During the epidemic, water should be boiled so that the microgerms contained in it are destroyed and then it should be used for drinking.

Mention which methods are used to purify water in your home. If water comes from Gram Panchayat or Nagarpalika at your home, then gets information that how can they purify water ?

Do it yourself :

1. Take water into a transparent glass up to half the level and making a level mark on it put it in the deep freezer of the refrigerator in your house. After it has turned into ice, mark the level. Now, keep the ice made in the glass outside and let it be turned into water. Now mark the level of water.

- What difference do you find in the levels.

- Why does it happen like this ?

2. Perform an experiment yourself and find it out that the water supplied in your school by the water-tank in the village or the city is hard or soft.

I am a compound; there are hydrogen and oxygen in me.
My chemical formula is H_2O.
You do eat me and you do drink me.
You wash clothes and vessels by me.
Some time when I am found in the hard form you make me soft by boiling me.
I exist in all the three forms; solid, liquid and gas.
Ninety per cent of the proportion of blood is me and I am the life for you.
The love of the clouds rains and I arrive on the earth in a splendid manner.
I am collected in rivers, brooks and wells.
If you waste me feeling that I am free, you will destroy your life in vain. Do you know who am I ?

I am water, I am water.

Q.1 Classify the following in solvent, soluble and solution :

Common salt, solution of common salt, sugar, solution of sugar, alum and water

Solvent	Soluble	Solution

Q.2 Answer the following questions :

(1) In modern times, which instruments are used to purify water ?

(2) What is the arrangement in your school to purify drinking water ?