

WATER - HARD AND SOFT

Chapter 5

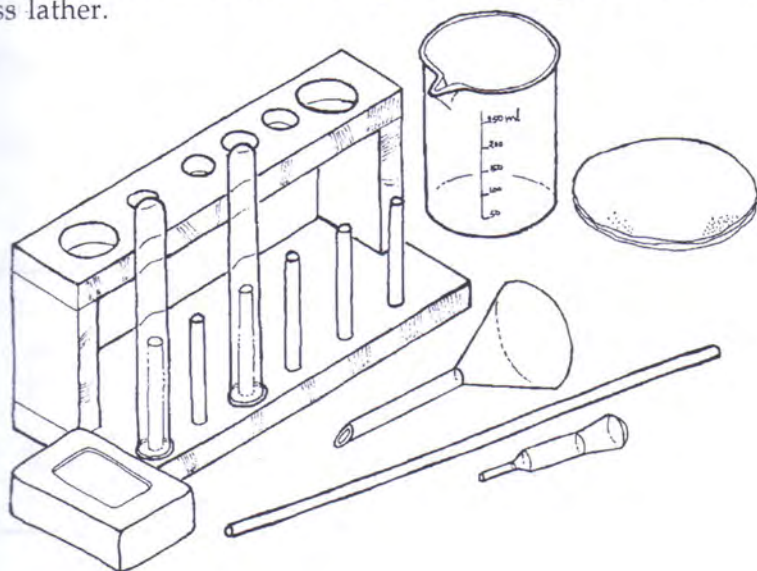
We use water all the time. Water is so important for us that we cannot imagine life without it. It is important because of its properties.

You have studied many properties of water. Since you use water daily, you must have also observed many of its properties. Make a list of these properties.

In this chapter we shall study a special property of water. Do you recall ever having used water in which soap does not lather? Can you remember where this water came from?

We shall try to understand why soap does not produce a rich lather in water collected from some sources and how we can change the quality of this water so that it can produce a better lather. To do this, you will have to collect water from different sources - well, tap, river, pond, etc.

However, before we begin our experiments, we need to answer one question. When we say water from a certain source produces less lather, what are we comparing it with? Less than what? We must have some **standard** with which to compare before we can decide whether a **sample** of water produces more or less lather.



The standard we shall use for comparison is rain water and the lather it forms.

Distilled water from rain

The experiments we shall now perform require a supply of **distilled water**. Each group will need at least one glucose bottle full of distilled water. To collect distilled water, place a utensil with a wide mouth in the rain. The utensil should be kept in the open so that water running off a roof or nearby trees cannot fall in it. Also, take care that mud doesn't splatter into the utensil. Store the rain water you collect in a clean glucose bottle and plug its mouth with a cork. This is your distilled water.

There is another way of collecting distilled water. This method has been explained in an interesting experiment given just before this chapter on Page 38.

Preparing a soap solution

We need soap solution for our experiments. We shall prepare enough soap solution for the whole class. But remember one thing - use bathing soap, not **detergent**, to prepare the solution. Take a beaker and fill it halfway with distilled water. Add a few pieces of bathing soap to the water. Let the soap soak and dissolve in the water and then shake the beaker well to make a solution. The solution should be so concentrated that 5 to 10 drops should produce a lot of lather when poured into a test tube which is filled a third with water.

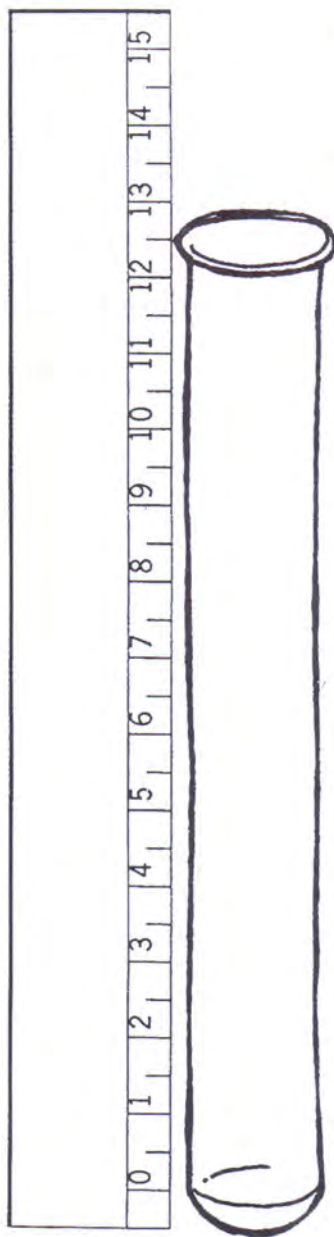
You now have all the things you will need for your experiments.

Experiment 1

In this experiment you will compare the lather produced in different samples of water with the lather produced in distilled water. But you must observe three precautions while doing this experiment:

1. Take equal amounts of water from each sample for comparison.
2. Add an equal number of drops of soap solution to each sample.
3. After adding the soap solution, shake each sample an equal number of times.

Why is it necessary to take these precautions? (1)



HOW MUCH IS ONE THIRD?

A diagram of a test tube is given above. A scale has been drawn alongside it. Mark the length of the test tube on the scale and measure one-third ($1/3$) of this length. Mark the test tube at this point with a pen.

Mark two test tubes in this way. Every time you need a $1/3$ test tube of water, fill the test tube to this mark.

Fill one-third of a test tube with distilled water. Add 8 drops of soap solution and shake well for a measured interval of time. We shall use this test tube as the standard for comparison. Label it and place it on the test tube stand.

Now take a fresh test tube. Pour your sample of river water into it.

How much water did you take?

Put as many drops of soap solution into this water sample as you did in the distilled water. Shake it well for the same interval of time as before. See how much lather is formed. Compare it with the lather in the standard test tube. If the lather in the standard test tube has settled, shake the test tube again before comparing.

Make a note of whether the lather formed with river water is less, equal to or more than the lather formed with distilled water.

Use the following signs to record your observations in Table 1:

(+) sign for equal or more lather than distilled water.

(-) sign for less lather than distilled water.

Table 1

No.	Source of sample	Amount of lather compared to distilled water	Precipitate formed or not
1.	River		
2.			
3.			
4.			

Check if any insoluble substance (**precipitate**) is produced after you shake the test tube. Fill in this column of the table as well.

Repeat the experiment with the samples of tap and well water. Don't forget to wash your test tube with distilled water every time you test a new sample.

Record your results in Table 1. (2)

Did all the water samples produce an equal amount of lather? (3)

Water that produces plenty of lather with soap (equal to or more than the lather produced with distilled water) is called **soft water**.

Water that produces less lather than distilled water is called **hard water**.

Should one consider distilled water to be soft or hard?

Experiment 2

We shall repeat Experiment 1 with some more samples of water. But we shall prepare these samples ourselves by mixing several different **salts** in water.

These salts are listed in Table 2. Use them one by one for your experiment.

Wash a test tube with distilled water and fill 1/3 of it with distilled water. Add a tiny bit of calcium chloride - the size of a grain of rice - to the water and shake well.

Add soap solution to the water and shake well.

How many drops of soap solution should you add?

Compare the lather formed with that of the standard test tube of distilled water and record your result in Table 2, using the same method you did in Experiment 1. (4)

Table 2

No.	Salt mixed with distilled water	Amount of lather compared with distilled water	Precipitate formed or not
1.	Calcium chloride		
2.	Sodium chloride		
3.	Calcium sulphate		
4.	Magnesium sulphate		
5.	Sodium carbonate		
6.	Sodium bicarbonate		

Repeat this experiment with each salt listed in the table. Answer the following questions on the basis of your observations.

Did all the salt solutions produce the same amount of lather with soap? (5)

List the names of the salts you used in your experiments in the appropriate columns of Table 3. (6)

Table 3

Salts that do not make water hard	Salts that make water hard	Salts that produce a precipitate with soap

Which salts, when dissolved in water, make the water hard? (7)

Are there any salts which, when dissolved in water, do not affect the softness of water? (8)

Which salts, when dissolved in water, leave a precipitate on adding soap? (9)

Do you see any relationship between salts that form a precipitate and salts that make water hard? If you do, explain what this relationship is. (10)

Are the salts that produce a precipitate the same as the salts that make water hard? (11)

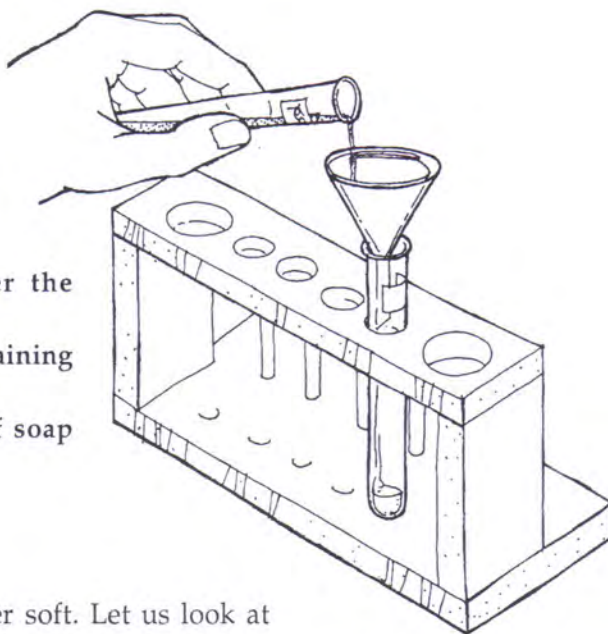
If we repeat this experiment with detergent instead of soap, would the results be the same? (12)

If you cannot answer this question, do the following experiment.

Experiment 3

You saw in Experiment 1 that some samples of water, when mixed with soap, gave less lather than distilled water. We labelled them samples of hard water. In Experiment 2 you saw that there are some salts that make distilled water hard if they are mixed in it.

You can use any sample of hard water from your previous two experiments for this experiment. Take two test tubes. Fill one test tube 1/3 with distilled water. Pour an equal amount of hard water in the second test tube. Add 2 to 3 drops of concentrated detergent solution to both the test tubes and shake well.



Did the hard water produce lather after the detergent solution was added? (13)

Did a precipitate form in the test tube containing hard water? (14)

Is there a difference between the action of soap and detergent on hard water? (15)

Experiment 4

Making hard water soft

There are many ways of making hard water soft. Let us look at one of these methods.

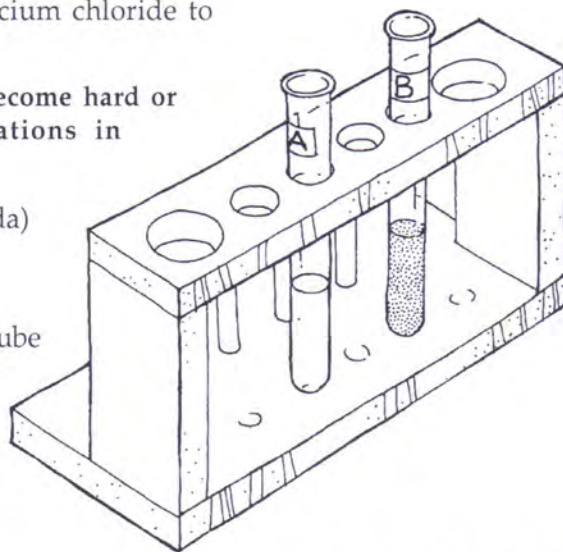
Take two test tubes A and B. Fill both 1/3 with distilled water. Add a pinch (the size of a grain of rice) of calcium chloride to each.

Did the distilled water in test tubes A and B become hard or soft? Answer on the basis of your observations in Experiment 2. (16)

Now add a little sodium carbonate (washing soda) to test tube B and shake well.

Did a clear solution form in the test tube? (17)

If it did not, filter the solution into another test tube and mark it B. Now add 8 drops of soap solution each to test tubes A and B. Shake them well. Observe the lather produced and compare the amount in both test tubes.



Is the amount of lather produced in test tube A the same as that in test tube B? (18)

If not, which test tube has more lather? (19)

Why did more lather form in this test tube? (20)

What conclusions can you draw from these observations? (21)

If you find you are using too much soap while washing clothes, what should you do? (22)

Why is sodium carbonate called washing soda? (23)

On the basis of the experiments that you have performed, can you suggest some other ways of making hard water soft? (24)

Hardness is of two types. One type of hardness disappears after the water is boiled.

Test the water from wells or lakes near your home and find out whether the water loses its hardness after it is boiled. (25)

You have learned to test the hardness of water.

Find out whether the items/substances listed below make water hard.

1. Chalk dust
2. Ash
3. Sugar
4. Black tea. (26)

Some questions for revision

1. Based on the experiments performed in this chapter would you say that soft water always remains soft?
2. The chemical name of the common salt we use to cook food is sodium chloride. Does water become hard if common salt is added to it?
3. Why did we use distilled water to make solutions of different salts in Experiment 2? Could we have used tap water? Give reasons for your answer.

New words

Standard	Distilled water	Process	Soft water
Detergent	Sample	Hard water	Precipitate
Salt			