Experiment 21

Aim

To compare the foaming capacity of different samples of soap.

Theory

Foam is produced when soap is shaken with water. Foaming of a soap is due to the presence of hydrophilic and hydrophobic portions in its molecule $RCOO^-Na^+$. (Refer Chapter 4, *Science Textbook for Class X*, published by the NCERT). Foaming capacity of different soap samples can be compared by measuring the quantity of the foam produced by equal amount of various soap samples.

Materials Required

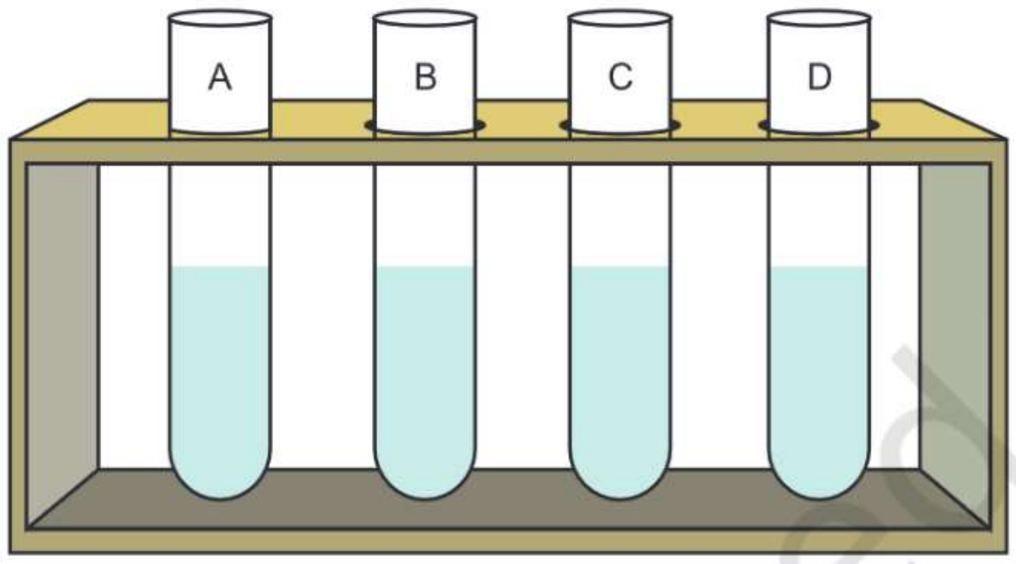
Four different samples of soaps, distilled water, physical balance and weight box, four test tubes, a test tube stand, four beakers (100 mL), a glass rod, burner, tripod stand, wire gauze, a measuring cylinder (50 mL) and a measuring scale.

Procedure

1. Take four 100 mL beakers and label them as beakers A, B, C, and D. Weigh 1 g each of the four different soap samples in a physical balance. Put them into four different beakers.
2. Add 20 mL of distilled water in all the beakers containing the soap

samples. Dissolve the soap in water by stirring the mixture with a glass rod. If a soap sample takes longer time to dissolve in distilled water, uniformly heat the contents of the beaker over a wire gauge.

3. Take a test tube stand and place the four test tubes in it and label them as tubes A, B, C, and D. Pour 1 mL each of the above-prepared soap solutions in corresponding test tubes. [Fig. 21.1(a)].
4. Add 5 mL of distilled water in each test tube.



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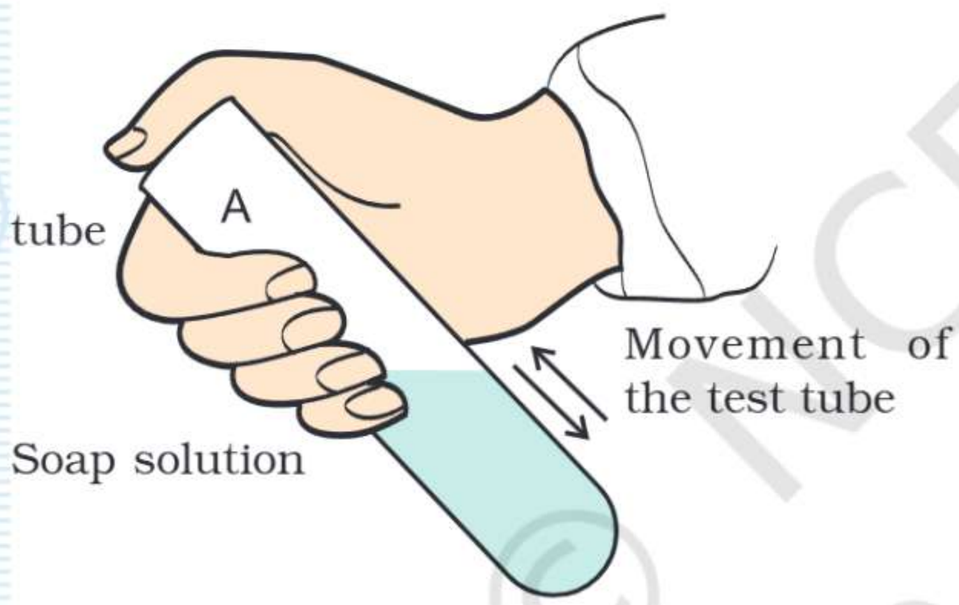

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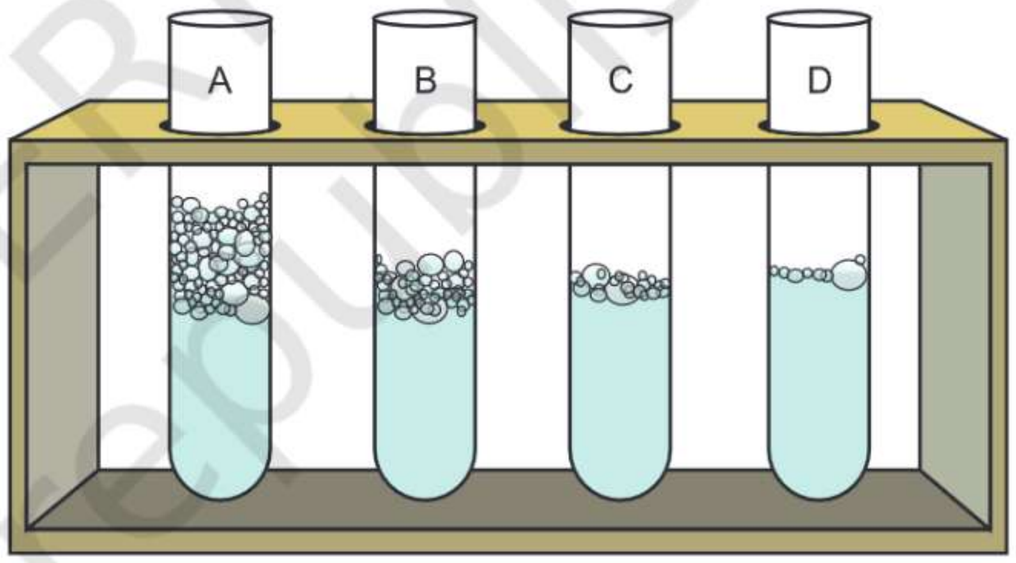


(c)

Fig. 21.1 : *(a) Test tubes containing different soap solutions*
(b) Showing the shaking of the test tube
(c) To compare the foaming capacity of different samples of soap

5. Take test tube labelled as tube A and shake it ten times by placing thumb on its mouth [see Fig. 21.1(b)].
6. By shaking the test tube, foam will be formed. Once the foam is formed, measure the length of the foam produced immediately with the help of a measuring scale [Fig. 21.1(c)].
7. Repeat steps 5 and 6 with the remaining three samples of soap solutions.

Observations and Calculations

(i) Mass of each soap sample taken in a beaker = ____ g

(ii) Volume of the distilled water added in each beaker = ____ mL

(iii) Volume of each soap sample taken in a test tube = ____ mL

(iv) Volume of distilled water added in each test tube = ____ mL

(v) Number of times each test tube shaken = _____

Soap solution	Initial length	Test tube readings Final length	Length of the foam produced
	(cm)	(cm)	(cm)
1. 2. 3. 4.			

Results and Discussion

Infer from the observations that which soap sample produces the maximum length of foam (lather) in test tube.

Why does the different soap solutions have different foaming capacities? Is it due to the presence of different alkyl groups (R) in different soap solutions? An alkyl group in a soap is the hydrophobic part.

Precautions

- Use distilled water for each sample because foaming of a soap solution does not take place in hard water.
- Stir the mixture carefully while dissolving soap in water so as to avoid spilling of soap solution.
- The quantity of soap samples in all solutions must be same. The amount of distilled water added in every soap sample must be same. That is the concentration of all test solutions must be same.
- The mass of the soap samples must be determined very carefully using a physical balance. In case of any need, take help from your teacher.
- Shake every tube for equal number of times and in a similar manner.
- Measure the length of the foam produced immediately after its production.
- Use wire gauge to heat the beaker containing soap sample(s) uniformly.

NOTE FOR THE TEACHER

- Detergents should not be used in this experiment. However a similar experiment can separately be performed for comparing the foaming capacities of different detergents.
- Students may be guided to use a physical balance for weighing sample accurately.

QUESTIONS

- What is the name of the chemical reaction which takes place during the alkaline hydrolysis of oils and fats?
- Why is it necessary to shake every test tube for equal number of times and in a similar manner?
- Why does the concentration of every soap solutions be same?
- Was the length of foam formed same in each of the test tube containing soap solution?
- Which soap sample formed maximum foam?
- If distilled water had not been taken and salts of Mg^{2+} and Ca^{2+} were present in water sample. What would have been your observation?
- In hard water, which will form more foam - a soap or a detergent?
- In this experiment it is advised that the length of the foam produced should be measured immediately after its production. Why?

Experiment 22

AIM

To study the comparative cleansing capacity of a sample of soap in soft and hard water.

THEORY

Hardness of water is caused by the presence of the salts of calcium and magnesium (hydrogencarbonates, chlorides and sulphates) in water. These salts are soluble in water. When soap is added to hard water, it reacts with the salts to form a scum, which is insoluble and floats on top of the water surface. The scum is formed due to the formation of insoluble calcium or magnesium salts of the fatty acid used in the soap formation. The soap in solution then becomes ineffective.

$$Ca(HCO_3)_2\ (aq) + 2Na^+\text{-stearate (aq)} \longrightarrow \underset{\text{Scum}}{Ca(\text{stearate})_2\ (s)} + 2NaHCO_3\ (aq)$$

(soap)

$$CaSO_4\ (aq) + 2Na^+\text{-stearate (aq)} \longrightarrow \underset{\text{Scum}}{Ca(\text{stearate})_2\ (s)} + Na_2SO_4(aq)$$

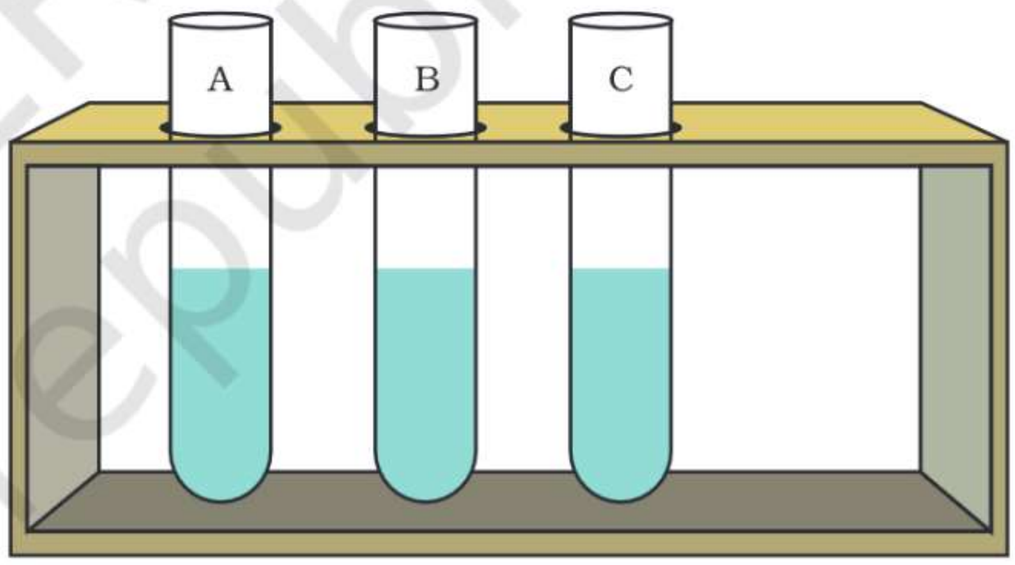
The salts of calcium and magnesium show similar reactions. Therefore, the presence of calcium and magnesium salts in water precipitates the soap thereby reducing its cleansing power and foaming capacity.

Materials Required

Underground water (well water), distilled water, calcium hydrogencarbonate or calcium sulphate, soap sample, a physical balance and weight box, three test tubes and a test tube stand, three beakers (100 mL), three glass rods, a measuring cylinder (50 mL), and a measuring scale,

Procedure

1. Take three beakers and label them as A, B and C.
2. Take 20 mL of distilled water in beaker A. In beaker B, put 20 mL of underground water, and in beaker C add 2 g of calcium hydrogencarbonate (or calcium sulphate) to 20 mL of distilled water.
3. Stir the contents of beaker C so that calcium hydrogen carbonate (or calcium sulphate) dissolves in water.
4. Put 1 g of soap in each beaker A, B, and C (after weighing it using a physical balance).
5. Stir the contents of these beakers with separate glass rods.
6. Place three test tubes in a test tube stand and label them as tube A, B and C [Fig. 22.1(a)].
7. Pour 3 mL of the above-prepared soap solution in the corresponding test tubes.



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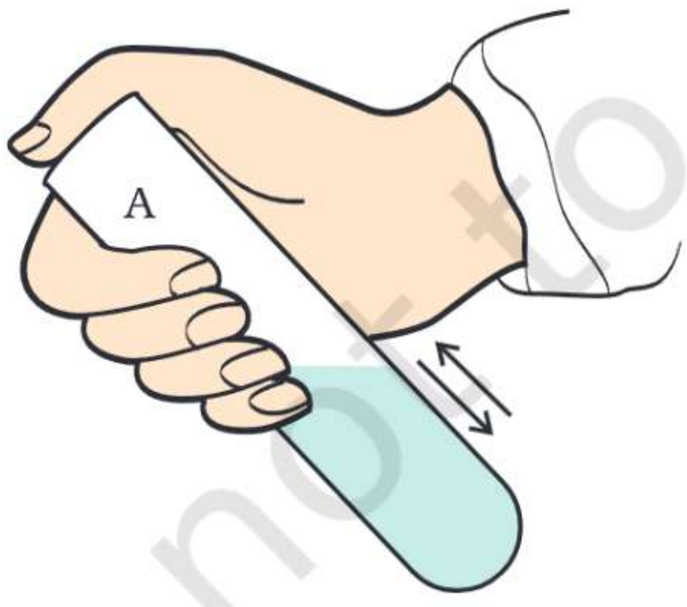

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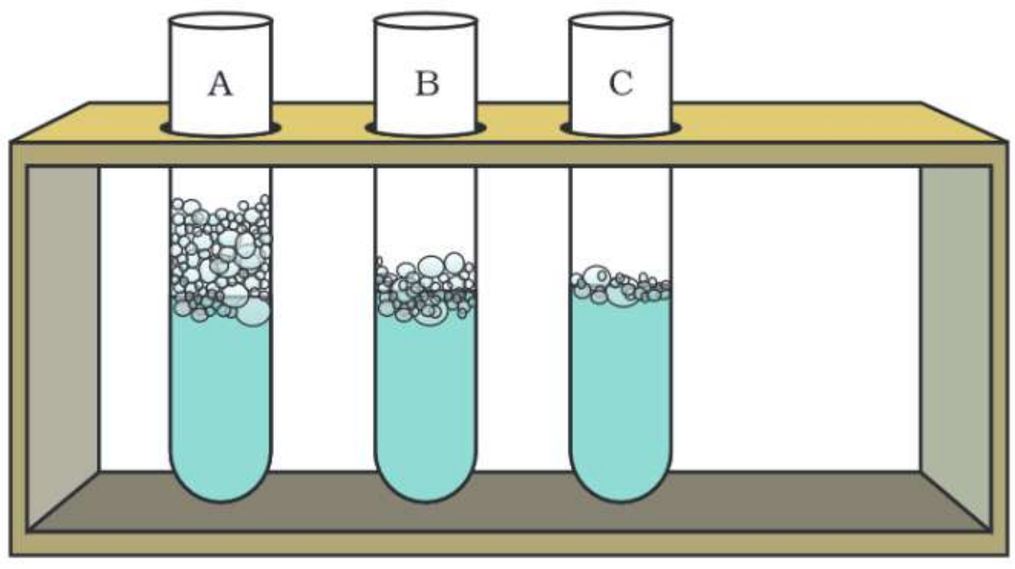

(c)

Fig. 22.1 : *(a) Test tubes containing different soap solutions*
(b) Showing the shaking of the test tube
(c) To compare the foaming capacity of different samples of soap

8. Take test tube A and shake it ten times by placing thumb on its mouth [Fig. 22.1(b)].
9. Foam or lather will be formed by shaking the test tube. Measure the length of the foam produced immediately with the help of a measuring scale [Fig. 22.1(c)].
10. Similarly, repeat steps 8 and 9 with the remaining two samples.

Observations and Calculations

(i) Mass of the soap sample taken in each beaker = _____ g

(ii) Volume of the distilled water and underground water added in each beaker = _____ mL

(iii) Volume of soap sample taken in each test tube = _____ mL

(iv) Number of times each test tube taken = _____

Sl. No.	Mixture (water + soap)	Test tube readings Initial length (cm)	Final length (cm)	Length of the foam produced (cm)
1.	Distilled water (soft water)			
2.	Well water or underground water (hard water)			
3.	Water containing $Ca(HCO_3)_2$ or $CaSO_4$ (hard water)			

Results and Discussion

Infer from the observations that which solution of the soap sample produces the maximum length of foam (lather).

For cleansing purpose, the foam needs to be produced which depends on free availability of hydrophobic portion of soaps (or alkyl groups). In hard water it is trapped due to scum or precipitation, this makes the hard water unsuitable for washing.

PRECAUTIONS

- Use same sample of soap for soft water and hard water.
- Stir the mixture carefully while dissolving soap in water so as to avoid spilling of soap solution.
- The quantity of soap sample in all solutions must be same. The amount of distilled water added in every soap sample must be same. That is the concentration of all test solutions must be same.
- The mass of the soap samples must be determined very carefully using a physical balance. In case of any need, take help from your teacher.
- Shake every tube for equal number of times and in a similar manner.
- Measure the length of the foam produced immediately after its production.

NOTE FOR THE TEACHER

- Students may be guided to use a physical balance for weighing sample accurately.

QUESTIONS

- Do both hard water and soft water produce foam with soap?
- Why is scum formed when hard water is treated with soap?
- Why did we add calcium hydrogencarbonate (or calcium sulphate) to beaker C?
- Was there any difference in the length of the foam formed in test tube C having water containing calcium hydrogencarbonate (or calcium sulphate) and test tube B containing well water or underground water?
- With their prolong use, white scales get deposited in the interior of boilers and electric kettles. What is the reason for this observation? How can these scales be removed?
- What do you understand by temporary and permanent hardness of water?
- What is the reaction between soap molecules and ions present in hard water?