

Investigating Hard and Soft Water



Introduction

Water containing calcium and magnesium ions is said to be “hard”, and it has been known for centuries that soaps lose their ability to form suds in hard water. Fortunately, there are many ways to remove these ions and make water “soft” so that soaps form more suds. In this lab, you will determine how both hard water and soft water affect soaps; you will also show how hard water can be turned into soft water.

Materials

5% calcium chloride [CaCl_2] solution	hard water
5% magnesium chloride [MgCl_2] solution	soap, solid and liquid
calcium sulfate [CaSO_4], solid	sodium carbonate [Na_2CO_3], solid
distilled water	

Equipment

test tube brush	test tubes
test tube rack	

Safety Considerations

- YOU MUST WEAR GOGGLES AT ALL TIMES DURING THIS LAB.
- Sometimes chemicals from previous labs still remain in glassware and on other lab equipment; wash all lab equipment before and after performing this lab.
- Wash your hands thoroughly after completing this lab.

Procedure #1

1. Arrange three test tubes in a test tube rack: A, B and C.
2. Add a pea-sized sample of solid soap to each test tube.
3. Add the following to each test tube:
 - Half fill test tube A with distilled water.
 - Half fill test tube B with tap water.
 - Half fill test tube C with hard water.
4. One at a time, seal the top of the test tube with your thumb and shake it well. Record your observations in the Data Table under “Procedure #1”.
5. Clean the test tubes thoroughly using tap water and a test tube brush.

Procedure #2

1. Arrange three test tubes in a test tube rack: A, B and C.
2. Add a very small sample of solid soap to each test tube.
3. Half fill each test tube with tap water.
4. Add the following to each test tube:
 - Add five drops of 5% CaCl_2 solution to test tube A.
 - Add five drops of 5% MgCl_2 solution to test tube B.
 - Do not add anything to test tube C; this will serve as your control.
5. One at a time, seal the top of the test tube with your thumb and shake it well. Record your observations in the Data Table under “Procedure #2”.
6. Clean the test tubes thoroughly using tap water and a test tube brush.

Procedure #3

1. Arrange two test tubes in a test tube rack: A and B.
2. Add 0.5 g of solid calcium sulfate to each test tube.
3. Half fill each test tube with tap water.
4. Add the following to each test tube:
 - Add a drop of liquid soap to test tube A.
 - Add 0.5 g of solid sodium carbonate to test tube B, mix by shaking, then add a drop of liquid soap.
5. One at a time, seal the top of the test tube with your thumb and shake it well. Record your observations in the Data Table under "Procedure #3".
6. Clean the test tubes thoroughly using tap water and a test tube brush.

Clean-up

1. Dump the contents of all test tubes down the sink.
2. Clean all test tubes using soap, water and a test tube brush.
3. Return all equipment to its proper location.
4. Wipe down your lab area.
5. Wash your hands before leaving the lab.

Data Table

	Test Tube A	Test Tube B	Test Tube C
Procedure #1			
Procedure #2			
Procedure #3			

Questions

1. Based on your observations, how is soap affected by hard water?

2. Based on your observations, how is soap affected by soft water?

3. Why did we need a control for Procedure #2?

4. Besides changing the amount of suds generated by soap, what is another practical reason for softening water?

5. List one way you could change this lab and describe how your results might be different.
