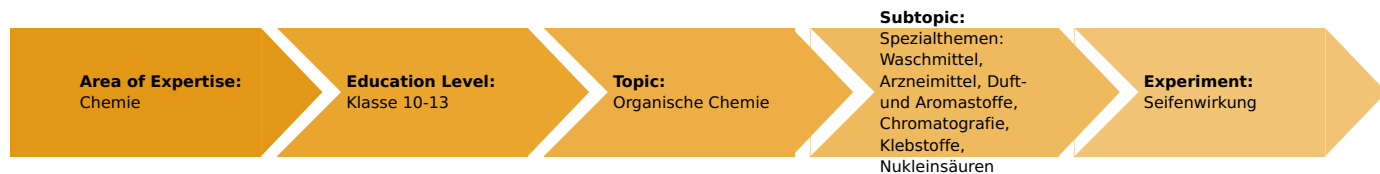


The action of soap (Item No.: P7173500)

Curricular Relevance



Difficulty



Easy

Preparation Time



10 Minutes

Execution Time



10 Minutes

Recommended Group Size



2 Students

Additional Requirements:

Experiment Variations:

Keywords:

soap, material property of soaps

Task and equipment

Information for teachers

Learning objectives

- Detergents reduce the surface tension of water.
- Their properties result from their molecular construction, with a long unpolar chain and a short, polar part.

Notes on setup and procedure

Preparation:

Ensure that warm water (boiler) is available. The temperature of the water should be near to the melting point of stearic acid (69 °C). Lycopod spores or dried herbs can be used instead of sulphur.

Remarks on the students experiments:

The detergent must be very carefully placed over the mouth of the bottle, as otherwise turbulence is caused. Ensure that the stearic acid is not heated much above its melting point. When the water is sufficiently hot (70 °C), and the pouring was carried out slow and carefully, a uniform disk is formed on cooling.



Hazard and precautionary statements

Ethanol:

H225: Highly flammable liquid and vapour.

P210: Keep away from heat/sparks/open flames/hot surfaces – No smoking.

Sulphur:

H315: Causes skin irritation.

P302 + P352: IF ON SKIN: Wash with soap and water.

Sudan III:

H315:	Causes skin irritation.
H319:	Causes serious eye irritation.
H335:	May cause respiratory irritation.
H341:	Suspected of causing genetic defects.
P261:	Avoid breathing dust/fume/gas/mist/vapours/spray.
P302 + P352:	IF ON SKIN: Wash with soap and water.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing.
P405:	Store locked up.

Hazards

- Splashing can occur when stearic acid is too strongly heated. Wear protective glasses!
- Sudan-III-solution contains ethanol which is highly inflammable. Extinguish all open flames, keep the bottles closed and remove them from the working area as soon as possible!
- Sudan-III-solution causes discolouration. Do not allow it to contact skin! Wear protective gloves!

Notes

Stearic acid molecules ($C_{17}H_{35}COOH$) align themselves on the water surface as described. This can be also be shown e.g. with a liquid fatty acid such as arachidonic acid, which, when placed on the surface of the water, resists the movement of a "swimmer" on the water and finally stops it.

Remarks on the method

The experiments can also be carried out in work-sharing groups, but the evaluation should be carried out together, as the evaluation of one experimental part becomes more plausible with the evaluation of the other parts. Explain how surface tension originates, the terms lipophilic, hydrophilic and the construction of other surface-active agents (tensides).

Waste disposal

- Pour coloured oil carefully in the container for organic liquids.
- Filter off the sulphur powder and after drying, store it in an appropriately labelled container for future re-use. Pour the remaining solution down the drain.

The action of soap (Item No.: P7173500)

Task and equipment

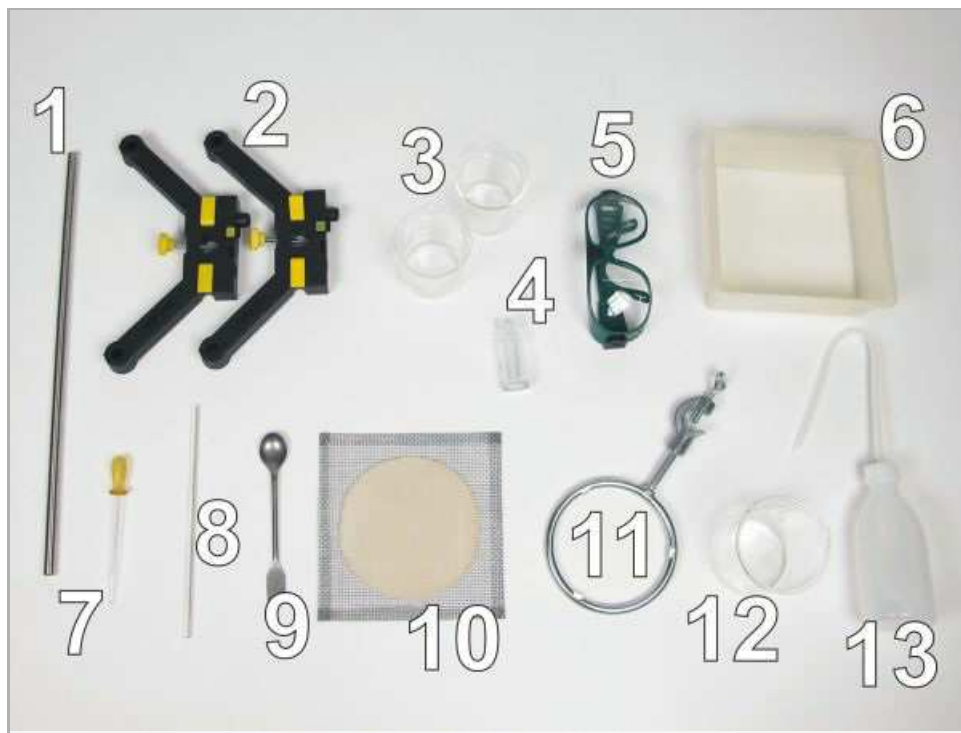
Task

How can the properties of soaps be explained?

Examine some specific reactions of detergents.



Equipment



Position No.	Material	Order No.	Quantity
1	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
2	Support base, variable	02001-00	1
3	Glass beaker DURAN®, short, 150 ml	36012-00	2
4	Pipette bottle 10 ml, clear, screw	64785-00	1
5	Protecting glasses, clear glass	39316-00	1
6	Dish, plastic, 150x150x65 mm	33928-00	1
7	Pipette with rubber bulb	64701-00	1
8	Glass rod, boro 3.3, l=200mm, d=6mm	40485-04	1
9	Spoon, special steel	33398-00	1
10	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
11	Ring with boss head, i. d. = 10 cm	37701-01	1
12	Glass beaker DURAN®, short, 250 ml	36013-00	1
13	Wash bottle, 250 ml, plastic	33930-00	1
	Butane burner f.cartridge 270+470	47536-00	1
	Butane cartridge CV 300 Plus, 240 g	47538-01	1
	Olive oil,pure 100 ml	30177-10	1
	Sulphur, subl. 500 g	30216-50	1
	Stearic acid 250 g	30228-25	1
	Sudan-III solution,alcohol 250 ml	31861-25	1
Additional material			
	Curd soap		
	Detergent		

Set-up and procedure

Set-up

Hazards

- Splashing can occur when stearic acid is too strongly heated. Wear protective glasses!
- Sudan-III-solution contains ethanol which is highly inflammable. Extinguish all open flames, keep the bottles closed and remove them from the working area as soon as possible!
- Sudan-III-solution causes discolouration. Do not allow it to contact skin! Wear protective gloves!



Procedure

Part 1

Put about 15 ml of olive oil in a 150 ml beaker, add a few drops of Sudan red (Fig. 1) and stir with the glass rod until all of the oil is coloured red (Fig. 2). Fill the bottle up to its mouth with the coloured oil and stand the bottle in a 250 ml beaker (Fig. 3).



Fill water into the beaker without pouring it on the oil. As soon as the water level reaches the height of the mouth of the bottle, add the water very slowly and only at the edge of the beaker (Fig. 4). Stop the addition when the water level is about 3 cm above the mouth of the bottle (Fig. 5). Slowly put a little detergent on the water surface above the mouth of the bottle.



Part 2

Fill the plastic dish two thirds full with warm water and sprinkle sulphur powder thinly on the surface of the water. Dip the edge of the piece of soap in at the center of the water surface (Fig. 6).



Part 3

Fill a 250 ml beaker two thirds full with warm water. Warm a 150 ml beaker filled to one third with stearic acid over a small flame. Stop heating when the stearic acid has melted completely. Pour the molten stearic acid carefully onto the water surface, so that it solidifies to an approximately 0.5 cm thick disk.

Loosen the disk at the sides of the beaker and take it out of the water when it has completely cooled. Hold the disk over the plastic dish and pour water first over the upper side, then over the lower side.

Waste disposal

- Pour coloured oil carefully in the container for organic liquids.
- Filter off sulphur powder and after drying, store it in an appropriately labelled container for future re-use. Pour the remaining solution down the drain.

Report: The action of soap

Result - Observations

Note your observations on part 1 to 3.

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Evaluation - Question 1

Draw conclusions from your observations on part 1 to 3 of the experiment.

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Evaluation - Question 2

Regarding your conclusions, explain the structure of a detergent and how it works (draw a sketch of this in Question 3).

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Evaluation - Question 3

Draw a sketch of what you explained in Question 2.

Evaluation - Question 4

Explain shortly the way in which soap molecules in water act against water-insoluble substances.

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Evaluation - Question 5

Sketch what you explained in Question 4.