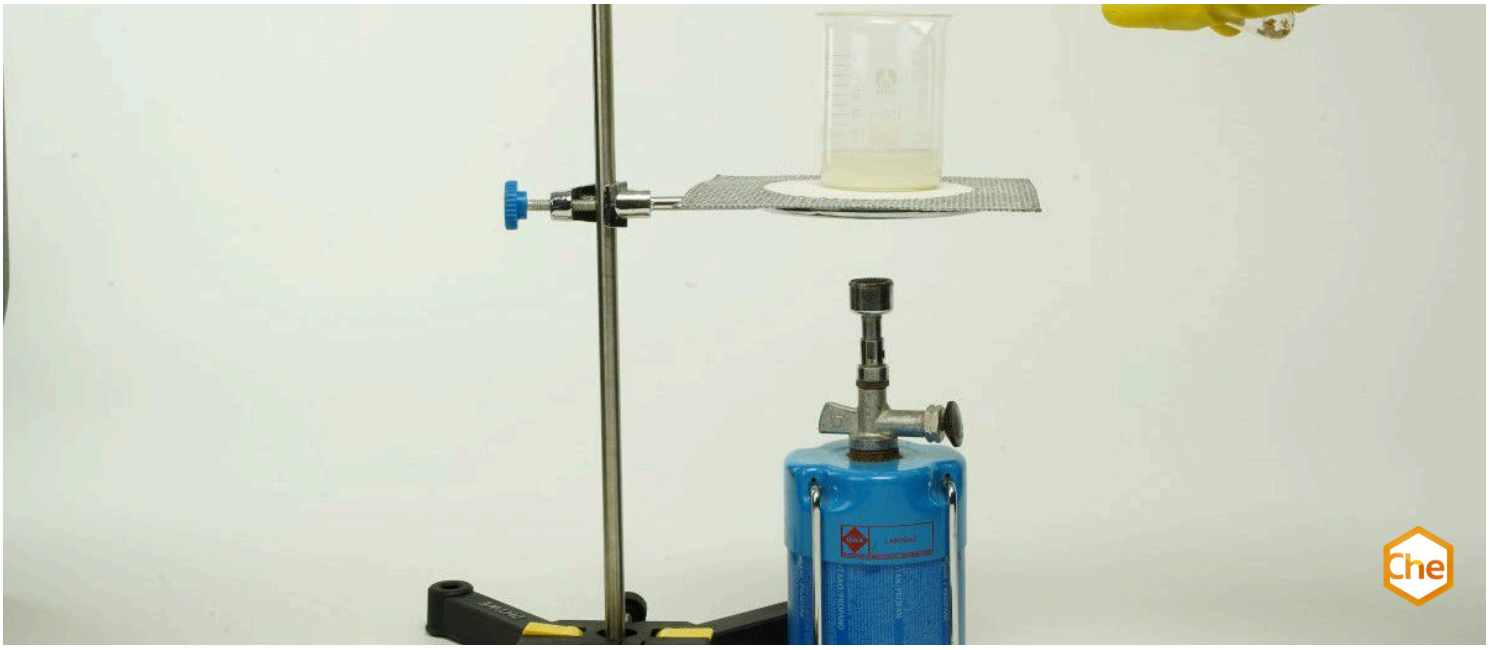
Production of soap



Chemistry > Organic chemistry > Dyestuffs / Household chemistry

Difficulty level	Group size	Preparation time	Execution time
easy	2	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/638666107df83e00030850a2

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Teacher information

Application

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The experimental setup

Soaps are usually made from vegetable or animal fats. For the production, fats are strongly heated with a lye (for example sodium hydroxide solution or potassium hydroxide solution). In the process, the fats are broken down into glycerine and the alkali salts of the alkanoic acids (fatty acids). Chemically speaking, soaps are mixtures of different alkali salts of long-chain fatty acids and belong to the group of surfactants.

In this experiment, students make soaps from long-chain alkanoic acids or fats by adding alkali lyes.

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Other teacher information (1/5)

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Prior knowledge

The students should already have a basic knowledge of alkanes, acids and bases, as well as carboxylic acids and their salts. A basic understanding of simple reaction equations and the safe handling of chemicals, as well as butane or Bunsen burners, should also already be present or can be acquired with the help of this experiment.

Principle

With the help of alkali lye, soaps can be made from long-chain alkanoic acids. Therefore, soaps must consist of the alkali salts of fatty acids.

Other teacher information (2/5)

PHYWE

Learning objective

The students learn about the production of soap. This is produced from the reaction of alkanoic acids or fats by adding alkali lyes. Soaps must therefore consist of alkali salts of fatty acids.

Tasks

Make soap from fat or stearic acid.

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Other teacher information (3/5)

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Notes on the experiment

Fats are glycerol esters of long-chain alkanoic acids. The ester is split by the sodium hydroxide solution. Accordingly, alcohol (glycerol) and the sodium salt of the fatty acid are formed. Example:

$$(C_{17}H_{35}COO)_3C_3H_5 + 3\ NaOH \rightarrow 3\ C_{17}H_{35}COONa + C_3H_5(OH)_3$$

Stearic acid is neutralised by sodium hydroxide solution. Sodium stearate and water are formed:

$$C_{17}H_{35}COOH + NaOH \rightarrow C_{17}H_{35}COONa + H_2O$$

Other teacher information (4/5)

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Notes on set-up and procedure

Preparations

Prepare concentrated sodium hydroxide solution and 25 % sodium hydroxide solution (34 g NaOH to 100 ml water). Keep the eye wash bottle handy. Margarine or hardened vegetable fat is particularly suitable as fat.

The "saponification" of fats carried out here corresponds to the classic soap-making process, which can also be carried out according to old recipes with plant ash (potash).

Notes on the student experiments

Both stearic acid and fat should only be heated to the point where they just melt. At higher temperatures, the caustic soda tends to splash out more.

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Other teacher information (5/5)

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Methodological remarks

Here, the group procedure has a particularly motivating effect, as the same product, which is phenomenologically very different from the reactants, is created from different starting materials. The different experimental procedures can be presented by the working groups and the similarity of the result can be fruitfully discussed.

Disposal

- Pour the contents of the test tubes into the beaker and filter off.
- Place the filtrate in the collection container for organic liquids, soap and grease residues with the normal waste.

Safety instructions

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The general instructions for safe experimentation in science lessons apply to this experiment.

For H- and P-phrases please consult the safety data sheet of the respective chemical.

Dangers

- Caustic soda has a strong corrosive effect. Put on protective gloves!
- Splashes may occur when sodium hydroxide is added to the molten substances. Put on protective goggles!
- Methylated spirits are highly flammable. Extinguish all open flames when filling!

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Student information

Motivation

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Soap bars

Soaps are generally used to remove dirt. They were already made about 4500 years ago, back then the recipes were based on mixtures of alkaline plant ash and oils. Even today, soaps are usually made from vegetable or animal fats. For the production, fats are strongly heated with a lye (for example sodium hydroxide solution or potassium hydroxide solution). In the process, the fats are broken down into glycerine and the alkali salts of the alkanoic acids (fatty acids).

In this experiment, we will now make soap ourselves.

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Tasks

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The experimental setup

Make soap from fat or stearic acid.

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Equipment

Position	Material	Item No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
3	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
4	Spoon, special steel	33398-00	1
5	Wash bottle, 250 ml, plastic	33930-00	1
6	Beaker, Borosilicate, low form, 250 ml	46054-00	1
7	Test tube, 180x18 mm,100pcs	37658-10	1
8	Test tube brush w. wool tip,d20mm	38762-00	1
9	Test tube rack for 12 tubes, holes d= 22 mm, wood	37686-10	1
10	Ring with boss head, i. d. = 10 cm	37701-01	1
11	Test tube holder, up to d 22mm	38823-00	1
12	Rubber stopper, d=22/17 mm, without hole	39255-00	1
13	Protecting glasses, clear glass	39316-00	1
14	Rubber gloves, size M (8), one pair	39323-00	1
15	Glass rod, boro 3.3, l=200mm, d=6mm	40485-04	1
16	Sodium hydroxide, pellets, 1000 g	30157-70	1
17	Stearic acid 250 g	30228-25	1
18	Denaturated alcohol (spirit for burning), 1000 ml	31150-70	1
19	Water, distilled 5 l	31246-81	1
20	Butane burner with cartridge, 220 g	32180-00	1
21	Graduated cylinder, 10 ml, plastic	36636-00	1

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Additional equipment

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Additional equipment

Fat (for example butter)

Set-up (1/2)

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1.Set up the tripod according to Fig. 1 to 4.

2. Attach the support ring to the rod and place the wire gauze on top.

3. Move the height of the ring so that the burner flame just reaches the wire gauze.

Figure 1

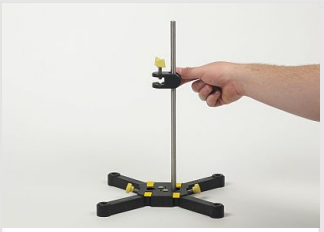

Figure 2

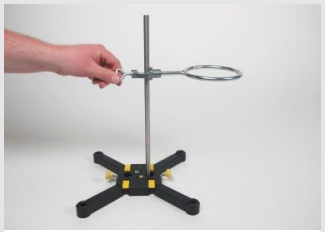

Figure 3

Figure 4

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Set-up (2/2)

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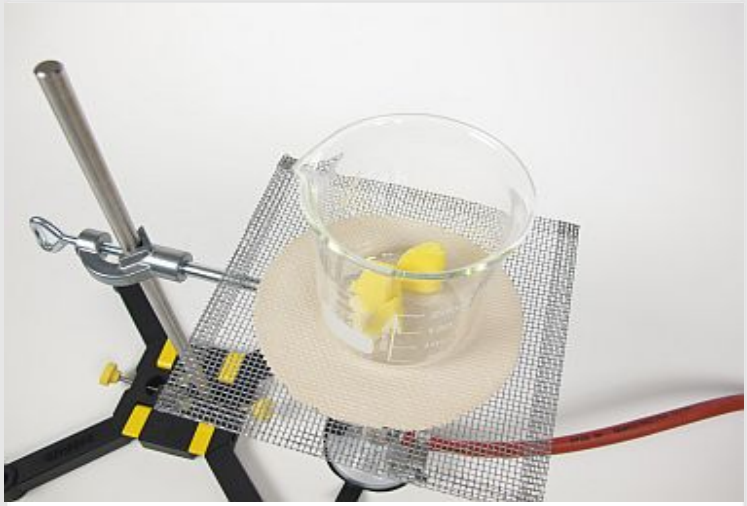

Figure 5

4. Add 3 spoonfuls of fat to the large beaker, place the first beaker on the wire gauze (Fig. 5).

Procedure (1/7)

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1. Carefully heat the beaker over a low flame so that the fat just melts.

2. Add 10 ml methylated spirit and 5 ml distilled water (Fig. 6).

3. Gradually add 10 ml of the 25% sodium hydroxide solution (Fig. 7) to this mixture and heat for a further 10 minutes while stirring with the glass rod (be careful not to splash!).

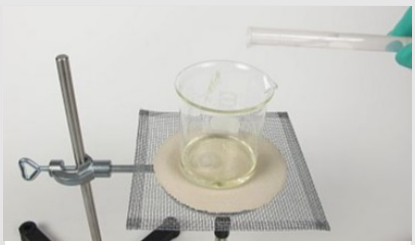

Figure 6

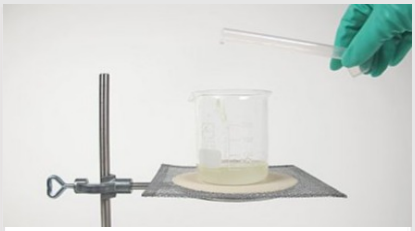

Figure 7

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Procedure (2/7)

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Figure 8

4. Replace the evaporating water by carefully adding distilled water.

5. Then let the beaker cool down (Fig. 8 and 9).

Figure 9

Procedure (3/7)

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6. Put a spoonful of stearic acid (Fig. 10) into a test tube, add 3 ml methylated spirit (Fig. 11) and 5 ml distilled water (Fig. 12).

Figure 10

Figure 11

Figure 12

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Procedure (4/7)

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Figure 13

Figure 14

7. Heat the mixture briefly (Fig. 13), then add 3 ml concentrated sodium hydroxide solution. Caution: Splashing may occur during the addition!

8. Then heat the mixture carefully for approx. 3 min, shaking gently, without letting it boil.

9. After cooling, place the test tube in the test tube rack (Fig. 14).

Procedure (5/7)

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Figure 15

Figure 16

10. Pour about 1 ml of the mixture just prepared from the part that settles on top into a second test tube (Fig. 15).

11. Add distilled water at a filling level of approx. 5 cm, close the test tube with a stopper and shake vigorously (Fig. 16).

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Procedure (6/7)

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12. Remove some of the settling substance from the beaker with the spoon (Fig. 17), put it into another test tube (Fig. 18), fill it with distilled water as before, close it with the stopper and shake vigorously again (Fig. 19).

Figure 17

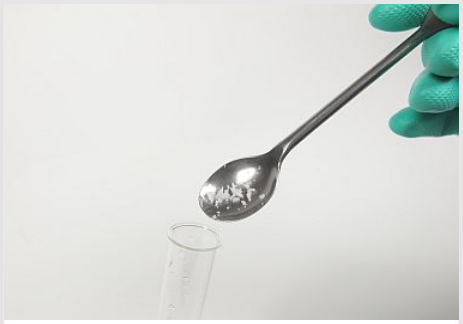

Figure 18

Figure 19

Procedure (7/7)

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Disposal

Pour the contents of the test tubes into the beaker and leave for disposal.

Figure 17

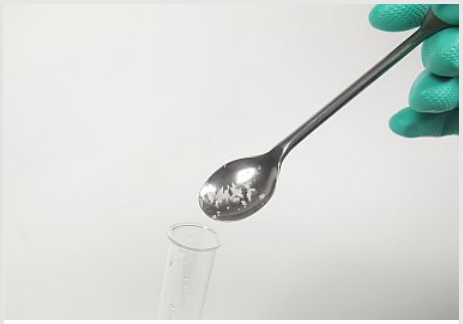

Figure 18

Figure 19

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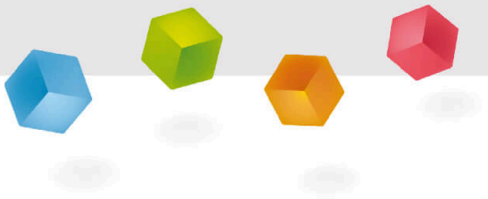

Report

Task 1

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Write down your observations.

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Task 2

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Formulate the corresponding reaction equations for both reactions.

a) Fat

b) stearic acid

Task 3

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What effect did the reaction products have on water?

- ○ The temperature of the water became cooler
- ○ The water foamed strongly
- ○ The water turned green

Check

According to the observation, what could the reaction products be?

- Soap
- Dye
- Coolant

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Task 4

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Fats are glycerol esters of long-chain alkanoic acids. Which reaction must have taken place in the first part of the experiment?

Since fats are glycerol esters of long-chain _____, the components of the acid (_____) react with the components of the alkali (_____) from the added sodium hydroxide solution in a neutralisation reaction to form _____. A further reaction product is _____.

water
oxonium ions
salts
alkanoic acids
hydroxide ions

Check

Task 5

PHYWE

What conclusion for the composition of soap must be drawn from the experimental parts?

- ○ The soaps produced consist of long-chain fatty acid molecules.
- ○ The soaps produced consist of water and glycerine.
- ○ The soaps produced consist of the alkali salts of the fatty acids used.

Check

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Slide	Score / Total
Slide 26: Multiple tasks	0/2
Slide 27: Expired reaction	0/5
Slide 28: Soap composition	0/1

Total 0 / 8

Solutions | Repeat | Export text

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