

MINISTRY OF EDUCATION
SECONDARY ENGAGEMENT PROGRAMME
GRADE 11
CHEMISTRY

WEEK 9

LESSON 2

Topic: Esters

Sub-topic: Preparation of Soaps

Objectives: Given the information, students will:

- (v) accurately describe the preparation of soap -saponification of fats and oils.
- (vi) accurately Compare the effect of soapy and soapless detergents on hard and soft water.

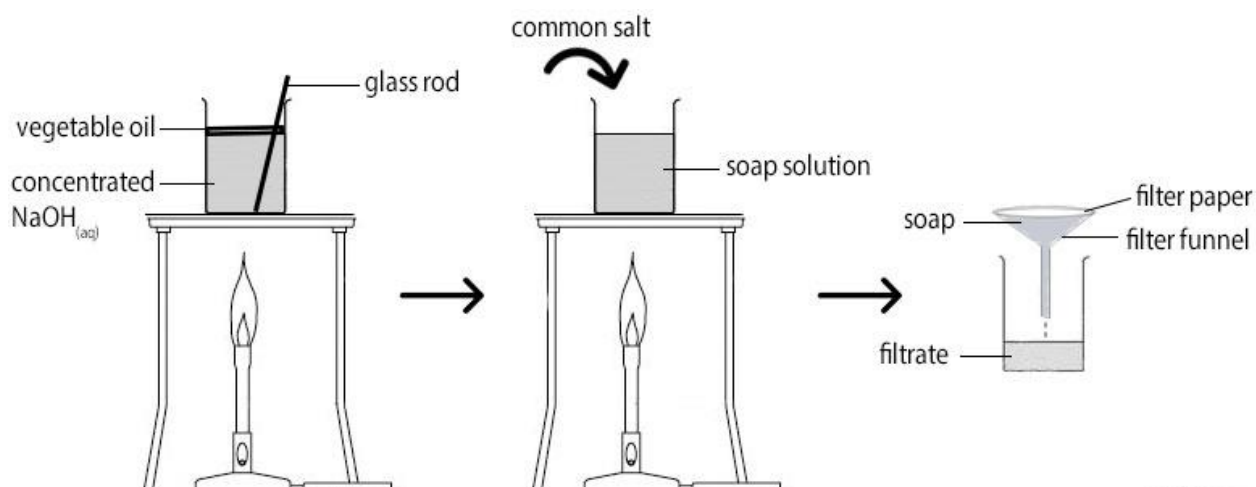
Content

Soaps are the sodium and potassium salts of long-chain carboxylic acids. **Saponification** refers to the process that produces soap. During saponification, large ester molecules found in animal fats and vegetable oils undergo alkaline hydrolysis by being boiled with concentrated potassium or sodium hydroxide solution.

Making soap

A simple method for making soap in the school's laboratory is as follows:

1. Put about 5cm^3 of vegetable oil into an evaporating dish and heat.
2. To the hot oil add 10 cm^3 of concentrated sodium hydroxide solution to which methylated spirit has been added. (the methylated spirit speeds up the reaction).
3. Add concentrated sodium chloride solution to the mixture.
4. Stir and heat for a further five minutes.
5. Allow the mixture to cool.
6. Filter the mixture to obtain the soap.



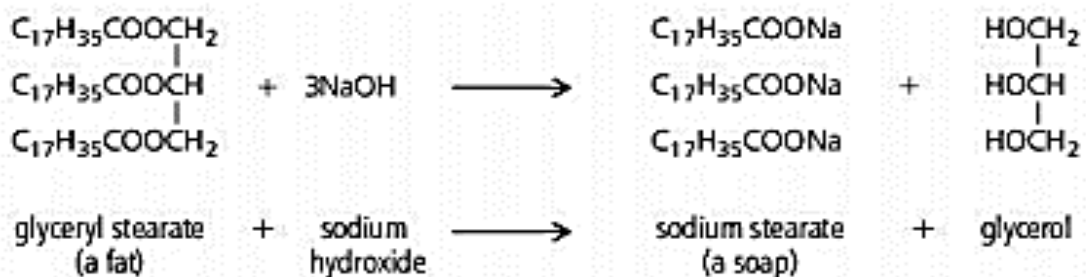
Soap preparation

Example

The fat glyceryl octadecanoate ($C_{17}H_{35}COO$)₃ C_3H_5) is an ester of octadecanoic acid also called stearic acid. ($C_{17}H_{35}COOH$) and glycerol ($C_3H_5(OH)_3$). Saponification of glyceryl octadecanoate by boiling with sodium hydroxide solution forms sodium octadecanoate ($C_{17}H_{35}COONa$) and glycerol. Sodium octadecanoate, also called sodium stearate, is the most common form of soap.



This can also be written as:



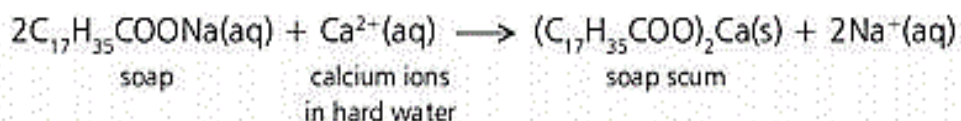
Soapy And Soapless Detergents

Soapy and soapless detergents are substances that are added to water to remove stains and dirt e.g. from the skin, clothes, household surfaces, and floors.

- Soapy detergents are made by boiling animal fats or vegetable fats and oils with concentrated potassium or sodium hydroxide solution. They may be simply called soaps, e.g. sodium octadecanoate ($C_{17}H_{35}COONa$)
- Soapless detergents are formed from petroleum. They are also known as 'synthetic detergents' and may be simply called detergents, e.g. sodium dodecyl sulfate, $C_{12}H_{25}OSO_3Na$.

EFFECT OF SOAPY AND SOAPLESS DETERGENTS ON HARD AND SOFT WATER.

Detergents form a lather(foam) with soft water. This is because soft water does not contain dissolved calcium and magnesium salts. Hard water contains a lot of calcium and magnesium salts as such they do not lather well with soap. Instead, they form an insoluble scum of calcium or magnesium salt.



Soapless detergents lather well with both hard and soft water because the calcium and magnesium salts they form are soluble. These detergents do not form scum.

COMPARING SOAPY AND SOAPLESS DETERGENTS

SOAPY DETERGENTS	SOAPLESS DETERGENTS
Manufactured from fats and oils, a renewable resource that will not run out.	Manufactured from petroleum, a non-renewable resource that will eventually run out.
Do not lather easily in hard water containing Ca^{2+} and Mg^{2+} ions. Their calcium and magnesium salts are insoluble and form	Lather easily in hard water. Their calcium and magnesium salts are soluble, so they do not form scum.

<p>unpleasant scum. This wastes soap discolours clothes and forms an unpleasant grey, greasy layer around sinks, baths, and showers.</p>	
<p>Are biodegradable, meaning they are broken down by bacteria in the environment. They do not cause foam to form on waterways such as lakes and rivers, or in sewage systems.</p>	<p>Some are non-biodegradable. These can cause foam to form on waterways and in sewage systems. This causes aquatic organisms to die because oxygen can no longer dissolve in the water, and it makes sewage treatment difficult. Most modern soapless detergents are now biodegradable.</p>
<p>Do not contain phosphates, so they do not cause eutrophication of aquatic environments.</p>	<p>Some contain phosphates, added to improve their cleaning ability. Phosphates cause pollution of aquatic environments by causing eutrophication, i.e. nutrient enrichment which stimulates the rapid growth of green algae.</p>