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T.Y.B.Sc. Sem-V

Industrial chemistry paper -505

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As per new revised choicebased credit system syllabus w.e.f. June 2021

# Soap And Detergents

Introduction, Manufacture of soap, Raw Materials for Soaps, Important uses of soaps

# Soap

## Introduction

The washing industry usually known as **soap Industry**, has roots over 2000 years in the past. The present soap was gradually developed from the crude mixtures of alkaline and fatty materials. The old process known as the **Batch process** in which a bulk of fatty acids is treated with caustic alkali in the reaction kettles. In old days the alkali required for manufacture of soap was obtained by the crude latching of wood ashes or from evaporation of naturally occurring alkaline waters (e.g. the water of Nile River). Lablane developed a method of preparation of lower priced, sodium carbonate (alkali) from sodium chloride.

After First World War, due to the shortage of raw materials led the **German** people to develop **synthetic soaps** or **detergents**, but has come to common use recently.

## History of Soap

Soap requires two major raw materials: fat and alkali. The **alkali** most commonly used today is sodium hydroxide (NaOH) or potassium hydroxide (KOH). Potassium based soap creates a more water-soluble product than sodium-based soaps, and so it is called **'soft soap'**. Soft soap alone or in combination with sodium-based soap, is commonly used in shaving products.

Animal fat in the past was obtained directly from a slaughterhouse. Modern soap makers use fat that has been processed into fatty acids. This eliminates many impurities and it produces byproduct water instead of glycerin. Many vegetable fats including olive oil. palm kernel oil and coconut oil, are also used in soap making.

Developments of commercially feasible methods in the 1930s for obtaining fatty alcohols provide a great impetus to **synthetic-detergent** production. The **first fatty alcohol** used in production of synthetic detergents were derived from body of the **sperm** or bottlenose whale (sperm oil). Efforts soon followed to derive these materials from the **less expensive triglycerides** (coconut and palm-kernel oils and tallow)

When the **chemical processing** developed high-pressure hydrogenation and oil-hardening processes for natural oils, **detergent** manufacturers began to adopt

these methods for **reduction** of coconut oil, palm-kernel oil and other oils into **fatty alcohols.**

Today **alkyl benzene** is the most important raw material for synthetic detergent production. The alkyl group is attached to benzenes sulphonate by a reaction called **alkylation**, with various catalysts to form alkyl benzenes. By **sulphonation** alkyl benzene sulphonate is produced, marked in powder and liquid form; it has excellent **detergent** and **cleaning properties** and produces high foam.

**Difficulties:** The foam produced by synthetic detergents remains on the surface of waste water as it passes from towns through drains to sewers and sewage systems; then to rivers and finally to the sea. It has caused **difficulties** with river navigation; and because the foam **retards biological degradation** of organic materials in sewage: it caused problems in sewage water regeneration systems. In countries where sewage water is used for irrigation, the foam was also a problem

**Solutions:** Intensive research in the 1960s led to changes in the alkyl benzene sulphonates molecules. The **tetrapropylene**, which has a branched structure, was replaced by alkyl group consisting of a **straight carbon chain** which is more easily **broken down by bacteria**.

**Chemistry of Soap:**

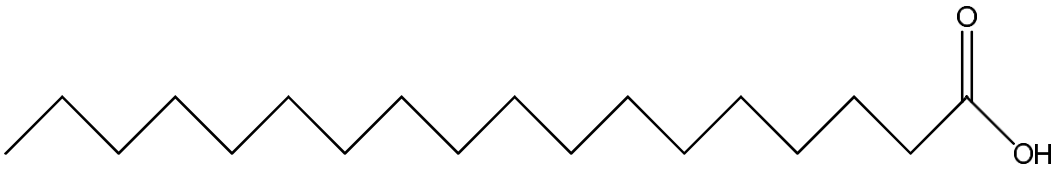
Soap and detergents are essential to personal and public health. They safely remove germs, soil and other contaminants and help us to stay healthy and make our surroundings more pleasant. Soaps are made from fats and oils or their fatty acids.

**Fatty acids (R-COOH):**

Fatty acids are merely carboxylic acids consisting of a long hydrocarbon chain one end and a carboxyl group (-COOH) at the other end. They are generally represented at R-COOH. They are an important component of plants, animals and other microorganisms. They found in various parts of the body, such as cell membranes, the nervous system and as lung surfactant.

**Types of fatty acids:** There are two groups of fatty acids.- Saturated fatty acids and unsaturated fatty acids.

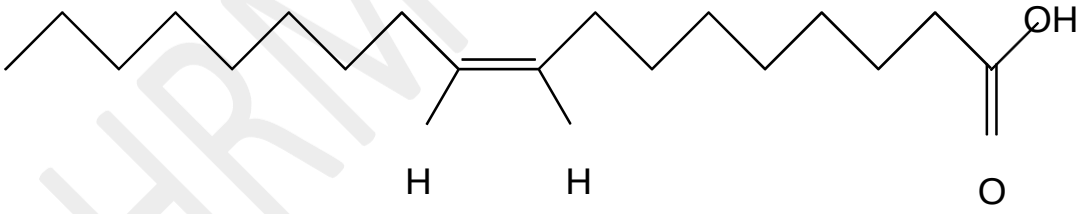
**(i) Saturated fatty acids :-** Fatty acids which contain carbon-carbon single bonds are called saturated fatty acids. Example - Stearic acid ($C_{17}H_{35}COOH$) and Palmitic acid ($C_{15}H_{31}COOH$)




Stearic acid ($C_{17}H_{35}COOH$)


Palmitic acid ($C_{15}H_{31}COOH$)

**(ii) Unsaturated fatty acids:** Unsaturated fatty acids contain one or more double bonds between carbon atoms. Example:- Oleic acid ($C_{17}H_{33}COOH$).




Oleic acid ($C_{17}H_{33}COOH$)

If the fatty acid has a single C-C double bond in the molecule, it is known as mono-unsaturated fatty acid (e.g. Oleic acid). If a fatty acid has two or more C-C double bonds in the molecule, it is known as poly-unsaturated fatty acid. (e.g. Linoleic acid).

$CH_3(CH_2)_4CH=CH-CH_2-CH(CH_2)_7COOH$, Linoleic acid.

Long chain fatty acids always exist as triglycerides and are found in fats and Triglycerides are esters of fatty acids and are formed combining fatty acids with glycerol.

**The chemical reaction for manufacture of soap**

The hot process or cold process is used for making the soap, To prepared the laundry soap and toilet soap or bath soaps the hot process is used while the cold process is used to prepared transparent and other special type of soap. If the hot process is used then in most of the cases, soap obtain is settle or grain and separated from spent layer containing the glycerol in the solution The by -product of soap industry is glycerol. Manufacture of various types of soap products involves the preparation of neat soap 1) By saponification of oils and fats with alkalies

2) By direct neutralization of fatty acids and its processing

The saponification of oils and fats with aq. alkali gives the mixture of alkali, glycerol

The soap making from fats and oils involved in the following two important steps

1) Preliminary processing of oils and fats
2) Preparation of neat soap by saponification process

## Manufacture of soap

The long chain fatty acids can be of either **plant origin** (linseed oil, castor oil, soya bean, coconut oil) or **animal origin** (tallow, from cattle and sheep). In general fats/oils from plant origin are high in unsaturated and low in saturated fatty acids. Fats / oils from animal source are high in saturated and low in unsaturated fatty acids.

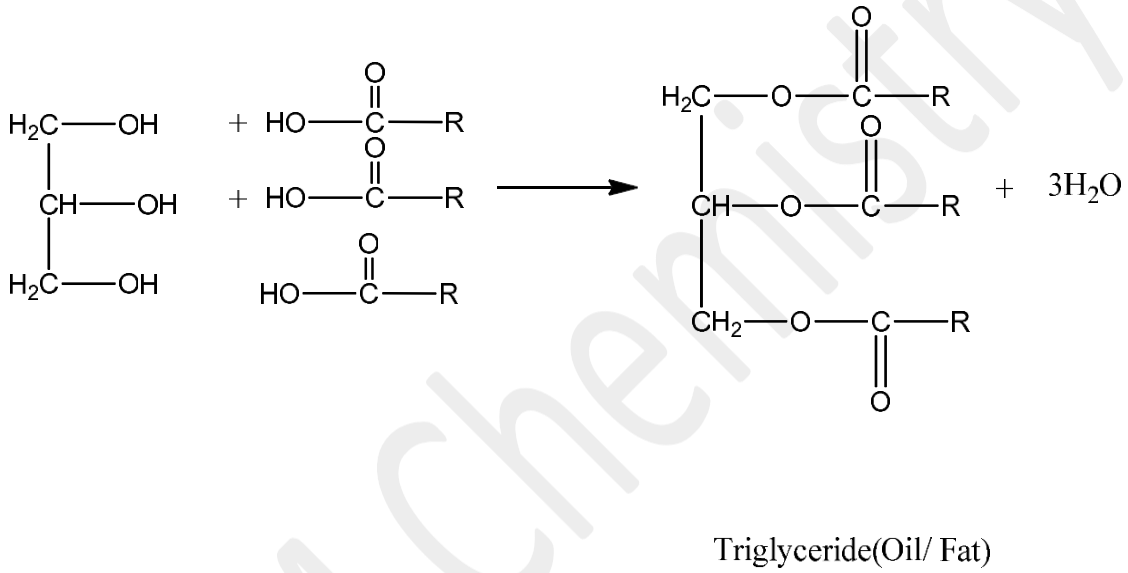



**Fig. 3.1 : Formation of Triglyceride**

**Raw Materials for Soaps:**

The triglycerides (triesters of fatty acids with glycerin) are the basic raw material for the manufacture of soap utilizing a variety of processes. The raw materials required for soap can be classified under following categories –

**(i) Oils and fats:** The principal raw materials required for soaps are oils and fats orfatty acids. The main sources of **slow lathering hard oils** are tallow, palm oil, whaleoil, fish oil, greases etc. **Quick lathering hard** oils include coconut oil, edible oliveoil etc.

**(ii) Caustic Soda (NaOH):** It is available in the form of flakes, blocks and sticks aswell as 70° (90.32% NaOH), 72° (92.9% NaOH) and 74° (94.98% NaOH). In soap making blocks form of NaOH is generally employed. Special quality soft soaps, shaving creams etc. make use of caustic potash (KOH) of 18.5 to 20% strength.

(i) Resin: It is a plant exudation product which mainly contains abietic acid. The colorless variety of resin is used in the manufacture of laundry soaps and dark variety is used in the manufacture of coloured soaps. Important applications of resin are - (a) It makes lather formation faster (b) It increases the cleaning action of soap and (c) It is used in softening of hard soaps.

(ii) Common salt or Sodium chloride: It is used for salting out of soap. About 12.5 parts of common salt per 100 parts of oil to be used for saponification.

(iii) Binding materials: The cleaning capacity of ordinary soaps is improved by adding certain binding materials such as-sodium silicate (5%), soda ash, tri-sodium phosphate and borax. The binding materials improve soap texture, correct the alkalinity of the solution and prevent the formation of precipitates in hard water.

(iv) Fillers: The bulk or weight of soap is increased by adding certain fillers such as tale (5-10%), starch (2%), pearl ash etc; without effecting the detergency.

(v) Coloring matter: Organic dyes and inorganic pigments are generally used for bar and flake soap products. As a soap dye, the colouring matter should be

inert to alkali used in making soap.

should not separate out on cooling the blended soap.

should not affect the fragrance of the soap.

Perfumes and Perfume Fixative :

The essential oils, known as perfumes impart fragrance to the soap. They may be natural or synthetic. Natural perfumes are sandal wood oil, lemon grass oil, clove oil, eucalyptus oil, lavender oil, cinnamon oil etc. Synthetic perfumes are Jasmin (Benzyl acetate), rose ( phenyl

ethyl alcohol), lilac and musk (benzoate).

Some other addition in soaps

(a) Super fatting agents : The material such as lanolin (a fatty material isolates from sheep's wool) is added to prevent the skin from becoming rough and dry. It is added to the soap to the extent of 2%. It also improves texture of the soap and presents cracks on soap when dry.

(b) Disinfectants: Extracts of various plants such as neem, eucalyptus, chaulmoogra etc. are added as disinfectants.

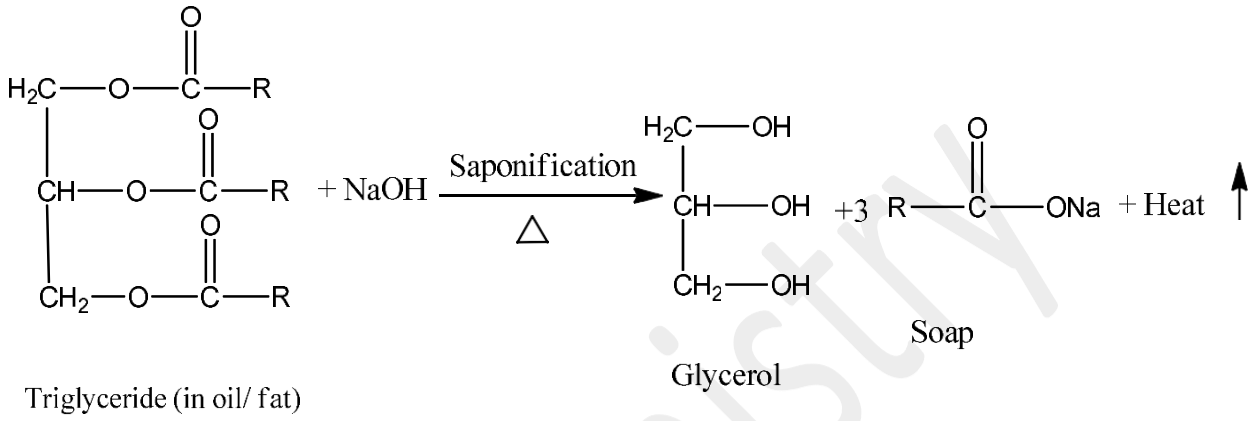
Germicides: Mercuric iodide is added as germicide in mercury soaps. Sulphur is added as a cure for dandruft and pimples. Hexachlorophene as an effective germicide against skin micro-organism

**Important uses of soaps :**

1. Soaps are mainly used as surfactants for washing. bathing and cleaning. They safe remove germs, soils and other contaminants and help us to stay healthy, and make o surroundings more pleasant.
2. They are also used in textile spinning and are important components of lubricants.
3. Soaps are key components of most lubricating greases, which are usually emulsions of calcium soap or lithium soaps and mineral oil.
4. Metallic soaps of aluminum and sodium are used as thickners to increase the viscosity of oils.
5. Soaps are very important for effective hand washing and hygiene; but if it is not available in difficult situations, then clean ash or sand/soil can be used as substitute as recommended by e.g. World Health Organization (WHO)

## Reaction

Soaps are Sodium or Potassium salts of long chain fatty acids When triglycerides in el react with aqueous NaOH or KOH, they are covered into soap and glycerol. This is called alkaline **hydrolysis** of esters. Since this reaction leads to the formation of so called the **Saponification** process.




The **Saponification** reaction is **exothermic** in nature, because **heat is liberated** during the process. The soap formed remains in suspension form in the mixture. Soap is precipitated as a solid from the suspension by adding common salt to the suspension. This process is **called Salting out of Soap**. The water layer is drawn off the top of the mixture and glycerol is recovered using vacuum distillation.

**Purification Process:**

The crude soap obtained from the saponification reaction contains sodium chloride sodium hydroxide and glycerol. These impurities are removed by boiling the crude soap curds in water and re-precipitating the soap with salt. After the purification process is repeated several times, the soap may be used as an inexpensive industrial cleanser.

Soap is an excellent cleanser because its ability to act as an emulsifying agent. An emulsifier is capable of dispersing one liquid into another immiscible liquid. This means that while oil (which attract dirt) does not naturally mix with water, soap can suspend oil/dirt in such a way that it can be removed.

## Types of soaps

**Nature of Alkali: -** Depending upon the nature of alkali used in the productionof soap, they are classified into two types: Hard soap and soft soup

Hard Soap: The Sodium salt of long chain fatty acid is known as hard soap. It is difficult to dissolve in water. It is used as laundry soap.

Soft Soap: The Potassium salt of long chain fatty acid is known as soft soap, as it produces more lather. It is used as toilet soap and shaving soap. In aqueous solution, soap ionizes to form alkali ions, -

Reference:-According to the new revised syllabus of Savitribai Phule Pune University from June 2021 Text book of Industrial chemistry for T.Y. B.Sc. course (CH- 505), Sem-v Manali Publication, Nirali Publication and google images

T.Y.B. Sc 2019 pattern syllabus study material for industrial chemistry

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