

OILS ,FATS & DETERGENTS

INTRODUCTION

Fats and oils constitute a very important class of natural substances which are widely distributed in living organisms. Chemically, they are esters of higher aliphatic monocarboxylic acids with glycerol and are, therefore, also called triacylglycerol. There is no clear line of distinction between oils and fats. triacylglycerol which are solids temp. are called fats while those which are liquids at room temp. are generally referred as oils. Butter, lard, cod-liver oil, coconut oil, ground nut oil are few examples of it.

Fats and oils are also known as lipids which is a general term used for a broad group of naturally occurring biomolecules which are insoluble in water but soluble in organic solvents.

OCCURRENCE OF FATS AND OILS

FATS and oils are abundantly distributed in nature animal and plant kingdom. In animals they are generally present under skin and in muscles while in plants they are mainly found in the seeds. The major sources of the world-wide production of oils are, however, plants rather than animals.

NATURAL FATS: The fats obtained from animal sources such as butter , tallow, lard are called natural fats. This term does not include the fats which are obtained by the hydrogenation of oils

Edible oils of vegetable origin

The oils which are used for cooking purposes are called edible oils. Huge quantities of such oils are produced annually from vegetable sources all over the world. The commonly produced vegetable oils are; coconut oil, corn oil , castor oil, ground nut oil , linseed oil, olive oil, palm oil , soyabean oil , sunflower oil and Tung oil

INDUSTRIAL OILS OF VEGETABLE ORIGIN

The oils which are used in various industries such as soap, paints, varnishes and lacquers are known as industrial oils.

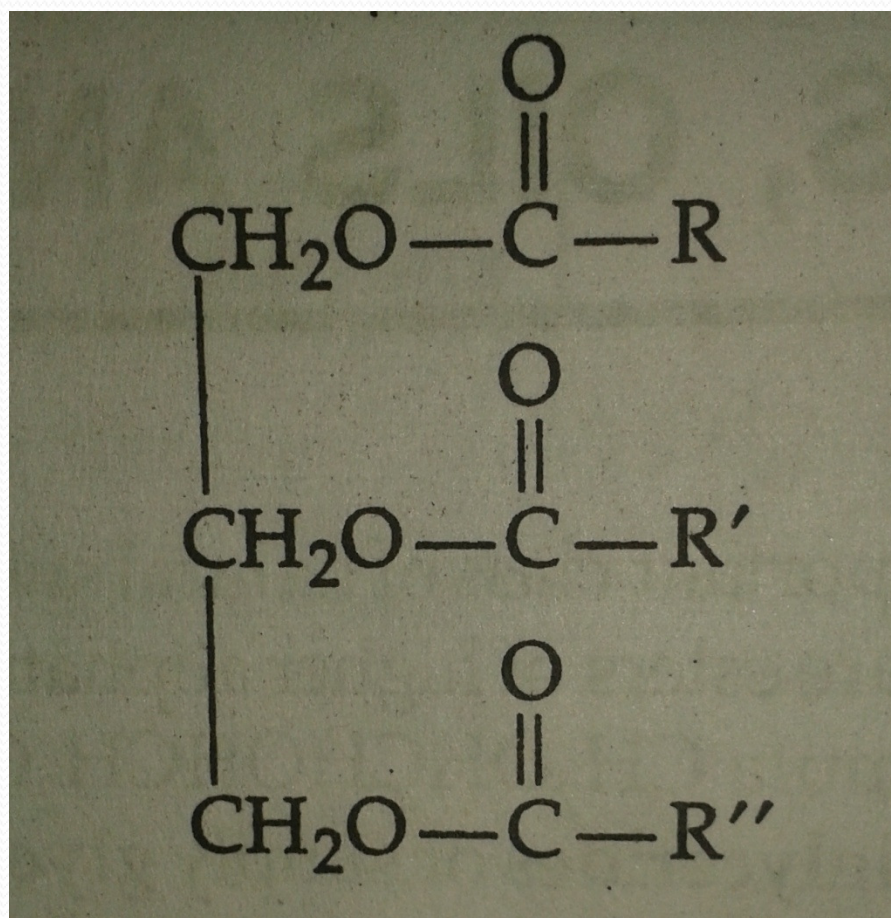
1. oils such as coconut oil, palm oils, and olive oil are commonly used in various industries such as soap, in the manufacture of soap.

2. oils such as linseed oil and perilla oil are used in paints and varnishes as drying oil.

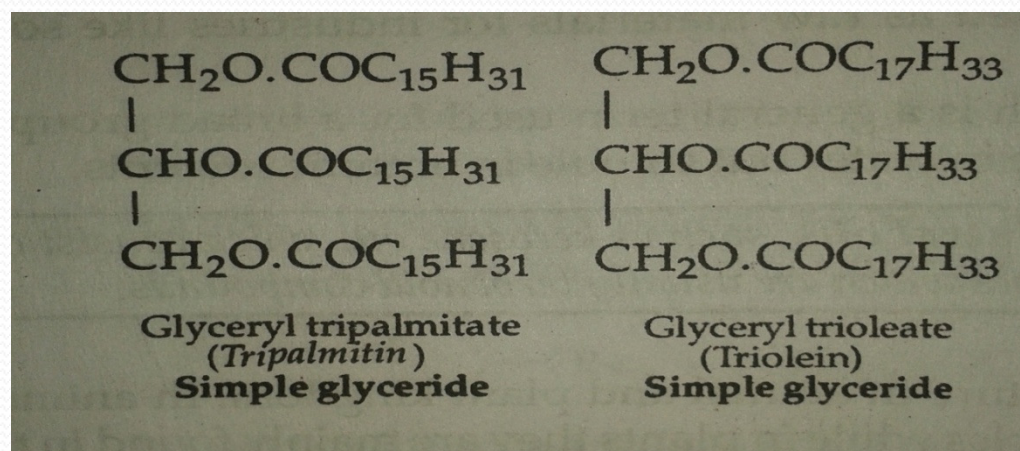
3. oils such as castor oils, linseed oil, rapeseed oil and soybean oil are used as plasticizers for lacquers and polymers,

Structure of fats and oils

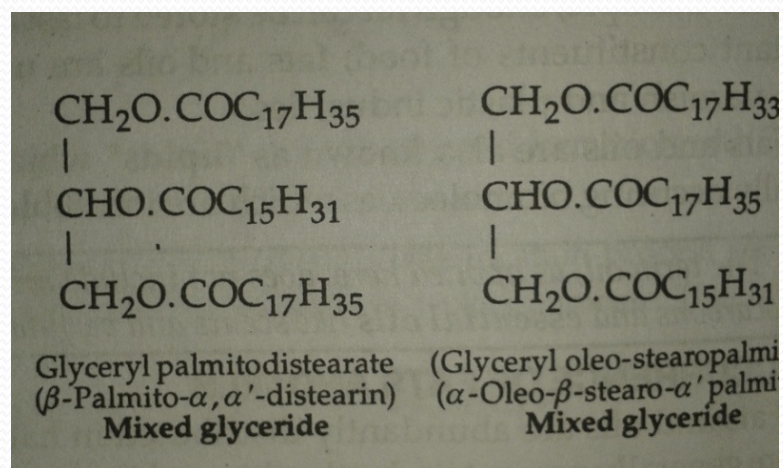
Chemically, Fats & oils are **triesters of glycerol** with long chain carboxylic acids and their structures are represented as:



SIMPLE GLCERIDES: It is when the groups R, R', R'' present in a glceride are the same.



MIXED GLCERIDES: It is when the alkyl groups are different from each other.





COMPOSITION OF INDIVIDUAL FATS AND OILS

A specific fat or oil does not consist of a single glyceride. It is usually a complex mixture of glycerides along with small amounts of simple glycerides.

DIFFERENCE BETWEEN FATS & OILS: the main difference between oils and fats is in the relative proportion of saturated and unsaturated acid part present in the glycerides. In general fats contain a high proportion of saturated acid part in the glycerids and are so at room temperature while oils have more unsaturated acid and are liquids at room temperature. In other words, fats are predominantly saturated while oils are mainly unsaturated in nature.

COMMON FATTY ACIDS:

The monocarboxylic acids obtained by the hydrolysis of fats and oils are known as **fatty acids**. Three most abundant acids are

1. Palmitic acid ($C_{15}H_{31}COOH$)
 2. Stearic acid ($C_{17}H_{35}COOH$)
 3. Oleic acid ($C_{17}H_{33}COOH$)
- } saturated acids
- unsaturated acid

FATTY ACIDS COMPOSITION OF SOME FATS AND OILS

FAT OR OIL	SATURATED FATTY ACIDS(MOL%)				UNSATURATED FATTY ACIDS(MOL%)		
	Lauric Stearic Acid Acid	Myristic Acid	Palmitic Acid		Oleic Linolenic Acid	Linoleic Acid	
Vegetable oils							
Coconut oil	50	18	10	2	6	1	-
Corn oil	-	1	10	4	35	50	-
Linseed oil	-	-	5	3	20	20	50
Olive oil	-	1	8	3	80	8	-
Peanut oil	-	-	8	4	60	25	-
Soya bean oil	-	1	8	3	25	55	8
Animal fats							
Butter	2	10	25	12	30	4	-
Lard	-	1	25	15	50	8	-



EXTRACTION OF FATS AND OILS

As already stated, fats and oils occur mainly in the seeds of plants and under the skin and in the muscles of animals. They are extracted from these sources by the following processes.

1. RENDERING: This method is used for obtaining fats and oils from animal sources. The animal tissues are treated with hot water or steam when the oil or molten fat forms layer at the top which is removed from time to time. Tallow is obtained by this method.

2. CRUSHING: The vegetable oils are obtained by crushing the seeds and then subjecting them to high pressure in hydraulic presses at ordinary or high temperatures. Cotton seed oil etc. are extracted by this method.

3. EXTRACTION WITH A SOLVENT :

Oils are also obtained by their extraction from the plants with the help of suitable solvents such as carbon tetrachloride, benzene etc. The method is very efficient although rather expensive.

REFINING. The crude oil or fat is warmed with a little alkali to neutralize any free acids and also to coagulate the colloidal impurities present. The oil or fat is then bleached with Plaster of Paris and finally heated with superheated steam to remove any odours.

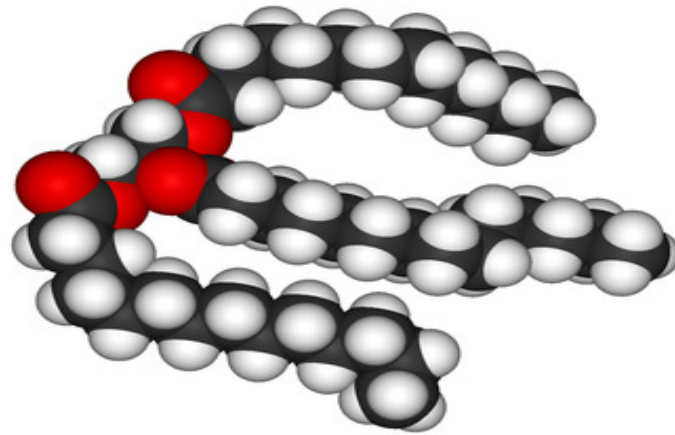
PHYSICAL PROPERTIES

- 1. PHYSICAL STATE AND SOLUBILITY:** Natural fats and oils are generally colourless, odourless and tasteless solids or liquids when pure. They are lighter than water and immiscible with it . They are freely soluble in organic solvents such as benzene, chloroform and petroleum ether.
- 2. MELTING POINTS:** Fats containing a high proportion of saturated acid groups in the glycerides have relatively high melting points but the presence of unsaturated acid units lowers the melting point. For example, tristearin melts at 344 K while the corresponding unsaturated fat, triolein, melts at 290 K. *The lower melting points of glycerides having unsaturated acid units are largely due to the cis configuration around carbon – carbon double bond.* The cis configuration does not allow efficient close packing of molecules to take place so that the glycerides has a low melting point.

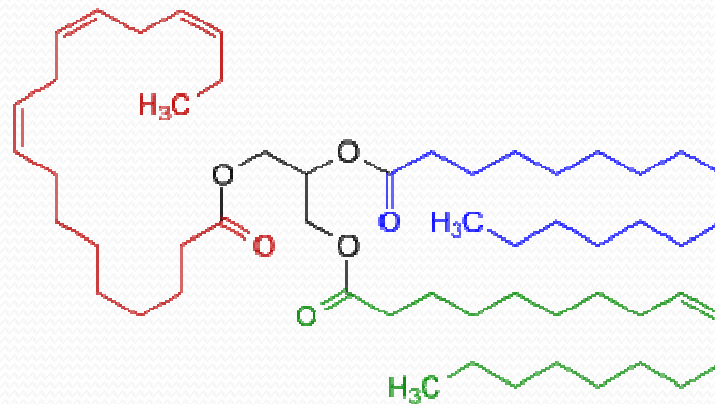


FATS AND OILS

Definition-Fats and oils, group of organic substances that form an important part of the diet and also are useful in many industries. The fats are usually solid, the oils generally liquid at ordinary room temperatures. Some tropical products, liquids in their sites of origin, become solids in cooler climates; in commerce these often retain the name originally given, e.g., palm oil and coconut oil. Chemically fats and oils are either simple or mixed glyceryl esters of organic acids belonging to the fatty-acid series.



A triglyceride molecule

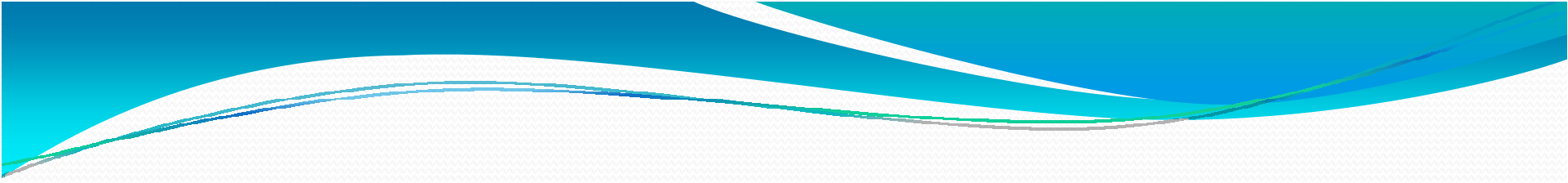


Example of a natural triglyceride with three different fatty acids. One fatty acid is saturated (**blue** highlighted), another contains one double bond within the carbon chain (**green** highlighted). The third fatty acid (a polyunsaturated fatty acid, highlighted in **red**) contains three double bonds within the carbon chain. All carbon-carbon double bonds are *cis* isomers.

CHEMICAL PROPERTIES :

Degree of unsaturation-Liquid fats (i.e., vegetable and marine oils) have the highest degree of unsaturation, while **solid fats** (vegetable and animal fats) are highly saturated. Solid vegetable fats melting between 20 and 35 °C (68 and 95 °F) are found mainly in the kernels and seeds of tropical fruits. They have relatively low iodine values and consist of glycerides containing high percentages of such saturated acids as **lauric**, myristic, and palmitic. Most animal fats are solid at ordinary temperatures; **milk fats** are usually characterized by the presence of short-chain carboxylic acids (butyric, caproic, and caprylic); and marine oils contain a large number of very long chain highly unsaturated acids containing up to six double bonds and up to 24 or even 26 carbon atoms.

Solubility- Fats are practically insoluble in water and, with the exception of castor oil, are insoluble in cold alcohol and only sparingly soluble in hot alcohol. They are soluble in ether, carbon disulfide, chloroform, carbon tetrachloride, **petroleum**, and benzene



Melting point- Fats have no distinct melting points or solidifying points because they are such complex mixtures of glycerides, each of which has a different melting point. Glycerides, further, have several polymorphic forms with different melting or transition points.

Hydrolysis- Fats are hydrolyzed readily. This property is used extensively in the manufacture of soaps and in the preparation of fatty acids for industrial applications. Fats are hydrolyzed by treatment with water alone under high pressure (corresponding to a temperature of about 220 °C [428 °F]) or with water at lower pressures in the presence of caustic alkalies, alkaline-earth metal hydroxides, or basic metallic oxides that act as catalysts. Free fatty acids and glycerol are formed. If sufficient alkali is present to combine with the fatty acids, the corresponding salts (known popularly as soaps) of these acids are formed, such as the sodium salts (hard soap) or the potassium salts (soft soaps).

ANALYSIS OF FATS AND OILS

Fats and oils are put to a number of industrial uses. For this purpose it is essential to characterise and test the quality of a given fat and oil. This involves the determination of physical constants, such as melting point, boiling point, refractive index, and chemical constants such as acid value and saponification value. The important chemical constants are described below:-

1. ACID VALUE.

*It is defined as-the number of **milligrams** of potassium hydroxide required to neutralize the free fatty acids present in **one gram** of the fat or oil.*

*The acid value indicates the amount of **free acids** present in a given fat or oil. A high acid value implies that the given sample of oil is an old one which has gone rancid.*

2. SAPONIFICATION VALUE

It is defined as *the number of **milligrams** of potassium hydroxide required to completely saponify **one gram** of the fat or oil.*

Saponification value is determined by refluxing a weighed quantity. One of the fat or oil with a known excess of standard alcoholic potash solution and the unused alkali is determined by titrating against a standard acid.

The saponification value gives an idea of the **molecular weight** of the fat or oil; *the **smaller** the saponification value, the **higher** the molecular weight.*


3. IODINE VALUE

It is defined as *the number of grams of iodine which combines with 100 grams of the fat or oil.*

It can be determined by the following methods:

Hubl's method. In this method, a known weight of the fat or oil is dissolved in carbon tetrachloride. This is then treated with a known excess of standard solution of iodine and mercuric chloride in ethanol. Then unused iodine is determined by titrating against standard sodium thiosulphate solution using starch as indicator.

Wij,s method. In this method, a known weight of the fat or oil is dissolved in chloroform. To this is added a solution of iodine monochloride (ICl) mixed with glacial acetic acid (called Wij,s solution).



ICl adds across the carbon-carbon double bond. The unreacted ICl is converted into equivalent amount of iodine by treatment with KI. The amount of iodine formed is determined by titration against standard sodium thiosulphate solution using starch as indicator. Knowing this, the amount of ICl added to the double bond is determined and from this iodine value is calculated.

Iodine value is a measure of **unsaturation** in a fat or oil and gives an idea of its “drying” character. *More the iodine value, more is the degree of unsaturation of the oil or fat.*

4. REICHERT – MEISSEL VALUE (R.M VALUE)

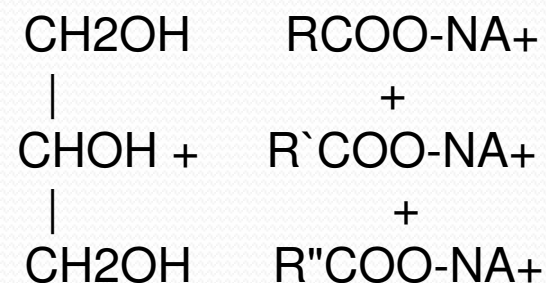
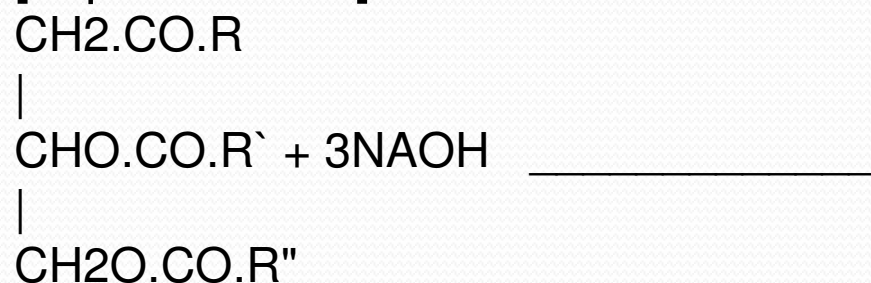
It is defined as *the number of milliliters of 0.1 N potassium hydroxide solution required to neutralize the steam volatile acids hydrolysis of 5 grams of the fat or oil.*

For determining the R.M value, a known weight of the fat or oil is completely saponified with alkali. The solution thus obtained is acidified with dilute sulphuric acid and then subjected to steam distillation. The distillate is titrated against 0.1N alkali solution and R.M value is calculated.

R.M value is a measure of the volatile fatty acids present in a given fat or oil. It is of special value in testing the purity of butter and desi ghee which contain a relatively large proportion of glycerides of butyric acid and other steam volatile acids. Adulteration of butter or ghee lowers its R.M value by about 20-35.

SOAP

soaps are organic compounds obtained from natural fats and oils which are used as cleansing agents for various purposes . Although there are many types of soaps in the use, Ordinary soap is a mixture of sodium salts of higher acids like stearic acid, palmitic acid and oleic acids. It is obtained by the hydrolysis of oils and fats by sodium hydroxide [saponification].





DIFFERENT KINDS OF SOAP

1. Toilet soaps = Toilet soaps consists of mainly sodium oleate.
 2. Laundry soaps= This type of soap is usually consists of mixtures of sodium palmitate and sodium stearate.
 3. Shaving soaps= Shaving soaps and other soft soaps are mixtures of potassium salts of higher acids and are obtained by carrying out the saponification with
potassium hydroxide.
 4. Ethanolamine= Ethanolamine soaps are used extensively in shampoos and cosmetics
- *HARD SOAPS = Soaps such as toilet and laundry soaps which are sodium salts of higher acids are also known as hard soaps.
- *SOFT SOAPS = Soaps such as shaving soaps which are potassium salts of are known as soft soaps.

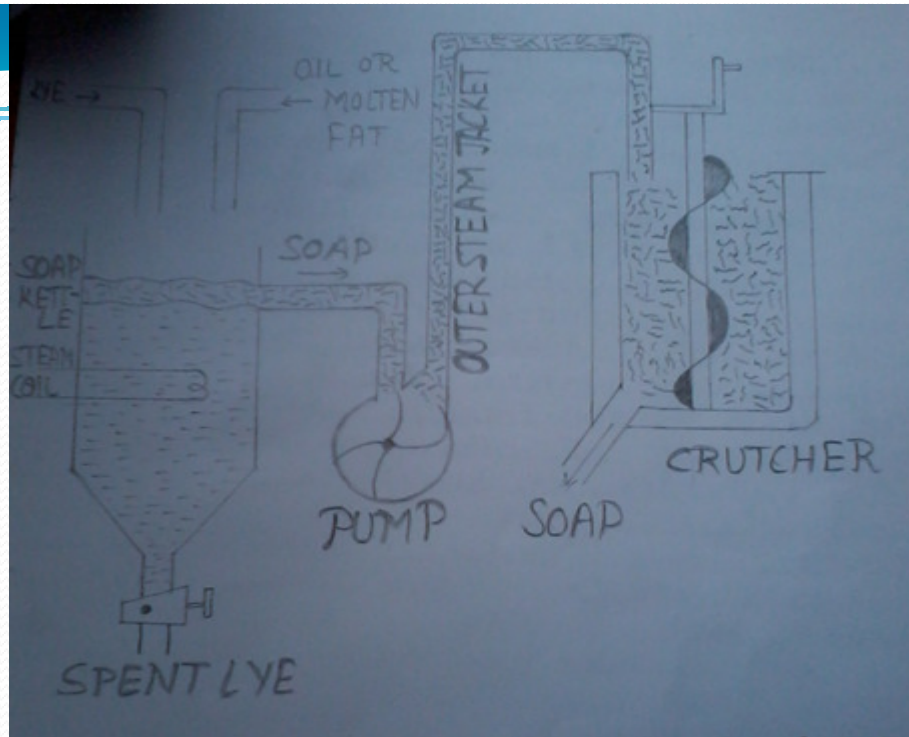
MANUFACTURE OF SOAP

Two main processes are used for manufacturer of ordinary soap from oils and fats.

(i) COLD PROCESS= In this process, the molten fat or oil is mixed with a calculated quantity of lye [sodium hydroxide] in an iron vessel. The mixture is stirred vigorously by a mechanical stirrer when the saponification takes place in accordance with the reaction given above. As soon as soap begins to set, it is drawn out into frames and allowed to set there. The solid soap is cut into bars and dried. The major drawback of this method is that it is not possible to recover glycerol. Moreover, the reaction between fat and oil and alkali does not proceed to completion.

(ii) HOT PROCESS = The molten fat or oil is taken in the soap kettle provided with steam coils for heating. An excess of lye (sodium hydroxide) is added and the mixture is boiled and agitated by steam through the steam coils. The saponification occurs as represented by the equation given above and is completed in 12-24 hours. The soap forms a separate layer at top. The lower aqueous layer of 'spent lye' is run off and treated for the recovery of glycerol. The soap left in the kettle is again boiled with more of sodium hydroxide to ensure complete saponification and then separated as before. Now soap is boiled with water and allowed to settle. The upper curdy layer of soap is pumped to the crutcher provided with an outer steam jacket.

The soap thus obtained is drawn out in the frames and allowed to solidify. It is finally dried and cut into bar. The hot process ensures the complete saponification of oils or fats and gives a pure product. Moreover, glycerol can also be recovered.



MATERIALS USED IN MANUFACTURE OF SOAP

(i) The oils and fats used in the manufacture of soaps are coconut oil, palm oil, olive oil and tallow .

(ii) Cheaper soaps are made from cotton seed oil and bone grease . Their hydrolysis is generally carried out by sodium hydroxide .

(iii) Soap flakes and laundry soap contain considerable amount of "fillers" or "builders" which mixed with soap in the crutcher . These fillers not only provide bulk to the soap but also improve its cleansing action. The commonly used fillers or builders are sodium carbonate , sodium phosphate , sodium silicate.

Toilet soaps contain little or no filler . At the same time , Some perfumes, dyes and medicinal are added to have desired quality of soap.



DISADVANTAGE OF SOAP

The main disadvantage of soaps relates to their use in hard water . When used in hard water, soap combines with the calcium and magnesium ions present in hard water to form insoluble calcium and magnesium salts which generate curd like precipitates . As a result , a good deal of soap is wasted in forming undesirable precipitate with calcium and magnesium ions before the excess soap begins to exert its cleansing action in solution. Soaps cannot be used in acidic solution also. this is because the acids present in the solution bring about the precipitation of insoluble free fatty acids . These fatty acid adhere to the fabric and prevent the removal oil and grease from the fabric.

SYNTHETIC DETERGENT

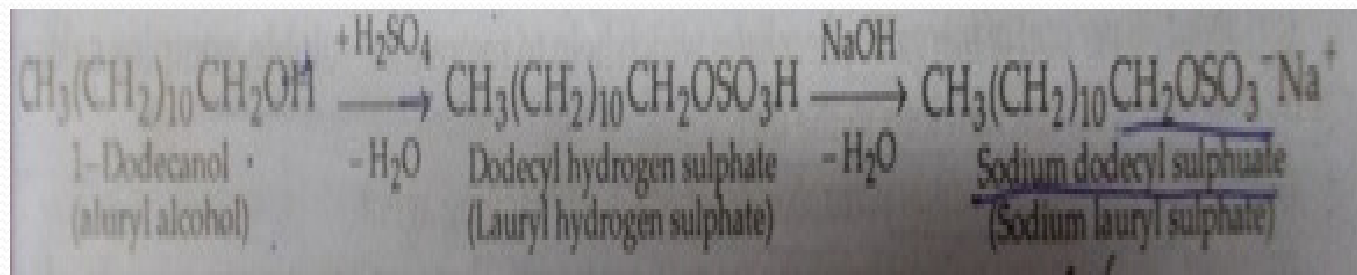
Introduction

Synthetic detergents or soap less soap, as they are sometime called, are synthetic substance that are being increasingly employed as cleaning agent these days. Unlike soap , detergent can be used satisfactorily even in hard water since they do not form curd like precipitate in such water. Huge quantities of different type of detergents, which differ chemically from soap as well as from the another ,are now being manufactured and used all over the world. However, all these detergent are similar to soap in that their molecules also have a large non – polar hydrocarbon end that is oil soluble and an ionic end that is water-soluble.

Typical Synthetic Detergents

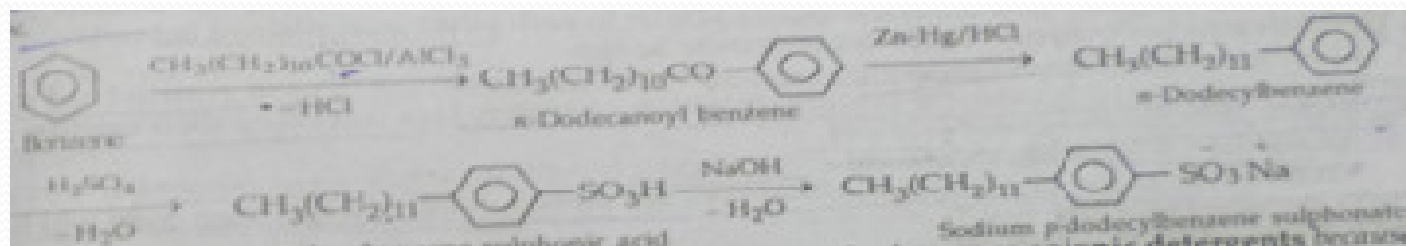
Some typical synthetic detergents are described below :

Sodium alkyl sulphates : These detergents consist of sodium alkyl sulphates obtained from long chain alcohols. The first such detergent was made from 12-carbon straight chain alcohol, 1-dodecanol (or lauryl alcohol).The alcohol was treated with concentrated sulphuric acid to form a sulphate ester which when neutralised with sodium hydroxide formed a detergent known as sodium dodecyl sulphate (SDS) as shown below.



Alkyl benzenesulphonates:

The most commonly used detergents these days are linear alkylbenzenesulphonates (LAS) such as sodium dodecylbenzenesulphonate. They are obtained by conversion of benzene into alkyl benzene followed by sulphonation and neutralization as shown below :



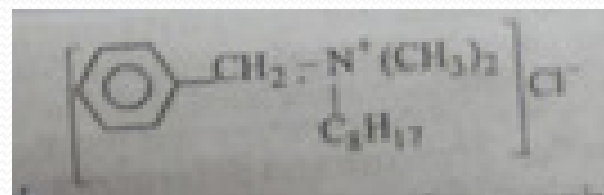
Sodium alkyl sulphate and alkylbenzenesulphonate are also known as anionic detergent because their cleaning action is due to the formation of anions having long hydrocarbon chain attached to them.

Cationic detergents:

These detergents consist of quaternary ammonium salt such as chloride and bromide containing one or more long chain alkyl groups . Two such detergent are:



Cetyltrimethylammonium chloride

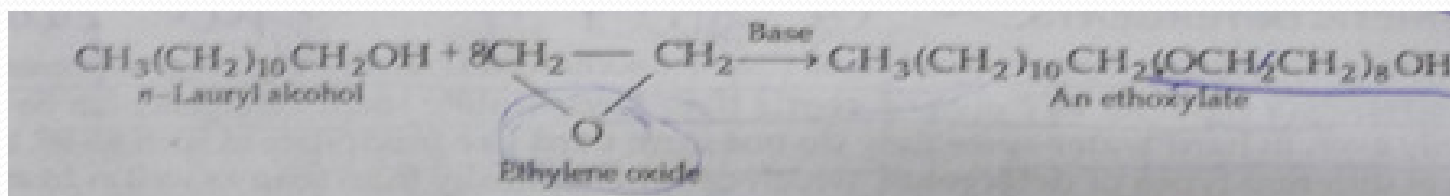


Benzyl dimethyloctyl ammonium chloride

These detergent are called cationic detergents or invert soap because their cleansing action is due to the formation of cation having one or more long alkyl groups and not due to negative ions as in detergents described above .These detergent also have germicidal properties but they are quite costly . Therefore, they are not used on large scale.

Non-ionic detergents :

Ethoxylates. These are non-ionic detergents consisting of long hydrocarbon chain plus repeating ethoxy units ending in an OH group. They are obtained from long chain aliphatic alcohols by treatment with ethylene oxide in presence of base. for example :



Even though these detergents are non-ionic, the presence of numerous oxygen atoms renders the polyether end of the molecule water soluble through the formation of hydrogen bonds. Thus it serves the purpose of a polar end. The long hydrocarbon chain is, of course, insoluble in water but soluble in oil. Such detergents are particularly suitable for washing machines and dishwashers because they have low lather washing action.



THANK YOU