# Swami Keshvanand Institute of Technology Management & Gramothan Jaipur

**B.TECH I YEAR**

**ENGINEERING CHEMISTRY**

SUBJECT CODE: 1FY2-03 /2FY2-03

CHAPTER-ENGINEERING MATERIALS

**TOPIC: LUBRICANTS**

**PROF. ARCHANA SAXENA**

**CHEMISTRY DEPARTMENT**

**SKIT, JAIPUR**

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# Lubricants

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# Lubricants

➢ **Introduction-**

- All material surfaces in all types of machines are never perfectly smooth even they are polished.
- If very smooth polished surfaces observed under a microscope, surface like a hilly area as elevations or peaks or asperities and depression or valleys.

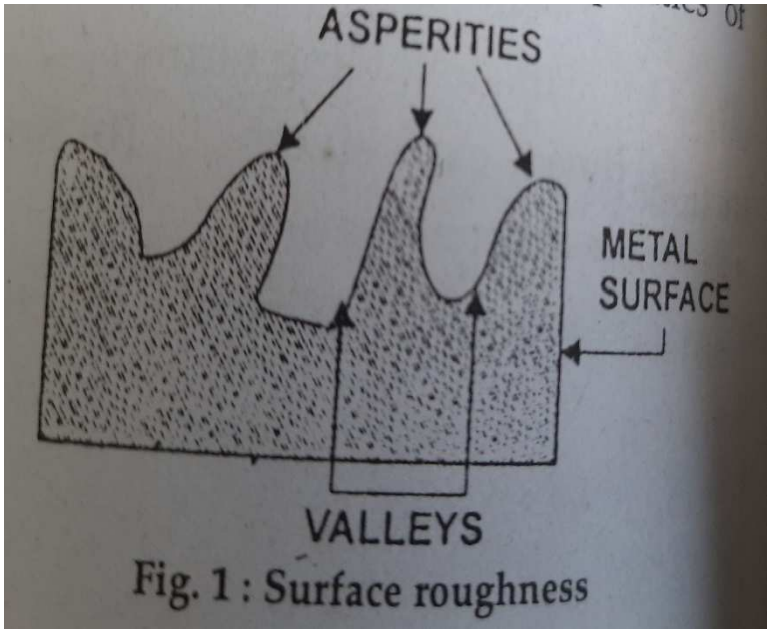


Fig. 1 : Surface roughness

# Lubricants

- When two solid surfaces are pressed over each other, a real contact between these surfaces occurs only at a limited number of asperities, i.e., peaks of the upper surface are in contact with peaks of the lower surface.
- A small load when applied on the metal surface ,develop a high pressure at these points (asperities) of contact, which then tend to interlock, thus develops a resistance to motion .

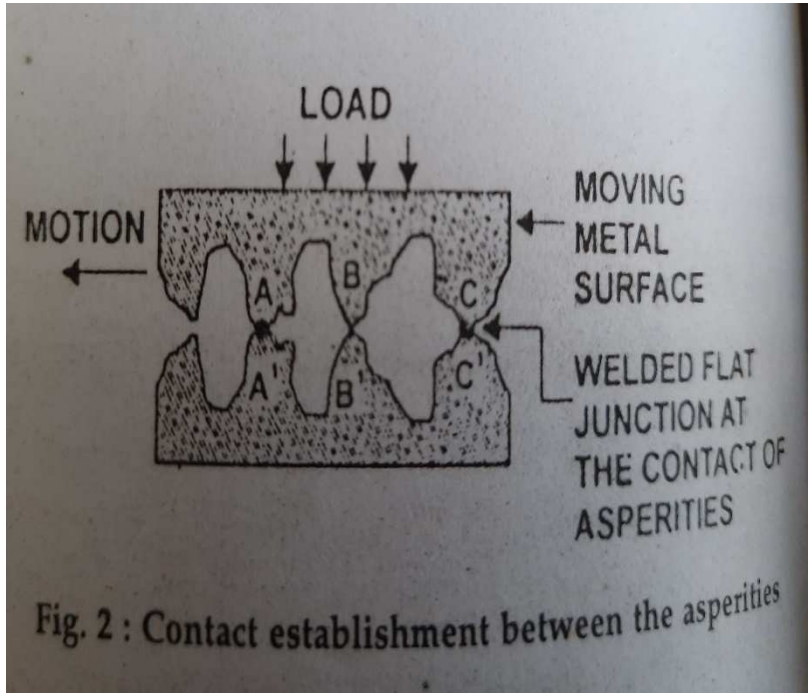


Fig. 2 : Contact establishment between the asperities

# Lubricants

- In all types of machines the moving surfaces rub against each other.
- Due to this rubbing a resistance is developed to their movement.
- This resistance is known as friction.
- This friction will cause wear and tear of surfaces of moving parts. Due to friction large amount of energy is dissipated in the form of heat, there by the efficiency of machine gets reduced.

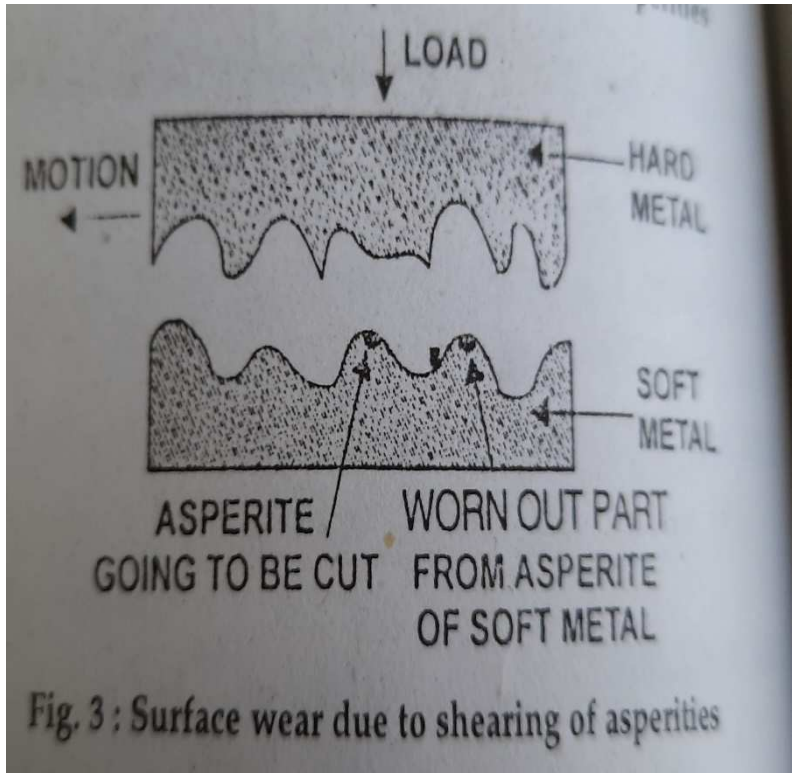
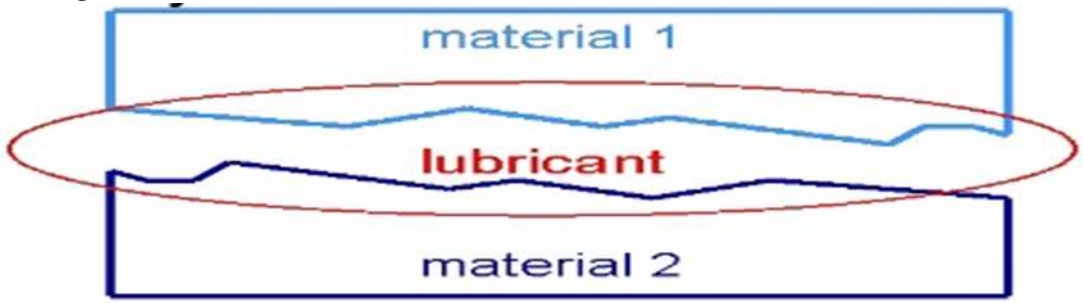


Fig. 3 : Surface wear due to shearing of asperities

# Lubricants

•Friction is the force that resists motion when the surface of one object comes into contact with the surface of another. In a machine, friction reduces the mechanical advantage.

•Substances introduced between moving surfaces in order to reduce friction and thus prevent welded joints and seizure, are called **Lubricants.**




•The process of prevention of metal to metal contact by means of an intervening layer of fluid or fluid like material is termed as **Lubrication** or the process of introducing lubricant is called **Lubrication.**

# Lubricants

➢ **Role / Functions (Objective of Lubricants)**

1. It reduces wear and tear and surface deformation, by avoiding direct contact between the rubbing surfaces.
2. It reduces the loss of energy in the form of heat by acting as a coolant.
3. It reduces expansion of metal by local frictional heat.
4. It minimizes the liberation of frictional heat and hence avoids seizure of moving surfaces.
5. It prevents unsmooth motion relative motion of the moving or sliding parts.
6. It reduces the maintenances as well as running cost of the machine to a large extent.
7. As seen above it also acts as a seal in IC engines.
8. Absorba dust and sound

# Lubricants

## ➢Characteristics of a good Lubricant

The following are the characteristics of a good lubricant.

i) It should not undergo any reactions such as oxidation or reduction at high temperatures.

ii) Lubricants should not produce corrosion in machine parts.

iii) It should have high viscosity index and aniline point.

iv) It should have much higher flash point and fire point than the operating temperature.

# Lubricants

➢**Composition**

- Typically contains 90% base oil(petroleum-mineral oils) and less than 10% additives

- Non liquid lubricants contains Grease, powder(dry graphite, Molybdenum disulphide), Teflon tape used in plumbing etc.

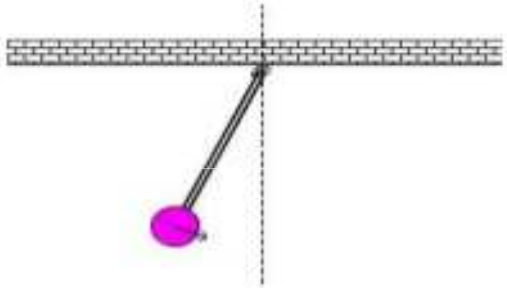
- Those non liquid lubricants provide lubrication at higher temp.(up to 350 °C)

# Lubricants

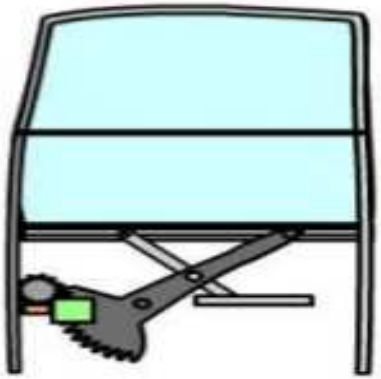
## SOME EXAMPLES

Almost every moving component requires LUBRICANT

Standard lock



Pendulum Clock



window lifting mechanism

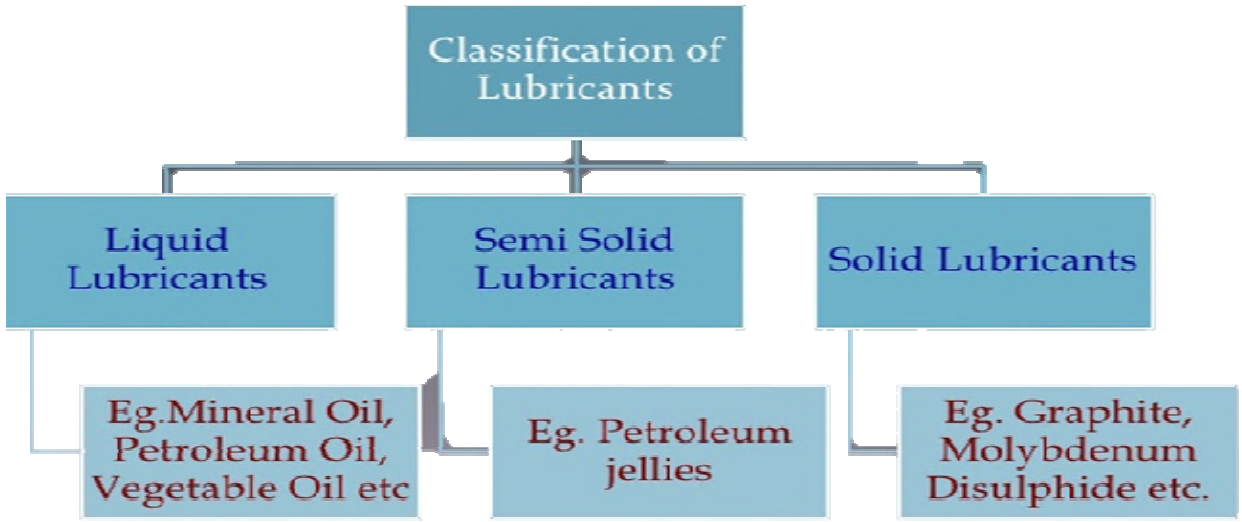
# Lubricants

## Machines Need Lubrication

- Bearings
- Gears
- Cylinders and their piston
- Flexible Coupling
- Chains
- Wire ropes

# Classification of Lubricants

➢ **Classification of Lubricants**



# Classification of Lubricants

**1) Liquid lubricants or lubricating oils**

**Animal and vegetable oils-**

- These are glycerides of higher fatty acids.
- Animal and vegetable oils play a major role as lubricants before the development and use of petroleum crude oils as lubricants.
- Compared to petroleum crude oils, animal and vegetable oil have better oiliness and adhere to the machine parts even under heavy load.

**Uses**

i) Common vegetable used as lubricant are palm oil, castor oil, coconut oil etc., which are used for lubricating bearings and light machine parts.

# Classification of Lubricants

ii) Animal oils such as lard oil made from the fat of pigs and tallow oil made from cattle fat are used for lubricating ordinary machine parts.

iii) Whale oil made from sperm whale fat is used as lubricant in the form of wax mainly to lubricate light machineries.

**Disadvantages**

i) The animal and vegetable oils undergo oxidation easily at a higher temperature and forms gummy and acidic products.

ii) These oils get hydrolysed easily under moist conditions. Hence animal and vegetable oils are mainly used as blending agents which can enhance the oiliness of lubricants.

# Classification of Lubricants

**Mineral oils or petroleum crude oil-**

- Petroleum crude oil fractions with hydrocarbon chain length about 15-50 carbon atoms fall under the heavy crude oil fraction which function as efficient lubricants.
- These are used because of their cost effectiveness, availability in abundance and stability under severe conditions make them widely used.
- The only drawback of the heavy fraction crude oils are their poor oiliness which can be compensated by mixing with animal or vegetable oils or long chain fatty acids like stearic acid, oleic acid etc.
- Crude oil fraction of petroleum has lot of impurities especially the asphaltic naphthenic and wax impurities.
- Before using as lubricants these asphaltic, naphthenic and wax impurities have to be removed

# Classification of Lubricants

**Synthetic lubricants**

- Synthetic lubricants have been developed for the effective lubrication at temperatures ranging from -50$^0$C to 250$^0$C Silicones, polyglycol, are the important synthetic lubricants used in aircrafts.
- In aircrafts, petroleum oils cannot be effectively used, because they tend to get oxidized at higher temperatures and wax separation will occur at lower temperatures.
- Hence synthetic lubricants are found suitable under these conditions.
- Polyalkene glycols can withstand high temperatures up to 300$^0$C whereas silicones can withstand very low and high temperatures.

# Classification of Lubricants

**Blended or compounded oils (or) Additives for lubricating oils**

- Blended oils serve as better lubricant than single lubricating oil. Especially petroleum oils when mixed with certain additives suit the requirement of modern machineries.

**Additives Used In Lubricants**

(1) Anti oxidant - Aromatic amines,Phenols,Sulphides and phosphates

(2) Corrosion Inhibitor - Amino salts and salts of sulphonic acids

(3) Antiwear agents - Tricresyl phosphate

(4) Foam inhibitors - Glycerol's

# Classification of Lubricants

**2) Semi-solid lubricants (Greases)-** Greases are semi-solid lubricants formed by the dispersion of soap in a lubricating oil. Soaps can be prepared by the saponification of mutton fat or coconut oil with alkali (like NaOH, Ca(OH)2). The soap formed is treated with hot lubricating oil under constant stirring to produce grease.

**Uses of Greases-**i) Greases have higher shear strength and will not be squeezed out under heavy load or on sudden jerks during the operation of machines.

ii) Greases are also used to seal bearings and small openings present in machines against dust and dirt.

iii)Gear boxes are lubricated using grease and oil which can withstand high temperatures.

iv)Machines manufacturing pure materials like paper, cloth etc are generally lubricated using grease since , if the oil is used, it will spur out and contaminate the material

# Classification of Lubricants

**3) Solid lubricants-**The important two solid lubricants generally used are **graphite** and **molybdenum disulphide**. Solid lubricants are used under special operating conditions:

i) If the lubricating film cannot be maintained under heavy load or high temperature using either oil or grease, then solid lubricants are made use of.

ii) Contamination of dust or solid particles through grease or oil is not acceptable in certain machines like electric generators, motors, commutator bushes etc., In such cases solid lubricants in pure form are made use of.

iii)In machines where combustible lubricants have to be strictly avoided solid lubricants are used.

# Classification of Lubricants

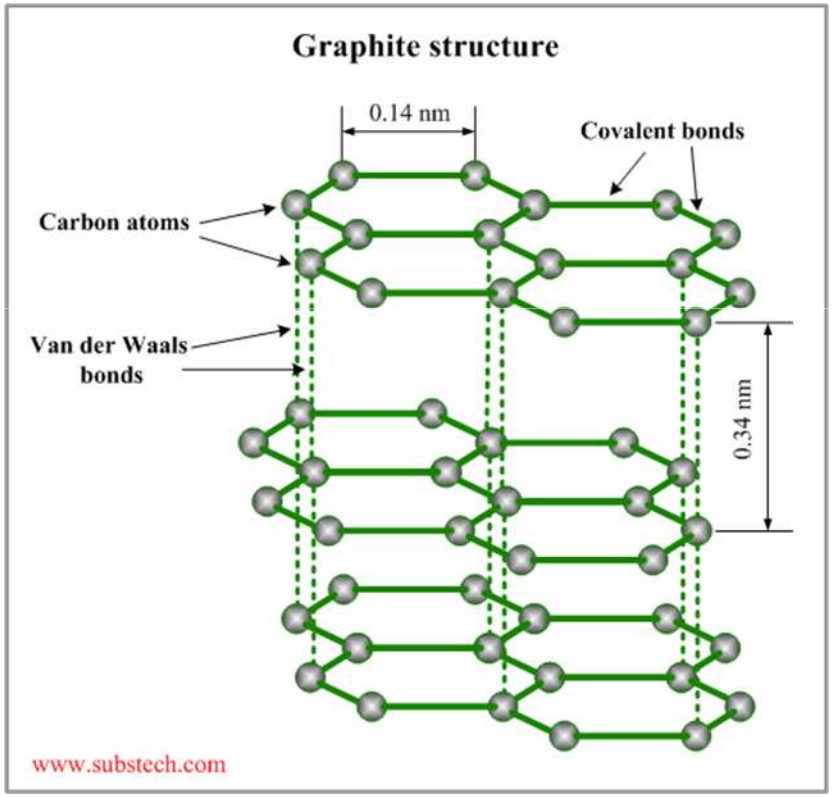
## Graphite

- Graphite is the most commonly used solid lubricant.
- Graphite can be used as dry powder or graphite water mixture or graphite oil mixture.
- Graphite has low frictional resistance (coefficient of friction 0.005 to 0.01), non-flammable and stable up to $375^0$C.
- Graphite is made of hexagonal arrangement of carbon atoms present in flat plates. Each plate is separated from one another by a distance of 3.4 A0.
- Plates are held together by weak Vander Waals forces. Hence the plates can slide over one another with little friction which produces the slippery nature with very low coefficient of friction.
- Suspensions of graphite with water or oil is made with the help of emulsifying agent like tannin.

# Classification of Lubricants

- It can be used upto $375^0$C and above this temperature it gets oxidized.
- Graphite is used either as a dry powder or as a colloidal dispersion.
- The water suspension of graphite is called “Aquadag”.
- The oil suspension of graphite is called as “Oildag”.
- Graphite is also mixed with grease and used in the form of graphite grease.
- Graphite is used in heavy machineries like lathe, general machine shop works, food stuffs industry, internal combustion engines, railway track joints, open gears etc.

# Classification of Lubricants



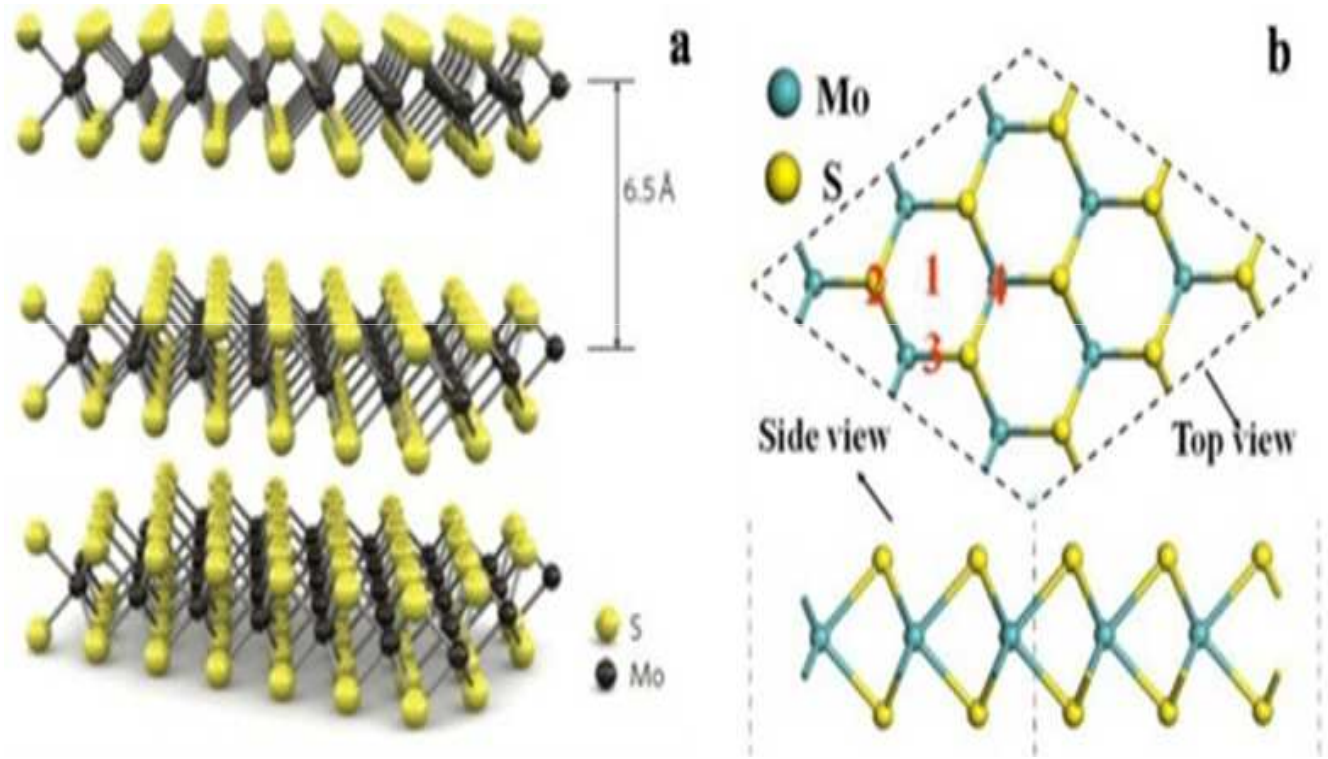
# Classification of Lubricants

**Molybdenum disulphide ($MoS_2$)**

Molybdenum disulphide also possess similar properties as that of graphite.

- In molybdenum disulphide, plates of molybdenum atoms and sulphur atoms slide over one another, smoothly keeping a distance of 3.13 A.
- The platelets are held together by weak Vander waal's forces as in that of graphite.
- As a result MoS2 possesses very low coefficient of friction.
- It is also stable up to $400^0$C.It is used in powder form or it can be mixed with grease and used.
- It is mainly used in heavy machineries working under heavy load and high temperatures

# Classification of Lubricants



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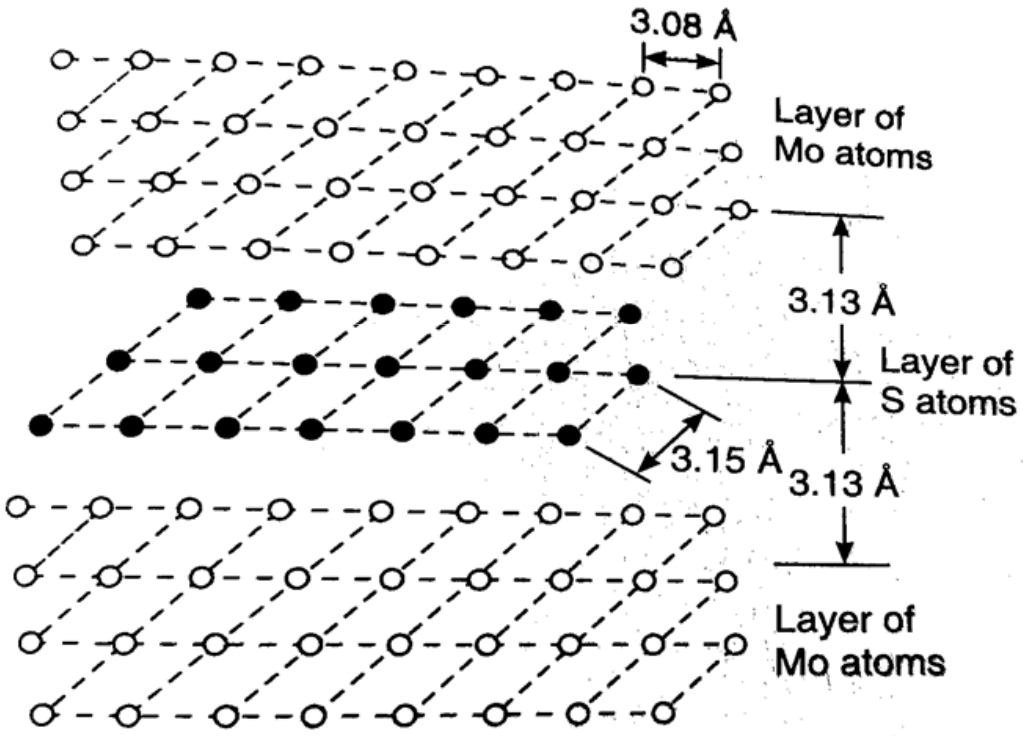


Fig 4.10: Sandwich-like structure of molybdenum disulphide


# Thanks

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## CONTENTS

LUBRICANTS :

MECHANISM OF LUBRICATION

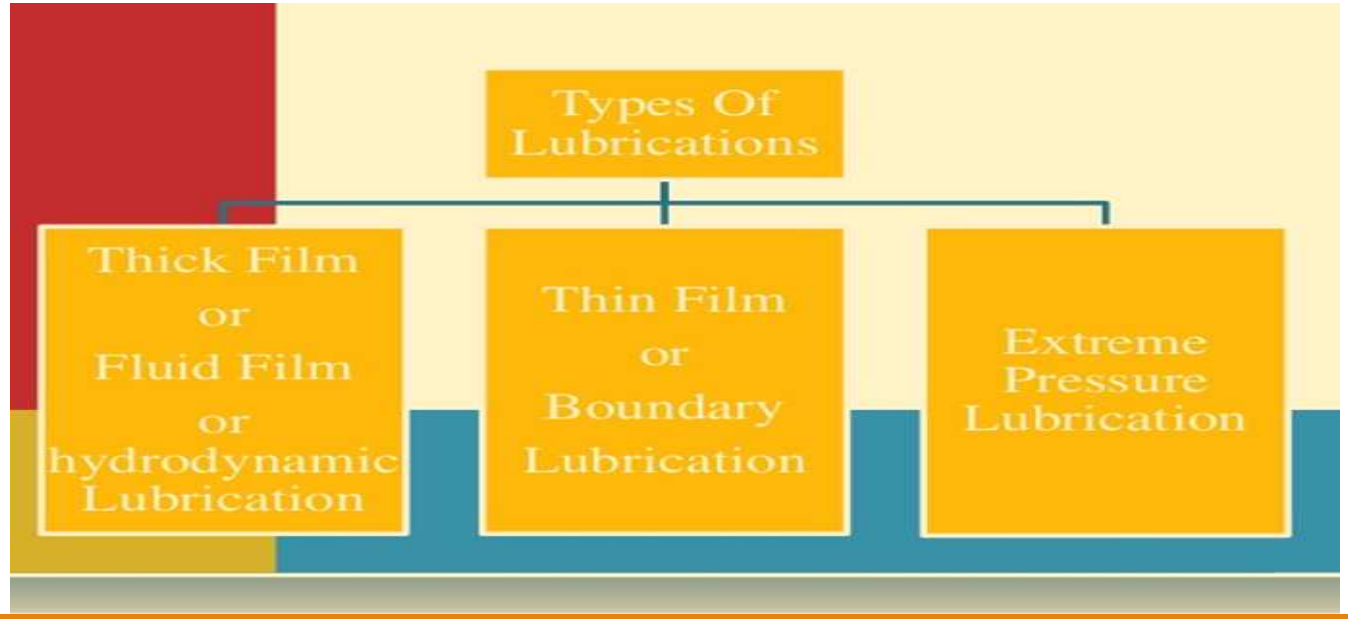
1. THICK OR FLUID FILM OR HYDRODYNAMIC
2. THIN FILM OR BOUNDARY
3. EXTREME PRESSURE

# Mechanism of Lubricants (Lubrication)

## Lubrication (Mechanism)

The process of reducing friction and wear between two moving surfaces by adding lubricant between them is known as lubrication.

There are 3 types of mechanisms by which lubrication is done.



# Mechanism of Lubricants (Lubrication)

## Thick Film or Fluid Film or Hydrodynamic Lubrication

- This type of lubrication is done in those cases where liquid lubricants having minimum viscosity under working conditions are used and at the same time, it should remain in place and separate the moving or sliding parts of the machine.

- In this mechanism, two moving and sliding surfaces are separated by thick film of lubricant fluid of about 1000A°, applied to prevent direct surface to surface contact and consequently reduce wearing and tearing of metals.

- Therefore it is known as thick film or fluid film lubrication or hydrodynamic(hydro meaning liquid and dynamic meaning relative motion)lubrication.

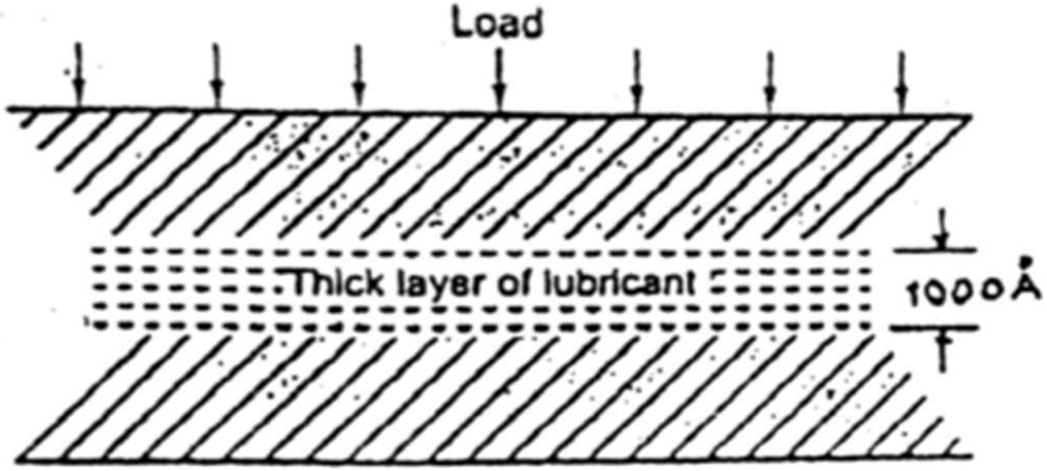
- In this case fluid is formed by mixing of hydrocarbon oils and anti-oxidants with long chain polymer so as to maintain viscosity. Fluid film lubrication is useful in delicate and light machines like watches, clocks, guns, scientific equipment's.

# Mechanism of Lubricants (Lubrication)

- In this type a continuous fluid film exists between the sliding surfaces.
- Employed when the sliding velocity is moderate and load is low.
- Used for machineries operated continuously.
- In fluid film lubrication, the fluid immediately adjacent to each surface travels at the same speed and direction of each surface.
- Film thickness is $\geq 1000^{o}$ A.
- Factors which affect the thickness of hydrodynamic fluid film include lubricant viscosity, rotation speed or RPM, oil supply pressure, and component loading.
- An increase in speed or viscosity increases oil film thickness.
- An increase in load decreases oil film thickness.

# Mechanism of Lubricants (Lubrication)

- Coefficient of friction is 0.001 to 0.03 cm/sec.
- Blended Mineral oils are used to introduce a thick film between sliding surfaces.
- Finds application in watches, clocks and scientific instrument (stop watches).
- Hydrodynamic lubrication often occurs in components such as cylinders, gears, and plain bearings




**Thick Film or Fluid Film or Hydrodynamic Lubrication**

- **Low Load**
- **High Speed**

# Mechanism of Lubricants (Lubrication)

## Thin Film or Boundary Lubrication

- Where thick film lubrication fails, thin film lubrication is done .

- Thin film or boundary Lubrication is done for those cases in which the continuous film of lubrication cannot persist and direct metal to metal contact is possible.

- It is carried out with semi-solid(grease)and solid (graphite and molybdenum disulphide) lubricants.

- Boundary lubrication is a condition in which the lubricant film becomes too thin to provide total separation.

- In this type of lubrication a thin film of lubricant is adsorbed on the surface by weak Vander Waals forces. A thin lubricant should have high viscosity index, good resistance to heat and oxidation, good oiliness and low pour point.

# Mechanism of Lubricants (Lubrication)

This happens when-

i) a Shaft starts moving from rest

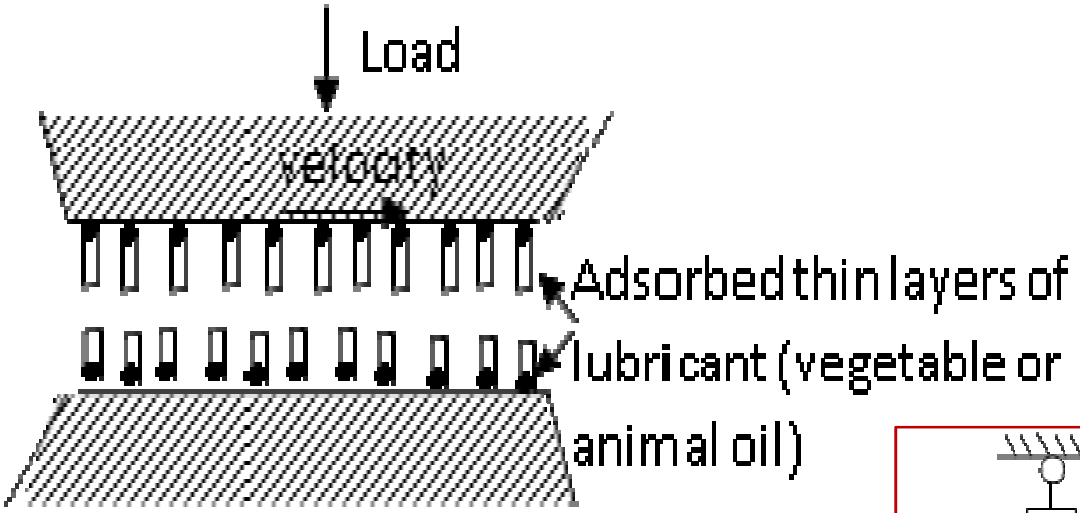
ii) the speed is very low

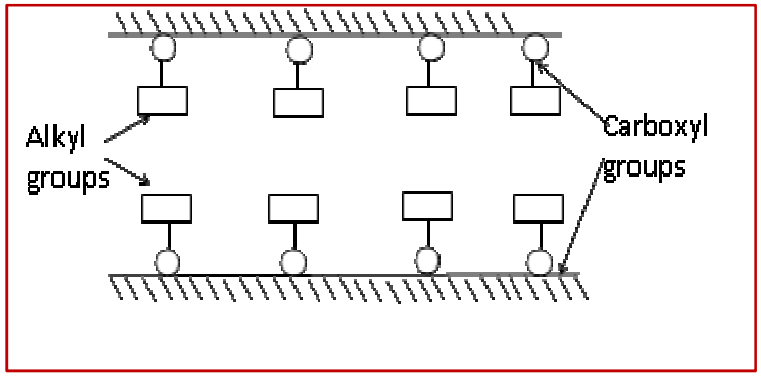
iii) load is very high and

iv) viscosity of lubricating oil is very low.

- In boundary lubrication, the oily lubricant is filled in between the sliding or moving metallic surfaces, which is adsorbed on both the metallic surfaces by any physical or chemical means and cannot be removed easily .
- The adsorbed lubricant from two thin layers between the sliding metallic surfaces and avoid the direct metal to metal contact.
- As a result of this ,the frictional resistance between the sliding metallic surfaces is reduced

# Mechanism of Lubricants (Lubrication)



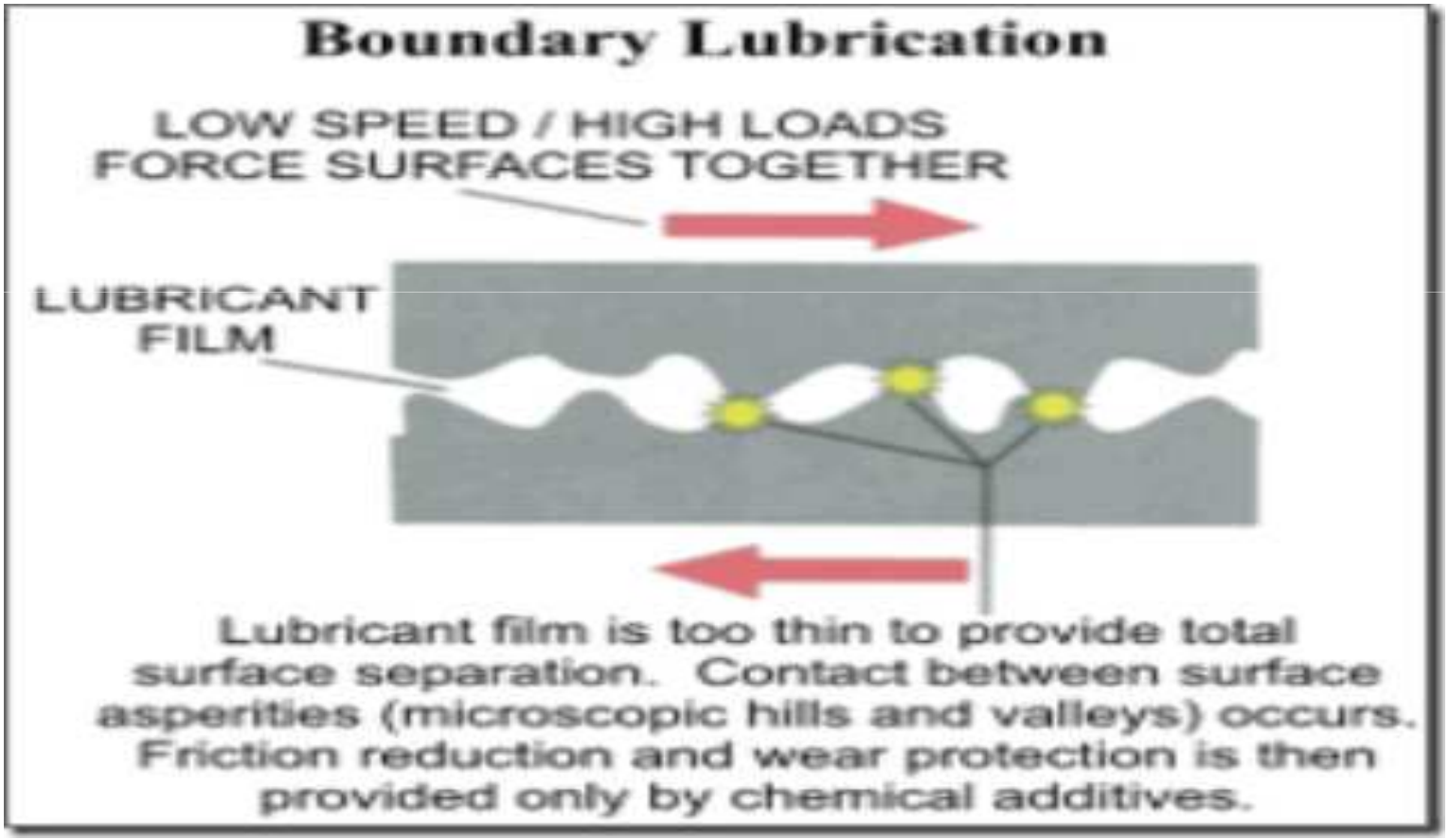




**Thin Film or Boundary Lubrication**

# Mechanism of Lubricants (Lubrication)

- Boundary lubrication often occurs during the start up and shutdown of equipment, or when loading becomes excessive.
- Thickness is 20 – 30 A.
- Coefficient of friction is 0.05 – 0.15 cm /sec.
- Oiliness should be high.
- Fatty acids and their soaps are used as additives.
- Used in automobiles and heavy machinery.
- Graphite and molybdenum sulphide in powder form or as stable suspension in oil can also be used as efficient lubricants in thin film lubrication process.
- Hydrocarbon chain of the fatty acid gets oriented outwards in a perpendicular direction

# Mechanism of Lubricants (Lubrication)



# Mechanism of Lubricants (Lubrication)

## Extreme Pressure(or Temperature)Lubrication

- High pressure lubrication process involves the use of lubricants mixed with extreme pressure additives.
- In this mechanism moving or sliding surfaces are under high pressure and speed, therefore this is known as extreme pressure lubrication.
- In such a case high temperatures generated due to friction, under these condition liquid lubricants are fail to stick and decompose or vaporize. These problems are minimized by special additives are added to mineral oils.
- These additives form durable films on metal surfaces which can withstand high loads and high temperatures.
- Important additives are organic compound having group like chloride, sulphur, phosphorus etc.

# Mechanism of Lubricants (Lubrication)

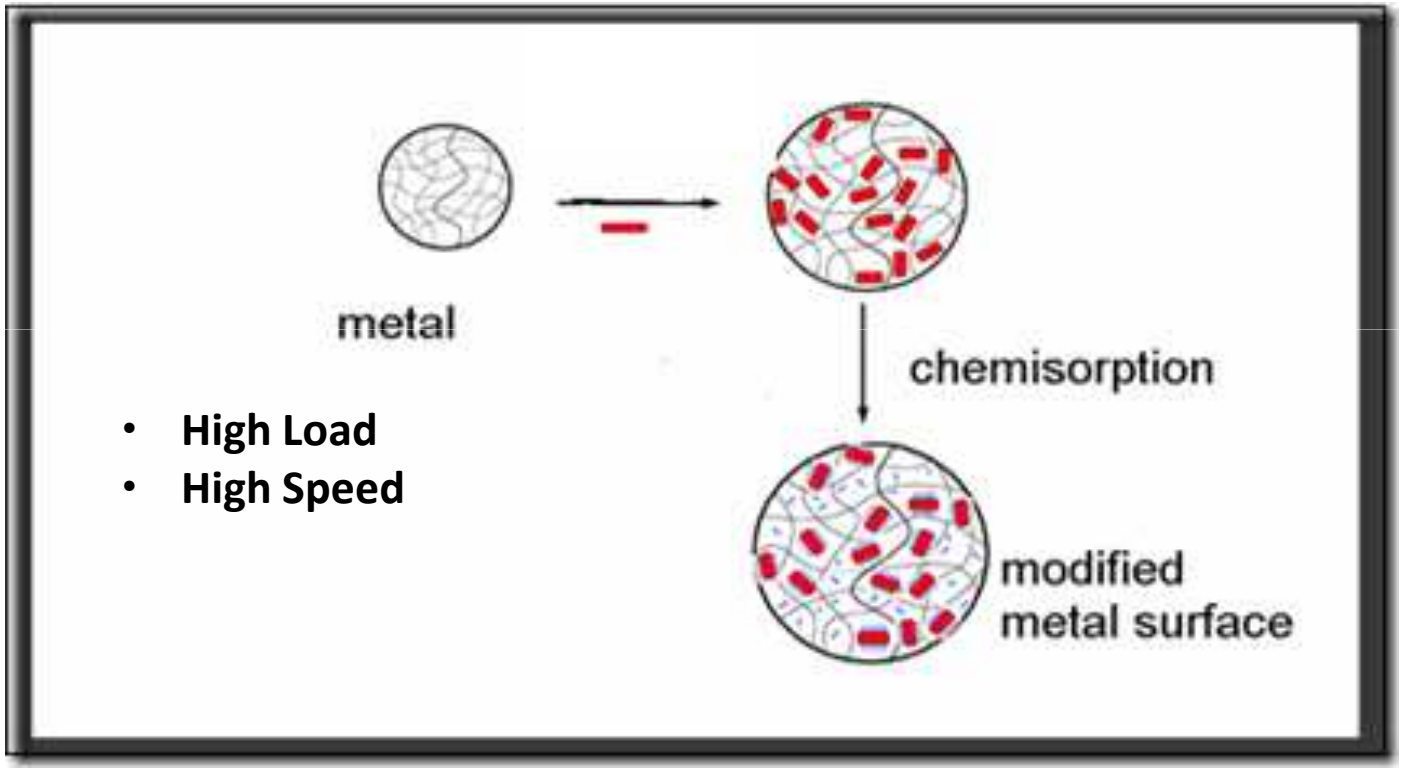
- They react with metallic surface to form metallic compound (possess high melting points and serve as good lubricants under extreme temperatures and pressures) like chlorides, sulphides, phosphate as more durable film.

- Co. efficient of friction 0.1 – 0.4 cm /sec.

- It finds application in Air crafts and space crafts.

- Unique character of this type of lubricants is its replenish ability / easy of replacement

# Mechanism of Lubricants (Lubrication)




- **High Load**
- **High Speed**

**Extreme Pressure(or Temperature)Lubrication**


# Thanks

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PROPERTIES OF LUBRICANTS

VISCOSITY AND ITS DETERMINATION

VISCOSITY INDEX

FLASH & FIRE POINT

CLOUD & POUR POINT

EMULSIFICATION &

SEN (STEAM EMULSION NO.)

# Lubricants

## Properties of Lubricants

- **Viscosity & Viscosity Index**
- **Flash & Fire Point**
- **Cloud & Pour Point**
- **Emulsification and Emulsion Number**

# Viscosity & Viscosity Index

## Viscosity & Viscosity Index

### Viscosity

- Viscosity is the measure of internal resistance in a liquid.
- **Viscosity is the property of a liquid which resistance to it's own flow.**
- Viscosity is usually expressed in centipoise or centistoke.
- Consider any two layers of a liquid, which are at a distance of moving with a velocity difference Then force per unit area (F) is given by
- $F=\eta V/d$, where $\eta$ = coefficient of viscosity
- $F=\eta$ (If V=1unit & d=1 unit)
- Coefficient of viscosity may be defined as the force per unit area required to maintain a unit velocity gradient between two parallel layers.

# Viscosity & Viscosity Index

- A low viscosity oil is thin and flows easily .
- A high viscosity oil is thick and flows slowly.

**Factor effecting on viscosity**

- **Temperature**: Viscosity of liquid decreases with increasing the temp. Because increases the K.E of the liquid hence the intermolecular attraction decrease.
- **Pressure** : viscosity increases with pressure. Because volume decrease with increase the pressure hence molecules come close each other
- **Nature of liquid**: The liquid having stronger intermolecular forces of attraction are expected to have more viscosity.
- Alcohol have higher viscosity than Benzene

# Viscosity & Viscosity Index

**Measurement of viscosity**

Viscosity can be measured using Redwood viscometer, Engler's viscometer and Saybolt viscometer.

**Determination of viscosity by 'Redwood Viscometer'-**Redwood Viscometer' are of two types:

**1. Redwood Viscometer No.1-Thin oil**

(For fluid having viscosity corresponds to Redwood seconds less than 2000)

**2. Redwood Viscometer No. 2 –Thick oil**

( For fluid having viscosity corresponds to Redwood seconds greater than 2000)

- The difference between Redwood Viscometer 1 & 2 are the difference of orifice diameter.
- Redwood Viscometer 1 for thin oil and Redwood Viscometer 2 for thick oil.

# Viscosity & Viscosity Index

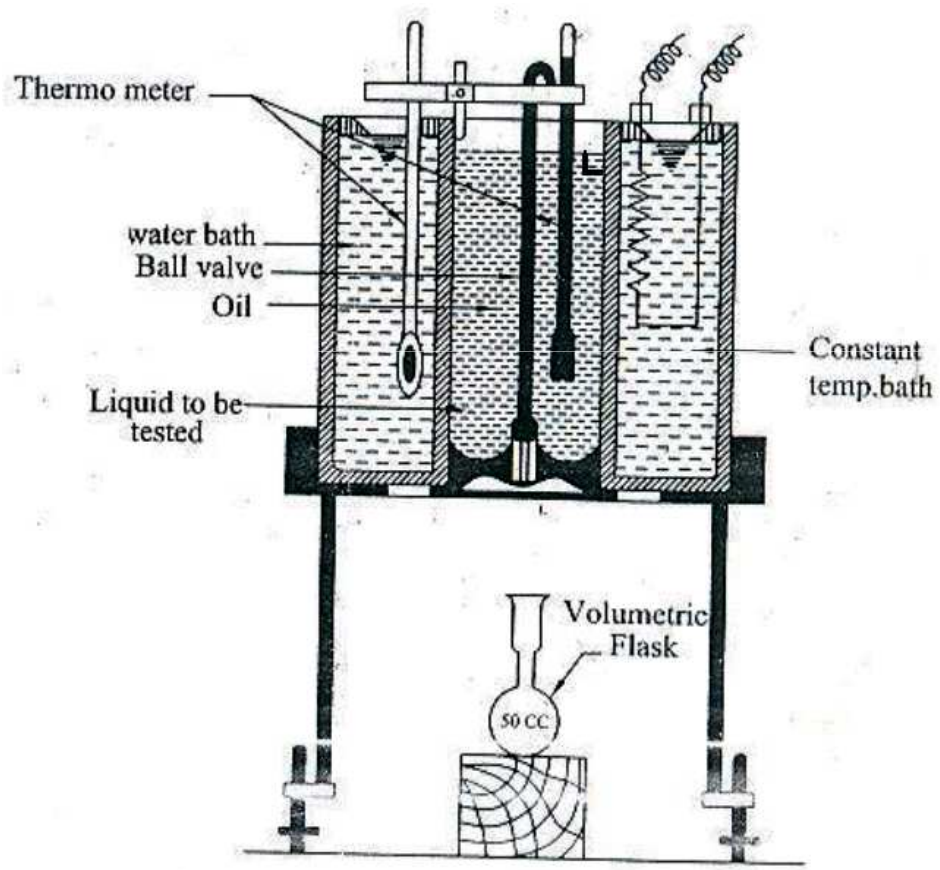
**Construction :** Redwood viscometer consists of following parts.

- **Oil cup**: It is a silver plated brass cup which is opened at the upper end. Oil has to be filled up to a certain mark. The bottom of the cup is fitted with a jet made up of agate and can be opened by valve rod fitted with a brass ball. Lid of the cup is fitted with a thermometer to measure the temperature of oil.

- **Heating bath:** The oil cup is surrounded by a water bath provided with an outlet for taking out the water, a stirrer with four blades and a thermometer.

- **Kohlraush flask 50 mL capacity**: It is a special type of receiver for receiving the oil.

# Viscosity & Viscosity Index




**Redwood Viscometer**

# Viscosity & Viscosity Index

**Procedure:**

- Fill the oil cup with given oil.
- Put the Kohlarausch 's flask below the jet.
- Maintain the desired temp. and stir the water to maintain equilibrium temp.
- Lift the valve rod and start the stop watch.
- Note the time for collecting the oil up to the mark in the receiver.
- Refill the oil cup, repeat the experiment at different temp. and note the respective time.

# Viscosity & Viscosity Index

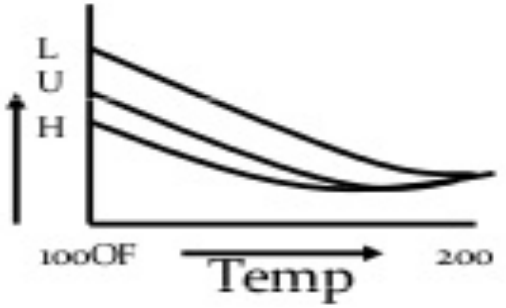
**Significance of viscosity**

- A good lubricating oil must have moderate viscosity.
- If the viscosity of the lubricating oil is high due to excessive friction, movement of the machine is restricted.
- On the other hand if the lubricating oil is having low viscosity, the liquid film cannot be maintained under heavy load or pressure.

# Viscosity & Viscosity Index

## Viscosity index (V.I.)

- The rate at which the viscosity of lubricating oil changes with rise in temperature is measured by a scale known as **Viscosity Index(V.I).**
- **High VI=Low rate of change of vis**
- **Low VI= High rate of change of vis**
- **Viscosity index is defined as "the average decrease in viscosity of an oil per degree rise in temperature between $38^0$C($100^0$F) and $99^0$C($210^0$F.)**
- If the increase in temperature makes notable d the lubricating oil, then the oil has a low viscosity in
- But if the viscosity of the oil is affected slowly the V.I of the oil is high.




- If V.I is high ,the V.T curve is flatter than if the V.I is low.

# Viscosity & Viscosity Index

**Measurement of V.I**

For the determination of viscosity index of an oil under test is determine with the help of two standard oils.

Two sets of standard oils are selected.

- One set of oils have viscosity index 100 ( maximum) and are known as paraffinic –base Pennsylvanian oils .
- The other set of oil have viscosity index O (minimum) and are known as naphthenic gulf oils.

# Viscosity & Viscosity Index

- The test oil is compared at $38^0$C with a zero V.I oil and 100 V.I oil.
- Both having the same viscosity as the test oil at $99^0$C($210^0$F.)
- From the above values the viscosity index of sample oil(U) can be found out using the formula -

$$V.I = \frac{L-U}{L-H} \times 100$$

where,
U = viscosity of the oil under test at $100^0$F
L = viscosity at $100^0$F Gulf oil ( V.I = 0) having the same viscosity of the sample at $210^0$F.
H= viscosity at $100^0$F Pennsylvanian oils ( V.I = 100) having the same viscosity of the sample at $210^0$F.

A good lubricant should have high viscosity index.

# Flash and Fire Point

## Flash and Fire Point

- **Flash point** is the minimum temperature at which a lubricant gives sufficient vapour and burn for a moment, when a flame is brought near it.
- **Fire Point** is the lowest temperature at which the lubricant gives sufficient vapour and burn continuously for at least five seconds, when a flame is brought near to it.
- The flash and fire point is determined by **Pensky Marten's apparatus**.
- Generally the fire point is 5 to $40^0$C higher than the flash point.

# Flash and Fire Point

**Construction:** Penskey marten's apparatus essentially consist of-

- **Oil cup**: It consists of brass and is of a standard size having a mark up to which the oil has to be taken.
- **Lid of oil cup**: The lid has four opening, which are used for stirrer, thermometer, an air inlet, and a device for introducing the standard flame.
- **Air Bath:** The cup is surrounded by an air bath which is heated with the help of electricity.
- **Flame exposure device and Pilot Burner:** Flame exposure device is a tiny flame, connected to the shutter by a lever mechanism. The test flame is lighted automatically with the help of pilot burner.
- **Shutter:** The shutter is provided at the top of the cup. By moving the shutter, the openings in the lid opens and flame can be taken to this opening.
- **Stirrer:** The lid is provided with a stirrer having two blades.

# Flash and Fire Point

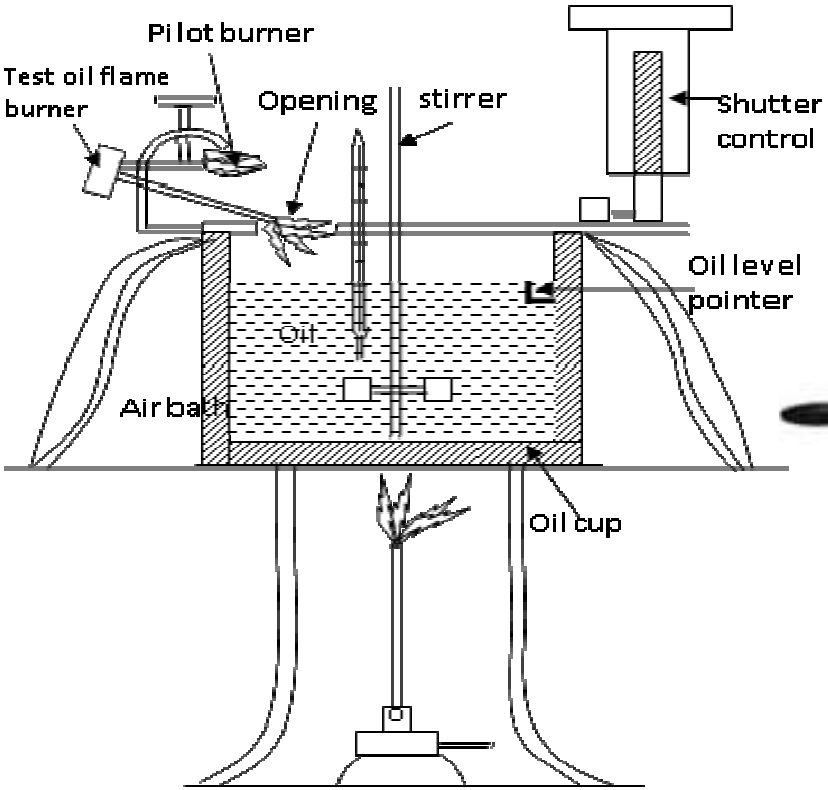



**Fig 3.8 Pensky-Marten's Flash-point apparatus**

# Flash and Fire Point

**Procedure (Working)**

•Fill the oil cup up to the mark and the apparatus is slowly heated.

• The test flame is brought near the oil vapours after every $2^0$C rise in temp.

• Note the temp. when test flame causes a flash **(Flash Point).**

• Heating is continued and test flame is introduced after every $2^0$C rise in temp.

• Temp. is noted at which the oil catches fire and stays for 5 seconds **(Fire Point**).

**Significance**

A good lubricant should have high fire and flash point so that it can withstand higher working temperatures. A knowledge of flash and fire point is useful in providing protection against fire hazard during transport and storage. Lubricating oils of paraffinic base possess higher flash points than those of naphthenic base. Hence the determination of flash and fire points is helpful in identifying the type of lubricating oil.

# Cloud & Pour Point

## Cloud & Pour Point

- **Cloud points:** When oil is cooled slowly, the temperature at which it becomes cloudy or hazy in appearance, is called its cloud-point.
- **Pour point** is the lowest temperature at which the oil just ceases to flow.
- It is important because the suitability of lubricants in the machine working at low temperature. It indicates the lowest servicing temperature below which the circulation of the oil is unreliable and inefficient, causing wear of machinery.
- When oil is cooled , wax starts crystallizing , and the oil becomes hazy.
- Both cloud and Pour points should be very less than the operating temperature.

# Cloud & Pour Point

- Polymeric additives such as poly amino alcohols are added to decrease cloud and pour points.
- The additives lower the pour point either by forming a thin coating over wax and prevent it from agglomeration or co precipitate along with wax , thus reducing the freezing point.

# Cloud & Pour Point

**Determination of cloud and pour point**

To determine the cloud point and pour point, we generally use cloud and pour point apparatus.

**Construction:**

**1. Flat- bottomed tube** : It is glass tube with standard dimension i.e. 12 cm height 3 cm diameter.

**2. Glass or a metal jacket:** The tube is enclosed in a glass or metal jacket which is filled with freezing mixture and a thermometer..

**3. Thermometer:** To measure cloud and pour point.

**4. A cork disc**: This is used to support the tube.

# Cloud & Pour Point

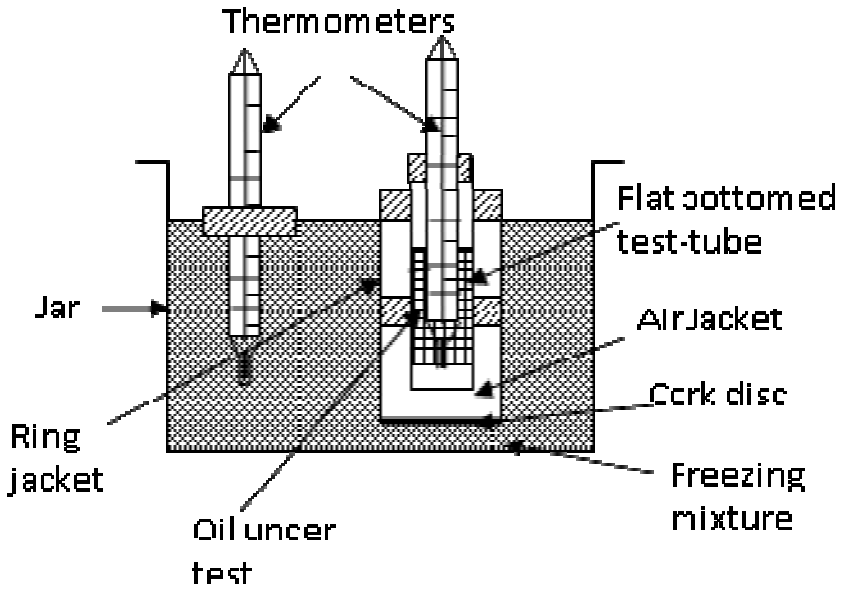



**Fig 3.9 Cloud and pour-point apparatus**

# Cloud & Pour Point

**Procedure (Working):**

- Take the oil sample in flat bottom tube up to the mark.
- Fill the freezing mixture in the cooling bath.
- The tube is kept in cooling bath and allowed to cool.
- Take out the tube after every $2^0$C decrease in temp.
- Note the temp. when oil becomes hazy or cloudy **(Cloud Point)**
- Continue the cooling and note the temp. when the oil stops flowing **(Pour Point)**

# Cloud & Pour Point

**Significance of Cloud & Pour Point**

- Most of the petroleum based lubricating oils contain dissolved paraffin wax and asphaltic impurities.
- When the oil is cooled these impurities undergo solidification which cause jamming of the machine.
- For machines working at low temperatures, lubricants with low cloud and pour point is preferred.

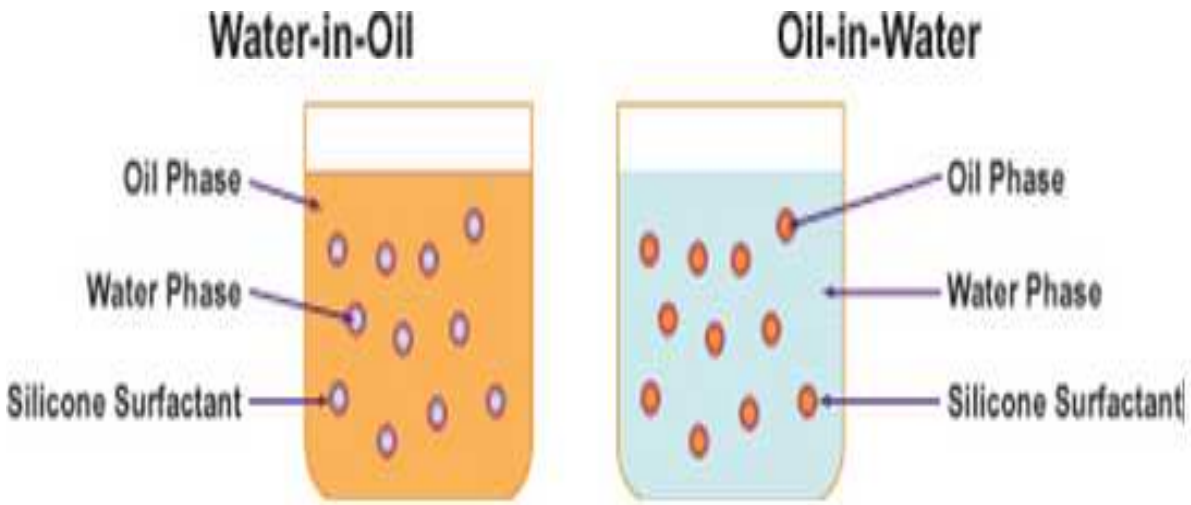
# Emulsification

**Emulsification:**

- It is the property of oils to get intimately mixed with water, forming a mixture, called emulsion.
- Emulsions have a tendency to collect dirt, grit, foreign matter etc., thereby causing wearing of the machinery parts.
- Emulsions can be oil in water emulsion or water in oil emulsion.
- A good lubricating oil should form such an emulsion with water which breaks easily. This property is called demulsification.
- The time in seconds in which a given volume of oil and water separates out in distinct layers is called **steam demulsification number** or **Steam Emulsion Number (SEN)**

# Emulsification

- A good lubricating oil should have **low demulsification number or SEN**.
- Quicker the oil separates out from the emulsion formed, better is the lubricating oil.



# Emulsification


# Emulsification

**Steam Emulsion Number (SEN)**

- The tendency of lubricant-water emulsion to break is determined by A.S.T.M. test.
- In this, 20 ml of oil is taken in a test-tube and steam at 100°C is bubbled through it, till the temperature is raised to 90°C.
- The tube is then placed in a bath maintained at 90°C and the time in seconds is noted, when the oil and water separate out in distinct layers.
- The time in second in which oil and water emulsion separates out in distinct layers, is called steam emulsion number **(S.E.N.).**
- A goad lubricant should possess a low steam emulsion number.

# Emulsification

**Significance of steam emulsification number**

- Good lubricating oil has low steam emulsification number; so that when it comes in contact with water it does not form an emulsion.
- The emulsion has a tendency to collect dirt, dust etc. which reduces the lubricating property.


# Thanks