LUBRICANTS

Course: B.Tech.

Subject: Engineering Chemistry

Unit: V (B)

DEFINITION: LUBRICANTS

- A lubricant is substance (often liquid) introduced between two moving surfaces to reduce the friction between them.
- Fluid which is introduced in between moving parts in order to reduce the friction, generated heat & wear and tear of machine parts are called Lubricants.
- This process of introducing lubricant is called Lubrication.

Automotive Oils

Gear and Transmission oils

- **Automotive Grease**

Composition

- Typically contains 90% base oil(petroleum-mineral oils) and less than 10% additives
- Non liquid lubricants contains Grease, powder(dry graphite, Molybdenum disulphite), Teflon tape used in plumbing etc.
- Those non liquid lubricants provide lubrication at higher temp.(up to 350 °C)

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 --- Glycerols

Functions of Lubricants

✓It acts as a thermal barrier and reduces friction and wear and prevents welded joints
✓Avoids seizure of moving surfaces
✓Acts as coolant
✓Acts as a seal and prevents entry of dust, moisture, & dirt between moving parts

✓Some lubricants acts as corrosion inhibitors thus reduce operational cost .

Characteristics

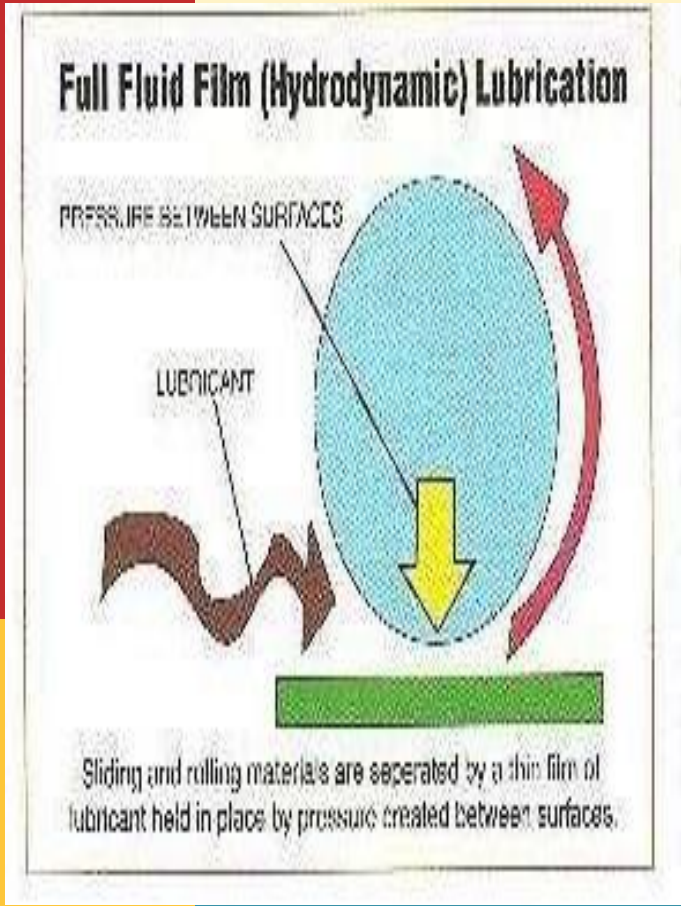
A good lubricating oil should have:

- High boiling point
- Adequate Viscosity
- Low freezing point
- High oxidation resist
- Non Corrosive properties
- Good thermal stability

Types Of Lubrications

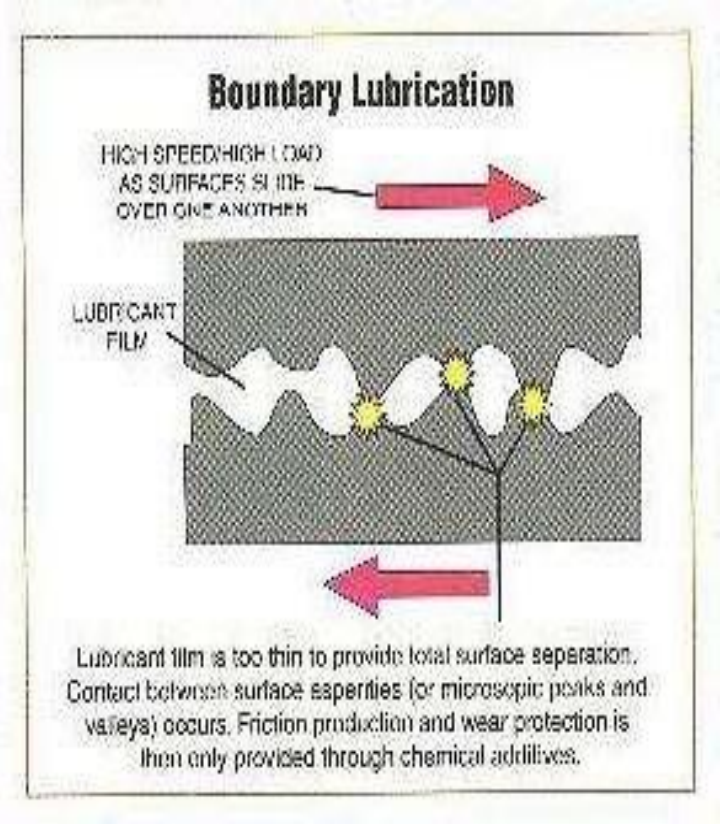
- Thick Film or Fluid Film or hydrodynamic Lubrication
- Thin Film or Boundary Lubrication
- Extreme Pressure Lubrication

Thick Film Lubrication



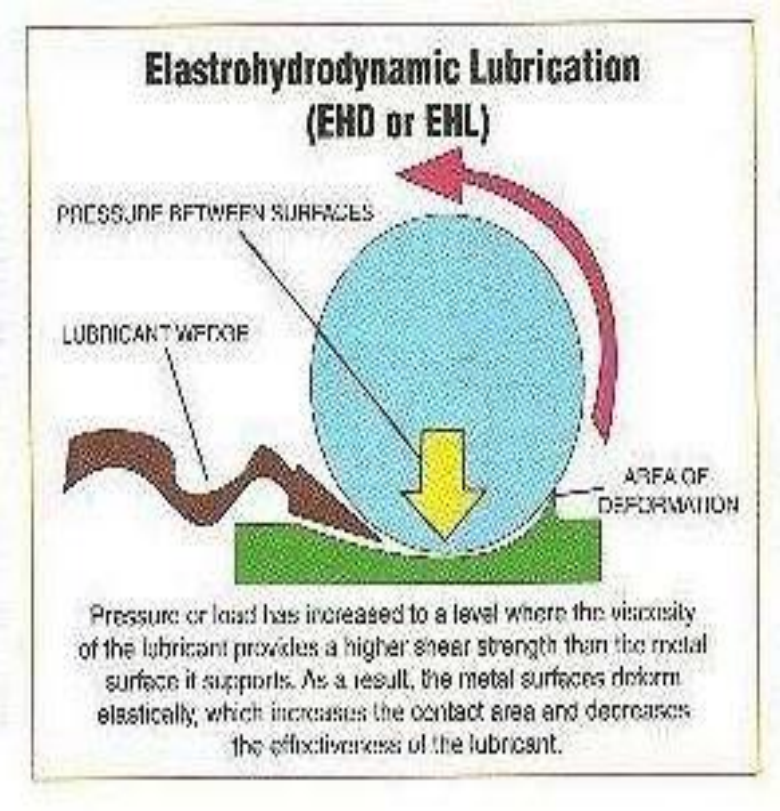
- This is also called Hydrodynamic or fluid film lubrication.
- Two sliding metal surfaces are separated from each other by a thick film of fluid (1000 A^{o} thick).
- The coefficient of friction in such cases is as low as 0.001 to 0.03
- Lubricants used : Hydrocarbon Oils.
- Provided in delicate instruments such as watches, clocks, light machines like sewing machines, scientific instruments etc.

Thin Film Lubrication



- This lubrication is also called Boundary Lubrication.
- Its used for high load conditions.
- Very thin film of the lubricant is adsorbed on the surface by physical or chemical forces or both.
- The coefficient of friction is 0.05 to 0.15
- Lubricants used for boundary lubrication should have high viscosity index, resistance to heat and oxidation, good oiliness.
- Examples are Organic oils, Vegetable oils, Graphite and MoS_2, Mineral Oils etc.

Extreme Pressure Lubrication



- This lubrication is for very high press/temp/speed sliding surfaces.
- Extreme pressure additives are used along with the lubricants.
- Chemicals used are compounds of Cl, S & P.
- These additives form solid surface films of Cl, S & P.
- High melting point metal compounds are good lubricants.
- E.g. graphite is used for drawing wires made up of mild steel.

Classification of Lubricants

- Liquid Lubricants
  - Eg.Mineral Oil, Petroleum Oil, Vegetable Oil etc
- Semi Solid Lubricants
  - Eg. Petroleum jellies
- Synthetic Lubricants
- Solid Lubricants
  - Eg. Graphite, Molybdenum Disulphide etc.

Types of Lubricants

- **Solid lubricants** e.g Wax, Talc, Mica, Molibdenum disulphide
- **Semi solid lubricants** e.g. Grease and Vaseline
- **Liquid Lubricants** e.g. Mineral oils, Vegetable oils, Animal oils
- **Synthetic lubricants** e.g. Polyglycols, Silicones, Organic amines, Imines, Amides.

Features of Lubricants

- Increase efficiency and reduce wear
- Dissolving or transporting foreign particles and distributing heat
- Single largest application is in form of **Motor Oil,** protecting internal combustion engines in motor vehicles and powered equipments
- Another approach is to use ball bearings, roller bearing or air bearings which in turn require internal lubrication themselves

Properties:

1. Viscosity

- It’s a measure of a fluid’s resistance to flow.
- Viscosity of the lubricating oil determines its performance under operating conditions.
- A low viscosity oil is thin and flows easily .
- A high viscosity oil is thick and flows slowly.
- As oil heats up it becomes more viscous (*Becomes thin)*
- Too low viscosity of the liquid > Lubricant film cannot be maintained between the moving surfaces > Excessive wear.
- Too high viscosity of the liquid > Excessive friction.
- Selected Lubricant must be proper viscous.
- Viscosity is usually expressed in centipoise or centistoke.

2. Iodine Number

- Iodine number is the number of Gms equivalent of iodine to amount of ICl absorbed by 100gm of oil.
- Each oil has its specific Iodine Number.
- So Iodine Number determines the extent of contamination of oil.
- Low Iodine Number is desirable in oils.

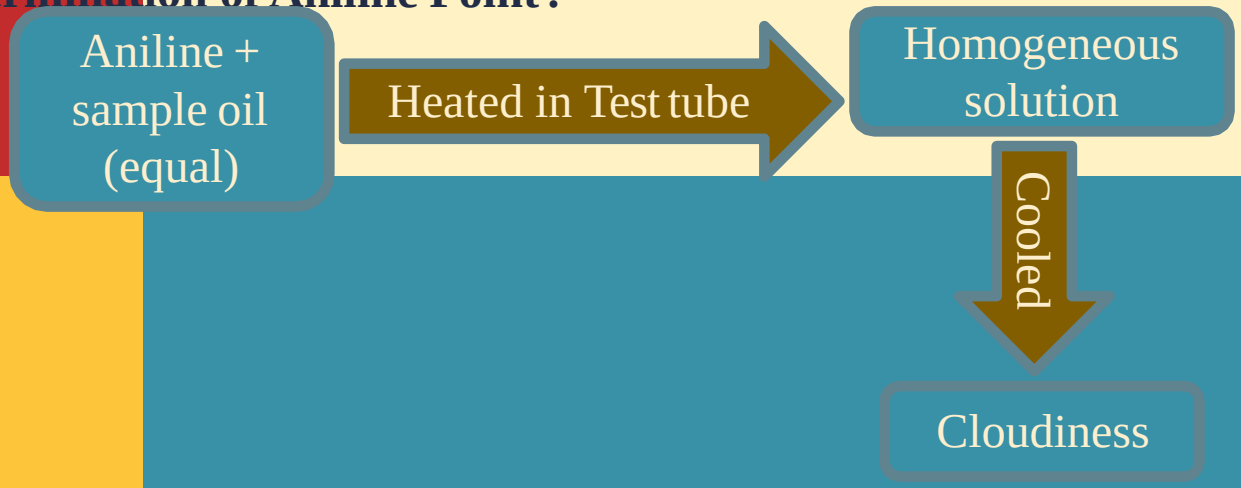
Some oils and their Iodine Numbers are given below :

Iodine Number	Oil	Example
>150	Drying oil	Linseed oil, tung oil
100-150	Semidrying oil	Castor oil , Soyabean oil
<100	Non-Drying oil	Coconut oil, Olive oil

3. Aniline Point

- Aniline point is the Min temp at which oil is miscible with equal amt of aniline
- Aniline Point is a measure of aromatic content of the lubricating oil.
- Low Aniline Point oil have high aromatic content which attacks rubber seals.
- Higher Aniline point means low %age of hydrocarbons (desirable).
- Thus Aniline Point is used as an indication of possible deterioration of rubber sealing etc.

Determination of Aniline Point :



The temperature at which separation of the two phases (Aniline + oil) takes place is the Aniline Point.

4. Emulsion Number

- Emulsification is the property of water to get mixed with water easily.
- 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.
- A good lubricating oil should have lower demulsification number.
- Quicker the oil separates out from the emulsion formed, better is the lubricating oil.
- In cutting oils the higher the emulsification number, better the oil is. This is because the emulsion acts as a coolant as well as a lubricant.

5. Flash point and Fire point

- Flash Point is the min temp at which the lubricant vaporizes that ignite for a moment when tiny flame is brought near.
- Fire Point is the Min temp at which the lubricant's vapours burn constantly for 5 seconds when tiny flame is brought near.
- If flash point < 140°F = Flammable liquids

  And if flash point > 140°F =Combustible liquids.

The flash and fire points are generally determined by using Pensky-Marten's apparatus.

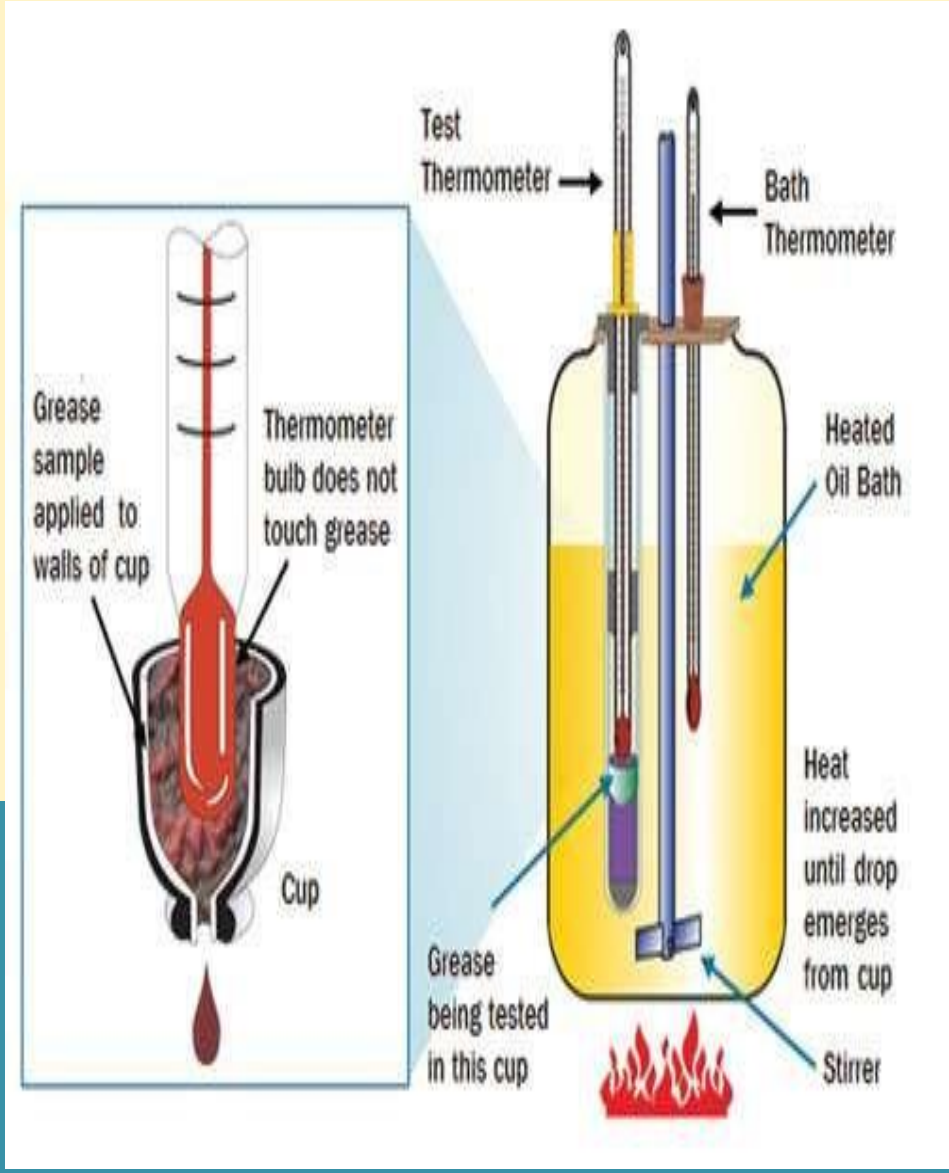
- Oil under examination is filled in the oil cup up to the mark and heated by the air bath by a burner.
- Stirrer is worked b/n tests at a rate of about 1 – 2 rev/sec.
- Heat is applied so as to raise the oil temp by about 5c/min.
- The temp at which distinct flash appeared in side the oil cup is recorded as flashpoint.
- The heating is continued to record the fire point.

6. Drop Point

- Drop Point is the Temperature at which grease passes from the semi-solid to the liquid state. So, it determines the upper temp limit for the applicability of grease.

Determination :

- Beaker is heated.
- Temperature is raised.
- Grease sample passes from a semi-solid to a fluid state.
- Temp at which its first drop falls from the opening is recorded as drop-point.



7. Cloud point and Pour Point

- Cloud Point is the temp at which the lubricant becomes cloudy or hazy when cooled.
- Pour Point is the temp at which the lubricant just ceases to flow when cooled.
- Both indicates suitability of lubricant in cold conditions and thus must be low.

8. Saponification Number

- It’s the mgs of KOH required to saponify 1 gm of oil.

- Saponification is hydrolysis of an Easter with KOH to give alcohol and Na/K salt of acid.

Uses

- Other uses are
- for cooking,
- biomedical applications on human(lubricants for artificial joints).

Applications

- Automotive Industry-Engine oil, Automatic transmission fluid, Gearbox fluid, Break fluids.
- Tractor(One lubricant for all systems)
- Other motors(2 stroke engine oil)
- Industrial(Hydraulic oils, Air compressor oils, Gas Compressor oils, Gear oils Bearing and circulating system oils, Refrigerator compressor oils)
- Aviation
- Marine

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