

Lubrication

Any substance introduced between the two moving/sliding surfaces with a view to reduce the friction resistance between them, is known as a lubricant. The process of reducing frictional resistance between moving /sliding surfaces by the introduction of lubricants in between them is called lubrication.

When one surface slides over another, three basic physical factors can affect the overall wear.

1. Distance between surfaces
2. Force acting on surfaces
3. The surface texture

Classification:-

1. **Solid:** - Examples are Graphite, Teflon, Molybdenum disulphide, Soap stone, Talc, Mica etc.
2. **Semi Solid:** - Examples are Grease, Vaseline.
3. **Liquid:** -
 - (a) Vegetable Oil: - Ex. Olive oil, Palm oil.
 - (b) Animal Oil : -Ex. Lard oil, Talon oil.
 - (C) Mineral Oil: - Ex. Petroleum fraction
 - (d) Blended or Compounded Oil: - Mineral oil added with other additives to impart desired properties like to increase oiliness, coconut oil is blended with oleic acid (fatty acid).
 - (e) Synthetic Oil: - Ex. Silicones
4. **Emulsion:-** (a) Oil-in water type:- Ex. cooling and cutting tool emulsion
It is obtained by adding oil containing about 3-20% water soluble emulsifying agent to a suitable quantity of water.
(b) Water in -Oil type: - Ex. cooling liquids.
It is prepared by mixing together water containing about 1-10% water soluble emulsifier like alkaline earth soap, (e.g. Calcium stearate $C_{36}H_{70}CaO_4$).

Uses:-

Solid type:-

1. Heavy machine doing crude job at high load where film can not be provided by lubricating oil.
2. Risk of contamination by dirt on oil Ex-Commutator blades of electric motors and generators.
3. As lubricant in air compressors, lathes, general machine shop works, railway track joints, open gears, cast iron bearing, internal combustion engine etc.

Semi Solid type:-

1. Machine working at low speed and high pressure, where oil may be detrimental to the product (like food product).
2. Use of oil is unsuitable to be maintained in position due to load or intermittent operation.

Liquid type:-

1. It is used to machine at low and high speed and high pressure.

Synthetic type:-

1. These are oily liquids not found in nature nor produced directly. This type is usable in
 - a. Metal forming process
 - b. Hot running bearing
 - c. Air craft turbines
 - d. Reactive environment

Compelling reason is that type is usable in wide range of temp. -50°C up to 260°C

Theory of lubrication:-

There are three different theories,

1. Hydrodynamics OR fluid film lubrication:-

In this, the moving/sliding surfaces are separated from each other by a thick –film of fluid (at least $1,000\text{\AA}$ thick), so that direct surface to surface contact and welding of junctions rarely occurs. This consequently reduces wear. Delicate instruments, light machine, like watch, clock, guns, sewing machine, scientific instruments etc are provided with this type of lubrication.

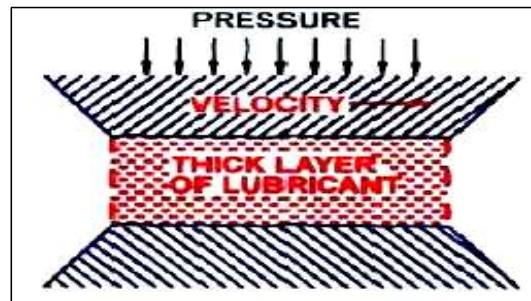


Fig. (1)

(B) Boundary lubrication:-

This theory is involved in cases where loads are high and speed is low or when the shaft is started after a long period of rest or when the viscosity of lubricant is too low. In this cases oiliness is important than viscosity and a layer of lubricating oil is adsorbed on metal surface to reduce friction. Ex. Bicycle Chain

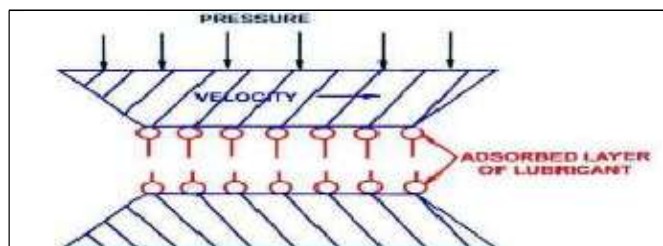


Fig. (2)

(C) Extreme pressure:-

This is used in cases of high load, temp. and speed rise between two metal surfaces.

The lubricant combines with the surface of metal at high temp. and form a stable surface layer to reduce friction e.g. Shaft of JCB machine.

Properties:-

1. **Flash and Fire point:** - Flash point is the lowest temperature at which the oil lubricant gives off enough vapours that ignite for a moment, when tiny flame brought near it. While fire point is the lowest temp. at which the vapour of the oil burn continuously for at least five seconds, when a tiny flame is brought near it.
A good lubricant should possess flash point at least above the temp. at which it is to be used.
2. **Cloud and Pour point:** - When oil is cooled slowly, the temp. at which it become cloudy and hazy in appearance is called its 'cloud point', while the temp. at which the oil cease to flow or pour is called 'Pour Point'.
Cloud and pour points indicate that suitability of lubricants in cold conditions. Lubricant used in machine working at low temp. should possess low pour point, otherwise solidification of lubricant will cause jamming of the machine. It has been found that presence of waxes in the lubricating oil raise the pour-point.
3. **Oiliness:** - Oiliness of a lubricant is a measure of its capacity to stick on to the surfaces of machine parts under conditions of heavy pressure or load.
4. **Emulsification:** - It is property of oils to get intimately mixed with water forming a mixture, called emulsion. Certain oils form emulsion with water easily. Emulsions have a tendency to collect dirt, grit, and foreign matters, etc. thereby causing abrasion and wearing out of the lubricated parts of the machinery. So good lubricating oil should form emulsion with water, which breaks off quickly.
5. **Volatility:** - When lubricating oil is used in heavy machinery working at high temp. , a portion of oil may vaporize; leaving behind a residual oil, which have different lubricating properties like increased viscosity. A good lubricant should have low volatility.
6. **Aniline Point:-** Aniline point of an oil is defined as "the minimum equilibrium solution temperature for equal volumes of aniline and oil sample". Aniline point gives an indication of the possible deterioration of oil in contact with rubber sealing, packing, etc.

Equal volume of (Oil + aniline ----- heat till the homogeneous solution obtained----
----- Cool at controlled rate. The temp. at which the two phases (oil and aniline) separated out is recorded as the aniline point.