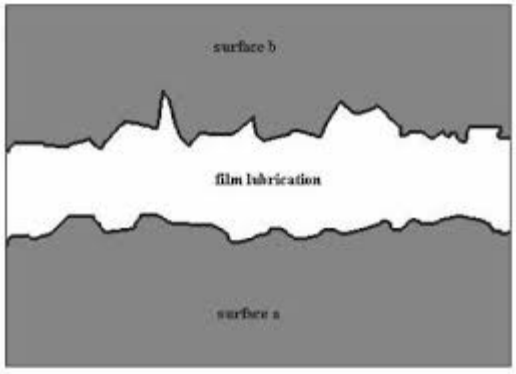
Mechanism of lubrication

There are mainly three types of mechanisms by which lubrication takes place. They are:

(i) Fluid film or thick film or hydrodynamic lubrication
(ii) Boundary lubrication or thin film lubrication (
(iii) Extreme pressure lubrication

Fluid film lubrication:-

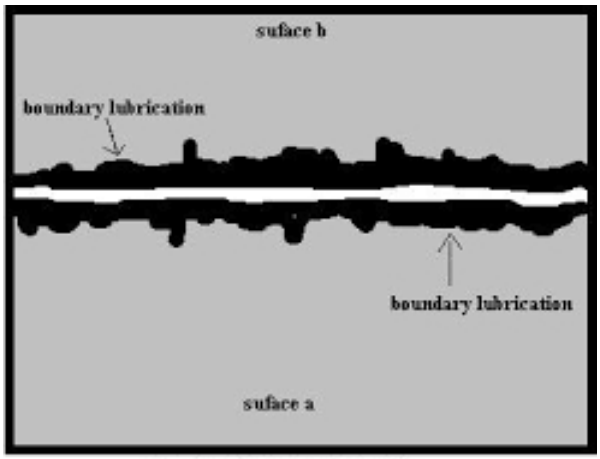
- In this type of lubrication, the moving or sliding surfaces are separated from each other by a thick film of fluid, so that there is no direct contact between them.
- The lubricant film covers the irregularities of the surfaces and reduces friction and wear and tear.
- The resistance to movement of sliding or moving parts is due to internal resistance between the particles of the lubricant moving over each other.
- For this, the lubricant should have minimum viscosity under working conditions. It should remain in place and separate the surfaces.
- The coefficient of friction which is a ratio of force required to cause motion to the applied load is as low as 0.001 to 0.03.



Delicate instruments, light machines like watches, clocks, guns, sewing machines etc. are provided with fluid film lubrication. The fluid film lubrication is done by hydrocarbon oils. These are blended with selected long chain polymers to maintain the viscosity of oil as constant in all seasons. The viscosity of hydrocarbon oils increases with increasing molecular weight. Hence appropriate fractions are blended from petroleum refining to meet the requirement for different applications.These fractions contain small quantities of unsaturated hydrocarbons which get oxidised under operating conditions and form gummy products. So antioxidants like amino phenols are used in hydrocarbon oils.

(ii)Boundary lubrication:-

- This type of lubrication occurs when a continuous film of lubricant cannot persist and direct metal to metal is possible.
- In these conditions, the space between the moving or sliding surfaces is lubricated so that a thin layerof lubricant is adsorbed on the metallic surfaces due to physical or chemical forces.
- This adsorbed layer helps to avoid the direct metal to metal contact between the rubbings surfaces. This load is carried by the layers of adsorbed lubricant on both thre metal surfaces.
- The coefficient of friction varies from 0.05 to 0.15.



BOUNDARY LUBRICATION

For boundary lubrication, the lubricant molecules should have

Long hydrocarbon chains,

Polar groups to promote wetting or spreading over the surface,

Lateral attraction between the chains,

Active functional groups which can form chemical bonds with metals or other surface,

High viscosity index,

Good oiliness,

Resistance to heat and oxidation,

Low pour point.

Solid lubricants, greases and oils with proper additives function as lubricants in this type of lubrication. For example, graphite, molybdenum disulphide, mineral oils with additives of fatty acids or fatty oils, vegetable and animal oils and their soaps. These materials form films on the metal surfaces having internal friction. So they can bear compression and high temperatures.

(iii) Extreme pressure lubrication:-

- When the moving or sliding surfaces are under high pressure and speed, a special type of lubricants is used called high pressure lubricants.
- They withstand high temperatures generated due to friction.
- Under these conditions, liquid lubricants fail to stick and decompose and may vaporise.
- These problems are minimised by adding special additives to mineral oils.
- These additives form durable films on metal surfaces which can withstand high loads and high temperatures.
- Important additives are organic esters as chlorinated esters, sulphur as in sulphurised oils or phosphorous as in tricresyl phosphate.
- These compounds react with metallic surfaces at high temperatures and form metallic chlorides, sulphides or phosphides.
- These metallic compounds possess high melting points and serve as good lubricants at high temperatures and high pressures.