

## Regimes of Lubrication

A lubricant is a type of substance which can be brought into the contact of loaded rolling / sliding bodies to control friction and wear. Most lubricants are some type of fluid (e.g. mineral and synthetic oils, etc.); however, there are some solid lubricants (e.g. gold, silver, polymers, etc.). Liquid lubricants can be brought into a converging contact due to rotation and pressure generation between the bodies; they can lower the temperature of interacting surfaces and remove contaminants. Liquid lubricants can be mixed with other chemicals to provide additional properties (i.e. corrosion resistance, surface active layers, etc.).

Four different forms of lubrication can be identified for self pressure generating lubricated contacts: *i*) hydrodynamic, *ii*) elastohydrodynamic, *iii*) partial or mixed *iv*) boundary.

*Hydrodynamic or full film lubrication* is the condition when the load carrying surfaces are separated by a relatively thick film of lubricant. This is a stable regime of lubrication and metal-to-metal contact does not occur during the steady state operation of the bearing. The lubricant pressure is self generated by the moving surfaces drawing the lubricant into the wedge formed by the bounding surfaces at a high enough velocity to generate the pressure to completely separate the surfaces and support the applied load.

*Elastohydrodynamic lubrication* is the condition that occurs when a lubricant is introduced between surfaces that are in rolling contact, such as ball and rolling element bearings. In this lubrication regime, the load is sufficiently high enough for the surfaces to elastically deform during the hydrodynamic action.

*Partial or mixed lubrication regime* deals with the condition when the speed is low, the load is high or the temperature is sufficiently large to significantly reduce lubricant viscosity – when any of these conditions occur, the tallest asperities of the bounding surfaces will protrude through the film and occasionally come in contact.

*Boundary lubrication* is the condition when the fluid films are negligible and there is considerable asperity contact. The physical and chemical properties of thin surface films are of significant importance while the properties of the bulk fluid lubricant are insignificant.

Later in this chapter further description and modeling technique for EHL and mixed lubrication is presented.