Oil or Grease Lubrication?

By Thomas Yoon

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A lubricating grease is usually a mixture of 85 to 90 percent mineral oil or synthetic oil together with a thickener. In a majority of all greases, the thickener is a metallic soap. One example is lithium stearate for lithium soap.

The function of the thickener, the metallic soap, is to hold the lubricating oil in a semi−liquid state for easier handling.

When there is rise in temperature, the oil bleeds out from the thickener and functions as a lubricating agent. When the temperature drops again, the thickener soaks up the oil again to become semi−solid once more.

The type of grease chosen for a particular bearing lubrication application must therefore be chosen very carefully. High temperature grease used in low temperature applications may cause the bearings to seize due to lack of lubrication because the oil does not bleed out. The common types of grease in use for rolling contact bearings are the calcium, sodium and lithium greases.

Calcium Soap Greases

These do not dissolve in water. They are recommended for installations exposed to water at temperatures below 60 degree C. They offer good protection against salt water in marine environments.

Sodium Soap Greases

Also called soda greases, they may be utilized over a wide range of temperatures up to 120 degree C. However, if too much water penetrates into the bearings, there is a risk that the grease will be washed out and the lubricating properties become deteriorated.

Lithium Soap Greases

These have excellent resistance to high temperatures. They can also be used over a wider range of temperatures from −50 to 150 degree C. They are not water soluble.

Additives are also added to some greases to improve their properties. Some examples of these additives are anti−rust, anti−oxidants, extreme pressure additives, and stabilizers.

Although it is very convenient to use grease for lubrication of rolling contact bearings, where some bearings come pre−packed with grease ready for use, grease lubrication becomes unsuitable if the operating temperature becomes high.

The high temperature may be because of high ambient temperature environment, or because the heat evolved in the bearing due to friction from high speed or heavy loading. Sometimes the use of oil becomes more logical if the lubricating intervals for grease lubrication becomes too short, perhaps due to leakage from seals.

In oil lubrication, the heat generated from the bearings are able to be transfered to a larger volume of oil which in turn can be pumped through heat exchangers for cooling. In this way, the oil functions both as a lubricating agent as well as a cooling agent.

Oils can also have additives to improve their properties. Some examples are anti−oxidants, corrosion protection additives, anti−foaming additives, surface tension additives, wetting agents, and extreme pressure additives. These additives are put in according to the application of the oil.

Compared to greases, oils can enable bearings to be operated at a wider range of temperatures. However, there are limits to this, especially at higher temperatures. At high temperatures of 90 degree C and above, mineral oils oxidize rapidly and they lose their properties to lubricate. Synthetic oils are increasingly being used for higher temperature applications.

Which to use? Oil or grease? The choice is yours!

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Lubrication − The Silent Component of Machinery

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The function of a lubrication medium is:

1. To form a film between moving bearing components so that metal to metal contact is prevented.
2. To reduce friction and eliminate wear
3. To protect against corrosion
4. To seal against impurities like dust, dirt, water.

In order for the oil film to be formed between the moving bearing components, the film must be sufficiently thick even under heavy load, high temperatures or vibrations.

Some sleeve bearings that has very heavy loads, like in the crosshead bearings of diesel engines, usually have provisions for injecting pressurized oil to float the shafts. This method is called hydrostatic lubrication.

However, the most common method of lubrication for sleeve bearings is by the hydrodynamic method. When the two surfaces of a bearing and shaft move rapidly relative to one another, the oil is carried along the shaft to fill the gap between shaft and bearing. When the moving components become completely separated by a cohesive film of lubricant, hydrodynamic lubrication occurs. Hydrodynamic lubrication prevents wear in moving parts, as there is no metallic

contact between them. The bearing metals can last for a long time.

During starting time, the rotating shaft does not have sufficient speed to pick up the lubricant. The film separating the moving surfaces is very thin − with only the thickness of a molecule. This is a condition called boundary−layer lubrication. With this condition, friction losses increases, producing heat, which raises the temperature of the lubricant, thereby reducing its viscosity so that the load−carrying capacity of the film is even lower. In worst case conditions, the surfaces can even seize together.

For rolling contact bearings like ball bearings, a condition called elasto−hydrodynamic lubrication occurs. At the point of contact, the ball deflects and flattens out slightly for a moment under the high pressure. When the ball rolls on, the contact surfaces return to their original shape. However, the lubricant is not forced away from the point of contact due to the dramatic increase in viscosity.

When the ball has passed, the viscosity falls back again.

When grease is used for lubricating ball bearings, they also act as protection against impurities like dust, dirt and water that will cause wear down and corrosion.

More about oils and grease for lubrication could be the subject of the next topic.

Until next time...

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