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How Lubricants Affect Equipment Reliability

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Synthetic oils are finding their way into more and more applications everyday. They provide many benefits that the standard mineral oils do not. Basically, mineral oils are described in several ways, depending on where the crude oil came from. The 4 types are:

- Paraffin-base Oils
- Naphtenic-base Oils
- Asphaltic-base Oils
- Mixed-base Oils

Paraffin-base oils contain varying amounts of wax-like material called paraffin. This type of crude oil is produced in Pennsylvania. Paraffin-based oils have a high natural viscosity index; i.e., they are less likely to change viscosity with temperature changes. At the same time, these oils have a higher pour point and are not as suitable as naphtenic oils for low temperature applications.

Naphtenic-base oils contain a high percentage of compound called naphtha. This type of oil comes from California and the area around the Gulf of Mexico. They have a low viscosity index and a low pour point. Naphtenic-base oils are used for lubricating in refrigeration equipment because they contain little wax (if any) allowing the oil to flow freely at low temperatures.

Asphaltic-base oils contain a considerable number of asphaltic compounds, which are heavy tar-like materials. Asphalt which is used on roads comes from these oils.

Mixed-base is the term used to describe oils that contain a combination of two or more of the bases mentioned above. An example of a mixed-base oil would be to combine a high viscosity naphthene-base oil and low-viscosity paraffin-base oil to get a particular viscosity specification.

The advantage of these types of mineral oils include the fact that they are extremely cheap, they have high stability, are available in a wide range of viscosities and form a good boundary lubrication. But any liquid can be used as a lubricant under certain conditions. Those that have been widely used include such varied substances as:

- Sodium
- Potassium
- Sea-Water
- Animal Fats
- Molten Glass
- Silicones

Some of the reasons for using a different oil in place of mineral-based oils include:

- Temperature too high for mineral oil
- Temperature too low for mineral oil
- Lower flammability needed

Synthetic liquid lubricants have properties very similar to petroleum products (mineral oils) including oiliness, film strength, variable viscosities, etc. These products are advantageous because they enhance the life of equipment exposed to varying conditions. For example, silicones are generally used for their good high temperature properties. They are chemically quite inert, repel water, are non-toxic, and electrically insulating. Silicones can be obtained in a very wide range of viscosities; however, they are not good boundary lubricants for steel-to-steel applications.

Polyglycols have one major advantage over other lubricants; when they are heated above their maximum temperatures (about 200°C) they decompose cleanly. Therefore, these lubricants are used in applications where temperatures, which are so high that other liquid lubricants will decompose (400°C or higher), because they will not leave the deposits of coke or ash that would be left by other lubricants. In addition, some polyglycols are soluble in water.

Organic esters are compounds obtained from the reaction of an alcohol with an acid. They are used almost entirely because of their ability to withstand higher temperatures than mineral oils. For this reason, almost all gas turbine engines are lubricated by organic esters.

Phosphate esters are compounds obtained from a reaction of alcohol with phosphate acid. These types of lubricants are widely used because of their outstanding fire resistance. Although they are excellent lubricants, phosphate esters are limited to temperatures of not much over 100°C due to poor thermal stability. In addition, phosphate esters also attack many paints, plastics and rubbers.

Any of these lubricants can be used under varying conditions. However, the friction and wear of the condition can be reduced by certain additives such as wear inhibitors, lubricity agents, friction modifiers and extreme-pressure additives.

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