BEHRAN OIL CO.

LUBRICANT CHARACTERISTICS

SPECIFIC GRAVITY

Specific gravity is the ratio of the weight of a given volume of substance at 60 degree F. to that of water.

VISCOSITY

Viscosity is a measure of the oil's resistance to flow. The more the viscosity of the oil more will be its resistance to flow, e.g. compare water and molasses. Water is less viscous and hence flows freely. Whereas molasses, which has a high viscosity, flows sluggishly.

An ideal oil film on a bearing depends on selecting an oil with the right viscosity to maintain separation of two metal surfaces. The speed of the journal and viscosity are closely allied in maintaining a good oil film in the bearing. The slower the journal speed, the higher viscosity or thicker oil we must use. As journal speeds are increased, a thinner of lower viscosity oil is needed.

Bearing loads must also be considered because the oil must have sufficient viscosity to maintain a good oil film to support the load.

Technically speaking, it is defined as the force required to move a plane surface of one square centimeter area over another plane surface at the rate of one centimeter per second, when the two surfaces are separated by a layer of liquid one centimeter in thickness. The unit of this force is poise and is called absolute viscosity. Kinematic viscosity is the ratio of absolute viscosity to the specific gravity of the oil at the 4-5 maintenance engineering and management temperature at which the viscosity is measured. Its unit is stokes.

For practical purposes, viscosity of petroleum oils is expressed in time in seconds taken by a given quantity of oil to flow through a standard capillary tube. It is expressed as Say bolt universal seconds at 100 degree F. or 210 degree F.

BEHRAN OIL CO.

VISCOSITY INDEX

Viscosity index is an expression of effect of change of temperature on the viscosity of oils. This change can be evaluated numerically and the result is expressed as V.I.

POUR POINT

Pour point of oil is an important quality. It is a temperature at which oil will still remain fluid. It reflects on the capability of the oil to work at low temperatures.

FLASH POINT

Flash point is the temperature at which the oil gives off sufficient vapors which can be ignited. It reflects on the capability of the oil to work at higher temperature without any fire hazard.

LUBRICANT ADDITIVES

The purification and manufacturing processes impact good qualities to lubricating oils. But still they cannot be used directly. They will be prone to contamination and decomposition in the exacting working conditions. Hence certain chemical compounds and other agents which are termed as additives are added to the oil. Most modern lubricant additives can be classified as follows:

1. **Those designed to protect the lubricant in service by maintaining deterioration.**
2. **Those that protect the lubricant from harmful fuel combustion products.**
3. **Those which improve existing physical properties or impart new characteristics.**

Use of chemical additives in lubricants is very wide. They are used in the lightest instrument and spindle oils to the thickest gear lubricants; automotive lubricants; cutting oils; and hydraulic fluids. There are over 50 characteristics of lubricating base oils which can be improved by the additives. Generally speaking the additives must have the following properties:

a) Solubility in base petroleum oil

b) Insolubility in and lack of reaction with aqueous solution.

c) Should not impart dark color to the oil

d) Low volatility

e) Additives must be stable in blending, storage and use.

f) Additives should not impart unfavorable odor. 4-6 maintenance engineering and management

Additives are substances formulated for improvement of the anti-friction, chemical and physical properties of base oils (mineral, synthetic, vegetable or animal), which results in enhancing the lubricant performance and extending the equipment life.

Combination of different additives and their quantities are determined by the lubricant type (Engine oils, Gear oils, Hydraulic oils, cutting fluids, Way lubricants, compressor oils etc.) and the specific operating conditions (temperature, loads, machine parts materials, environment).

Amount of additives may reach 30%.

- **Friction modifiers**
- **Anti-wear additives**
- **Extreme pressure (EP) additives**
- **Rust and corrosion inhibitors**
- **Anti-oxidants**
- **Detergents**
- **Dispersants**
- **Pour point depressants**
- **Viscosity index improvers**
- **Anti-foaming agents**

FRICTION MODIFIERS

Friction modifiers reduce coefficient of friction, resulting in less fuel consumption.

Crystal structure of most of friction modifiers consists of molecular platelets (layers), which may easily slide over each other.

The following Solid lubricants are used as friction modifiers:

- **Graphite;**
- **Molybdenum disulfide;**
- **Boron nitride (BN);**
- **Tungsten disulfide (WS_2);**
- **Polytetra fluoro ethylene (PTFE).**

ANTI-WEAR ADDITIVES

Anti-wear additives prevent direct metal-to-metal contact between the machine parts when the oil film is broken down.

Use of anti-wear additives results in longer machine life due to higher wear and score resistance of the components.

The mechanism of anti-wear additives: the additive reacts with the metal on the part surface and forms a film, which may slide over the friction surface.

The following materials are used as anti-wear additives:

- **Zinc dithiophosphate (ZDP);**
- **Zinc dialkyldithiophosphate (ZDDP);**
- **Tricresylphosphate (TCP).**

EXTREME PRESSURE (EP) ADDITIVES

Extreme pressure (EP) additives prevent seizure conditions caused by direct metal-to-metal contact between the parts under high loads.

The mechanism of EP additives is similar to that of anti-wear additive: the additive substance form a coating on the part surface. This coating protects the part surface from a direct contact with other part, decreasing wear and scoring.

The following materials are used as extra pressure (EP) additives:

- **Chlorinated paraffins;**
- **Sulphurized fats;**
- **Esters;**
- **Zinc dialkyldithiophosphate (ZDDP);**
- **Molybdenum disulfide;**

RUST AND CORROSION INHIBITORS

Rust and Corrosion inhibitors, which form a barrier film on the substrate surface reducing the corrosion rate. The inhibitors also absorb on the metal surface forming a film protecting the part from the attack of oxygen, water and other chemically active substances.

The following materials are used as rust and corrosion inhibitors:

- **Alkaline compounds;**
- **Organic acids;**
- **Esters;**
- **Amino-acid derivatives.**

ANTI-OXIDANTS

Mineral oils react with oxygen of air forming organic acids. The oxidation reaction products cause increase of the oil viscosity, formation of sludge and varnish, corrosion of metallic parts and foaming. Anti-oxidants inhibit the oxidation process of oils. Most of lubricants contain anti-oxidants.

The following materials are used as anti-oxidants:

- **Zinc dithiophosphate (ZDP);**
- **Alkyl sulfides;**

- **Aromatic sulfides;**
- **Aromatic amines;**
- **Hindered phenols.**

DETERGENTS

Detergents neutralize strong acids present in the lubricant (for example sulfuric and nitric acid produced in internal combustion engines as a result of combustion process) and remove the neutralization products from the metal surface. Detergents also form a film on the part surface preventing high temperature deposition of sludge and varnish. Detergents are commonly added to Engine oils.

Phenolates, sulphonates and phosphonates of alkaline and alkaline-earth elements, such as calcium (Ca), magnesium (Mg), sodium (Na) or barium (Ba), are used as detergents in lubricants.

DISPERSANTS

Dispersants keep the foreign particles present in a lubricant in a dispersed form (finely divided and uniformly dispersed throughout the oil).

The foreign particles are sludge and varnish, dirt, products of oxidation, water etc.

Long chain hydrocarbons succinimides, such as polyisobutylene succinimides are used as dispersants in lubricants.

POUR POINT DEPRESSANTS

Pour point is the lowest temperature, at which the oil may flow.

Wax crystals formed in mineral oils at low temperatures reduce their fluidity.

Pour point depressant inhibits formation and agglomeration of wax particles keeping the lubricant fluid at low temperatures.

Co-polymers of polyalkylene methacrylates are used as pour point depressant in lubricants.

VISCOSITY INDEX IMPROVERS

Viscosity of oils sharply decreases at high temperatures. Low viscosity causes decrease of the oil lubrication ability.

Viscosity index improvers keep the viscosity at acceptable levels, which provide stable oil film even at increased temperatures. Viscosity improvers are widely used in multigrade oils, viscosity of which is specified at both high and low temperature. Acrylate polymers are used as viscosity index improvers in lubricants.

ANTI-FOAMING AGENTS

Agitation and aeration of a lubricating oil occurring at certain applications (Engine oils, Gear oils, Compressor oils) may result in formation of air bubbles in the oil - foaming. Foaming not only enhances oil oxidation but also decreases lubrication effect causing oil starvation.

Dimethylsilicones (dimethylsiloxanes) is commonly used as anti-foaming agent in lubricants