ADDITIVES IN LUBRICATING OILS

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);
- Polytetrafluoroethylene (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 Ba (barium), 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 inhibit formation and agglomeration of wax particles keeping the lubricant fluid at low temperatures.

Co-polymers of polyalkyl 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.

Source : http://www.substech.com/dokuwiki/doku.php?id=additives_in_lubricating_oils