# LUBE

# TECHNI-GRAM

FROM:

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## LUBRICANT ADDITIVES

Periodically, I receive inquiries from customers requesting clarification of the elements reported under the spectrometric analysis section of SWEPCOs Laboratory Oil analysis (LOA) results. This generally involves distinguishing wear metals from the metallic additives that are used in the manufacturing of lubricants.

The wear metals most predominately reported in used oil analysis are iron, aluminum, lead, chromium and copper. Each of these metals are the primary metals used in most engines, gear boxes, transmissions, hydraulic systems and compressors. But, not all of these metals are found in every different system. The recommendation and analysis results are based on the manufactures recommendations and specifications for each component. As a rule of thumb, a significant increase in the level of wear metals can be possible cause for concern.

The testing of metallic additives, on the other hand, is designed to check how much additive is left in the oil or how much additive depletion has taken place. This is very important, because, if we are going to recommend an extended drain, we want to make sure that the oil has enough chemical additive to properly function and perform the task that it was designed to do. It is important to note that there are many different types of additives and additive combinations or systems available in the market place. Many of these have higher levels of one additive and lower levels of another. But, that system may be designed to function at those levels. So, it is impossible for us to predict the quality of an oil by doing a Laboratory Oil Analysis. All the oil analysis does in this case is provide us a baseline for future evaluation of the oil and how it is holding up under actual service. As an example, if we do an analysis of an unused sample of oil, then later, we do an analysis of this oil used, we can compare the results of the used oil with the new oil. Then, we are able to pinpoint any impending problems such as an increase in the viscosity, additive depletion, excessive wear metals, etc.

The following is a list of additives and their functions. These are the primary additives that are used in formulating lubricants. These additives are divided into three categories: surface protective additives, performance additives, and lubricant protective additives.

Basically, the **surface protective additives** build a bond with metal surfaces, thereby, protecting them from friction, wear, rust/corrosion, etc. The **performance additives** improve the performance of the lubricant. The **lubricant protective additives** protect the lubricant from degradation or breakdown.

**SURFACE PROTECTIVE ADDITIVES**

| ADDITIVE TYPE | PURPOSE | TYPICAL COMPOUNDS | FUNCTIONS |
|---|---|---|---|
| *Antiwear and EP Agent* | Reduce friction and wear and prevent scoring and seizure | Zinc dithiophosphates, acid organic phosphates, phosphates, organic sulfur and chlorine compounds, sulfurized fats, sulfides and disulfides | Chemical reaction with metal surface to form a film with lower shear strength than the metal, thereby preventing metal-to-metal contact |
| *Corrosion and Rust Inhibitor* | Prevent corrosion and rusting of metal parts in contact with the lubricant | Zinc dithiophosphates, metal phenolates, basic metal sulfonates, fatty acids and amines | Preferential adsorption of polar constituent on metal surface to provide a protective film, or neutralize corrosive acids |

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|---|---|---|---|
| *Detergent* | Keep surfaces free of deposits | Metallo-organic compounds of sodium, calcium, and magnesium phenolates, phosphonates and sulfonates | Chemical reaction with sludge and varnish precursors to neutralize them and keep them soluble |
| *Dispersant* | Keep insoluble contaminants dispersed in the lubricant` | Alkylsuccinimides, alkylsuccinic esters, and mannich reaction products | Contaminants are bonded by polar attraction to dispersant molecules, prevented from agglomerating and kept in suspension due to solubility of dispersant |
| *Friction modifier* | Alter the coefficient of friction | Organic fatty acids and amides, lard oil, high molecular weight organic phosphorus and phosphoric acid esters | Preferential adsorption of surface-active materials |

**PERFORMANCE ADDITIVES**

| ADDITIVE TYPE | PURPOSE | TYPICAL COMPOUNDS | FUNCTIONS |
|---|---|---|---|
| *Pour point depressant* | Enable lubricant to flow at low temperatures | Alkylated naphthalene and phenolic polymers, poly-methacrylates | Modify wax crystal formation to reduce interlocking |
| *Seal Swell agent* | Swell elastomeric seals | Organic phosphates and aromatic hydrocarbons | Chemical reaction with elastomer to cause slight swell |
| *Viscosity modifier* | Reduce the rate of viscosity change with temperature | Polymers and copolymers of methacrylates, butadiene, olefins and alkylated styrenes | Polymers expand with increasing temperature to counteract oil thinning |

**LUBRICANT PROTECTIVE ADDITIVES**

| ADDITIVE TYPE | PURPOSE | TYPICAL COMPOUNDS | FUNCTIONS |
|---|---|---|---|
| *Antifoamant* | Prevent lubricant from forming a persistent foam | Silicone polymers, organic copolymers | Reduces surface tension to speed collapse of foam |
| *Antioxidant* | Retard oxidative decomposition | Zinc dithiophosphates, hindered phenols, aromatic amines, sulfurized phenols | Decompose peroxides and terminate free-radical reactions |
| *Metal deactivator* | Reduce catalytic effect of metals on oxidation rate | Organic complexes containing nitrogen or sulfur, amines, sulfides and phosphites | Form inactive film on metal surfaces by complexing with metallic ions |

When manufacturing lubricants, it takes very careful balancing of the different types of additives to maximize the performance. These additives do a fantastic job, but, if they are over used, then they have a negative effect. As an example, if you add a demulsifier to an oil to improve its ability to separate from water, it would do an outstanding job in certain concentrations; however, if you add too much demulsifier, then it reverses and becomes an emulsifier and becomes an additive that promotes the formation of a stable mixture of water and oil. So each of these additives have to be scientifically formulated to optimize their performance…that is where SWEPCO's 70-year heritage of technological development we call **SPX Technology** becomes vital.