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DEPARTMENT OF AUTOMOBILE ENGINEERING

COURSE NAME : 19AUB301 – AUTOMOTIVE FUELS AND LUBRICANTS

III YEAR / V SEMESTER

Unit 3 - Lubricants

Topic : Degradation of Lubricants and Additives and its Mechanism

DEGRADATION OF LUBRICANTS

- A lubricant in service is subjected to a wide range of conditions which can degrade its base oil and additive system.
- Such factors include heat, entrained air, incompatible gases, moisture, internal or external contamination, process constituents, radiation and inadvertent mixing of a different fluid.

OXIDATION

- Oxidation is the reaction of materials with oxygen.
- It can be responsible for viscosity increase, varnish formation, sludge and sediment formation, additive depletion, base oil breakdown, filter plugging, loss in foam properties, acid number increase, rust and corrosion.
- Controlling oxidation is a significant challenge in trying to extend the lubricant's life.

THERMAL BREAKDOWN

- In a mechanical working environment, the temperature of the lubricant is a primary concern.
- In addition to separating the moving parts of the machinery, the lubricant must also dissipate heat.
- This means the lubricant will sometimes be heated above its recommended stable temperature.
- Overheating can cause the light ends of the lubricant to vaporize or the lubricant itself to decompose.

THERMAL BREAKDOWN

- This can cause certain additives to be removed from the system without performing their job, or the viscosity of the lubricant may increase.
- At temperatures greatly exceeding the thermal stability point of the lubricant, larger molecules will break apart into smaller molecules.
- This thermal cracking, often referred to as thermal breakdown, can initiate side reactions, induce polymerization, produce gaseous by-products, destroy additives and generate insoluble by-products.
- In some cases, thermal degradation will cause a decrease in viscosity.

MICRO DIESELING

- It is known as pressure-induced thermal degradation
- It is a process in which an air bubble transitions from a low-pressure to a high-pressure zone, resulting in adiabatic compression.
- This may produce localized temperatures in excess of 1,000°C, resulting in the formation of carbonaceous by-products and accelerated oil degradation.

ELECTROSTATIC SPARK DISCHARGE

- When clean, dry oil rapidly flows through tight clearances, internal (molecular level) friction within the oil can generate static electricity
- It may accumulate to the point where it produces a sudden discharge or spark.
- These sparks are estimated to be between 10,000°C and 20,000°C and typically occur in mechanical filters.

CONTAMINATION

- Foreign substances can greatly influence the type and rate of lubricant degradation.
- Metals such as copper and iron are catalysts to the degradation process.
- Water and air can provide a large source of oxygen to react with the oil.
- Therefore, a contaminant-free lubricant is ideal and monitoring a fluid's contamination levels provides significant insight to the machine's health.

ADDITIVES

- Additives are a chemical component or blend used at a specific treat rate, generally from < 1 to 35 percent, to provide one or more functions in the fluid.
- Ideally, additive components are multifunctional.
- They are soluble in mineral oil, water or sometimes both.
- Second, additives offer or help with a wide variety of functions, such as:
  - boundary lubricity
  - extreme pressure (EP)
  - inhibiting corrosion
  - emulsification
  - antimisting
  - antimicrobial pesticide
  - antifoam additives and defoamers

ROLES OF ADDITIVES

Enhance Existing Base Oil Properties	Suppress Undesirable Base Oil Properties	Impart New Properties to Base Oils
Antioxidants Corrosion Inhibitors Anti-foam Agents Demulsifying Agents	Pour Point Depressants VI Improvers	EP Additives Detergents Metal Deactivators Tackiness Agents

ADDITIVES


Performance Modifiers
Pour point depressants
VI Improvers
Seal Swell Agents
Lubricant Protectors
Oxidation Inhibitors
Metal Deactivators
Foam Inhibitors
Surface Protectors
Rust & Corrosion Inhibitors
Detergents & Dispersants
Antiwear Agents
Friction Modifiers

ADDITIVES

MACHINE	COMMON ADDITIVES USED	PERCENT OF OIL VOLUME
Engines	Antioxidant, corrosion inhibitor, detergent/dispersant, anti-wear, anti-foam, alkalinity improver	10 - 30%
Steam turbines, compressors	Antioxidant, corrosion inhibitor, demulsifier, anti-foam	0.5 - 5%
Gears (spiral, bevel or hypoid)	Anti-wear, antioxidant, anti-foam, sometimes corrosion inhibitor, extreme pressure	1 - 10%
Gears (worm)	Extreme pressure, antioxidant, corrosion inhibitor, fatty acids	3 - 10%
Hydraulic systems	Antioxidant, anti-wear, anti-foam, corrosion inhibitor, pour-point depressant, viscosity index improver	2 - 10%

REFERENCE

- https://www.finol.ie/news/the-main-causes-of-oil-degradation/
- https://www.machinerylubrication.com/Read/31107/oil-lubricant-additives

THANK YOU !!!