Lubricants; Composition & Properties

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Why lubricants are needed

- Friction / Wear
- Heat Generation
- Combustion Products
- Sealing
- Material Protection
The Stribeck Curve

The Abscissa,

\[ \frac{Z \cdot N}{P} \]

Where: 
- \( Z \) = the oil’s viscosity
- \( N \) = speed
- \( P \) = load on the lubricant film
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Lubrication Systems:

ONCE THROUGH OIL SYSTEM

Fig. 1.40 Drip feed.
- a Adjustable screw
- b Sight glass for drop control
- c Lubricant

Fig. 1.41 Wick oiler.
- a Screwed lid
- b Base
- c Lubricant
- d Wick

Fig. 1.42 Needle oiler.
- a Lubricant
- b Moving rod
- c Rotating axle
Lubrication Systems:

BATH LUBRICATING SYSTEM
Lubrication Systems:

CIRCULATING LUBE OIL SYSTEM
Composition:

LUBRICANT IS MADE OF

**BASE OIL** + **ADDITIVES**

- PARRAFFINIC (HVI)  LUBE PROTECTION
- NAPHTHENIC (MVI)  ADD PERFORMANCE
- AROMATIC (LVI)    SURFACE PROTECTION
Properties of Lubricants

Base Oil Dependent
- Viscosity
- Pour Point
- Specific Gravity
- Flash Point
- Oxdn. Stability
- Demulsibility
- Foaming
- Air Release

Additive Dependent
- Neutralization Value
- Metal Corrosion
- Oxidation Stability
- Antiwear
- Extreme Pressure
LUBRICANT PROPERTIES

1. KINEMATIC VISCOSITY
   - RESISTANCE TO FLOW
   - UNIT: cSt (CM²/SEC)
   - SAE NOS. FOR AUTOMOTIVE GRADES
   - ISO VG NOS. FOR INDUSTRIAL GRADES

2. VISCOSITY INDEX
   - INDICATES CHANGE OF VISCOSITY WITH TEMP.
   - EMPIRICAL NO.
   - HVI, MVI AND LVI OILS
“IDEAL” FLUID: FOR AUTOMOTIVE ENGINE DESIGNER

- VISCOSITY
- TEMPERATURE, °C

MULTIGRADE OILS

MONOGRADE OILS

IDEAL FLUID
A TYPICAL VISCOSITY - TEMPERATURE GRAPHS

- 10°C  TEMPERATURE   + 100°C

SAE 20W - 40
SAE 40
SAE 20
LUBRICANT PROPERTIES

3. FLASH POINT
- TEMP. AT WHICH PRODUCT IGNITES IN PRESENCE OF A FLAME
- IMPORTANT FROM SAFETY ANGLE

4. POUR POINT
- LOWEST TEMP. AT WHICH OIL IS OBSERVED TO FLOW

5. OXIDATION STABILITY
- ABILITY TO RESIST OXIDATION
- ACCELERATED BY HIGH OPERATING TEMP.
- PRESENCE OF CERTAIN METALS ACT AS CATALYST
- DETERMINES LIFE OF THE OIL
6. DETERGENCY
- ABILITY TO KEEP THE SYSTEM CLEAN

7. DISPERSANCY
- ABILITY TO KEEP HARMFUL PARTICLES IN SUSPENSION

8. DEMULSIBILITY: RESISTANCE TO EMULSION
- WATER SEPERATION ABILITY

9. ANTI - WEAR PROPERTY
- REDUCE WEAR BY FORMING A FILM BETWEEN SLIDING SURFACES
11. **EXTREME PRESSURE**
   - ABILITY TO WITHSTAND SHOCK LOADING AND IMPACT LOADS.

12. **CORROSION RESISTANCE**
   - ABILITY TO PROTECT METAL AGAINST CORROSION AND RUST.

13. **ANTI - FOAM**
   - CAPACITY OF BREAKING AIR BUBBLES REACHING THE OIL SURFACE
LUBRICANT PROPERTIES

14. BASICSITY - TOTAL BASE NUMBER
   - Neutralization of acid production in Engines

15. AIR RELEASE PROPERTY
   - ABILITY TO RELEASE ENTRAINED AIR IN OIL

16. ADHESIVENESS
   - ABILITY TO WET THE SURFACES
   - ADDITION OF FATTY OILS
Lubricant Additives
What is an Additive in the Lubricant?

- Any material added to the base stock to change its properties, characteristics, and performance.
- Improve existing properties:
  - Viscosity improver
  - Pour Point Depressant
  - Friction Modifiers
- Impart new properties
  - Detergents/dispersants
  - Anti Oxidants
  - Oiliness and Tackiness Agents
- Protect base stock properties
  - Anti Oxidants, Anti Foamants, Acid neutralizers
General Properties Of Additives

- Solubility In Base Petroleum Product
- Color / Odor: Additive blended product color and Odor should not give an impression of inferiority.
- Volatility: The volatility should be low, especially in High Temperature applications.
- Stability: An additive should remain stable in blending, storage and use. It implies chemical, thermal and hydrolytic stability.
- Compatibility: Two or more additive blends should be compatible to each other’s properties.
Common Additives In An Engine Oil

- **VI Improvers**
- **Detergent & Dispersants**
- **Antiwear**
- Oxidation Inhibitors
- Corrosion & Rust Inhibitors
- Metal Deactivators
- Defoamant
- **Pour Point Depressant**
Detergents

- Provides detergency for engine cleanliness
- Neutralize acids, prevent corrosion from acids.
- Calcium, barium salts of petroleum sulfonic acids, phenates and salicylates, phosphorous containing polymers used.
Dispersants

- Function is to keep the sludge, carbon, varnish, and other deposits in colloidal suspension.
- Reduce the deposit formation and minimizes particulate wear and oil thickening.
- Dispersants have an oxygen, nitrogen-based polar group and a large non-polar group, usually a polymeric olefin.
Oxidation Inhibitors

- Decrease oil oxidation, reducing oil degradation and corrosive action of the oil.
- Classified as primary and secondary anti oxidants.
- Eg are Hindered Phenols, Aromatic amines, ZnDDP, Metal Deactivators such as Disalicylidene propylene diammine and substituted benzatriazole.
Extreme Pressure Additives

- EP additive also known as Anti Scuffing additive.
- Form protective film on the metal surface by reacting chemically with the metal surface to form a layer at conditions of high temperature (>1000 deg F).
- Zinc Dialkyl di thio phosphate, tricresyl phosphate, organic phosphate, chlorinated and sulphurised hydrocarbons, metal soaps of lead, antimony and molybdenum used.
Anti Wear Additive

- Anti wear reduces the wear at low and medium speeds.
- Works by forming an oxide film on the metal surface thus preventing the metal-metal contact and also inhibiting action from the rust and corrosion initiators.
- Eg are ZNDDP (Zinc Dialkyl Dithio Phosphate)
VI Improvers

- Used in case of varied temperature applications.
- Polymers are used, which expand with increasing temperature to counteract oil thinning.
- Poly iso butylene, Methacrillates, Acrylate polymers, Olefin copolymers are used.
Pour Point Depressants

• Pour Point depressants work at low temperatures by minimizing the formation of wax networks and thereby reducing the amount of oil bound up in the network.
• Examples are Polyalkyl methacrylates, styrene ester polymers, alkylated napthalenes, ethylene vinyl acetate copolymers and ployfurmates.
Rust / Corrosion Inhibitors

- Prevents corrosion and rusting of metal parts in contact with the lubricant.
- Commonly used are Zinc diethiophosphate, metal phenolates, basic metal sulfonates, fatty acids and amines.
LUBRICANTS MANUFACTURING
LUBRICANT BLENDING

1. SCHEDULING

2. DEHYDRATION OF BASE OILS

3. Q/C CHECKS OF BASE OILS

4. BLENDING OF BASE OILS & ADDITIVES

5. Q/C CHECKS OF BLENDED PRODUCT

6. FINISHED LUBRICANTS
KEY PROCESS

- Base Oils Receipt
- Additives Receipt
- Blending
- Quality Control
- Filling
- Distribution
THANK YOU