Lube oil processing: propane deasphalting Solvent extraction, dewaxing, Additives production from refinery feedstocks.

**Solvent selection criterion:**

\[
\text{Selectivity} = \frac{\text{Aromatic in ext/Non aromatic in ext}}{\text{Aromatic in Raffinate/Non aromatic in Raffinate}} = \frac{Y_B/Y_A}{X_B/X_A}
\]

Y = extract  
X = Raffinate  
B = aromatics  
A = Non aromatics

Solvent power -> should have high power for aromatics would lead to lower S/F for given aromatics extraction capability.  
Solvent Power generally decreases with increasing selectivity.  
T increases the solvent power (exception is propane deasphaltive).  
Corrosion -> It should not be corrosive.  
Liquid SO\(_2\) (for H\(_2\)O extraction)  
70.05 wt% H\(_2\)O causes severe corrosion.

**Toxicity = should not be toxic**

- Liquid SO\(_2\) need replacement with H\(_2\)O solvent.  
- Phenol extraction of lubes is being displaced by NMP.

**Melting point (MP):**

MP should be lower than ambient temperature for easy handling.

**Interfacial Tension (IFT)**

- High IFT permits rapid settings due to easier coalescence.  
- Low IFT facilitates dispersion (drops are smaller and more interfacial area for mass transfer) whereas too low IFT lead to emulsification and coalescence.  
- Density difference between disperse and continuous phase S must be large for ease of setting of phases.  
- Viscosity: High viscosity of either phase reduces master efficiency.  
- Low viscosities are preferred for rapid setting of phases (more viscosity phase is usually dispersed).  
- Low viscosity is preferred for ease of pumping.

**Dewaxing:**

Waxes are large MW Paraffinic compounds having melting point 32-100 °C.  
**High viscosity Index lube oil cuts: contain large amount of wax.**

- Lower wax content: lower the pour point  
- Dewaxing is done to lower the pour point.  
- All heavy fraction of crude oil contains at least some amount of waxy material.  
- Waxes: It can not be distilled as it boils in the range of lubricating oils (can not be distilled)  
- Classified based on penetration index and melting point

**Dewaxing Process:**

1. Chilling and Pressing (Filteration).  
2. Solvent Dewaxing.  
3. Urea Dewaxing- Urea forms complex compound with large chain paraffin i.e wax range higher molecular weight of HCs but not within the lubrication oil (some m.w paraffins).

**Dewaxing method without solvent (chilling and pressing)**

Dewaxing method is simple process but time consuming. Based on the principle of decreases solubility of wax
in cold setting process. Dilutant such as naphtha added to speed setting.

1. Paraffins wax cannot be separated by setting on certifying.
2. Filteration can be used.

Cold pressing
T= -17 °C (O° F)
P=35°C to 300°C

For microcrystalline wax cold pressing cannot be used because these wax either pass through filter on may clog it.
Lighter change-Pressing.
Heavier change-Setting.

**Solvent dewaxing**[9-15]
Most widely used solvent are MEK or propane .
Expensive process for separating lube oil.

**MEK Dewaxing** :Two components
Aromatic components – benzene or Toluene Maintains good oil solubility and Dewaxing temperature.Ketone (MEK) – used to maintain wax solubility. It Causes the wax to solidify in a easy of filterable form.In absence of MEK , it spread between filtration temperature and pourpoint of dewaxed oil.
Solvent concentration: Maximum MEK concentration required in order to obtain highest filtration rate.

**Iso dewaxing**:[6-12,16-18]
- Isomerizes a significant portion of the wax to lubes.
- Selective for mid distillates By products.
- Isodewaxing has a VI and yield advantage.
Propane Dewaxing: Same as MEK. Propane is cheaper easily available.

**Urea Dewaxing:**\(^{[1-2,16-19]}\)

Urea forms solid filterable complex (adducts) at room temperature with large paraffic (\(> C_{18}\)) \(\text{HC}_s\) with no branching. To increase the rate of adduct formation some activator (methanol) is added.

\[\text{3lb urea}\]
\[\text{1lb HC}\]

Urea Dewaxing is more effective with lighter stocks.
Additives:
- VI improver (poly isobutylene, poly methyl methacrylates (PMMA))
- Pour point depressants (Poly alkylated condensed aromatics).
- Anti oxidants – phenols, N compounds.
- Detergency dispersants – alkyl phosphates, petroleum sulfonates.

Iso Dewaxing:

Advantages of Iso dewaxing Technology:
- Has much lower capital and OP cost than solvent dewaxing.
- Give higher VI base oils than solvent and catalytic dewaxing.
- Has flexibility to handle or broad range of wax content in feed.
- Increases lube yields and extends catalyst life in Lube hydrocrackers.
- Can produce ultra low pour point base oils.

Iso Dewaxing Process Conditions (depend on feed and product requirement)

LUBE OIL PROCESSING

The lube oil base stocks are prepared from selected crude oils by distillation and special processing to meet the desired qualifications. The additives are chemicals used to give the base stocks desirable characteristics which they lack or to enhance and improve existing properties. The properties considered are:

1. Viscosity
2. Viscosity change with temperature (viscosity index)
3. Pour point
4. Oxidation resistance
5. Flash point
6. Boiling temperature
7. Acidity (neutralization number)

Viscosity index is the most important characteristics of a lube oil. It is defined as the rate of change of viscosity with temperature is expressed by the viscosity index (VI) of the oil. The higher the VI, the smaller its change in viscosity for a given change in temperature. The VIs of natural oils range from negative values for oils from naphthenic crudes to about 100 for paraffinic crudes. Specially processed oils and chemical additives can have VIs of 130 and higher. Additives, such as polyisobutylene and polymethacrylic acid esters, are
frequently mixed with lube blending stocks to improve the viscosity–temperature properties of the finished oils. Lube oil blending stocks from paraffinic crude oils have excellent thermal and oxidation stability and exhibit lower acidities than do oils from naphthenic crude oils. The neutralization number is used as the measure of the organic acidity of an oil; the higher the number, the greater the acidity.

**Lube oil treatment**[^1-4,20]

The first step in the processing of lubricating oils is the separation of the crude oil distillation units for the individual fractions according to viscosity and boiling range specifications. The heavier lube oil raw stocks are included in the vacuum fractionating tower bottoms with the asphaltenes, resins, and other undesirable materials. The raw lube oil fractions from most crude oils contain components which have undesirable characteristics for finished lubricating oils. These must be removed or reconstituted by processes such as liquid–liquid extraction, crystallization, selective hydrocracking, and/or hydrogenation. The undesirable characteristics include high pour points, large viscosity changes with temperature (low VI), poor oxygen stability, poor color, high cloud points, high organic acidity, and high carbon- and sludge-forming tendencies.

The processes used to change these characteristics are:

1. Solvent deasphalting to reduce carbon- and sludge-forming tendencies
2. Solvent extraction and hydrocracking to improve viscosity index
3. Solvent dewaxing and selective hydrocracking to lower cloud and pour points
4. Hydrotreating and clay treating to improve color and oxygen stability
5. Hydrotreating and clay treating to lower organic acidity

**References**

[^8]: http://www.veendeep.com/dewaxing.html