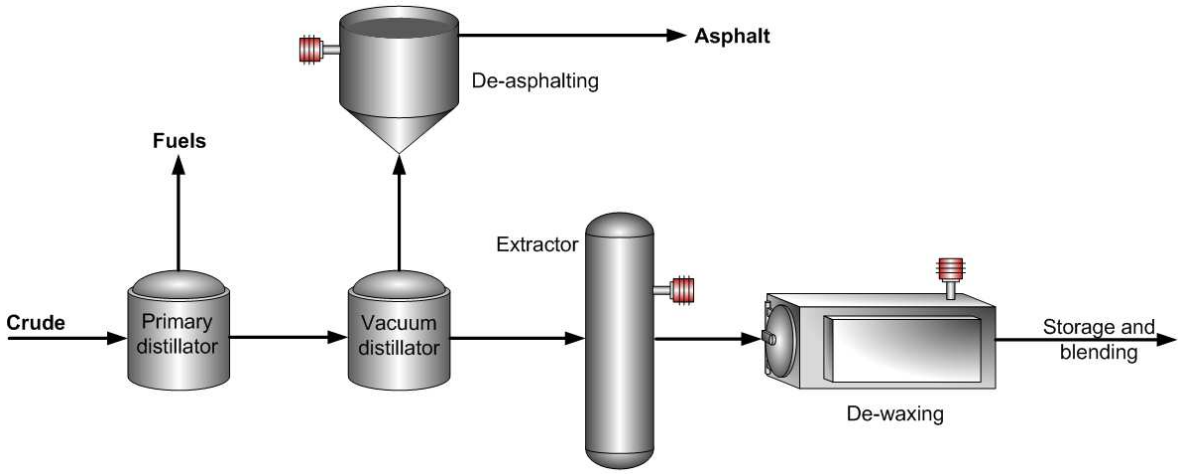


LUBE OIL

Typical end products
Lube oil

Introduction

Continuous on-line monitoring of the Refractive Index in lube oil plants allows highly efficient refining process control. Before the development of the K-Patents Process Refractometer PR-23-GP, operators used to do waxy raffinates Refractive Index analysis with a laboratory refractometer. This analysis is described in the ASTM D 1747-89 Standard Test Method for Refractive Index of Viscous Materials.

When manufacturing different kinds of Viscosity Index (V.I.) oils, it has been established through laboratory experimentation that the Refractive Index (R.I.) of waxy raffinates should remain within defined limits.

The operators need to adjust the process temperatures of the different catalytic beds to maintain the Refractive Index of the waxy raffinates within these limits.

Application: Lubricating Base Oil Processes

Vacuum Distillation Unit

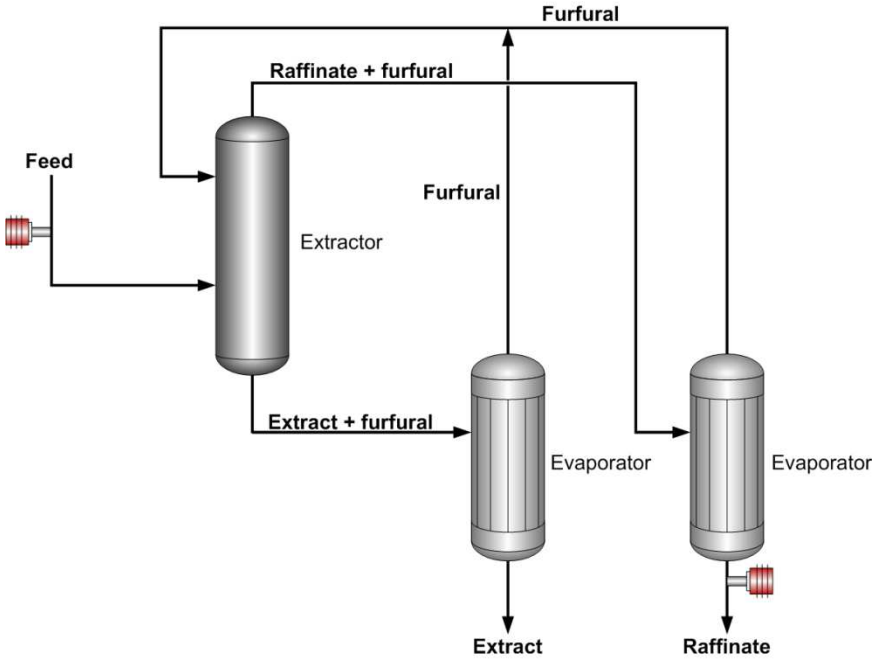
The first step in the refining process for lubricating oils is separation in the distillation units of the individual fractions according to viscosity and boiling range specifications. The heavier raw stock for lube oil settles at the bottom of the vacuum fractionating tower with the asphaltenes, resins and other undesirable materials.

The raw lube oil fractions from most crude oils contain components, which have undesirable characteristics for finished lubricating oil. These must be removed or reconstituted by processes such as extraction, crystallization, hydrocracking and hydrogenation. Vacuum distillation separates raw lube oil into two or three grades with increasing viscosity. The heavier grades are derived by removing asphalt from the residue in a de-asphalting unit. The lighter feedstocks are sent directly to solvent extraction. This first stage determines the final base oil viscosity grades.

Further processing is usually done in the following order; de-asphalting, solvent extraction, de-waxing and finishing.

De-asphalting

Propane is typically used as the solvent in de-asphalting but it may also be combined with ethane or butane, in order to obtain specific solvent properties. Propane has unusual solvent properties at temperatures from 40℃ (104℉) to 60℃ (140℉). Paraffines are very soluble in propane but the solubility decreases as the temperature increases, until the critical temperature of propane (96,8℃ or 206,2℉), when all hydrocarbons become insoluble. In the range of 40℃ (104℉) to 96,8℃ (206,2℉), the higher molecular weight asphaltanes and resins are largely insoluble in propane. Separation by distillation is generally through molecular component weight and solvent extraction through molecule structure type.



Solvent Extraction

There are three solvents used for the extraction of aromatics from lube oil feedstocks. The solvent recovery portions of the systems are different for each one. The solvents are furfural, phenol and N-methyl-2-pyrrolidione (NMP). The purpose of the solvent extraction is to improve the Viscosity Index (V.I.), oxidation resistance, color of the lube oil base stock, and to reduce carbon and lubricants' sludge-forming tendencies by separating the aromatic portion from the naphthenic and paraffinic portion of the feedstock.

Furfural Extraction

The process flow through the furfural extraction unit is similar to that of the propane de-asphalting unit, except for the solvent recovery section, which is more complex. The oil feedstock is introduced to a continuous counter-current extractor at a temperature, which is the function of the feed's viscosity; the greater the viscosity, the higher the temperature used.

Phenol Extraction

The process flow for the phenol extraction unit is somewhat similar to that of the furfural extraction unit, but differs markedly in the solvent recovery section because phenol is easier to recover than furfural.

NMP Extraction

NMP extraction uses N-methyl-2- pyrrolidone as the solvent to remove the condensed aromatics and polar components from the lubricating oil distillate brightstocks. This process was developed as a replacement for phenol extraction because of health, safety and environmental problems associated with phenol use.

De-waxing

All lube oil stocks, except those from a relatively few highly naphthenic crude oils, must be de-waxed or they will not flow properly at ambient temperatures. De-waxing is one of the most important and most difficult processes in lubricating oil manufacture.

Hydrofinishing

Hydrotreating of de-waxed lube oil stocks is needed to remove chemically active compounds that affect the color and color stability of the lube oils.

Installation

A typical sampling point for the K-Patents in-line Process Refractometer is the heat exchanger outlet, where off-line lab samples are usually taken from. The sampling line for the K-Patents refractometer should be insulated. To maintain a constant temperature, reheating of the sample just before the sensor is recommended. A flow velocity in the

sampling loop of 1,5 m/s (5 ft/s) or higher is recommended.

In conclusion, the K-Patents Process Refractometer PR-23-GP eliminates sampling, improves product consistency and helps to optimize the process. A uniform product can be achieved through continuous monitoring.

Unlike periodic sampling, continuous monitoring can provide instant feedback on process fluctuations. This instant feedback is then utilized to control the process in real-time.

Instrumentation	Description
	K-Patents Process Refractometer PR-23-GP is an industrial refractometer for large pipe sizes and tanks, cookers, crystallizers and kettles. Installation through a flange or clamp connection.
Measurement range:	Refractive Index (nD) 1.3200 – 1.5300, corresponding to 0-100 % by weight.