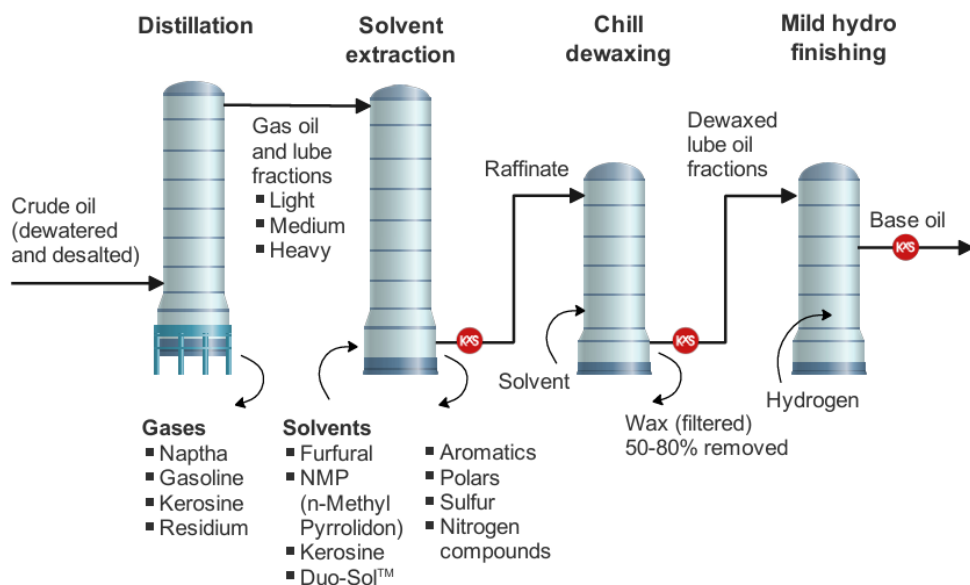




Benefits of R.I. measurement

- Real-time monitoring replaces slow lab analysis
- Improved product uniformity across viscosity grades
- Immediate detection of process drift
- Reduced waste and energy usage
- Safer operation with no need for sampling hot, solvent-rich streams
- Seamless DCS integration for process automation

From the first distillation cut to the final hydro finished product, RI measurement ensures that lube oil base stock meets performance and purity standards—regardless of API classification.



Overview

Lubricants used in industrial and automotive environments all begin with a common building block: **base oils**. These base oils are produced through a multi-stage refining process that transforms crude oil into highly purified and chemically stable fluid fractions.

The performance of the final lubricant depends heavily on how the base oil is refined.

Traditionally, laboratory-based refractometry methods (e.g., ASTM D1747-89) were used to monitor waxy raffinates, a key intermediate in lube oil base stock production. While effective, lab sampling introduces delays and cannot offer real-time insight into process deviations.

With the KxS DCM-20 inline process refractometer, continuous monitoring of the refractive index (RI) is now possible throughout critical process stages.

This enables tighter process control, optimized operating parameters, and immediate detection of off-spec product—ensuring consistency and product quality across API lube oil base stock groups.

Refractive index measurement in lube oil base stock refining

The DCM-20 refractometer provides precise inline measurement of RI, which correlates directly with concentration, purity, and component composition. It supports operators in maintaining optimal process conditions during distillation, extraction, dewaxing, and hydro finishing—critical stages for tailoring viscosity, color, pour point, and oxidation stability of the base stock.

Distillation

The refining journey begins with vacuum distillation, where heavier crude fractions are separated under reduced pressure into light, medium, and heavy components based on viscosity and boiling range. While this stage sets the foundation for lube oil base stock production, it does not remove all undesirables.

DCM-20 refractometers can be installed downstream of the vacuum column to monitor the consistency and quality of the extracted lube oil fractions. Refractive index trends reveal changes in composition and help fine-tune separation efficiency in real time.

Solvent extraction

The next stage—solvent extraction—is key to enhancing the oxidation stability, viscosity index, and color of the final base stock. Common solvents like furfural, NMP, and phenol are used to remove polar compounds and aromatics.

KxS refractometers can be installed in the raffinate outlet, where they ensure that solvent removal and separation performance meet defined purity standards. Monitoring RI here also helps optimize solvent recovery operations, contributing to sustainability and cost control.

Chill dewaxing

To improve cold temperature performance and meet pour point specifications, waxes are removed by chilling the lube oil, allowing wax crystals to form and be filtered out.

The DCM-20 refractometer can track residual wax content and solvent balance in dewaxed fractions, ensuring the final product maintains flowability at low temperatures without overprocessing.

Inline refractometry provides a fast and reliable way to confirm that dewaxing has reached the desired endpoint before further treatment.



Mild hydro finishing

In the final refining step, hydro finishing removes the last traces of chemically reactive impurities through mild hydrogenation. This improves product color, enhances oxidative stability, and prepares the lube oil base stock for final blending.

A KxS DCM-20 installed post-hydro finishing can verify that product refractive index falls within desired specifications—ensuring that the batch is ready for downstream use or packaging.

Instrumentation and installation considerations

The KxS DCM-20 process refractometer is specifically engineered to deliver precise and continuous real-time refractive index measurement under the demanding conditions of lube oil base stock refining. For this application, the recommended configuration is the long probe model installed in the process line or bypass loop using a standard industrial flange.

The DCM-20 features automatic prism cleaning using steam to prevent fouling in hydrocarbon-rich environments, while the CMOS-based optical image detection ensures stable, drift-free performance in long-term continuous operation.

Designed for industrial robustness, the DCM-20 is equipped with full-range temperature compensation up to 150 °C (302 °F), allowing it to maintain measurement accuracy across wide temperature fluctuations. Wetted parts are available in 316L stainless steel, offering excellent resistance to solvents used in lube oil base stock refining, such as furfural or NMP. ATEX and IECEx Zone 2 hazardous area certification is available.

For optimal performance, the refractometer should be installed in an insulated bypass line, with a sample flow velocity of at least 1.5 m/s (5 ft/s) to ensure stable readings. Where needed, inline heating or thermal jackets may be used to maintain representative temperatures—particularly after cooling phases or in solvent-rich streams.

The DCM-20 can be seamlessly integrated into the plant's DCS system, enabling real-time data logging, trend visualization, process alarms, and automated control loops for enhanced process reliability and product consistency.

The real-time data provided by these instruments allows operators to respond instantly to process fluctuations and ensure product uniformity. The result is improved efficiency, reduced waste, and enhanced product quality, all while meeting the stringent demands of modern refining operations.