

# Producing lubes and fuels

## Hydrocracking is beneficial when producing both feed for lube base stocks and fuels

Charlie Wills and Art Dahlberg *Chevron Lummus Global*

**T**he benefits of hydrocracking when producing feed for lubricant base stocks are well known and utilised in many plants around the world. In most cases, there is a dedicated lube hydrocracker, followed by dewaxing and finishing steps. However, the integration of a hydrocracker devoted primarily to making high-quality fuels (especially ultra-low-sulphur and low-aromatics diesel), as well as excellent feed for a dewaxing/finishing unit, is more unusual. In this dual role, Chevron Lummus Global (CLG) has exploited both process and catalyst to meet process objectives.

CLG's first innovation is purely process based and allows the refiner to use a single configuration to make a range of base oil qualities while producing superior fuels. CLG's patented principle is shown in Figure 1, where the configuration can be set up to produce three lube base oil feedstocks while maintaining to a large degree the desired overall conversion level for fuels. Investment to recover each stream for further Isodewaxing/Isofinishing steps can be phased to match market requirements. BPCL's plant in Mumbai, India, the Bapco/Neste plant in Bahrain and GS-Caltex's proposed plant in Yosu, Korea, all use this scheme to meet their specific market requirements. While this process is ideal for grass-roots plants desiring both lubes and fuels with utmost flexibility, there are situations where it is used to produce

high viscosity index (V.I.) Group III base oil from an existing hydrocracker/dewaxer/finisher unit.

In such cases, the refiner uses a high-conversion hydrocracker (single-stage or two-stage), which produces feedstock for manufacturing high V.I. Group III base oils. Any refiner targeting Group III is particularly interested in the V. I., Cold Cracking Simulator (CCS) and other properties of the 4cSt (@100°C) base oil. The fundamental challenge for producing suitable base oils with high-conversion hydrocracking is

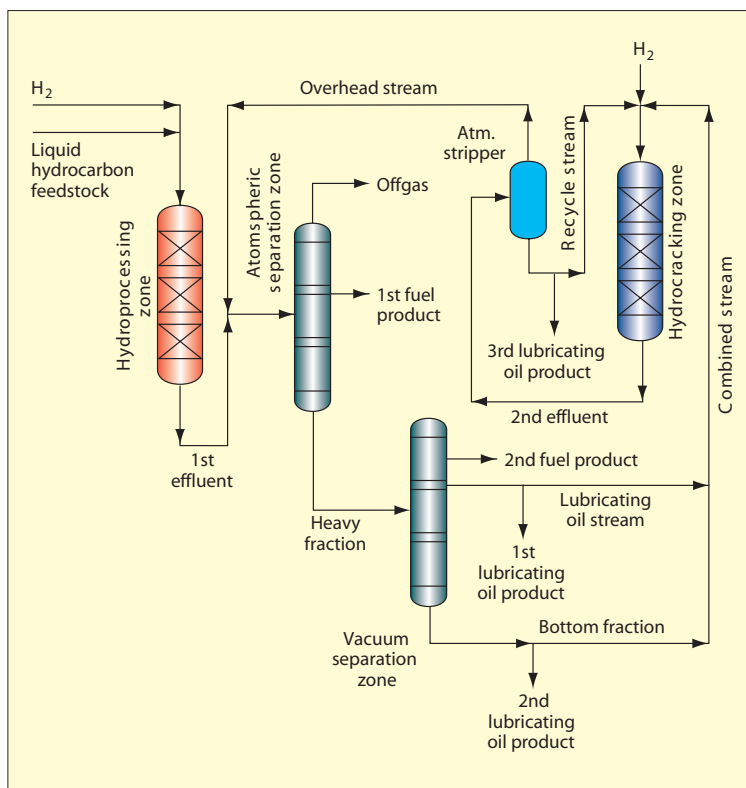
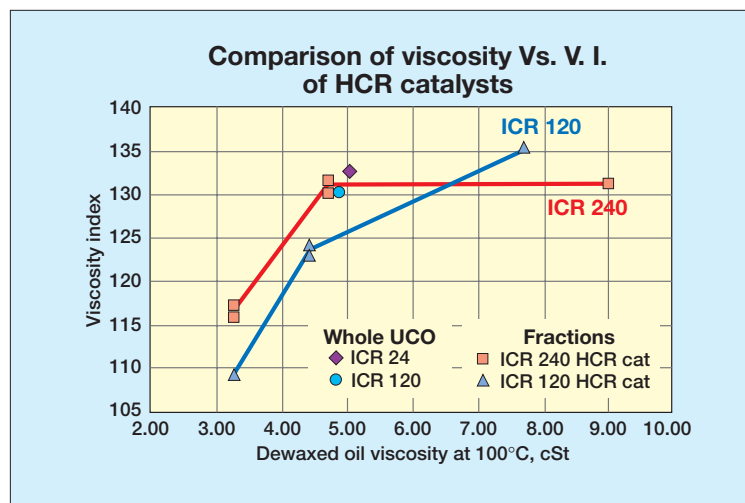


Figure 1 Isocracking for fuels and lubes



**Figure 2** Yield and V.I. improvements on LN feed (Group II, 150N)

Viscosity Index (V.I.) improvements at 4cSt				
	Yield of 4cSt base oil	V.I.	CCS	CAT at Isodewaxing catalyst
ICR 240/Isodewaxing catalyst combination	Base	Base + 5–7	Base- (200–300)	Base – (4–5) C
Best in class	Base	Base	Base	Base

**Table 1**

overcoming “droop”; that is, over a given boiling range, the lower the boiling point, the lower the viscosity and V.I. Even with typical Arabian-type VGO, it is a real challenge to produce high yields of 120+ V.I., 4cSt base oil feedstock that meet the Noack and CCS specifications necessary for premium Group III base oils.

The Isodewaxing catalysts demonstrate substantial improvement in yields and V.I. of base oils compared to previous-generation catalysts. Another breakthrough in performance was discovered when combining CLG’s latest hydrocracking catalyst, ICR 240, with the Isodewaxing catalysts. ICR 240 is specially formulated for mid-distillate yields with exceptional qualities (smoke point, cetane), but it also flattens out the droop characteristics of the unconverted oil. The performance of ICR 240 in second-stage operation relative to typical top-of-the-line

hydrocracking catalyst is shown in Figure 2. At 4cSt, a substantial V.I. boost is obtained where it is needed, even if it is lower at the higher viscosities, where a V.I. boost is not so vital. What is surprising is that the result holds whether the unconverted oil is from the second stage of a two-stage hydrocracker or simply from a single-stage recycle operation, of which there are many worldwide. Combining these results with Isodewaxing catalysts in the dewaxing step and Isofinishing catalysts for hydrofinishing produces superior base oils that are a step above what can be produced currently. Results of extensive tests conducted at CLG’s pilot plant in Richmond, California, and at a third party confirm this performance (Table 1).

These results are being employed by two of CLG’s upcoming licensees: the BAPCO/Neste project and the GS-Caltex plant in Korea. Ongoing development for both

Isocracking and lubes catalysts concentrates on improvements for use in existing plants, where increased throughputs and more difficult feeds require greater initial catalyst activity.

Isodewaxing (ISODEWAXING), Isofinishing (ISOFINISHING), Isocracking (ISOCRACKING) are marks of Chevron Lummus Global.

**Charlie Wills** is catalyst sales manager for CLG in Richmond, California, USA. Email: [chwi@chevron.com](mailto:chwi@chevron.com)

**Art Dahlberg** is R&D manager for CLG in Richmond. Email: [ajda@chevron.com](mailto:ajda@chevron.com)

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