BY DAVID WEDLOCK

Feedstock a Key Factor for Efficient Base Oil Production

Careful feedstock selection allows specifications to be met more easily and more economically.

It is easy to concentrate on the chemical and physical characteristics of finished base oils while ignoring the many feedstock variants that ensure those characteristics can be produced easily and economically. Ironically, API Group I base oils, at least in their solvent-extracted forms, are among the most demanding in terms of feedstock requirements. This is mainly because all the final base stock molecules need to be in the crude used. Therefore, not just any paraffinic crude will do, mainly because of the interplay of yield-by-grade and required hydrocarbon types to produce specific viscosity index characteristics.

Some paraffinic crudes may provide excellent yields in the lighter grades and be deficient in yields of heavier grades. The saturates characteristics of other paraffinic crudes may just be deficient altogether to produce a reasonable viscosity index, irrespective of how severely they are solvent extracted.

Group II base stocks are a bit more tolerant of paraffinic crude types because their manufacturing steps can chemically convert molecules to the required saturate types. But even Group IIs benefit from being given a head start if they initially contain at least some of the component molecules required in the finished product. Such oils will require lower severity hydroprocessing, which will benefit throughput rates (space velocity) and minimize unwanted cracking, thus improving both capacity and yield.

Moving up the performance scale to Group III base stocks, there is a swing back to more selectivity on feedstock type. If the feedstock is simply crude oil, the requirements are for very waxy crudes. This allows the relatively high isoparaffinic content of a finished Group III to be easily produced from the paraffinic waxes in the crude. If such species were not present naturally, trying to create them by severe hydrocracking could lead to unacceptable yields.

Fortunately, Group III production can benefit from the byproducts of other base oil types or fuels production. For example, slack waxes or foots oil, both byproducts of Group I dewaxing, provide excellent waxy feeds for subsequent hydrocracking to Group III base oils.

Also, refineries that produce gas oils (road diesel, marine gas oil, etc.) by hydrocracking for their fuel pools naturally produce highly saturated output from the hydrocracker to meet diesel cetane requirements. The heavy fraction in excess of the normal diesel boiling range is normally recycled to the hydrocracker for more fuel, but it can just as easily be diverted to form a Group III feedstock. This fraction

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is variously called fuels hydrocracker bottoms, for obvious reasons, or more simply hydrowax because it is produced by hydroprocessing and is very waxy with high viscosity index.

Hydrowax availability is partly the reason for the highly regional production of Group III base stocks, which is essentially limited to Europe and the Far East. U.S. refineries are largely geared to producing gasoline for the home consumer market, with a more aromatic output from their hydrocrackers for gasoline octane requirements. Diesel use in the U.S. is largely the preserve of commercial road transport. Hence, few U.S. refineries have excess hydrowax of the right type. Admittedly, a limited amount of the appropriate hydrowax does find its way from Europe to United States plants that produce Group III.

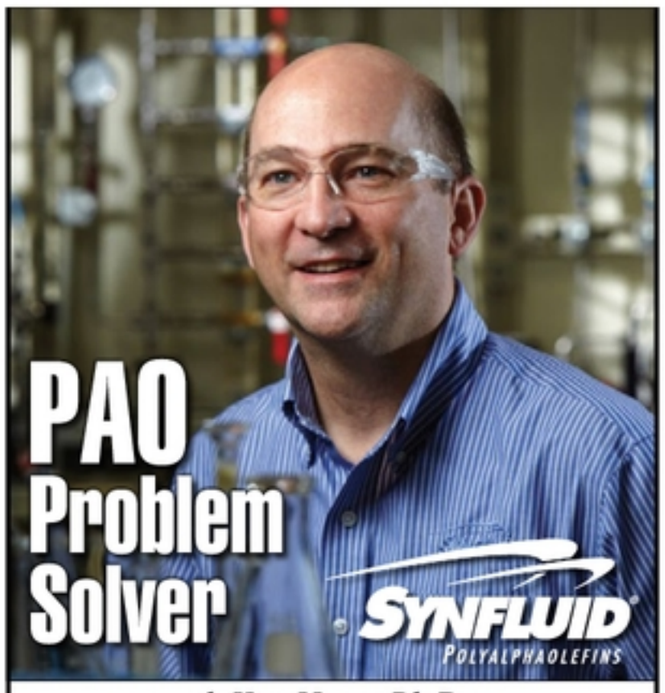
Synthetic waxes from the Fischer-Tropsch process can also be used for Group III production. This is the basis of gas-to-liquids base oils and is processed in the same way as slack waxes or foots oils.

Even naphthenic base stocks have special requirements. Genuine naphthenic crudes – that is, those that are essentially wax-free – are more difficult to source today because many wells have either reached the end of their economic life or are affected by local supply issues. Thus, it is becoming ever more challenging for those still producing naphthenic base stocks to source their feedstocks.

Naphthenic crudes tend to be more acidic than paraffinic crudes. Sometimes, this results in them being discounted relative to paraffinic crudes, although that can vary depending on whether the naphthenic crude is identified as having good base stock potential.

Other synthesized feedstocks, such as those used for polyalpha olefins, are normally C10 to C14 linear alpha olefins. Here, feedstock production is a relatively high proportion of the finished base stock price, although there are several competing processes to manufacture the linear alpha olefin feedstock. There tends to be significant competition for the feedstock from detergent manufacturers, for example, that explains their relatively high cost. However, PAOs significantly outperform any other hydrocarbon base stock type in terms of low temperature properties and antioxidant responses.

Feedstock availability and price are important parts of a base stock's business case and go some way toward explaining how the overall global base stock palette is evolving, by both capacity and region. The importance of feedstock procurement and management in the overall scheme of base stock production can be seen. Careful feedstock selection allows specifications to be met more easily and more economically. This all provides more consistency in base stock quality, which is what the formulator needs. Nothing is more frustrating than having to make minor modifications to formulations to compensate for lack of base stock consistency. □



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