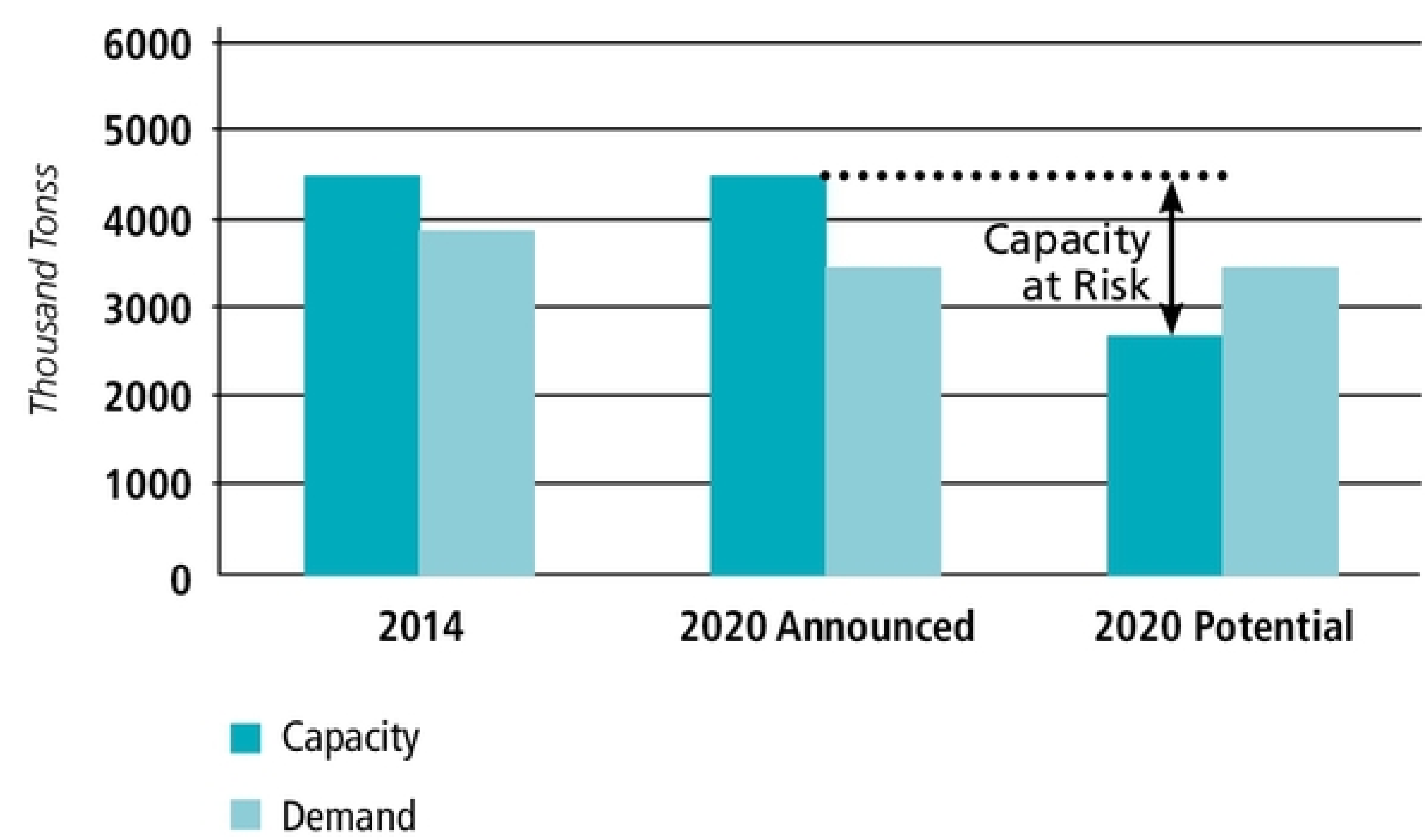
No Clear Replacement for Brightstock – Yet

API Group I brightstock seems to still have a big fan club even if other Group I stocks are losing favor. On the basis that imitation is the sincerest form of flattery, the fact that we see naphthenic, Group II and potentially even Group III forms of brightstock, surely means there is a need.

For many years, operators of base oil plants viewed brightstock as almost a by-product to be blended away. Now, the fact that blenders are willing to pay a significant premium not only for distillate Group I base stocks but sometimes for Group III stocks indicates that it still is a mainstream product. And users are worried about its potential demise on the back of Group I plant closures.

Brightstock is a residual base stock. This means its feedstock is the vacuum residue once distillates have been vacuum distilled off for distillate base stock grades. That residue has to be de-asphalted to remove asphaltenes and heavy metals, producing a feedstock for brightstock manufacture. This generates an asphalt by-product in the refinery, too. But not all refineries have de-asphalters. Hence, some Group I plants make only distillate grades (SN-100 to SN-600) and export the residue for processing elsewhere.

Bright Stock Demand Versus Potential Capacity



Source: K&E Petroleum Engineering

If we are content with a low performance but very high viscosity grade residual base stock, we can just dewax that paraffinic de-asphalted oil to produce a very heavy grade base stock of around 50 centistokes at 100 degrees C. Because it effectively contains all of the brightstock extract molecules, it is highly aromatic and does not have an especially high viscosity index, sometimes less than 80. This would mean that formally such a residual base stock is Group V rather than Group I.

However, extraction and dewaxing – by solvent processing – produces a conventional and good performing Group I brightstock with a kinematic viscosity in the range of the high 20s to low 30s cSt, depending on crude source and processing. Since it has been upgraded, viscosity index is normally 95 or higher; hence, it is Group I. The upgrading stage need not be solvent extraction; it can be hydroprocessing with sulfur-tolerant versions of the hydroprocessing catalyst.

However, the dewaxing stage is

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usually solvent dewaxing for Group I brightstock, due to catalyst constraints on the tolerable sulfur levels but more particularly to the sheer dimensions of the molecules being isomerized. The size issue can lead to hazy products that are not clear and bright when catalytically dewaxed, due to a fraction of the wax remaining unconverted.

Naphthenic brightstocks have emerged recently that still need a de-asphalted feedstock from the naphthenic crude, but they can be upgraded routinely by hydroprocessing. Or, if necessary, a conventional catalytic dewaxing finishing stage, depending on just how naphthenic the crude feed is.

Such naphthenic brightstocks can resemble Group II base stocks in their saturates and aromatics levels. Indeed, some are formally Group II brightstocks, even though they are made from naphthenic crudes because viscosity indexes can exceed 80. They also have only trace amounts of sulfur and aromatics as a result of hydroprocessing.

The fact that we see naphthenic, Group II and potentially even Group III forms of brightstock, surely means there is a need.

The relatively high viscosity index in these cases results from the way it comes about. Viscosity index is a function not only of the chemical nature of base stock constituents, but also the average size of the molecules. The average size of brightstock components serves to boost viscosity index.

On the whole, viscosity index varies much more widely across the grade structure for naphthenic stocks compared to paraffinics. One advantage of naphthenic brightstocks is the easier production of a clear, bright product because true naphthenic crudes do not contain wax molecules, the normal source of haze.

Various manufacturers are now offering Group II brightstocks derived from paraffinic crudes, but some have yet to reach a robust manufacturing state in terms of producing clear, bright base stocks. This again results from limitations in the channel sizes in current isomerization dewaxing catalysts.

Gas-to-liquid and coal-to-liquid technology is also capable of producing paraffinic brightstocks that formally meet Group III specifications. This is helped by the fact that in the synthesis of the Fischer-Tropsch wax feedstock, the average carbon number is only a function of the synthetic wax generation set-up. In contrast, for all crude-derived brightstocks, the average carbon number is already limited by the crude oil.

De-asphalting is not necessary with Fischer-Tropsch feeds, but they are still limited at the pour point dewaxing stage by the same isomerization catalyst limitations. Hence, we will probably have to wait before we see routine supplies of Group III brightstocks.

Inevitably, considerations come down to current heavy hydrocarbon fluids that can substitute for Group I brightstock. Polyisobutylenes are frequently cited, but most are deliberately made with a reactive olefinic end-group for subsequent functionalization. This end-group is a significant source of oxidative instability when using unsaturated PIB as a base stock, which would limit uses in all but a few lubricant applications. If the end-group has been saturated by hydrofinishing, PIBs might be considered for formulating more than just single-pass (e.g. marine cylinder oils) lubricants.

Heavy PAOs are excellent paraffinic alternatives to brightstock, but they carry a cost premium due to expensive LAO feeds and the need to polymerize and then work up. However, they probably have no equal for heavy-grade, long-life industrial gear oils.

The discussions about brightstock supply and heavy-grade alternatives is likely to continue for some time to come. There is no doubt that there is an on-going need for cost-effective heavy-grade supplies, and current R&D efforts in base stock manufacturing and catalysis will provide a wider range of alternatives in time. □

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