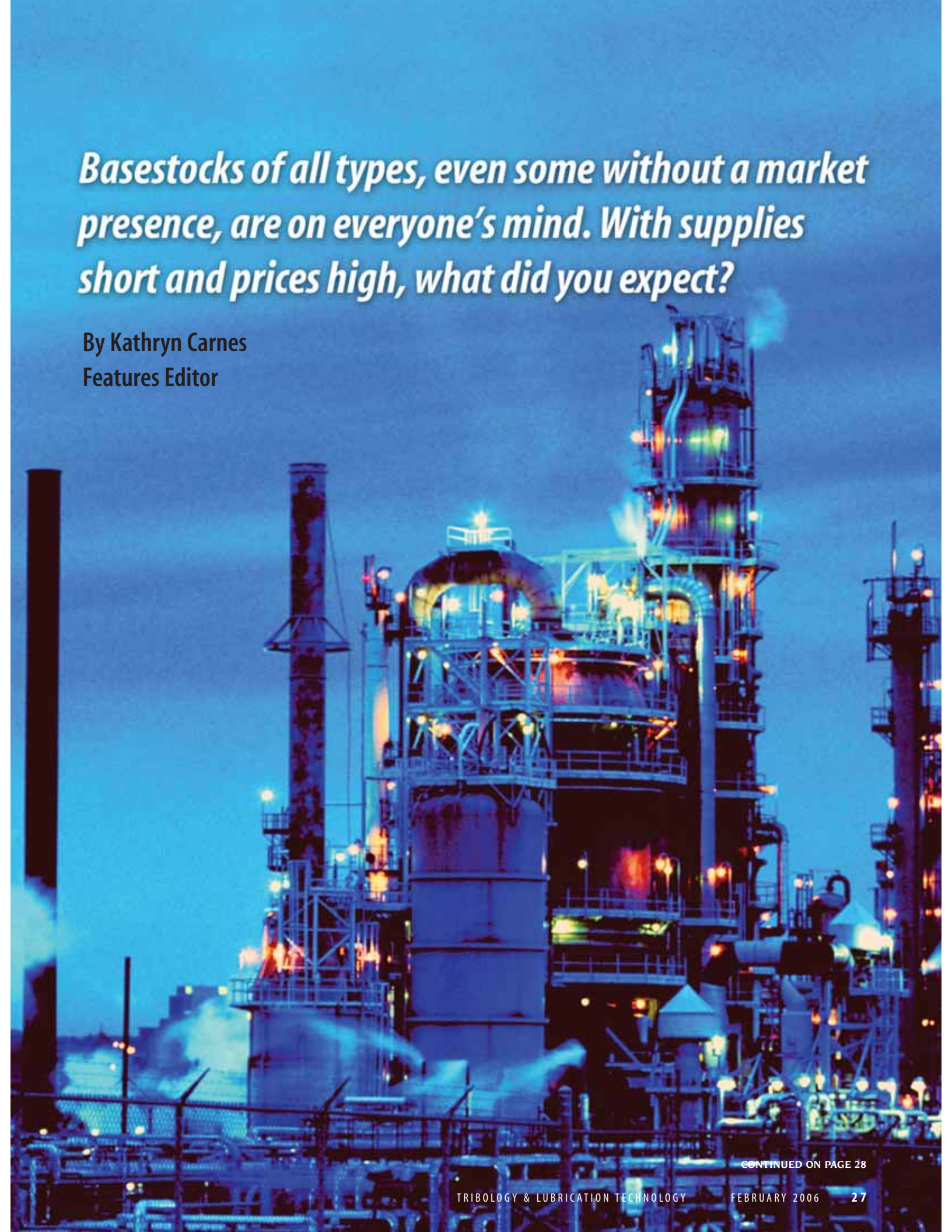




Taking Stock



Basestocks of all types, even some without a market presence, are on everyone's mind. With supplies short and prices high, what did you expect?

By Kathryn Carnes
Features Editor

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'Decisions about where and how to use feedstocks may have little or nothing to do with the lubricants market at all.'

Ask people to talk about basestocks now and prepare yourself for some unexpected answers. While you might expect that, after years of depressed prices, current values would

have refiners and marketers grinning from ear to ear, the end of 2005 found them surprisingly low key, sobered perhaps by the challenges of a marketplace battered by storms and beset by shortages. Not that basestock suppliers are downcast—they still anticipate strong demand and steady growth—but they appear cautious in their optimism, mindful of old difficulties that remain and new ones that will arise in the years ahead.

In November 2005, TLT invited several basestock manufacturers, marketers and distributors to participate in an informal survey designed to gather their opinions and thoughts about the current state of and future prospects for these products. Some 24 executives responded, and this article presents our survey findings plus additional discussions with survey participants and other industry representatives. This dual approach gave us the opportunity to elucidate certain intriguing bits of insight and prophecy.

What is perhaps most remarkable in both the survey and our subsequent interviews was a subtle shift in the types of basestocks that were discussed most often. Although American Petroleum Institute (API) Group II and II+ paraffinic basestocks have long been in the limelight (especially as GF-4 and PC-9 engine oils were being specified and developed), it is the stocks that flank them (so to speak) that seem to be garnering much of the industry's attention now: Group I oils (and their co-products) and Group III-V stocks. One big reason for this shift can be summed up in a single word: shortages.

Shortages & 'anxious resignation'

If there is one area most everyone seems to agree on, it is that paraffinic petroleum lube basestocks are in short supply, a situation that applies to all grades from Group I to Group II, Group II+ and Group III. In addition to the basestocks themselves, the byproducts of Group I production (or co-products, if you prefer) such as paraffin wax and aromatic extracts are becoming increasingly difficult to find, says Houston-based

Lithcon Petroleum USA Inc.'s Joe Rousmaniere, who was co-chair of the ICIS-LOR Pan American Base Oil & Lubricants Conference held in December 2005. Similarly, naphthenic stocks are tight, as reported by Sara Logue of Nynas USA at the ICIS meeting (for a good synopsis of this presentation, see DeMarco⁽¹⁾).

The sum of these situations is that the mood amongst manufacturers/refiners and formulators is one of "anxious resignation" says Rousmaniere. "The feeling is that while the shortages of some certain Group I grades may be alleviated in 2006, the market for Groups II, II+ and III will remain tight at least through 2007 and 2008. As long as demand stays steady, the solution will have to be more production, and the only new production we see that can serve the U.S. market before late 2007 is Motiva's 14,000 bpd of Group II coming onstream Feb. 1, 2006. Even when the Motiva expansion is complete (making a total capacity of more than 40,000 bpd, which is almost twice as large as any other refinery in the world), the increased supply may soon be absorbed. And in any case, it will have to last awhile because the next new refineries won't be coming on until 2007-2008 in Asia."

In 2007 Formosa Plastics is expected to start up a Group II plant in Taiwan. Petronas is planning on a Group III plant in Malaysia for late 2007, and GS Caltex (in South Korea) and China Petroleum Corp. (Taiwan) are talking about Group II/III plants for 2008. Also, China National Offshore Oil Corp. is considering building a new naphthenic plant in China in 2008 or 2009.

One indication of the recent rise in market pressures on basestock supply lies in recent decisions by the API and ATIEL (the Technical Association of the European Lubricants Industry) to suspend certain requirements for formulators seeking to substitute base oils or additives in their formulated lubricants because of disruptions in supply that create *force majeure* conditions. The U.S.'s API instituted its "emergency provisional licensing" rules in early October 2005, following Hurricane Katrina's and

Rita's widespread disruption of crude production, refining and shipping activities along the U.S. Gulf Coast⁽²⁾; ATIEL announced its "emergency derogation provision" in mid-December.⁽³⁾

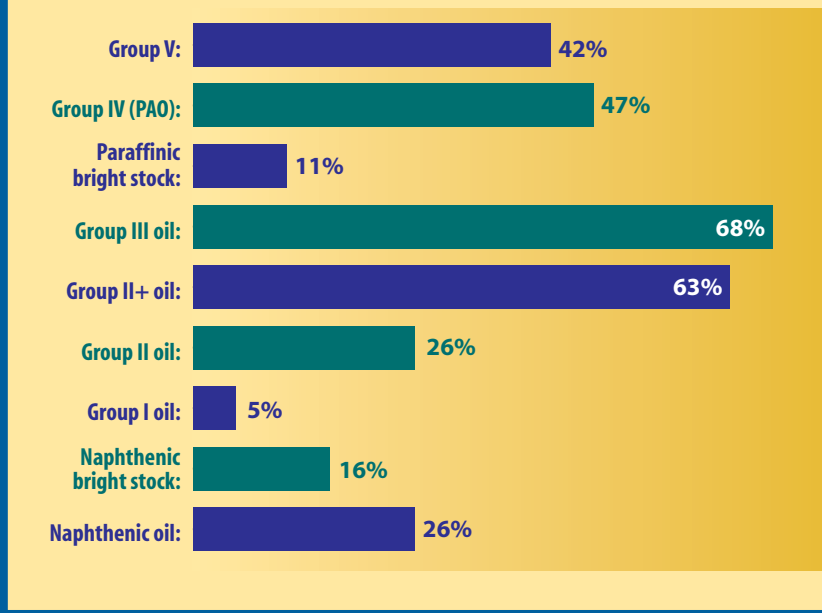
Both sets of rules allow formulators to deviate from accepted standards for base oil and additive interchange as they develop and submit products for approval by the organizations; in both cases, the provisional licenses would be granted for a maximum of 90 days, during which time the interchangeability data would be generated. While this opens the door to unscrupulous (or careless) marketers who might foist off substandard products onto an unsuspecting public, it points to the degree to which the automotive lubricant industry is hamstrung.

And especially since the hurricanes, Rousmaniere says "pricing has gone off the scale. Sometimes basestock pricing moves with the cost of basestock production, sometimes with market factors, but usually it is a combination of both. However, something else has happened these past few months to create such short supply and high prices.

"A lot of people think that basestock feedstocks are being shunted off into higher margin fuel products and so base oil supplies have been cut short," Rousmaniere adds. "During the run-up in crude and VGO (vacuum gas oil) prices, the base oil refiners were making terrible margins or running at a loss." Citing a presentation by Citgo's Karl Schmidt, general manager of the Lake Charles Lube & Wax plant, at the December ICIS-LOR Pan American Base Oil & Lubricants Conference, Rousmaniere says, "Decisions about where and how to use feedstocks may have little or nothing to do with the lubricants market at all."

Whatever their cause, shortages affect not only formulators but also distributors, notes Greg Wyatt, director of specialty products for Lubricant Technologies in Cary, N.C. Wyatt particularly noted the declining supply of Group I and bright stock. "Demand remains steady on these products primarily for industrial processing, although refining focus has shifted to Group II and above, following lubricant trends," Wyatt says. "Foreign supply of Group I solvent-refined products are being sold in the domestic market at very competitive pricing, although to this point the supply has been sporadic.... It

Figure 1. Survey respondents' prediction of worldwide capacity to be added over the next 5-10 years.



also appears that major suppliers have re-focused efforts away from light/medium base oils and bright stock used for industrial oil process. These oils have traditionally been sold for low margin, as their volumes were high. As supplies have tightened, refiners have been reluctant to sell these type products for such low profits, and this has created price hikes to industrial users, as supply has again tightened. This trend will likely continue, and most of the supply will have to be filled with 'darker' color basestocks, which generally are not preferred for automotive product blending. This supply may come from foreign competition or from a small number of domestic refiners."

These observations were mirrored in responses to TLT's online survey (see Figure 1). Group II+ and III paraffinic stocks were most often predicted to rise, with 63% and 68% of respondents choosing these for expansion. Slightly lower on the list were the synthetic stocks and others (Groups IV and V, in the API system); 47% of respondents stated that Group IV (polyalphaolefin, or PAO) capacity will expand, and 42% said Group V (all others, including other synthetics, vegetable stocks, etc.) would do so. Despite the prediction from one brave soul that Group I capacity would grow, the prevailing view echoes Wyatt's: Group I and especially its associated products will con-

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tinue to be difficult to come by.

"The industry has been predicting the demise of Group I for years," Rousmaniere says, "and while the long-term trends in motor oil specifications are certainly working against them, the Group I refiners are making money now with specialty products that only a Group I refinery can make, like bright stock, waxes and extracts. As far as we know, no one in the world is planning on building a new Group I refinery, nor even making a major expansion of any old one, so it is safe to say that these products will remain profitable for many years to come in the U.S., especially so when one or more of the big Group I base oil plants closes or converts to hydrocracking, as could happen in the next year or two.

"When that occurs, Group I base oil and side products will become specialties dominated by independent producers, as is the case now in the naphthenic base oil business," Rousmaniere says. "In the past 20 years, all the international majors shut down their U.S. naphthenic base oil refineries, leaving the business to smaller independents. When the last major closed down its last naphthenic refinery in the U.S. the market took off, and the remaining independents are prospering. After numerous Group I refinery closures in the past 10 years, there is now only one U.S. major still in the Group I business. How long will that last?"

By which Rousmaniere means that the economics of refining Group I are becoming prohibitive. As Group II/III+ and (to a lesser extent) III stocks have become the mainstay for modern high-volume applications such as motor oil and automatic transmission fluid, integrated majors have (with the exception of ExxonMobil) exited the Group I business, leaving it to smaller, independent refiners. This pattern reflects changes in naphthenic refining, which saw consolidation and shedding of low-margin products like naphthenic oils up through the most recent period of upheaval in the mid-to-late 1990s.

Thus, naphthenic and Group I refining are dominated by independents, leaving the high-volume oils' production to the integrated majors and non-U.S. suppliers. What this bodes for supply of the stocks from the independents is unclear, especially as non-U.S. Group I production remains very high, feeding a world increasingly hungry for engine oils, transmission fluids and indus-

trial lubricants of many quality levels. As noted by one survey respondent, the need to upgrade and maintain plants while also preserving "reasonable margins" will probably require the "shakeout of some Group I production."

Worldwide shortages do have their hopeful side, of course, helping to alleviate any nervousness that may arise from the threat that non-fluid lubrication and other types of friction-reduction systems will begin to supplant oils and greases. Perhaps this will happen in some applications, but, "We do not anticipate a big shift to non-fluid lubricants over the course of the next 15-20 years," says John Rosenbaum of Chevron Global Base Oils in Richmond, Calif. "However, there will be some significant changes in lubricant consumption patterns, especially for automotive lubricants, which comprise roughly two-thirds of total lubricant volume worldwide.

"Smaller, low-emission engines, such as those found in hybrids in North America and passenger car diesels in Europe, illustrate the move to lower crankcase capacities and extended drain intervals," Rosenbaum adds. "This trend in declining lubricant consumption in developed countries will be more than offset by very healthy sales of vehicles of all types in developing countries in Asia and Latin America. The motive power for the great majority of new vehicles worldwide will continue to be the internal combustion engine. All-electric and fuel-cell vehicles will require much less liquid lubricant than vehicles powered by internal combustion engines, but those vehicles are still inherently more expensive, so we don't see them being much of a factor in the next 15 years."

Hopes & fears for Groups III, IV & V

As the overall U.S. demand for lubes (and thus basestocks) is remaining about static, the demand for higher quality lubes (and thus basestocks) is growing. In the United States, this means greater use of lighter viscosity, synthetic and partial synthetic motor oils, all of which require Group II+ and higher quality basestocks. In the developing world this means a move in motor oil demands from mono- to multigrades, creating a growing demand for low-viscosity basestocks.

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Table 1. Comparison of GTL and other high-performance basestock properties¹

Parameter	Group II+ (average) ²	Group III (hydrocracker bottoms)	Group III (hydrocracker bottoms)	Group III (slack wax)	Group III (Fischer-Tropsch wax [GTL])
Kinematic viscosity @ 100 C, cSt	4.58	4.51	4.32	5.08	4.5
Viscosity index	118	126	123	143	144
Pour point, C	-18	-21	-15	-18	-21
Cold crank simulator @ -25 C, cP	1360	970	960	1185	816
Noack volatility, wt %	14.8	11.7	13.7	10.4	7.8

¹ Adapted from Table 8 in Henderson.⁽⁴⁾

² Represents average of North America quality (see original for reference).

As an example Rousmaniere notes that, "Fifteen years ago the Brazilian oil company Petrobras exported huge quantities of SN150 to the U.S. and Europe. Now it is importing SN150 on a regular basis. As it happens in Brazil, so it is happening in other large markets like Mexico, China and India. In the not too distant future the world (and especially the Far East) won't have enough Group I light neutral. As it happens, the new Group II/III refineries going up in the Far East mainly produce lower viscosities, which should segue neatly into these new multigrade markets."

So while the shortages are worst for Group I stocks and co-products, what everyone really seems to want to talk about is Group III, IV and V stocks—particularly gas-to-liquid (GTL) stocks, which were mentioned frequently in our survey and by others we talked to for this article. The chatter is amazingly loud and strident, given that GTL has essentially zero market presence, but it seems justified given market trends toward cleaner, longer-lasting fluids.

"GTL base oils will take off" in the next 5-10 years, wrote one survey respondent. "They will be a super-Group III quality level, driven by forces outside of our industry. By 2015, large GTL base oil plants will contribute 10% of the world's base oil supply." Of course, GTL is being actively pursued by several of the supermajors and so represents another stream of basestock income for a world increasingly hungry for low-sul-

fur/volatility, high-viscosity index (VI) base fluids.

If at one time—and not too very long ago—it was popular to compare Group I physicochemical properties with those of Group II basestocks or Group II/II+ with PAO, it has now become fashionable to compare and contrast "conventional" (hydrocracked) Group III basestocks with GTL stocks (which can be thought of as unconventional Group IIIs or III+ stocks). Ernie Henderson, technical manager, lubricant basestocks, at Lithcon Petroleum and formerly with Syntroleum Corp. (developer of one GTL process technology), has been very active on the speakers' circuit this fall and winter, discussing just this topic.⁽⁴⁾

Table 1 compares the performance properties of a Group II+ basestock with those of a Group III GTL basestock (identified as the [Fischer-Tropsch] wax stock) and Group III basestocks manufactured from slack wax and hydrocracker bottoms (HCB). While the GTL stock's VI is comparable to that of the slack wax Group III, its cold-temperature properties (cold-crank simulator performance and pour point) are markedly better, as is its volatility, provided it is properly dewaxed using catalytic rather than solvent processing. These results demonstrate the real potential value of GTL stocks in the marketplace.

"The next-generation basestocks derived from GTL will have much higher viscosity indices" than current options, says Chevron's Rosenbaum, "resulting in low-temperature capabilities not before seen in Group III basestocks. For example, GTL basestocks can be used to make 0W-20 and 0W-30 engine oils, products which previously required PAO." For an industry already looking for advantages in engine oils and transmission fluids, including lower sulfur levels, fuel economy improvements and better soot-handling, GTL stocks represent a huge advance.

Never fear, though, that these stocks will displace the high-performance stocks already on the market, as would seem to be a natural concern. As Henderson notes, "Commercialization will be primarily in the hands of a few major oil companies who in turn have a large internal demand...and many of whom also have a vested commercial interest in Group III and/or IV production," meaning that GTL will be introduced

in a “structured” manner so as not to upset these top-tier markets.

What will suffer (and somewhat counter-intuitively) will be the Group I stocks, says Lithcon’s Rousmaniere. “Imagine a base oil Napoleon layer cake: The icing on top is the current crop of Group III, over a layer of Group II+, over a layer of Group II, with a layer of Group I at the bottom. GTL Group III will become the icing, pushing the others down a notch. Group I will feel the most pressure.”

Meanwhile, the PAO makers have had to adapt in response to their own pressures, none of which can be traced to GTL. Rather, processing shifts and end-use markets have led PAO manufacturers to increase demand of C4-C8 linear alpha olefin (LAO) feeds to a greater extent than they have for C10+ LAO feeds. C10 traditionally has been the primary feedstock for PAO, and so although demand (or at least potential demand) for PAO is good, manufacturers have not been able to make as much of it.

Declining availability of C10 feed was noted both in our survey of industry representatives and by Lithcon’s Rousmaniere. The move away from C10 feedstock is compounded by years of price competition, wherein PAO, despite its performance advantages, was forced to go head-to-head with petroleum stocks (especially Group IIs) in an effort to gain market share and therefore was forced to maintain a competitive (read “low”) pricing structure.

At the recent ICIS-LOR Pan American Base Oil meeting, Shell Chemicals’ Sean Clarry⁽⁵⁾ outlined two strategies PAO producers may employ to counteract the effects of declining C10 availability: use of mixed C8-C12 LAO feeds and development of PAO based on different feeds (particularly C12). Both options have their advantages, but neither is without its drawbacks, too, Clarry notes; these features are summarized in Table 2. Performance properties of C10- and C12-based PAO6s (also adapted from Clarry’s presentation) are given in Table 3.

For its part, ExxonMobil Chemical (which did not participate in the survey but did submit a written response to queries from TLT) says that it believes “the future remains bright for PAO as specialty basestocks because of their unique chemistry. They continue to have performance features unlike any other basestock and can be

Table 2. PAO processing strategies to compensate for shortage of C10 LAO¹

Type of Strategy	How It Works	Pros	Cons	Questions
Mixed-feedstock PAO	Use mix of C8, C10 and C12 LAO to produce PAO with same specifications as C10-based PAO.	Broadens LAO supply for PAO. Produces product with similar specifications to C10-based PAO. Investment in C8 LAO in 2007. Strategy has been employed by a PAO producer in prior C10 LAO shortages.	Constraints of C8 LAO availability. Competing with high-growth co-monomer for C8 LAO.	Could other LAO grades be incorporated, such as C6 or C14 LAO?
New PAO products	Develop new PAO products based on different feedstocks.	Broadens LAO supply for PAO. Produces new products that may be of value in certain applications.	New product which is not a drop-in for many applications; may require re-qualification and potentially reformulation. Patent and intellectual property issues around C12-based PAOs. Requires special PAO campaigns; adds operational complexity.	Could other LAO grades be incorporated, such as C14 LAO? What is/will be C12 LAO availability?

¹ Adapted from Clarry. ⁽⁵⁾

Table 3. C12-based PAO: Comparison of Properties¹

Specification Properties	PAO6, C10-based	PAO6, C12-based
Bromine number, g Br/100 g	0.4 max	0.4 max
Flash point, C	225 min	245 min
Pour point, C	-60 max	-33 max
Viscosity @ 100 C, cSt	5.7-6.1	5.7-6.3
Viscosity @ -40 C, cSt	8200 max	Frozen
Noack volatility @ 250 C, wt% in 1 h	9 max	6.5 max
Moisture, ppm	25 max	25 max
Acid number, mg KOH/g	0.01 max	0.01 max
Color	0.5 max	0.5 max
Specific gravity, 15.6/15.6 C (60/60 F)	0.825-0.829	0.81-0.84

¹ Adapted from Clarry ⁽⁵⁾ (see original for test methods). Original cites data obtained from Innovene.

developed to offer even more options.”

ExxonMobil Chemical recently developed its SpectraSyn Plus PAOs, which the company says offer “step-change improvements over existing low-viscosity PAO products normally included in Group IV.” Rather than look to high-volume applications, the company adds, “the PAO market will contin-

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Figure 2. Survey respondents' predictions of biggest challenges to the base oil industry overall over the next 5-10 years.

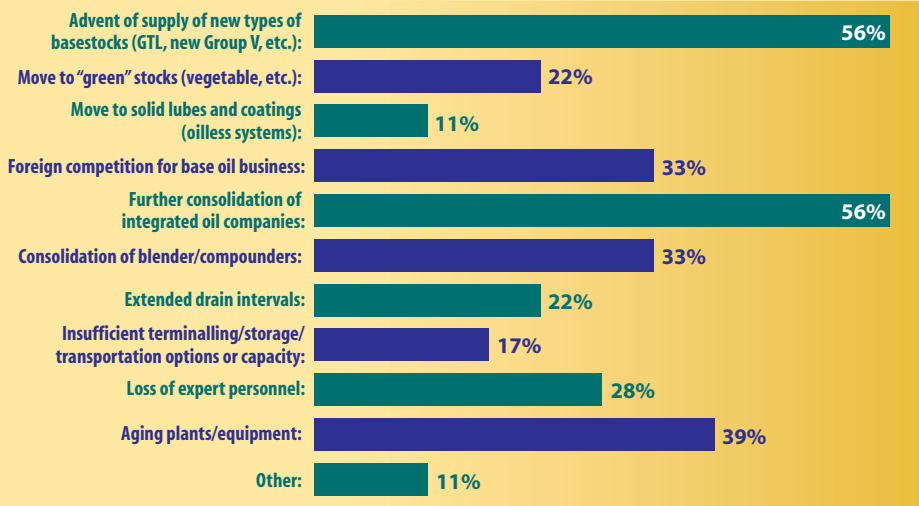
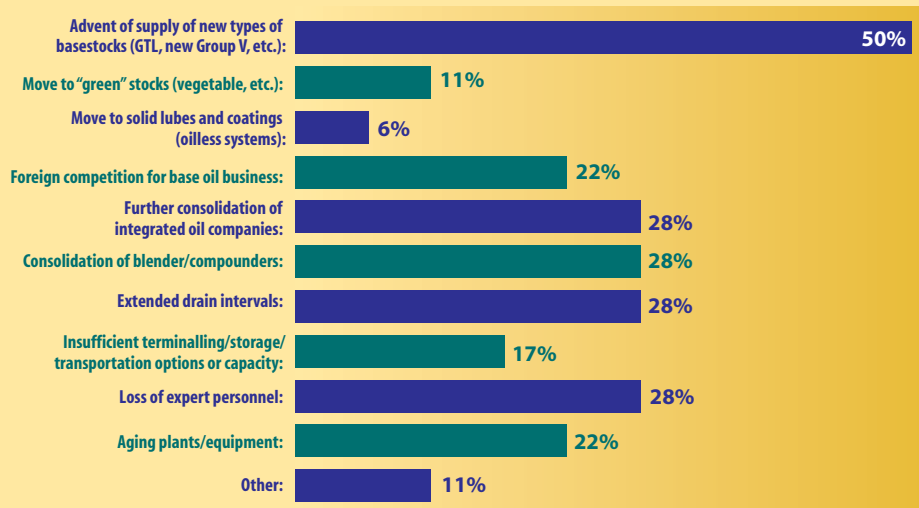


Figure 3. Survey respondents' predictions of biggest challenges for their companies over the next 5-10 years.



ue to be driven by the need for high-performance fluids in specialty applications. These needs range from changing industry or OEM specifications to changing environmental regulations to niche problem solving."

Challenges ahead

As we stated at the beginning of this article, basestock refiners/manufacturers and marketers anticipate some significant challenges in the years to come, despite the current bump-up in prices and the relatively rosy market outlook. Our survey respondents pointed to several areas of concern, including business pressures, calls for further performance improvements and aging equipment and people (see Figures 2 and 3).

Still, said one respondent, "The future looks good to me: lots of challenges but also opportunities." Another opined that "the base oil industry as a whole will always have a future," while a third suggested that the best way to ensure that future is to "focus on total benefits of systems" and not take "a short-sighted approach." Surely, when taking stock of an industry as active as this one, those are good suggestions indeed. <<

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