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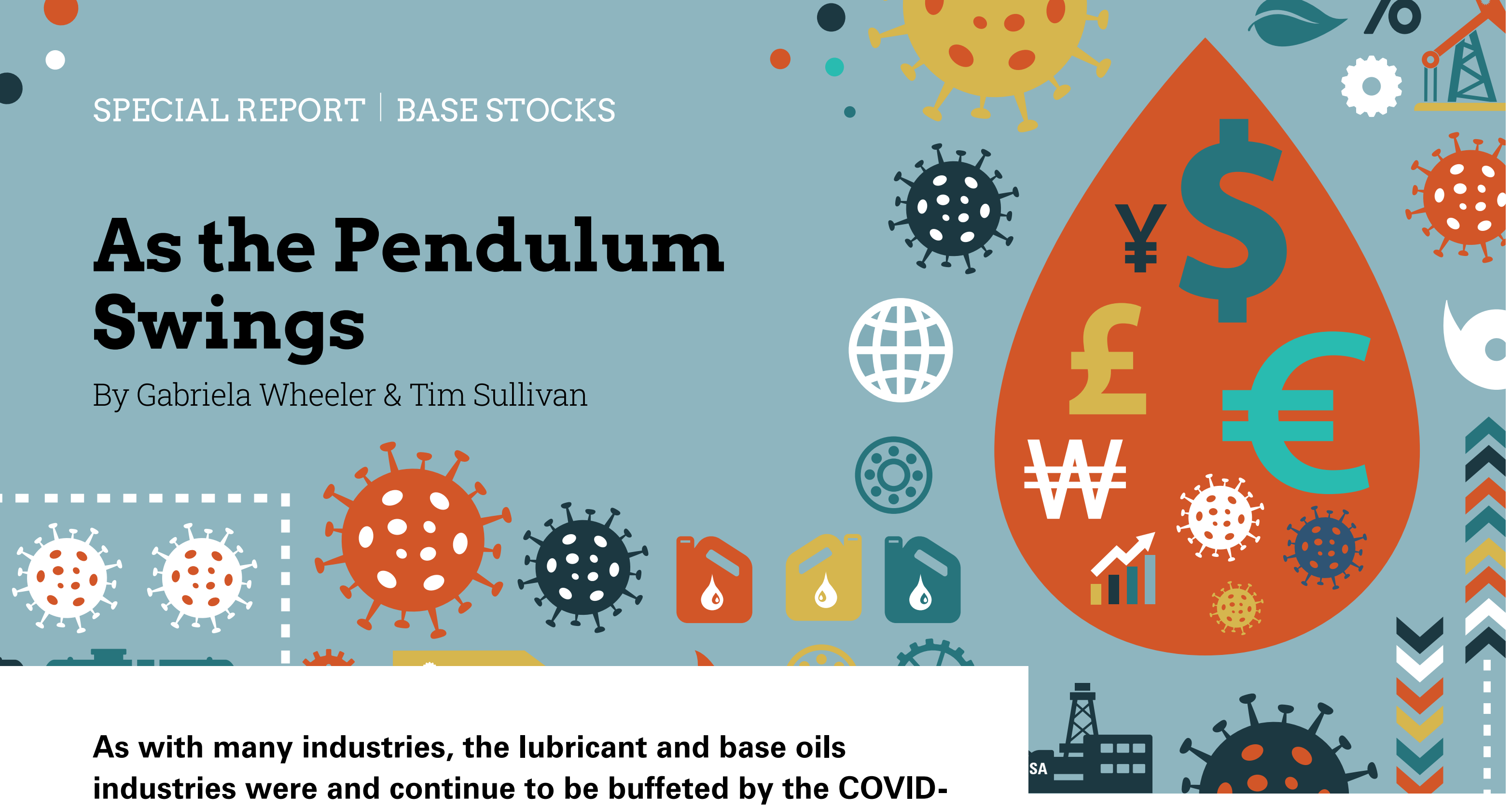
SPECIAL REPORT

FEBRUARY 2022

Base Oils Emerge from Pandemic



As the Pendulum Swings

By Gabriela Wheeler & Tim Sullivan

As with many industries, the lubricant and base oils industries were and continue to be buffeted by the COVID-19 pandemic—from a large drop in demand to supply chain disruptions, transportation shortages and increases in costs. One of the biggest impacts was an unprecedented run-up in base oil prices, a development that encompassed all grades in all regions.

Like a gigantic pendulum, price tags on the industry's far-biggest raw material began with a brief backward swing, then went on a year-long climb, reaching historic levels. Then they reached a plateau where they've hovered for the past seven months.

All eyes are watching to see what happens next. With the pandemic perhaps ebbing, some predict the pendulum for base oils will swing toward surplus capacity and tighter profit margins, pressuring some producers to exit the market even as new capacity continues to enter.

Base oil suppliers braced for disruptions as COVID-19 made an appearance in late 2019. Those were realized by March when large numbers of cases plagued most of the globe. Governments imposed severe lockdown measures early on, drastically curtailing some types of transportation—especially personal use of automobiles and air travel. At the same time, numerous types of businesses temporarily closed or cut back on operations, most in conformance with government policies but some due to decreased business. The upshot was a sudden decrease in demand for automotive and industrial lubricants—and therefore base oils.

Demand for transportation fuels fell even more drastically, creating two shocks for base oil markets. The most immediate was an unprecedented fall in crude oil prices. The drop in fuels demand slammed the brakes on products coming from the back end of refineries, but the supply chain gives much momentum to crude oil and other feedstocks coming in the front end. Refiners produced significantly more product than they could sell and quickly ran out of room to store the excess. To avoid being overwhelmed, they cut prices and in some cases paid to have material taken away. West Texas Intermediate crude oil futures dropped below zero and traded as low as minus $37.63 per barrel on April 20.

Crude quickly moved back into the black, but refiners had to take drastic action that caused the second shock. Around the world, oil companies cut back sharply on fuel refinery operating rates. In some cases they temporarily closed facilities; in others they throttled operations to significantly less than full capacity. In the United States, which has the world's largest oil refining base, utilization rates dove below 70% in April 2020.

As is often the case, these actions were driven by considerations for fuels—the highest volume product from refineries. The actions affected other products, including base oils. Less crude throughput meant less production of vacuum gasoil and other feedstocks, placing a cap on base oil production capability.

Partly because of base oil inventories and partly because base oil demand had dipped, it took some time for the effects of less base oil production to bubble to the surface.

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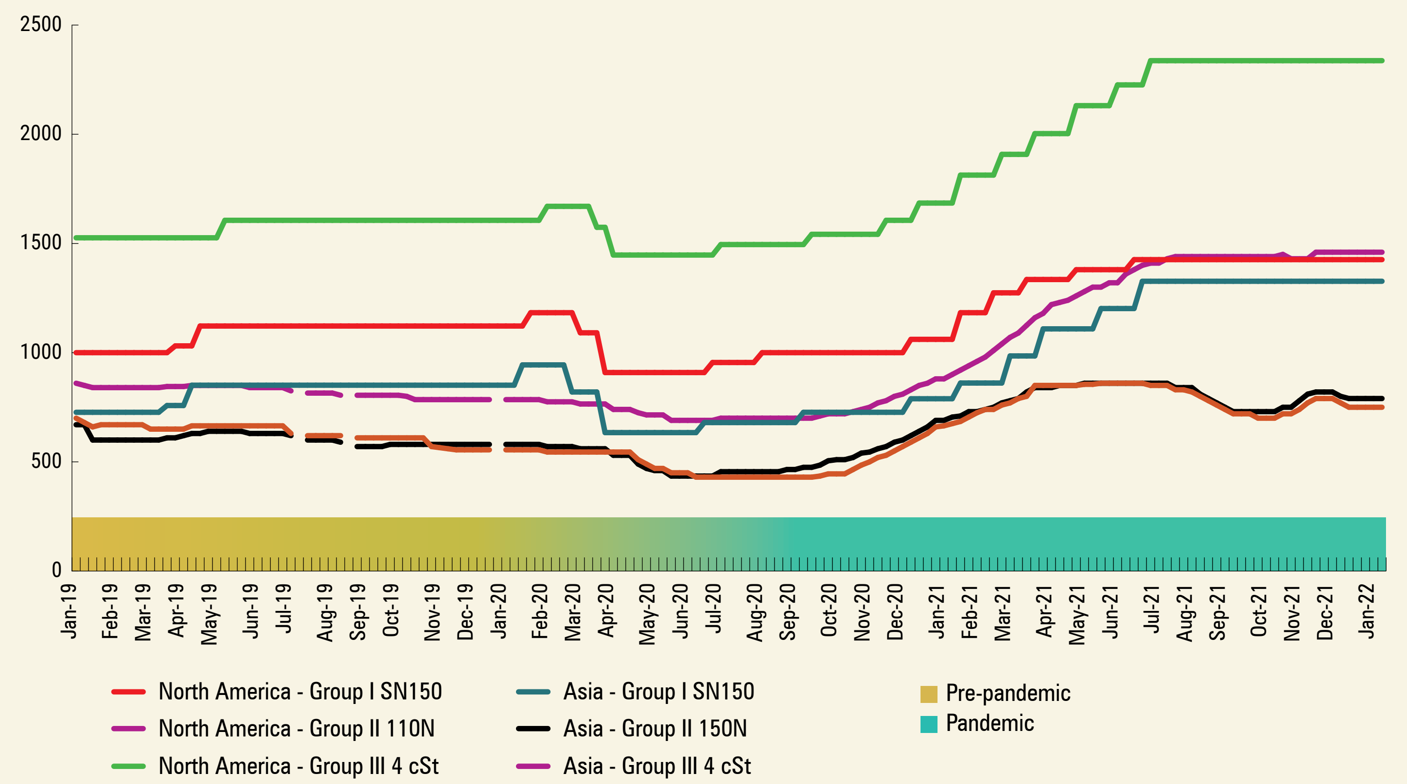
Paraffinic Base Oil Prices

U.S. dollars per metric ton



Note: North American prices are lowest posted price for each API group. Asia prices are midpoint of range of spot prices gathered by Lubes'n'Greases.
Source: Lubes'n'Grease Base Oil Pricing

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As inventories were drawn down and lubricant demand began to recover, shortages developed that spread around the globe and became increasingly severe over the next year. Other factors also made impacts. The biggest may have come from arctic storm Uri, which struck Texas in February 2021. It temporarily closed several refineries along the U.S. Gulf coast, causing a loss of capacity exceeding 5 million barrels per day.

The result was unprecedented volatility in base oil prices. Initially values fell sharply in tandem with crude oil. According to Lubes'n'Greases Base Oil Pricing Data, in mid-February 2020 the lowest posted price in North America for API Group I solvent neutral 150 was $1,183 per metric ton while the lowest postings for Group II 110 neutral and Group III 4 centiStoke were $944/t and $1,670/t, respectively. By early April, each had fallen between $223/t and $310/t.

At mid-year all grades began a gradual climb that brought them back to March 2020 levels by January 2021. By the start of 2021, though, shortages had become clearly evident, and they continued to worsen, causing the run-up to accelerate sharply. The first half of the year saw five rounds of hikes for North American postings. At that point the lowest Group I value had increased 56% from the low point just over a year earlier. Group III had risen 62%, and Group II 90%.

Crude costs remained in the same neighborhood where they'd been in 2019, so much of the increase was reflected in gross margins—the difference between base oil and crude prices and a rough indicator of base oil profitability. From the start of 2020 to mid-2021, the gross margin for the lowest North American Group II 150N more than doubled from $388/t to $798/t.

Base oil prices around the world vary significantly, but other regions followed the same pattern. North America is the only region where base oil producers post prices, but in Asia values for spot sales of Group I, II and III fell between 10% and 22% in April and May, then rose between 74% and 112% by November 2021. Group II margins jumped 245% from the start of 2020 to mid-2021.

The price swings were wildest in Europe, where spot prices for Group II 150N sold within the region and Group I SN150 exported from the region fell about 40% in April 2020,

Base Oil Capacity Changes During Pandemic

Subtractions				
Galp	Matosinhos, Portugal	Closed	150,000 t/y Group I	Early 2021
TotalEnergies	Gonfreville, France	Closed	289,000 t/y Group ?[1]	2021
Shell	Pulau Bukom, Singapore	Closing	386,000 t/y Group I	Due to close 2022
Eneos	Negishi, Japan	Closing	229,000 t/y Group I	Due to close 2022
Additions				
Handi Sunshine Petrochemical	Hainan	Expansion	400,000 t/y Group II/III	May 2021
SK-Repsol	Cartagena, Spain	Expansion	194,000 t/y Group II/III	July 2021
Qinghe Petrochemical	Zibo, China	Expansion	800,000 t/y Group II	2021
Shengdong Petrochemical	Lianyungang, China	New plant	700,000 t/y Group III	Due in 2021; no announcement yet
Feitian Petrochemical	Xinji, China	Expansion	250,000 t/y Group II	Due in 2022
Hindustan Petroleum	Mumbai, India	Expansion	150,000 t/y Group II/III	Due in 2020; no announcement yet
Bharat Petroleum	Mumbai, India	Expansion	450,000 t/y Group II/III	Due in 2022
Gazprom	Omsk, Russia	Expansion	220,000 t/y Group II	Due in 2022
Indian Oil	Haldia, India	Expansion	270,000 t/y Group II	Due in 2022
Rosneft	Novo-Kuibyshev, Russia	Upgrade	250,000 t/y Group II	Due in 2022

[1]Had been dormant since 2019 fire.
Source: Lubes'n'Greases Base Stock Plant Data

then more than tripled by mid-2021. Group II margins swelled more than three-fold from the start of 2020 to the middle of 2021, while those for Group I exports rose more than five-fold.

"The price increases that we saw during the first year and a half of the pandemic were remarkable and may have been unprecedented," said Joe Rousmaniere, a long-time participant in the base oil industry. "Margins were also exceptional. That's what happens when you develop a big shortage. Refiners couldn't make enough base oil, but on the barrels they did sell they made very good money."

In the third quarter, the run-up stalled. From autumn through January, values for all grades in all regions plateaued or retreated. Refiners had gradually ramped up operations during the last eight months of 2020. U.S. utilization rates were still significantly below average pre-COVID levels at the start of 2021 and briefly crashed below 60% during Texas' cold spell. They climbed to the upper 80s by June and have mostly remained in that range since.

"Since the start of the pandemic, we'd seen major decreases in refinery utilization related to weak transportation fuels demand," said Lance Puckett, president of Ergon Refining Inc. and Ergon–West Virginia Inc. "Now we see base oil production catching back up as refinery utilization has increased and more stable operations have resumed. This is apparent in the price of many base oil products softening over the past several months."

Gerald Heaton, director of consulting firm Elementalle, concurred. "Refinery run rates gradually increased, resulting in more [vacuum gasoil] availability, so base oil supply improved, closing the supply-demand tightness and tension that had existed. The 1-0-1 of market economics occurred with price stabilization first, and then some price declines."

Now the question is whether the pricing pendulum is preparing to swing back in the other direction. That depends partly on whether the crisis wanes. At the time of writing, COVID continued to rage, but some healthcare experts were predicting that numbers of new infections would plummet in coming months. Many in the base oil industry are anticipating the market's return to normal.

The outcome for base oils may depend much on what happens to economies as well as fuel and lubricant demand. Some economists worry that the world could experience a hard landing as governments withdraw the fiscal stimulus that has buoyed economies during the crisis.

Nevertheless, many argue that the best base oil barometer in the long run is the balance between demand and production capacity. Market insiders and analysts agree it makes more sense to talk in terms of base oil margins rather than prices. Prices have historically depended largely on crude and feedstock costs, and the strength of that link may be restored in the absence of feedstock shortages. Many agree that crude prices are nearly impossible to predict and that it is as difficult to forecast whether base oils will rise or fall. It's easier, they contend, to predict whether base oil margins will narrow or widen.

Attention is turning to the balance between capacity and demand and the impact it had on margins before the pandemic. For years leading up to the pandemic, the world had a chronic surplus of base oil capacity that grew steadily, compressing margins. Since the pandemic started, that imbalance has worsened. Refiners shuttered several plants and set schedules to close others. The combined capacity of those facilities is 1.1 million t/y. That number was more than offset, however, by two expansions in China and a third in Spain, which added 1.4 million t/y of capacity during the pandemic.

Moreover, seven projects in China, India and Russia are scheduled to be completed by the end of 2022 with combined capacity of 2.3 million t/y. In 2021 worldwide base oil capacity totaled 63 million t/y, according to Lubes'n'Greases Base Stock Plant Data, versus pre-pandemic base oil demand of roughly 40 million t/y.

"The market really has shut down very little capacity, and it keeps adding new capacity," said Stephen Ames, principal of SBA Consulting. "Demand is not increasing; demand is falling. So as things get back to normal we are going to be right back where we were in terms of surplus capacity. In fact, we'll have even more of a surplus. So margins are going to be rotten."

Some think the outlook for suppliers is less dire—or less certain. Dale Fatland, U.S. vice president of procurement for Schutz Specialties and Lubricants, said it's possible that the price run-up still has legs.

"In November and December, prices plateaued but only because that was the slow time of the year, although November was relatively strong," he said. "Prices have been bouncing around too much, and we have not seen a solid trend so far, but we will have to wait to see what happens in January. I don't expect the market to be flooded with product, but if people are driving less, or not driving to the office, the market will be a bit long."

Fatland also predicted that the shortages encountered during the pandemic will cause buyers to purchase larger volumes under contract and suppliers to carry more inventory. If true, those factors could help soak up supply for a time.

If the squeeze on margins

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resumes, analysts say it won't press evenly on all grades. Demand from lubricants continues a decades-long trend shifting from Group I to Group II and III grades, so low- and medium-viscosity Group I oils would feel the press most. Bright stocks are the exception among Group I grades, as the loss of Group I plants has made them somewhat of a premium product, along with petroleum wax.

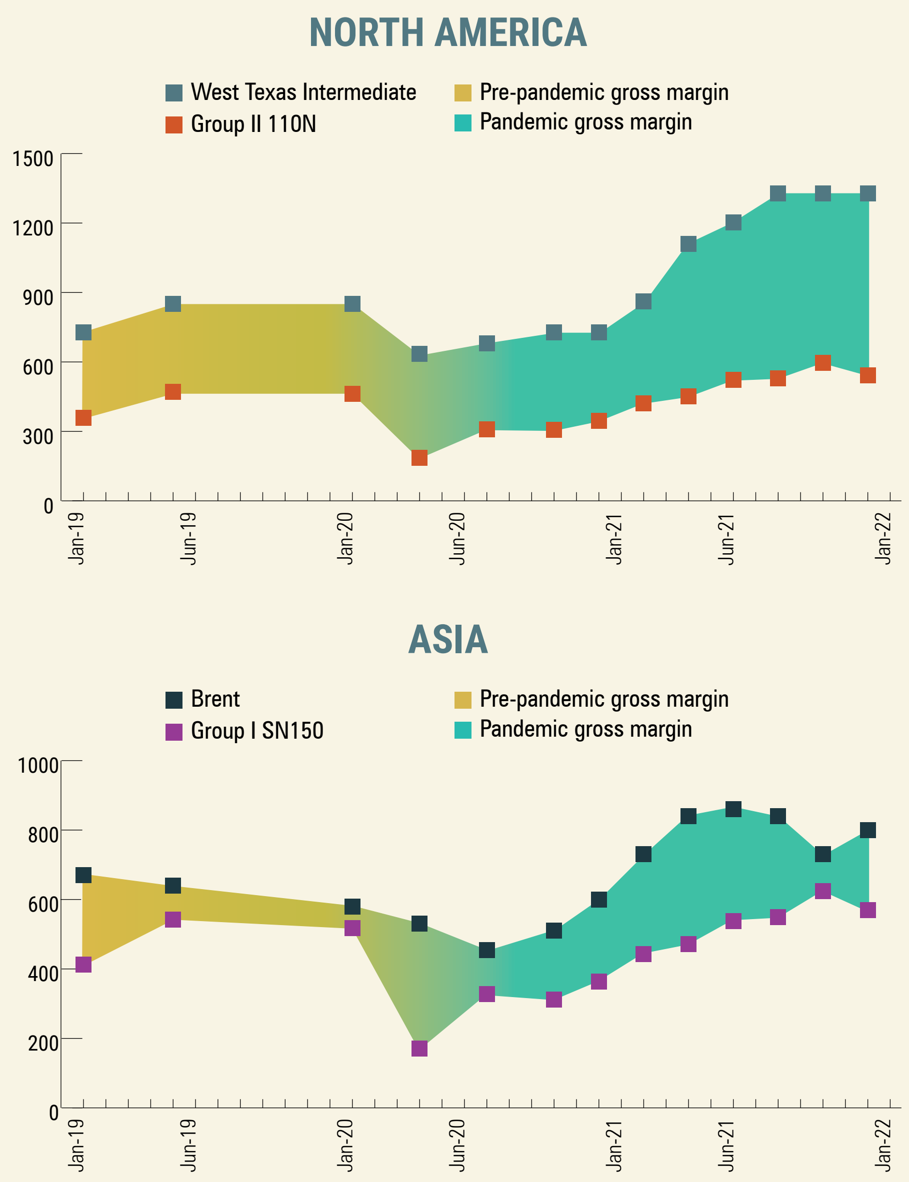
"Group IIs have an advantage because they are considerably less expensive to produce than Group I," Ames said. Some insiders expect Group III grades to retain their margins best due to growing demand from passenger car motor oils. Ames noted, though, that refiners in China and India are adding new capacity.

Most analysts do not expect demand growth to absorb the surplus. Finished lube consumption may still be expanding in developing economies, but for years it has been basically flat in the U.S. and shrinking in Europe, keeping global growth in the low single digits. A more likely way for the surplus to significantly diminish is for base oil plants to close. For years leading up to the pandemic analysts predicted that plants would shutter for this reason. A few did, but never constituting as much output as analysts said was necessary to reduce the surplus.

There seems to be wide opinion that base oil profits made during the pandemic are not sustainable with today's capacity surplus once feedstock constraints cease.

"The past two years were a very profitable time to be in the base oil business," Rousmaniere said. "If refinery operating rates return to normal levels, though, base oils are going to be back to baseline, which means a large surplus of capacity. In fact, the surplus is getting bigger. In the long run that means margins are going to go down, and things will be a lot tighter—at least until something happens to reduce the surplus." ♦

Base Oil Margins Fatten on COVID-19
U.S. dollars



Source: Lubes'n'Greases Base Oil Pricing Data

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SPECIAL REPORT | BASE STOCKS

Base Oil Rerefiners Rebounding from Pandemic

By Will Beverina

Price fluctuations. A pandemic. Lack of supply. It has been a chaotic two years for the base oil industry. But as it continues to recover, at least one winner has emerged: rerefined base oils. With increasingly available feedstock and a push toward sustainability, rerefiners are reaping the benefits while their products are becoming a more attractive option for buyers. In a world marked by volatility, rerefined base oils could be on the upswing.

Though rerefined base oil capacity is far behind products made with fresh crude oil, rerefiners have still carved out their niche in the industry. One of the draws of the product is its use of waste oil—which would have otherwise been burned or disposed of, thus saving carbon dioxide emissions—rather than crude oil.

An independently verified life cycle assessment conducted by rerefiner Safety-Kleen found lubricants using rerefined base oil saved 7,500 metric tons of greenhouse gases for every 1 million gallons used. The company alone has saved a total of 24 million metric tons of greenhouse gases throughout its history, according to the assessment.

With that kind of impact, the move toward more sustainable products has borne fruit for the rerefining industry. Customers—both new and longstanding—are more interested in rerefined base oils than before, multiple representatives of rerefiners told *Lubes'n'Greases*. Companies have already sold products to, if not had conversations with, new customers, while current clients are asking for more stock.

Ellie Bruce, vice president of business management and marketing at Heritage-Crystal Clean, based in Elgin, Illinois, said its customers, including oil majors, are already looking for additional product. New majors are also reaching out, inquiring about rerefined base oils.

Craig Linington, executive vice president of Safety-Kleen, has also observed increased interest in his products from clients new and old. "I think in numerous segments of the value chain there's increased interest," he told *Lubes'n'Greases*. "Large customers, whether they're publicly or privately held, may be under some sort of pressure from investors to demonstrate progress around sustainability. As you move up the value chain, I think those that are in the blending space are either trying to respond to their customer needs or have their own needs as it relates to making progress with sustainability." The company is also working to update its life cycle assessment, he noted.

"I think companies want to build their own narratives toward their customers," said Juan Fritschy, CEO of Avista Oil USA. "They want to say, 'We are buying these base oils that have an advantage from an environmental point of view.' They may have customers that are more sensitive to those topics."

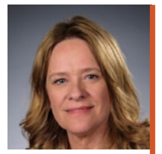
The rerefining industry was not spared from the effects of the pandemic. Amy Claxton, CEO of My Energy Consulting, told *Lubes'n'Greases* in May that U.S.-based rerefiners suffered because they "produce base oils suitable for automotive uses, which are highly exposed to consumer behavior and demand for passenger car engine oils."

Other factors contributed to a tough year, some even exacerbated by the pandemic, Linington said. Even before COVID, crude oil prices dropped significantly, he said, while the ensuing pandemic also influenced pricing for oil products. A drop in demand for lubricants as the United States shut down then went hand in hand with less oil available for rerefiners to collect.

Indeed, revenues and profits fell for major rerefiners in 2020. Heritage-Crystal Clean reported a 19% drop in revenue. Safety-Kleen, based in Richardson, Texas, shuttered about half of its rerefining capacity last year to protect its profitability, Linington said, adding that he believes it was the right decision. Avista Oil experienced a decline in demand but applied for a PPP loan and was able to keep all of its employees, Fritschy said.

Collection during COVID was also an issue. Collection volumes dropped by at least 35%-40% at the height of the pandemic, depending on the location of the company regionally, Bruce estimated. Fritschy said collection for Avista dropped as low as 50% during the second quarter of 2020. And rerefiners don't have spare feedstock laying around.

The industry recovered quickly, and as the increase in interest might suggest, rerefiners are already in a strong position even as the pandemic continues.



"I really think the respect for the rerefined product has grown. Most majors are going to tell you the rerefined product is as good or even better quality."

Ellie Bruce
Heritage-Crystal Clean

"Used oil collection came back fast, much faster than some of our other services," Bruce said. "Things have improved really since quarter three of [2020]. It was slow improvement, not like there was a switch, but then quarter four was better than quarter three and then quarter one of [2021] was better than that. It came back relatively quickly considering we're almost two years into the pandemic now."

Linington has seen similar strength. "I think we're much stronger in our used motor oil collection business," he said. "We've taken the opportunity the last two years to make investments in our rerefineries, to increase capacity and improve uptime. We're in a stronger position market-wise due to the adaptations of our company."

Linington also pointed to an almost forgotten development: IMO 2020—which limited the sulfur content in the fuel used on ships—went into effect just before the pandemic. "The impacts of IMO 2020 were blurred by the pandemic, but that's created some more used motor oil as well and improved effectiveness of collections," he said.

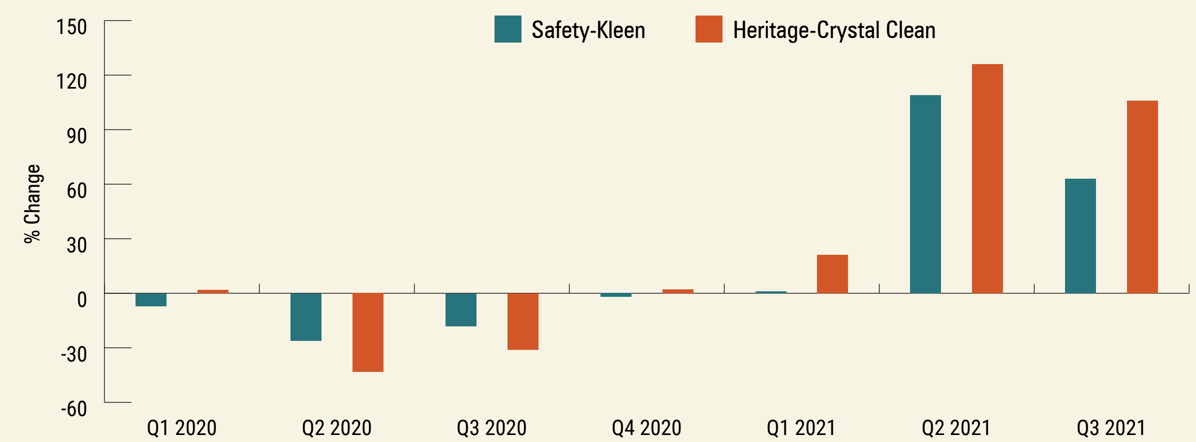
Rerefining operations across the pond are also finding success. One obvious factor is the European Green Deal, which has pushed European original equipment manufacturers and oil majors to find environmentally friendly ingredients for their products.

A supply chokepoint of base oils derived from crude also benefited rerefiners. While crude oil supply waned, rerefined base oil remained a reliable source for lubricant producers. "What can be the worst for a producer of lubricants is that they have commitments to sell to their clients, that they have demand for their products, but they cannot buy the products they use for making their blends," said Marc Verfürth, CEO of Avista Oil AG, based in Uetze, Germany. "That has happened in 2021. The only industry which was able to deliver these base oils was the rerefiners."

Avista's European operations experienced only a few months of heavy disruptions to its business during the pandemic in 2020 due to lockdowns. The rerefining industry on the continent has recovered since then and is

Rerefining Revenue

How have rerefiners fared during the pandemic?



Sources: Financial reports from Safety-Kleen and Heritage-Crystal Clean on its way to a better situation than pre-pandemic.

Growth is capped, however, due to sourcing issues. E-mobility means less waste oil, especially in mainland Europe where electric vehicle sales are growing in France, Germany and the United Kingdom. Securing adequate supply will become more competitive, meaning companies will carefully consider what investments to make.

"I'd say right now we are in a very regular environment that is not impacted anyhow by recent COVID developments," Verfürth said. "From an Avista European perspective, we look very hopeful into next year."

Verfürth would like to see lubricants made from higher quality base oils used in Europe. "The U.S. rerefined base oil is comparably better because of the good input quality of the waste oil," he said. "In the U.S. you have very solid Group II and Group III used lubricant oil bases while in Europe it's high Group I content. The U.S. can produce, with equal technology, better base oil products. We predict that used oil quality is going to increase over the next three or four years to support the quality of the rerefinery from the base oil perspective."

Future growth for the rerefining industry on both continents will be modest. In the U.S., there are a couple of expansion projects in the pipeline, but most companies seem to be standing pat. According to *Lubes'n'Greases* 2021 Global Base Stock Plant Guide, U.S. refined base oil capacity sits at 875,000 metric tons per year, the majority of which is Group II.

In Europe, capacity totals 877,000 t/y for rerefined base oils, and is mostly Group I. That capacity is likely to increase in Europe after 2025, according to Verfürth. Avista's own European facilities in Germany and Denmark have capacity for 140,000 tons and 100,000 tons of waste oil input, respectively, and the company is upgrading capacity by 30,000 metric tons at each site.

"I really think the respect for the rerefined product has grown. Most majors are going to tell you the rerefined product is as good or even better quality" than crude-based products, Bruce said.

"I do feel that the time for rerefining is really coming," she said. "I'm glad that people are taking a look at it under a different lens." ♦

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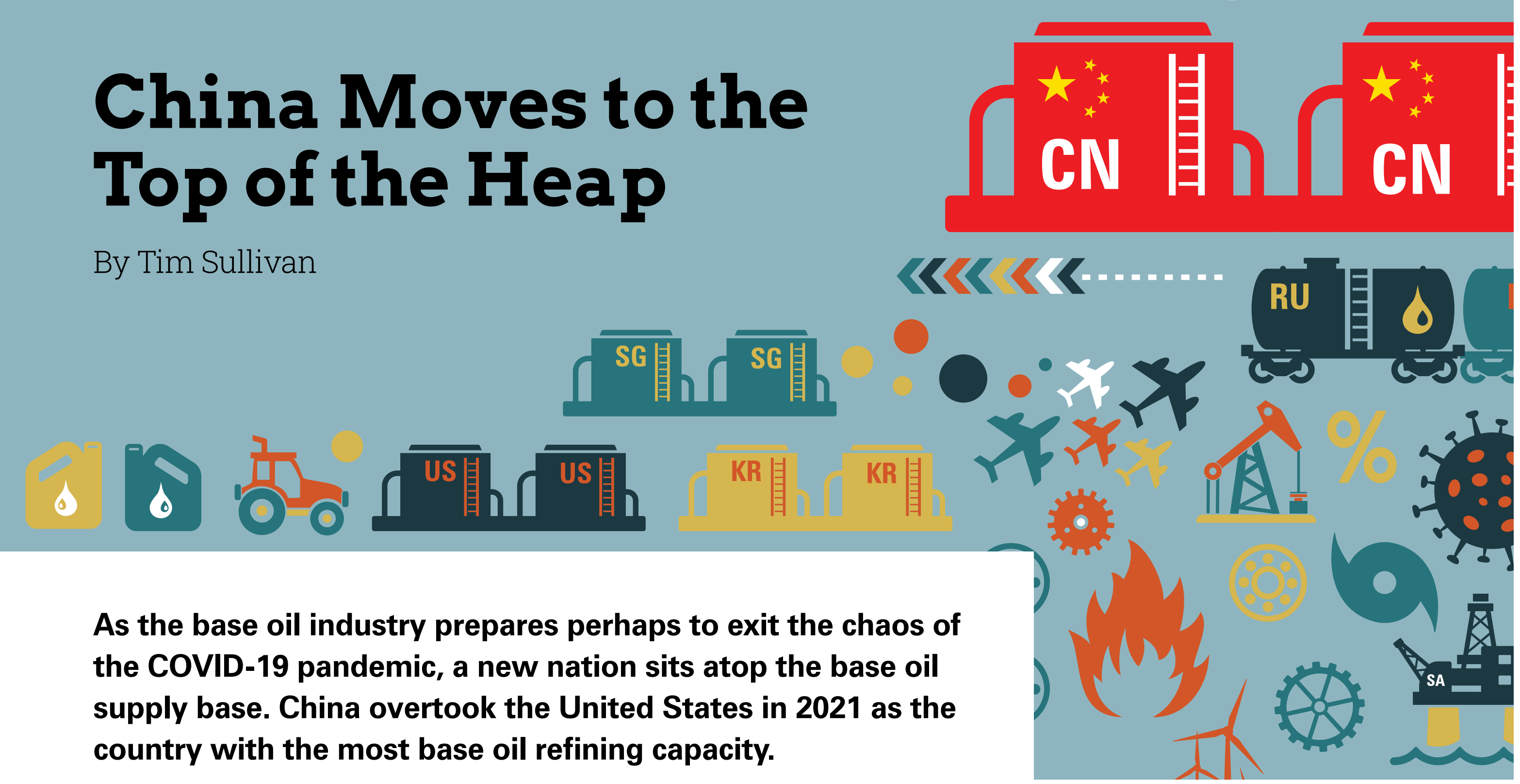

China Moves to the Top of the Heap

By Tim Sullivan

As the base oil industry prepares perhaps to exit the chaos of the COVID-19 pandemic, a new nation sits atop the base oil supply base. China overtook the United States in 2021 as the country with the most base oil refining capacity.

The U.S. has been the top base oil nation for at least several decades, but China moved ahead thanks to expansions at two plants and a change in reported operations at a third, which brought its total to 14 million metric tons per year, according to Lubes'n'Greases Base Stock Plant Data, just in front of America's 13 million t/y.

China's ascent is the result of a remarkable expansion over the past decade and more. Since 2010 its capacity has tripled from 4.6 million t/y. The supply base has also transformed in terms of the types of operators and types of base oils it produces. In 2010 the country had 16 base oil plants, all the possessions of state-owned oil giants Sinopec, PetroChina and China National Offshore Oil Co. Eighty percent of output was API Group I stocks or naphthenic. Today the state-owned trio operate 19 plants, while independent and semi-independent refiners have opened 15 others. Two-thirds of capacity is Group II or III.

The country's refiners are not yet finished expanding that supply base. Feitian Petrochemical is working to complete a 250,000 t/y Group II expansion of its plant in Xinji, and market insiders predict companies will add more Group III capacity.

Analysts say many base oil plants in China are operating at significantly less than capacity. The country has long been one of the world's largest base oil importers and still buys large volumes from South Korea, Singapore and Taiwan. Many facilities have flexibility, however, to switch production to white oils, solvents

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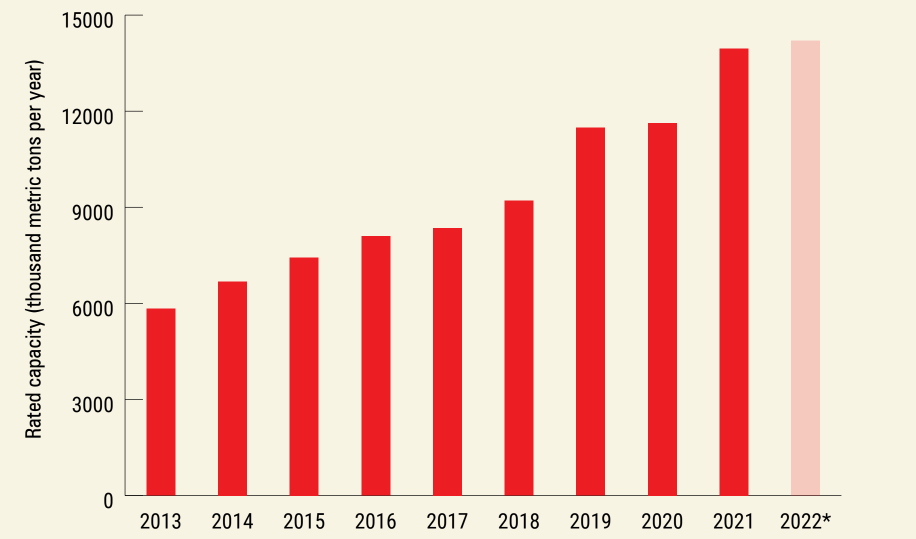
China's Run to Biggest Base Oil Supply Base



* Projected
Source: Lubes'n'Greases Base Stock Plant Data

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and process oils used for applications such as rubber.

The growth of domestic production creates competition for foreign suppliers.

"South Korean companies especially sell big volumes of Group II and III oils into China, as well as India," said Stephen Ames, principal of SBA Consulting in the United States. "Construction of all these Group II and III plants in China poses a threat to that business."

Some analysts say that during the pandemic new Chinese suppliers have taken advantage of disruptions in supply chains and the resulting desire by some lubricant companies to lean more on local sources.

"Since last year, many international and domestic additive manufacturers and lubricant manufacturers believe that it is very necessary to strengthen the localization of the supply chain, because it's been more difficult to obtain imported base oils and additives," said Zhang Chenhui, an independent lubricants consultant in China.

In one way China is a peculiar market: It is the only nation with a large base oil supply base that does not export significant volumes to other markets. China base oil exports have long been negligible, though a few companies have begun recently to sell small volumes abroad. CNOOC and such newcomers as Hengli Petrochemical and Qinghe Petrochemical have all established export sales desks and said they aim to sell base oils abroad as well as within China.

Some observers think that they probably will.

"Until now, the export volume of China's base oil is small, mainly because China has been such a large importer, and the country still has restrictions on the export volume of base oil," Zhang said. "With the increase of output in the future, the export volume will certainly increase."

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