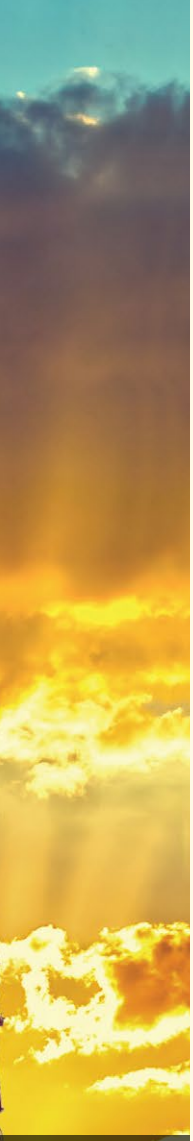
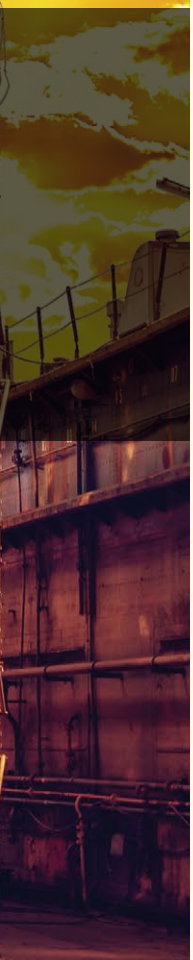




BY MARK TOWNSEND

**The marine lubricants sector has historically been an API Group I market, where small gains in engine performance take a back seat to cost, oil life and engine protection. But a qualitative market shift is seeing greater use of Group II base oils in trunk piston engines, a type often found in medium to large merchant marine vessels.**

This mirrors an industry trend towards higher-quality base oils amid the widespread closure of Group I plants around the world as demand switches to Group II. Increased Group II consumption is also being driven by a number of pivotal factors in the major markets of Europe and North America.

**Turning Point**

Despite a vote in May 2017 by members of the European Parliament to ban the use of palm oil to mitigate deforestation in Southeast Asia, Europe has increased palm oil derived biodiesel use fivefold over the past six years in order to meet renewables targets. This coincides with a trend towards smaller engines.

Smaller engines suffer greater thermal stresses caused by temperature or expansion differences that necessitates base oils with a higher viscosity index (VI), which remain more stable in wider temperature ranges. Thermal stress, and the presence of oxygen, lead to the oxidation of the lubricating oil, which increases viscosity, the acid number, and the production of insoluble compounds, all of which cause damage.

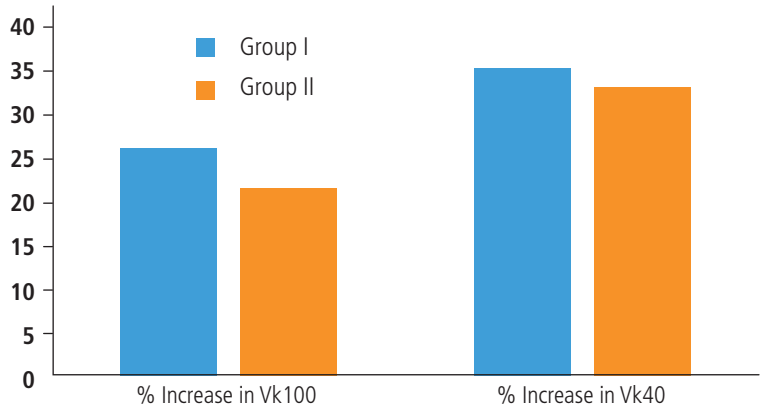
Meanwhile, in North America, longer drain intervals and retained oxidation performance are also pushing the use of higher-quality base stocks.

Group II base oils in marine applications are therefore expected to grow as more competitive prices and increased capacity makes the shift from Group I almost inevitable. The world's marine lubricants market could be worth U.S. $13.1 billion by 2023 up from more than $6 billion in 2015, according to economic data analytics company Global Insights, as fuel economy and increasingly stringent emission control regulations reshape base oil specifications.

The Middle East has established itself as an important source for Group II and Group III base oils, but the ongoing political standoff between Qatar and several of its Arab neighbors has increased market uncertainty after trade and diplomatic ties were cut in June 2017. Fortunately, there is continuous investment in Group II base stocks in the Asia-Pacific region with the commissioning in 2014 of Shell and Hyundai's 650,000 metric tons (716,502 tons) per year plant in South Korea.

Speaking during the Base Oils and Lubes Middle East conference in Dubai at the end of April this year, Ahmad Zarah, a senior technologist at Infineum International Ltd., said there is increasing recognition of the

**Group II Improves Viscosity Control**




*Source: Infineum*

benefits of Group II.

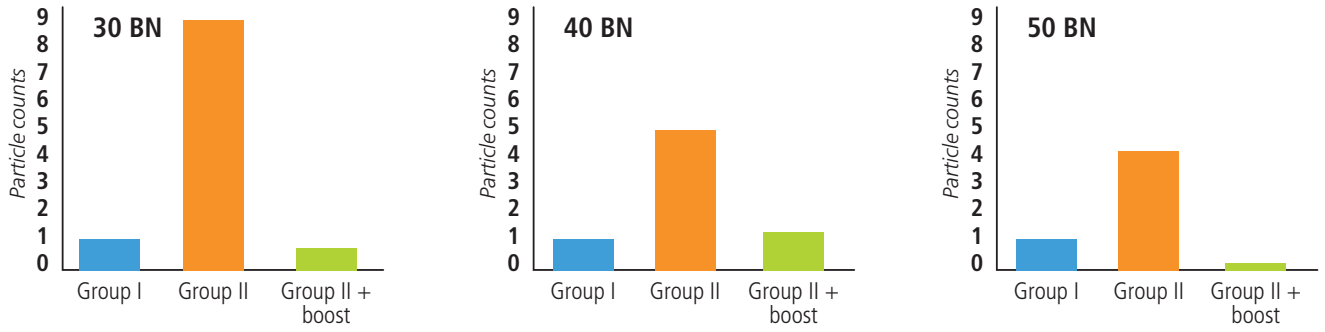
"Group II has higher saturates, lower sulfur and higher VI compared to Group I and these are critical attributes," Zarah said. Saturates yield better oxidation stability – a major benefit in marine applications – as well as lower sulfur oxide and nitrogen oxide formation, and better engine cleanliness. Improvements in viscosity control are clearly evident in bench tests.

Despite the benefits, there are technical challenges particularly from fuel contamination as the use of heavy fuel oil is highly prevalent in marine engines. Heavy fuel oil contains asphaltene, which increases crude's viscosity. "In Group I, the natural aromatic content helps, but once it is removed there is a problem," said Zarah.

Group I base stocks used in conjunction with the right additive package have an excellent tolerance to asphaltene, but that is not the case when Group II base stocks are used with the same package. In Group II base stocks, asphaltene sheets form and stick together to become micelles (aggregates of surfactant molecules) and because of lower aromatics they agglomerate, which leads to sludge build up. Sludge is damaging to normal engine operation because it can choke the oil galleries that feed lubricant around the system and then, more worryingly, to oil starvation.

"Using the same additive technol-

**Bench test development**




*Source: Infineum*

ogy in Group I and Group II formulations, Group II performs worse because the asphaltene has not been properly dissolved and sits on engine parts," Zarah said.

**Getting a Boost**

Infineum researched the issue in a bid to resolve the problem of heavy deposits on pistons that sometimes occurs. Deposits on piston undercrowns act as insulation, which prevents the lubricant from conducting heat away and quickly leads to hot corrosion on the piston crown, against which combustion occurs in the cylinder.

In tests conducted over two years, data showed that although Group II base stocks from different supply sources indicate varying results, they do not perform as well as Group I. During the tests, heavy fuel was introduced into the samples and the

**Products with greater detergent and dispersant capability will be increasingly in demand, as fleet owners comply with new regulations.**

resulting outcomes were measured using a Lasentec probe, a particle analysis tool that counts the number of coagulated ashpaltenes. After reviewing the results, Infineum subsequently developed a booster, and in similar formulations data revealed Group II performance levels that were very close and in some cases better than Group I when the booster was deployed.

"We took these formulations and put in a Wärtsilä engine. The results convinced us to conduct field trials for 4,000 hours, and the results were fairly clean. The field trial then carried on for 20,000 hours, or five years, and when they opened the engine it was still clean," Zarah said. When using the booster, better viscosity control over a non-modified Group II was evident.

**Green Stamp**

Pressure applied by environmental regulation is also being felt by the marine sector. The overarching regulator, the International Maritime Organization (IMO), has laid out more stringent restrictions on airborne NOx emissions in designated NOx Emission Control Areas in several waterways on ships built after January 2016. The U.S. Environmental Protection Agency has also issued the 2013 directive for Environmentally Acceptable Lubricants used in vessels that, according to the EPA, meet standards for biodegradability, toxicity and bioaccumulation potential that minimize their likely adverse effects on the marine environment.

Such measures are likely to lead to deeper industry collaboration, as the search for more ecofriendly products gathers pace. Indeed, additive companies quickly need to evaluate the potential use of bio-based fuels, including castor oil, palm oil, and animal derived oils, in addition to the current mineral and synthetic formulations. Products with greater detergent and dispersant capability will be increasingly in demand, as fleet owners comply with new regulations.

Regulation and fuel economy are part of wider insecurity in the marine market as it continues to adjust to the enormous upheaval from recession and consolidation of the last few years. Still, 2017 appears to be a better year for the global fleet, with capacity expected to grow 4.3 percent to reach 2.1 billion dead weight tons this year compared with by 3.4 percent in 2016, according to marine oil supplier and reseller Cockett Marine Oil.

**Marine Lubricants Market in Flux**

The frenetic consolidation in the industry and the trend toward ultra-large containerships may yet prove to be bearish for the marine lubricants market, as fleet owners' preoccupation with economies of scale could limit upside potential. Recovery of the broader sector is also inextricably tied to the health of the global economy. Although freight rates have steadily recovered, climbing back to 1,385 in September this year, the benchmark Baltic Dry Index is far from the last peak of 2,330 in December 2013.

The emergence of new base oil supplies, particularly from the Middle East, is redefining the supply chain, as traditional long-range base oil shipping routes compete with new oil export areas. Fujairah in northern United Arab Emirates is rapidly establishing itself as a storage center for base oil trading, and Iran's re-emergence as a base oil supplier is yet to fully quantified as doubts that the current U.S. administration will not reimpose full sanctions means only a handful of owners call to lift base oils at Sepahan, the Middle East's largest Group I producer with production of at 700,000 metric tons (771,817 tons) per year.

**Outlook**

Adding to uncertainty about the size of the marine lubricants market are ongoing engine research and evolving designs that continue to drive operating efficiencies. Equally, demands for low sulfur fuel oil and a tendency for multiple grades of onboard cylinder oils are adding to complexity and operating costs for fleet owners.

For the lubricant marketers, the IMO's deadline of 2020 for a global sulfur cap of 0.5 percent on marine fuels places the marine market into unchartered territory. Currently, OEMs are recommending SAE BN 40 for engines operating on low-sulfur fuel oil and BN 25 for distillates, said Cockett.

For modern engines using heavy fuel oils, OEMs are recommending cylinder oils complying with SAE 50 BN 100 and new formulations for ultra-low sulfur fuel oils are likely to emerge, as suggested by the recent introduction of a SAE 50 BN 140 by Chevron.

Whatever the ebb and flow of the marine market, the performance benefits of Group II base oils when correctly formulated will see their greater penetration in a critical lubricant sector. □