A NEW 200BN SOLUTION FOR ENGINES RUNNING ON HSFO

In preparation for IMO 2020, Chevron Oronite has developed and marketed additive technology for the formulation of 200BN marine cylinder lubricants as an extension to their marine additive portfolio

Test results demonstrate 200BN marine cylinder lubricant was as effective as 100BN marine cylinder lubricant at controlling engine liner wear, at half the lubricant feed rate compared with 100BN marine cylinder lubricant commercial references, writes Alex Cole, consultant and former product line manager, Marine, Chevron Oronite.

After January 1, 2020, marine vessels, which have installed an exhaust cleaning system (i.e. scrubber), will continue to bunker and burn heavy fuel oil (HSFO) requiring high BN marine cylinder lubricant for proper lubrication and the control of cold corrosion. Currently in the marine cylinder lubricant market, 100BN is the most commonly used level of high BN. However, Oronite has developed an additive solution for 200BN marine cylinder lubricant that has been extensively tested in the laboratory and in the field. Test results demonstrated that engine liner wear, evaluated in an application with severe cold corrosion, was equally well controlled by the 200BN marine cylinder lubricant at half the lubricant feed rate compared to 100BN marine cylinder lubricant commercial references. The test furthermore showed the use of 200BN oil at such a reduced feed rate did not negatively affect piston cleanliness compared to the 100BN reference lubricants tested. A letter of no objection (NOL) has been granted by MAN ES for Oronite's 200 BN MCL additive technology.

IMO 2020

Preparation for IMO 2020 by vessel operators and owners was the subject of much debate and discussion through 2019.

IMO 2020 refers to Regulation 14.1.3 of MARPOL Annex VI which states the global fuel sulfur limit was reduced from ≤3.50% to ≤0.50% outside Emission Control Areas (ECAs) effective January 1, 2020.

Instead of using a fuel with a sulfur content ≤0.50%, it is also permitted to use exhaust gas cleaning (e.g. scrubbers) to reduce SOx emissions to a level that corresponds with the use of ≤0.50% sulfur fuel. Predictions of the rate of future growth in scrubber installation depend upon the view of the evolution of the price differential or spread between High Sulfur Fuel Oil (HSFO) with ~3.50%S fuel and Very Low Sulfur Fuel Oil (VLSFO) with ≤0.50%S fuel.

A key piece of advice from the Original Equipment Manufacturers (OEMs) and engine lubricant suppliers is to match the lubricant used to the engine, application, operation and fuel used. The composition of available HSFO may well be affected by the supply and composition of the new VLSFO in 2020. Furthermore, the sulfur content of HSFO is no longer required to be <3.5%. With an excess of residual oil from refineries it may well be that HSFO with >3.5%S becomes available. Such high sulfur HSFO can be used if the vessels are equipped with scrubbers that can reduce the sulfur emission to the equivalent of operation on ≤0.50% sulfur fuel.

LUBRICATION OF LOW SPEED TWO STROKE ENGINES

Low speed two-stroke crosshead diesel engines operated either on HSFO or VLSFO are lubricated by once-through lubricants designed to protect piston, rings and liners. These marine cylinder lubricants (MCLs) must provide wear protection and detergency to prevent piston deposit formation. MCLs also deliver basicity (BN) to neutralize acids formed from the combustion of sulfur-containing fuels.

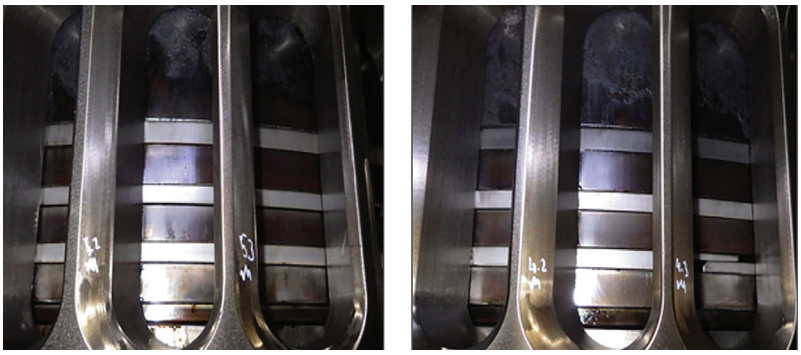

Figure 4: Cleanliness performance of 200BN and 100BN MCL

COLD CORROSION

Cold corrosion results from condensation on the liner walls of sulfuric acid that is formed upon combustion of sulfur containing fuels.

Cold corrosion is the most serious in modern engine designs, and engines that work under low-load operation known as "slow steaming" where vessels may operate as low as 10-20 percent load.[1] The sensitivity of two stroke engines to cold corrosion is expected to continue with the requirement of new engines to meet efficiency and emission criteria. At the same time the potential increase in the actual sulfur level of HSFO (used in combination with scrubbers) may lead to even more corrosion. It is important to note that it is these larger modern engines, with the potential to be sensitive to cold corrosion, that are also most likely to be fitted in vessels for which the installation of a scrubber would result in a positive business case under certain HSFO - VLSFO price spread scenarios.

BASICITY OF MARINE CYLINDER LUBRICANTS

Marine cylinder lubricants can be characterised by their base number (BN), which is the basicity according to ASTM 2896 measured in mgKOH/g. For highly corrosive situations with HSFO, OEMs (MAN ES and WinGD) recommend MCLs of 100BN or greater. Chevron Oronite identified the need for an ultra-high BN marine cylinder lubricant for engines running on high sulfur heavy fuel oil (HSFO) and consequently developed a new 200BN MCL additive package.

Alex Cole has worked in additive technology since the late 1980s acting as a consultant and former marine product line specialist at Chevron Oronite since 2006

INTRODUCING 200BN MCL

Chevron Oronite's 200BN technology was selected from a screening programme including laboratory bench tests designed to mimic engine and field conditions, followed by engine testing of candidates

in test stands and finally to blending quantities of lubricant test candidates to be used in the operation of a commercial vessel. Since the basicity of a 200BN MCL is beyond the BN of previous MCL development, this new technology posed new challenges to interpret results and to gain knowledge of the characteristics of 200BN MCLs. Once the formulation was decided upon, Chevron Oronite's 200BN marine cylinder lubricant was proven in real-world conditions for over 7,000 hours during a closely monitored operation in the field.

NOL FIELD TESTING

In order to obtain a no objections letter from MAN ES, the new 200BN MCL was tested in the field using a propulsion unit of a VLCC, a MAN B&W 7G80 ME-C Mk 9.2 engine. This specific engine was equipped with a split lubrication system, allowing for side-by-side testing of three lubricating oils. The 200BN MCL was tested in the field and compared to two 100BN MCL reference oils.

It is important to determine the correct lubricating oil feed rate for a given engine operating on a fuel with a certain sulfur level.

When operating on HSFO, the MANB&W 7G80 ME-C Mk 9.2 engine required a high BN MCL and/or a high lubricating oil feed rate to control cold corrosion of the liner surface. A feed rate of 0.8 g/kWh was selected for the 200BN MCL to keep drain oil iron below 200 ppm.

The feed rate of 100BN MCL is required to be twice the level of 200BN. For example, 1.6g/kWh feed rate of the 100BN MCL was required in order to inject the same amount of base to control corrosion and keep residual BN and iron in the drain oil below the warning limits advised by MAN ES. The feed rate ratio of 100BN MCL was maintained at twice the level of 200BN MCL throughout the test.

Drain oil samples were taken regularly during the test and sent to an external laboratory for analysis. Results are shown in Figure 2. Analysis shows acceptable values for the drain oil, with iron typically in the 50-100 ppm range. Similarly, the remaining BN was monitored and was typically in the 30-60 mgKOH/g range.

At the end of the test, the engine was rated according to MAN ES standards to assess piston cleanliness, liner and ring conditions and liner wear.

Liner wear data results are shown in Figure 3. For all cylinders, the liner wear is well below 0.1 mm per 1,000 hours (the maximum level of liner wear acceptable by MAN ES).

Scavenge port inspections were done at start and end of test. Picture shown in Figure 4 shows that 200BN MCL maintained cleanliness at half the feed rate compared to 100BN MCL.

OPERATOR BENEFITS OF USING 200BN MCL

For owners and operators of vessels equipped with scrubbers, 200BN MCL is an exciting development. Highly corrosive engines operating on HSFO no longer need to use high feed rates well above the minimum feed rate for adequate control of cold corrosion. Indeed, 200BN MCL allows the minimum recommended feed rate to be approached, depending on the actual sensitivity of each individual engine and halves the requirement of lubricant compared to 100BN MCL. The potential savings from this reduced consumption of lubricant are evident and should be welcomed as an opportunity by the marine lubricants market which continues to be very focussed on end user cost and value.

There is also the consequent benefit of extended range of operation between resupply of lubricant The same amount of 200 BN lubricant will cover up twice the operational period as 100BN MCL. Less frequent port calls for lubricant supply or more judicious choice of supply ports are possible.

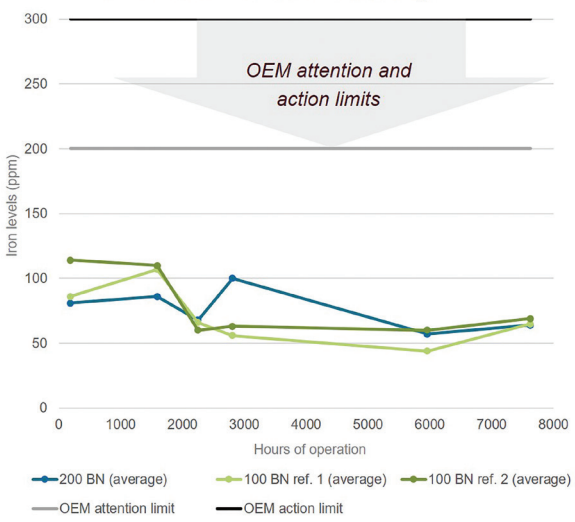

Figure 2. Iron levels in drain oil analysis of 200BN and 100BN MCL

SUMMARY

For engines running on HSFO in 2020 and beyond, Chevron Oronite has developed additive technology for the formulation of 200BN marine cylinder lubricant. The 200BN MCL has been extensively tested and shown to perform as well as two commercial reference 100BN MCLs, 100BN MCL being the current usual high BN MCL available. Additionally, 200BN has proven to lubricate successfully at half the feed rate to 100BN MCL, thus offering the potential for savings in lubricant consumption. The additive package is now available to marine lubricant suppliers from Chevron Oronite's global supply points.

Chevron Oronite is a leading developer, manufacturer and marketer of fuel and lubricant additives, helping provide solutions to customers globally. Headquartered in San Ramon, California (USA), Chevron Oronite maintains regional offices in Houston (Americas Region), Paris (Europe-Africa-Middle East Region), and Singapore (Asia-Pacific Region); operates manufacturing sites in Belle Chasse, Louisiana (USA), Gonfreville (France), Singapore, and Mauá (Brazil); an affiliated blending and shipping plant in Omaezaki, Japan; technology centers in the USA, France, The Netherlands, Japan and China and has interests in additive companies operating in other locations, including India.

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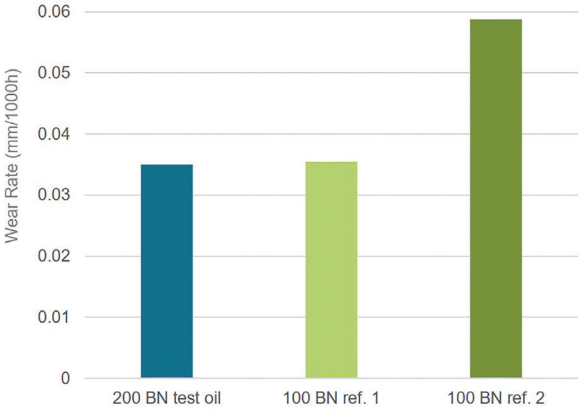

Figure 3. Liner wear measurements of 200BN and 100BN MCL