

# Marine diesel engine oils

Oil requirements in Europe spark concern for the shipping industry.

**TECHNICAL REQUIREMENTS FOR MARINE DIESEL ENGINE OILS** in Europe have been changing. The primary drivers are fuel efficiency, fuel type and reduced exhaust emissions.

Most large marine diesel engines (both two-stroke and four-stroke) are designed to run on residual fuel oil, which has a high sulphur content sometimes up to 5 percent weight. During combustion, the sulphur is oxidized ultimately to sulphuric acid. Marine diesel engine oils must therefore contain alkaline additives to neutralize the corrosive effects of the combustion acids. The amount of these additives determines the total base number (TBN) of the oil.

Some of the sulphur is emitted from the engine either as sulphur dioxide or sulphur trioxide. In 2005 the International Maritime Organization (IMO) imposed limits on emissions of nitrogen oxides (NOx) and sulphur oxides (SOx) in designated Emission Control Areas (ECAs) under regulations in Annex VI to the MARPOL Convention. SOx limits were imposed in the Baltic Sea in 2005 and in the North Sea in 2006. (SOx, NOx and particulate limits were also imposed for North America in 2011 and for the Caribbean Sea ECA in 2013.)

The current limits for SOx from the start of 2015 are 0.10 percent for ECAs and for all ships at berth in European waters. The IMO also has a global cap on SOx emissions, currently 3.5 percent, but it is proposed to reduce this to 0.5 percent starting in 2020, subject to a feasibility review to be completed no later than 2018.

These limits mean that ships operating in the ECAs must either burn low sulphur distillate fuel or fit scrubbing systems to remove most of the sulphur from the exhaust gas. They can burn higher sulphur fuel elsewhere.



Marine lubricant marketers differ on how to best formulate oils for use with low-sulphur fuels.

Exhaust gas scrubbing is permitted by the IMO and the European Union as an alternative to using low-sulphur fuel. Studies have demonstrated that scrubbing is economically attractive, particularly for ships that operate mostly within ECAs.

Switching between low-sulphur and high-sulphur fuels needs little or no system changes. But it may require the use of two different engine oils: one with a low TBN from 10 to 20 and another with a high TBN, between 70 and 100. The alternative is to use a mid-TBN oil (50 to 60) for both types of fuel.

Marine lubricant marketers differ on how to best formulate oils for use with low-sulphur fuels. Shell, ExxonMobil and Total endorse a single TBN solution, while BP and Chevron support OEM recommendations and endorse a two-oil approach. Many industry analysts believe that two oils are more likely to be required, particularly as 2020 approaches and distillate fuels are more widely required.

The single-oil solution may become attractive if more ships are fitted with scrubbers and fuel suppliers are able to make heavy fuel oils with lower sulphur contents. There is some concern that oil refiners may not be able to make sufficient lower-sulphur

heavy-fuel oil in the future or that it may not be cost effective for refineries to produce low-sulphur fuel specifically for the marine industry. Significant refinery upgrades would be needed to produce these fuels and companies may have to charge a premium for the fuels.

Another problem is that there is little experience of operating large two-stroke marine diesel engines on distillate fuels for long periods. The optimum TBN and formulation for oils used with low-sulphur fuel still needs to be established.

Marine diesel engines also can be designed to burn liquefied natural gas (LNG). The long-term supply outlook for LNG is better than for crude oil, and the energy-equivalent cost of LNG is generally lower than for heavy-fuel oil. Also there is considerable experience of using natural gas to power medium-speed engines while suitable oils for spark-ignition gas engines are available commercially. These oils also have low TBNs, but it is not as simple as reducing the amount of alkaline additives, which have detergency properties. Detergency is necessary to reduce combustion and degradation deposits on pistons and piston rings. Supplementary detergent additives are required.

At present few ships have been fitted with scrubbers, and not many new ships have been built with engines designed to run on LNG. This may change as the shipping industry gets closer to 2020.



David Whitby is chief executive of Pathmaster Marketing Ltd. in Surrey, England. You can contact him at [pathmaster.marketing@yahoo.co.uk](mailto:pathmaster.marketing@yahoo.co.uk).