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BUNKERSPOT

TAKING THE PLUNGE

IS SHIPPING READY FOR THE 2020 GLOBAL SULPHUR CAP?

INSIDE:

Complete solution

Michael Banning from Innospec's Marine Fuel Specialties division charts the development of its fuel additives, and outlines the properties of its new, independently tested, heavy fuel oil treatment, Octamar Complete

Innospec is a well-established additive producer which supplies to refineries globally and whose expertise lies particularly in automotive and aviation fuel applications. This knowledge and Innospec's extensive R&D resources were applied within the marine industry in the 1990s. This initially started with the development of Plutocen, in cooperation with AP Møller-Maersk. Plutocen, was designed as a soot catalyst to mitigate the risk of economiser fires on Maersk's fleet of modern container ships, and hence Innospec's first marine fuel additive was born.

Over the next decade, further benefits of this initial product were realised, and formulation improvements and issues such as maintenance reduction were addressed. Further advances in technology have meant that this original additive has also been improved to consider fuel consumption. During this period, dispersant stabiliser additives were under development to provide assurances against compatibility issues along with reducing the amount of fuel sludge produced onboard. Sludge is a problematic and costly by-product to dispose of, not only in monetary terms but also in terms of the time allocated to it by already busy crew.

These heavy fuel oil additives have been the mainstay of Innospec's marine business for many years, with many of the largest shipping companies in the world using them on a routine basis.

Fast forward another 10 years to the present day, with the shipping industry struggling against the headwinds of severely depressed freight rates and ever increasing fuel and operating costs. Innospec has now drawn upon the 25 plus years of experience in the market and worked with its wide customer base to develop the most advanced product to come to the marketplace, Octamar Complete, which we believe combines the best chemistries available to provide the complete tank to stack fuel treatment.

Octamar Complete combines the latest asphaltene stabilisers and dispersants, with an ignition improver and soot catalyst.

The asphaltene stabilisers and dispersants act to stabilise and improve the compatibility of residual fuel oil blends, clean fuel tanks and systems, reduce fuel sludge production and offer less operational risk. The product does this by simulating the natural stabilisers which have been removed from the fuel by secondary refining, and by gently dispersing asphaltenes which have agglomerated already within the system.

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The combination of ignition improver and soot catalyst has a well proven record of providing direct fuel savings whilst keeping combustion spaces and exhaust systems clean. The ignition improver acts to reduce ignition delay of the fuel, and provide a smoother rate of heat release. The catalyst acts to react with carbon soot, reducing its quantity and altering its composition such that it is drier and less likely to stick to engine components such as turbocharger blades, which will negatively affect the efficiency and maintenance requirements of an engine further.

Innospec has had many of its products independently verified by reputable third parties. The first of these was Octamar LI 5 Plus which underwent the rigorous Product Verification Scheme operated by Lloyd's Register. This scheme verifies that the product 'does what it says on the tin', along with ensuring that quality assurance is paramount throughout the manufacture of the product. Innospec has continued this theme throughout our distillate range; however, for Octamar Complete, Innospec has gone one step further.

Octamar Complete has been independently tested on an engine test bed by Shell, at its Marine and Power Innovation Centre (MPIC) in Hamburg, Germany.

Innospec is committed to providing the highest in quality assurance through its rigorous third party testing and certification programmes. Measuring fuel consumption and emissions on an operational vessel is a challenge, and doubt can sometimes be placed on the results gained. Innospec wanted to test Octamar Complete on a stationary engine, with accurate measuring equipment, and using the most common grade of marine fuel, RMG380. The Shell MPIC centre in Hamburg offered the perfect facility for such a test, is reputable, and eliminates any doubt from the results.

TEST RESULTS

The test bed used at Shell MPIC Hamburg used advanced measurement technology, including mass flow meters for fuel flow and a crankshaft dynamometer. During the test, 128 parameters were monitored for engine operation only, and this is not considering additional measurements such as emissions. In total, more than 1 million data points were collected for the tests.

'From the testing of Octamar Complete, a significant improvement in all measured parameters using the FIA test was noted, meaning the Estimated Cetane Number was greatly improved from the reference fuel'

Both reference and additised test runs were conducted with the same fuel, which was representative of fuel seen on the market.

Innospec took the raw data, normalised the figures using ISO 15550:2002 and ISO 3046-1:2002, and then utilised statisticians to assess the data using the Wilcoxon Matched Pairs Test. The result showed a highly statistically significant difference in SFOC, averaging 1.6% across the load range, and with a maximum recorded at 2.2% at 50% engine load. In relation to fuel consumption and other test bed measurements, MPIC also evaluated the performance of Octamar Complete in industry recognised laboratory tests.

Within the ISO 8217 marine fuel specification, the method CCAI (Calculated Carbon Aromaticity Index) is used to estimate ignition properties. However, this empirical formula based on density and viscosity cannot reliably predict the ignition and combustion characteristics of today's fuels. One method which can more reliably show these properties (which has been generally accepted by the marine community and is the subject of a CIMAC guide) is IP 541.06 (Determination of ignition and combustion characteristics of residual fuels – Constant volume combustion chamber method, 2006).

This method provides accurate information via a combustion pressure trace and a rate of heat release curve, on the three phases of combustion – ignition, main combustion and post combustion. Ignition quality is expressed as ECN (Estimated Cetane Number), and is a deliberate attempt to link the expression of results to Cetane Number, which is the recognised method for middle distillate fuels.

From the testing of Octamar Complete, a significant improvement in all measured parameters using the FIA test was noted, meaning the Estimated Cetane Number was greatly improved from the reference fuel.

Another important function of this additive package is the dispersant stabiliser function, which over the years has proved to be invaluable in mitigating compatibility issues when changing over between low and high sulphur fuels along with ensuring stability of HFO blends.

Stability is a fuel's ability to resist change as a function of time and temperature. Heavy fuel oil is comprised of both light and heavy fractions. Asphaltenes are a high molecular weight fraction and are highly aromatic. They are held in suspension by other high weight fractions and naturally occurring resins (maltenes) that are present in residual fuel. Secondary refining processes such as vis-breaking reduce these naturally occurring components and can destabilise the fuel, and this causes the asphaltenes to agglomerate, fall out of suspension and precipitate into sludge.

ISO 8217 recommends the traditional hot filtration method and it is believed that it provides a good indication of the stability of the fuel. In reality, the method does not always provide a true picture of the dispersion of the asphaltenes and is only really an indicator of the total sediment content in today's fuels (organic asphaltene material plus inorganic sediment already present in the fuel).

Another method widely utilised is Turbiscan, ASTM 7061-12. A sample of HFO is diluted first with Toluene and then with Heptane. This process destabilises the fuel and causes the asphaltenes to flocculate. The Turbiscan

S.N. Between 0 and 5	Good asphaltene peptisation state, fuel is considered stable
S.N. Between 5 and 10	Indicates a risk of fast drift towards higher S.N. values. Care must be taken that the storage conditions do not lead to a further agglomeration process.
S.N. Greater than 10	Indicates a highly degraded asphaltene peptisation state, potential for operability problems due to the size of asphaltene agglomerates.

Reference Fuel	Reference Fuel plus Octamar™ Complete
9.53	0.01

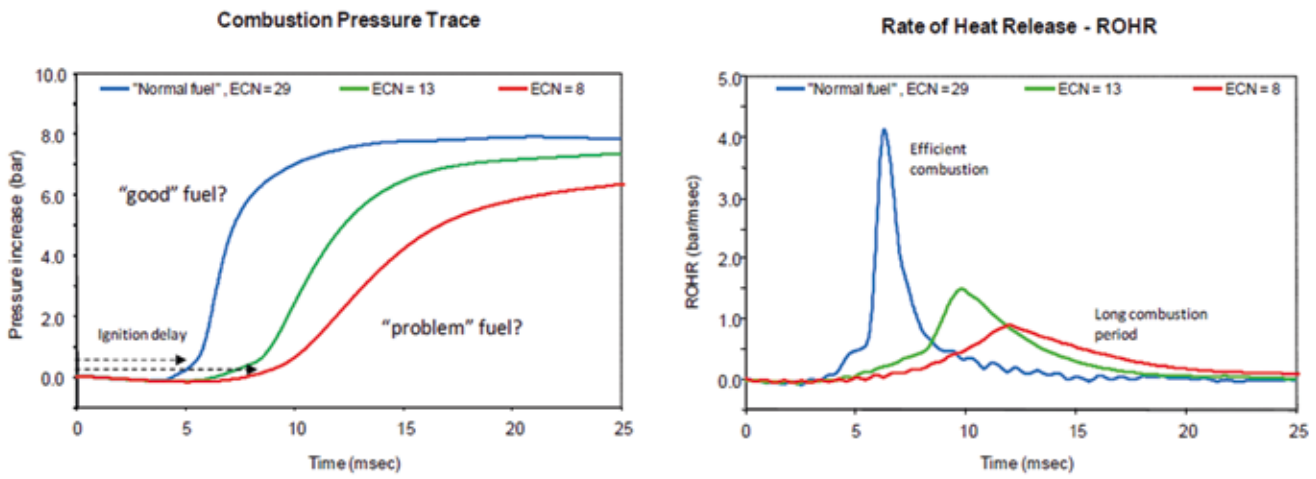
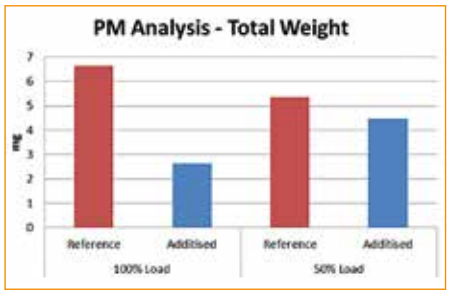
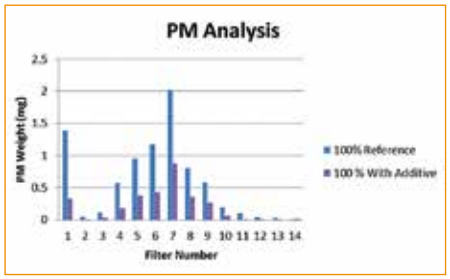


Image source CIMAC Fuel Quality Guide – Ignition and Combustion, 2011





method monitors the rate of aggregation by means of light scattering. Data from this test is processed and defines a Separability Number (SN) and therefore the Stability Reserve.

The Stability Reserve defines the ability of a fuel oil to maintain asphaltenes in suspension during prolonged storage time and fluctuations in temperature. The Separability Number has a range of 0 to 15, and the results are interpreted as shown below.

Particulate matter (PM) was also measured during the testing, using a low pressure impactor; the one used is a 13-stage cascade low pressure impactor. The impactor filters the exhaust through progressively smaller-sized mesh filters, meaning that not only can the total PM weight be measured but also the particle size distribution.

Using Octamar Complete realised a 60% reduction in PM at 100% load; this is significant as it shows not only a reduction in total mass of particulates but a uniform reduction in each measured particle size. The reduction in PM means that the engine and exhaust systems will be cleaner, prolonging their optimal efficiency and reducing the maintenance requirement. Smoke and soot will be dramatically reduced, even during starting, idling and low load operation.

CONCLUSION

In summary, here are the benefits demonstrated in the Shell test, and they translate to a ship's operation:

- An average SFOC Reduction of 1.6% determined by statistical analysis of the raw data
- A maximum SFOC reduction of 2.2% determined at 50% engine load
  - Save money, use less fuel
- Improvement across ignition and combustion profile
  - More complete burn of the fuel, nothing wasted
- Dramatic improvement in reserve stability number (RSN)
  - Produce less fuel sludge, more fuel to burn and lower incompatibility risk
- Up to 60% reduction in particulate matter
  - Less impact on environment, reduced smoke and exhaust fouling.

In addition to the benefits verified in this test, Innospec has a history of providing real life efficiency gains over many years for their customers. Users can expect cleaner fuel handling, engine and exhaust systems, improved reliability and reduced maintenance. With Octamar Complete, the business case is very compelling – there are no capital expenditure expenses, and the payback is immediate. All in all, the complete package.

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