www.bunkerspot.com Volume 16 Number 1 February/March 2019

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A clean start

As many shipowners prepare for a switch from high viscosity, high sulphur bunkers to 'new' very low sulphur fuels in 2020, **Albert Leyson** of Drew Marine draws attention to the importance of thorough bunker tank preparation

'Specialised additives added to the bunker tanks would be able to reclaim as useable fuel any organic sludge remaining that was previously left as un-pumpable'

With the exception of vessels equipped with SOx scrubbers, there is less than one year remaining before most ship operators will need to switch to very low sulphur fuel oil (VLSFO). VLSFO has an allowable maximum sulphur content of 0.50 mass percent. Vessels that are equipped with SOx scrubbers will still be allowed to burn high sulphur fuel oil (HSFO) after 1 January 2020, but for the most part, HSFO, as we know it, will become history and be relegated alongside tall ships and coal-fired steamships.

Since VLSFO is still relatively new to the marine bunker industry, it may not be widely available, at least initially. For the bunker ports where this fuel will be available, there remains some uncertainty as to its overall fuel quality. Specifically, the uncertainty lies in VLSFO's quality in terms of its overall stability, especially when the fuel is comprised of two or more blend components. By 2020, ship operators and bunker suppliers alike will be compelled to adopt such blended fuels and other, non-conventional fuels, which would be considered to be outside of the current standard, the ISO 8217 marine fuel specifications.

These new compliant fuels of 0.50% maximum sulphur will likely be created from blends coming from several refinery streams. With each refiner potentially blending its own unique version of compliant fuel from a wide but finite range of low sulphur blend components, concerns have been raised about the blended fuels' inherent stability. Unstable or incompletely blended fuels can stratify and/or form sludge deposits whilst in storage. Moreover, these blended fuels would unlikely to have been fully tested beforehand by engine manufacturers.

In fact, very few global bunker suppliers have actually released the names, never mind the global availability, of their compliant marine fuel offerings. One oil major has

even gone to great lengths to patent product formulation for creating compliant fuel using various blend ratios and blend components. It cannot be over-emphasised how new these blended fuels are to the marine bunker market. Many of these new fuels have yet to be produced on a global scale simply because there has not been any significant demand.

For the ship operator, when it comes to using multiple fuels from different suppliers located in different parts of the world, there is an additional concern over what could occur when fuels are mixed together in a single tank or when different fuels come into contact with each other during fuel switchover. In either scenario, the preferred outcome for the ship operator would be for the two different bunkers to be compatible.

In any event, regardless of whether a fuel is compliant or not compliant, incompatible fuels can lead to significant sludge formation. The greater the incompatibility between two fuels, the more severe the sludge deposits formed. Severe sludge formation can inundate onboard fuel cleaning equipment by overloading centrifuges and blocking filters.

To potentially serve as an alternative to VLSFO, another fuel with an even lower sulphur cap of 0.10%, ultra-low sulphur fuel oil (ULSFO), is available. It is expected that until the availability of VLSFO becomes widespread, the demand for ULSFO will initially increase near the latter half of 2019 as ship operators load their first compliant fuel.

ULSFO is more commonly known as marine gasoil or marine distillate. ULSFO complies with ISO 8217 DMA grade set with a maximum 0.10% sulphur content. While its definition may have been relatively recent, ULSFO has been required since 2015 in locations designated by the International Maritime Organization (IMO) as an emission control area (ECA) and thus its availability is at least established, albeit on a small scale.

As an aside, to the uninitiated, the history of the reduction of sulphur oxide (SOx) emissions within ECAs by limiting the source of sulphur from fuel began when IMO's MARPOL Annex VI entered into force on 19 May 19, 2005. In fact, the same day that MARPOL Annex VI entered into force, the world's very first ECA was established for the Baltic Sea. Once the Baltic Sea ECA came into force a year later on May 19, 2006, all ships of 400 gross tons (GT) or above engaged in international voyages that entered the ECA were required to use compliant fuel that met the maximum fuel sulphur content stipulated by MARPOL Annex VI. Soon after, a second ECA for the North Sea came into force on 21 November, 2007.

At the time of their respective enforcement dates, both the Baltic Sea and North Sea ECAs were initially capped with a maximum 1.50% fuel sulphur. The ECA sulphur limit was subsequently lowered to a maximum 1.00% on 1 July 2010. Two additional ECAs were subsequently added by IMO - the US & Canadian ECA on 1 August 2012, and the US Caribbean ECA on 1 January 2014. However, it was not until 1 January 2015, when the limit for all established ECAs was further reduced to its current maximum of 0.10% fuel sulphur.

In contrast, the sulphur for fuels used outside ECAs had largely been set at a maximum 4.50% since 1 November 2005. Applicable to predominantly residual fuels, the 4.50% sulphur cap was stipulated by the third edition of the ISO 8217 marine residual fuel specification. Although the fourth edition of ISO 8217 deferred the sulphur cap for residual fuel to statutory requirements on 6 June 2010, the 4.50% limit essentially remained in effect until 1 January 2012. On this date, the maximum sulphur allowed for fuel used outside the ECAs was reduced globally to its current 3.50% limit set by the statutory requirement by the Revised MARPOL Annex VI.

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In addition to the IMO fuel sulphur regulations, China established national ECAs that would be gradually implemented over the course of five years. The history of the Chinese ECAs began on 1 January 2016, when three new ECAs required the use of 0.50% sulphur fuel while at berth in the Pearl River Delta, the Yangtze River Delta, and the Bohai Rim. Initially, the respective Chinese Marine Safety Agencies in 11 key ports within the three Chinese ECAs had to be notified in order to determine whether compliance was required. By 1 January 2017, the use of 0.50% sulphur fuel was required at the predefined Chinese ports. In the following year, on 1 January 2018, the use of 0.50% sulphur fuel became required for vessels that were berthed in any port situated in the three Chinese ECAs.

As of 1 January 2019, the use of 0.50% sulphur fuel became a requirement for vessels operating within any part of the Chinese ECAs. This requirement has also been expanded to cover all territorial waters within 12 nautical miles from the Chinese coastline. On 1 January 2020, the maximum allowable sulphur content of fuel used in the Chinese ECAs and coastline will be lowered to 0.10%, which would align it with the ECA fuel sulphur limit per IMO.

Given the total number of ECAs that have been established since the mid-2000s, ship operators certainly would have become proficient with bunkering two, perhaps even three types of fuel oil, in order to comply with the various sulphur limits as their ships travelled about the world. The shipboard crew likely would have learned to overcome the various challenges that could arise during fuel switchover. Some of the challenges that could arise include, but are not limited to, increased fuel pump wear, insufficient fuel viscosity and/or fuel lubricity, sticking fuel injectors, excessive sludge formation due to fuel incompatibility, reduced service life of centrifuges and/or fuel filters, and fuel starvation, which can lead to possible engine shut down.

Since 2015, ships' crews operating in and out of ECAs undoubtedly would have more experience in using ULSFO. However, these very same ships' crews may not have had the experience in understanding the risks associated with permanently switching to VLSFO prior to 1 January 2020. Those ships that operate in the Chinese ECAs have only just begun to use VLSFO on a broader scale and not just at berth, as of 1 January 2019. As such, the overall lack of experience in the regular use of VLSFO, at least on a macro level, would apply to most global ship operators.

Take, for example, the number of shipboard crews that are truly familiar with permanently switching to and using different VLSFOs for prolonged periods – this number may actually be few and far between. Next, let us consider the number of bunker suppliers that have claimed to be able to consistently produce VLSFO with the same quality around the world – this number may be smaller still! To reemphasise an earlier point, engine

manufacturers would have unlikely been able to fully test on their current engine test beds all the possible permutations of VLSFOs (whose blending formulas have yet to produce compliant fuels on a large scale) from various suppliers from around the world.

Be that as it may, ship operators still need to prepare for the permanent switch from HSFO to VLSFO. Now the question that remains for ship operators who have not yet decided, is exactly how much preparation their fuel tanks require before the permanent switch. In our preliminary discussions with ship operators, we have learned that tank preparation runs the gamut from just short of doing absolutely nothing to complete tank cleaning during planned drydock later this year before loading their first compliant fuel.

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It is conceivable that after many years of using HSFO, there could be a severe accumulation of fuel deposits present in the fuel tanks. Fuel deposits in the tanks can result over prolonged periods of time if regular tank cleaning has not been completed. Fuel deposits typically include both organic sludge and inorganic sediments, along with harmful contaminants (e.g., cat fines). If not sufficiently reduced to acceptable levels, harmful contaminants could lead to fuel pump and engine damage.

As per International Association of Classification Societies (IACS) Req. 1990/Rev.25 2016, Z7 – Table 3, the minimum Class requirements at hull special surveys for internal examination of fuel oil bunker tanks is between 10 and 15 years for fuel oil tanks in the engine room and 5 and 10 years for fuel oil tanks outside the engine room e.g., cargo length area. So, depending on the age of the vessel, it is possible that a vessel's bunker tanks have not been examined unless the vessel recently had such a hull special survey. Outside of such Class requirements, it is unlikely that ship operators would regularly inspect the condition of their bunker tanks, never mind determine the severity of fuel deposits present.

To increase awareness about the risk of having severe fuel deposit build-up in bunker tanks, IMO Circular MEPC.1/Circ.878 issued in November 2018 suggests consideration be given to gradually cleaning the sediments and asphaltenic sludge from HSFO tanks and fuel systems by dosing additives as an alternative to manual cleaning.

Drew Marine believes that gradually cleaning tanks *in situ* with specialised additives can prevent harmful contaminants which have concentrated at tank bottoms from being dissolved and flushed out with the vessel's first compliant fuel bunkering. If not removed gradually, these contaminants would subsequently overload centrifuges and fuel filters during the first compliant fuel bunkering. Moreover, specialised additives added to the bunker tanks would be able to reclaim as useable fuel any organic sludge remaining that was previously left as un-pumpable.

As a specialised additive, Drew Marine's premium fuel tank conditioner, AMERGY 222, has been formulated to improve fuel oil storage, handling and transfer systems. Powerful solvents, dispersants, and surfactants in AMERGY 222 have the ability to suspend asphaltic particles and prevent them from precipitating out of the fuel as sludge. The application of a series of AMERGY 222 treatments to a minimum of at least two bunkerings before loading the first compliant fuel is able to slowly clean out bunker tanks of any accumulated deposits without overloading the purifiers and fuel filters. The series of AMERGY 222 begins with a conservative dosage rate of 1 litre per 15 cubic metres (cbm) for the first treatment and 1 litre per 10 cbm for the second treatment.

To ensure proper mixing of AMERGY 222 with new HSFO bunkers, Drew Marine recommends to always add the additive to empty nominated fuel tanks (e.g. via sounding tubes) as early as possible to allow the additive to penetrate the un-pumpable material in the tank bottoms before bunkering commences. After the treatment has been applied to the minimum of two bunkerings, a post-treatment tank inspection should follow. However, for fuel tanks that have severe deposit accumulations, additional fuel treatments may need to be repeated.

The effectiveness of the fuel treatments is best determined by inspecting the fuel tanks. For those who are reluctant to or incapable of inspecting the fuel tanks, Drew Marine recommends performing at least one additional AMERGY 222 treatment to all bunker tanks at the highest dosage of 1 litre per 6 cbm. Note that even after a successful tank cleaning *in situ*, manual tank cleaning may still be required to remove stubborn deposits and contaminants (i.e. sediment, cat fines, etc.) left in the tank. As fuel slop tank capacity for manual tank cleaning/flushing may be limited, the use of specialised additives minimises the amount of manual cleaning of the fuel tanks and production of slop water from any tank cleaning/flushing that may still be required by the crew.

Post 2020, there are other concerns raised by the IMO, including several important fuel-related safety issues, such as fuel stability or cleanliness, compatibility, lower flashpoint, inadequate safety margin for handling of cat fines with onboard fuel cleaning equipment, and extended ignition delays because of poor fuel combustion characteristics. In addition to these fuel-related issues, other preparatory considerations such as cylinder oil requirements, crew awareness/training, machinery performance impact/monitoring, voyage calculations, etc., need to be considered.

Ultimately, with the deadline only months away, ensuring compliance with the 0.50% sulphur limit on 1 January 2020 likely remains the most important concern for ship operators. Performing a tank cleaning *in situ* mitigates possible operating disruptions and technical challenges associated with the permanent switch to a relatively low viscosity compliant fuel after many years of using high viscosity, high sulphur fuel and to ensure the change to 0.5% sulphur fuel will be achieved as smoothly as possible.

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