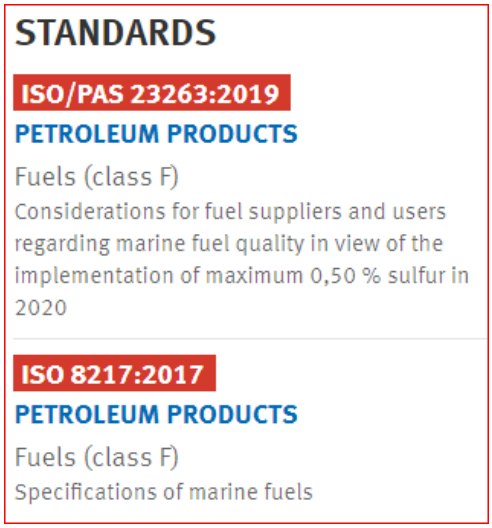
Early Experiences and Future Challenges: IMO 2020 Fuels

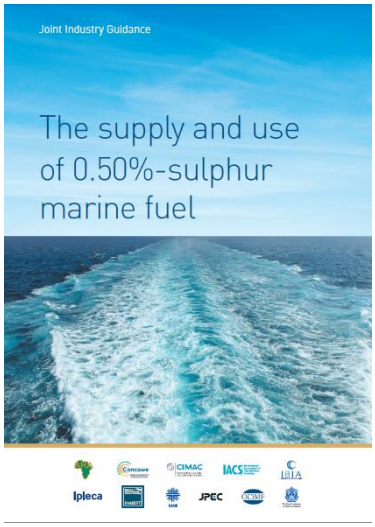
By Don Gregory, Technology & Solutions Director, Gulf Oil Marine Ltd.

Despite the prior media hype and concerns expressed by regulators and operators, the transition to a global sulphur cap of 0.50% and the ban on the carriage of high sulphur fuel oil has hardly been reported in the marine press. Has the transition been easy and uneventful? This paper reports to our customer a synopsis of the challenges and changes that have characterized IMO 2020 and also considers the future challenges driven by regulations.

Documents & plans

Much research was undertaken prior to 2020 which resulted in a number of documents related to the implications of using IMO 2020 compliant fuels. The International Standards Organisation publicly available specification (PAS) and the joint industry guidance (JIG) are all documents which should be available to Masters and Engineering Officers on board ship. These documents consider the changes in fuel characteristics and provide important advice on ordering, handling, storing and use of IMO 2020 fuels on board ship.





To assist in the transition the IMO MEPC developed a guidance document known as a ship implementation plan, [SIP]. This document not only covered preparedness for changeover to low sulphur fuels but also the ongoing of management and use of IMO 2020 fuels. Gulf Oil Marine developed an online version of the SIP which included recording plans for switching lubricating oils as well as recording how continuing use of “new fuels” would be managed on board ship. Each ship should have its own SIP. The document is designed to guide the Master & Engineering Officers beyond the 1st January 2020 implementation date. This should be a live working document and is not there simply to pull out during a Port of Flag state control inspection. Over 300 ships have made use of the Gulf Oil Marine SIP.

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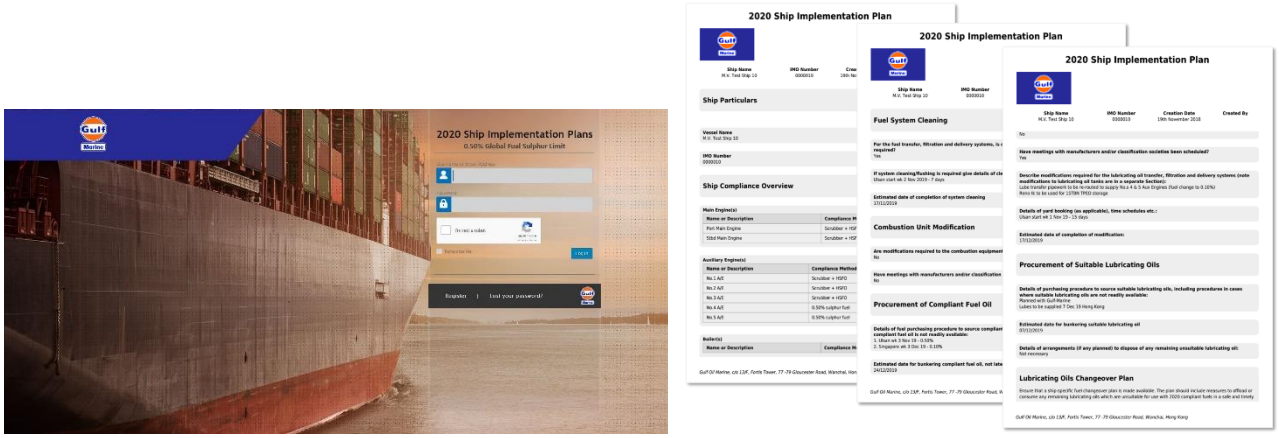

Caption: Ship Implementation Plan Portal

IMO 2020 bunkers

Have fuels changed beyond having a lower sulphur content? The data reported by Lloyds FOBAS suggest there are key parameters that were expected to change, and by measurement of bunker samples are reporting significant change. The following measured changes relate to potential operational problems and NOT to non-compliance issues such as exceedance of the 0.50% sulphur limit.

Sediments

Lloyds FOBAS has reported significant number of exceedances of sediment, with 11% related to samples from Rotterdam and 18% of samples from Piraeus. The port of Galle was exceptional with a bunker alert regarding sediment exceedance on all samples tested! Sediment values which exceed the ISO 8217 fuel standard indicate inherent instability in the fuel due to either thermal or physical effects, or both. Paraffinic components have inherently less solubility and thus are inherently less stable when blended with other components. High sediment levels may result in filter blockages, centrifuge blockages and in the most serious cases sludging in fuel tanks which can only be removed manually.

Viscosity and density

The development of the bunker standard, evolving from the British standard (BS) to ISO 8217 [2017], classified bunker fuels by their viscosity. Unfortunately, the new VLSFO are blends between a huge variety of low sulphur feedstocks. The resulting viscosity variations for a typical RMG 380 now ranges from 380 cSt down to as below 20 cSt. Typically, Lloyds FOBAS report that nearly 80% of fuels tested are in the range of 20cSt to 180 cSt. Whilst the total viscosity range Lloyds FOBAS has measured range from 3cST to 500cST. Likewise, the well-recognized density ranges for diesel fuels and residual fuels is no longer relevant. Densities for VLSFO now range from 840 to 1010kg/m3.

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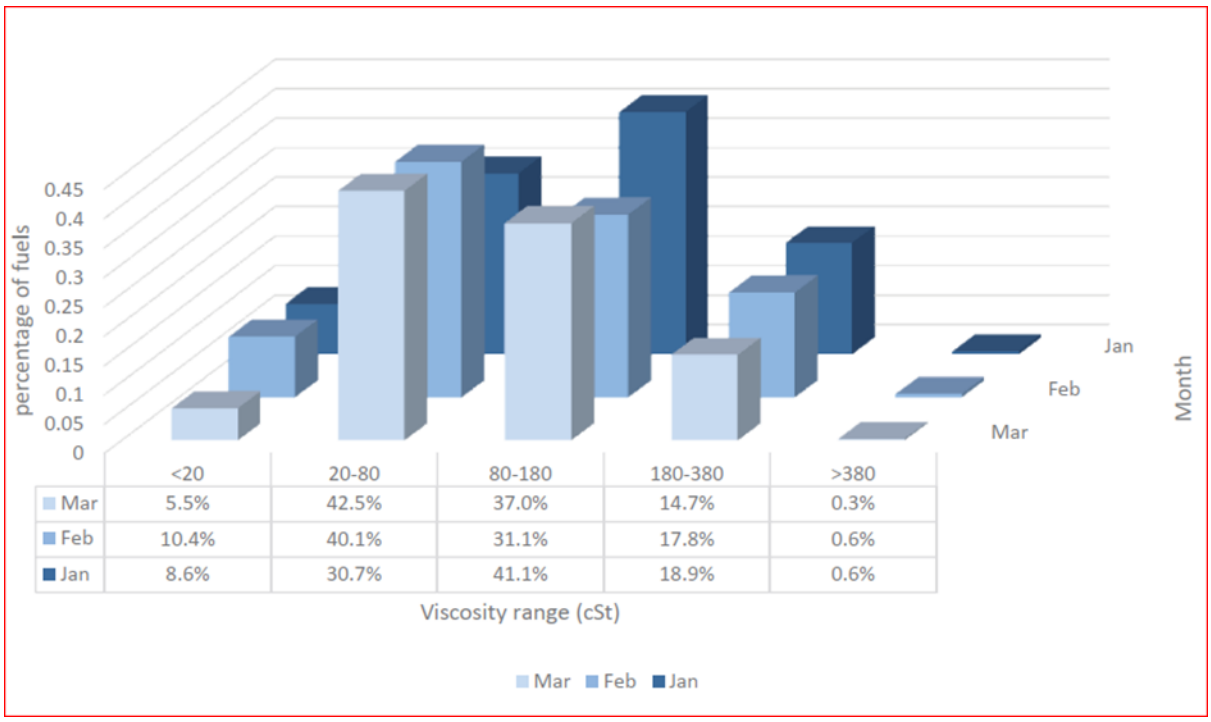

	<20	20-80	80-180	180-380	>380
Mar	5.5%	42.5%	37.0%	14.7%	0.3%
Feb	10.4%	40.1%	31.1%	17.8%	0.6%
Jan	8.6%	30.7%	41.1%	18.9%	0.6%

[Graph courtesy of Lloyds FOBAS]

What does this mean for storage and operation? The ship's SIP should record how fuels are to be stored on board including segregation and switching bunkers. It should also record how fuel centrifuging is controlled, including purification temperatures and any adjustments to ensure water fuel interfaces are optimized for most efficient separation. The centrifuge manufacturers normally recommend pre-heating fuel below 80cSt to a lower temperature than the normal 95dgeC to 105degC recommended for high viscosity fuels. However, experience has indicated that often VLSFO can contain undissolved waxes at the lower temperatures. These higher melting point waxes may be centrifuged out creating heavy sludges and centrifuge bowl blockages. Knowing the fuel characteristics is important in determining if the fuel contains high melting point waxes. Generally, to avoid sludging by waxes it is recommended to operate the fuel pre-heat to at least 20degC higher than what would be normal for lower viscosity fuels.

The fuel viscosity at high pressure fuel pumps and at injectors must be controlled within a range of 3cSt to 15cST. In the past many ships controlled the fuel temperature with an automatic viscometer. Fuel was heated in a range from about 110°C to 150°C. With much lower viscosity fuels, temperature control becomes critical and in some cases the heater controls may need to be bypassed if they become ineffective. For very low viscosity fuels, cooling may be required to maintain at least 5cSt prior to the injectors [note 3cSt is the limit for most OEMs].

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Fuel flow and filtration

Data from Lloyds FOBAS and other testing agencies indicates that many VLSFO are being blended with highly paraffinic feedstocks. Paraffins have excellent ignition properties and make very good diesel fuels. However, the structure of paraffin molecules results in waxy compounds forming when cooled. In the past wax formation in marine fuel on board ships, except in exceptionally cold climate operations, has not been a serious problem. Lifeboat engines and other emergency diesel engines have always been provided with very low pour point and high cetane number fuels for reliable emergency starting under the worst cold weather conditions. With VLSFO ranging in viscosity between 20cSt and 180cSt fuel tank heating is often either to a very low temperature or not required.

As expected, and advised in industry briefings, fuel flow particularly through filters has caused fuel shortages and in some cases loss of propulsion and blackouts. The normal cold flow properties tests are not entirely suitable for predicting wax formation in VLSFO.

In general, the temperature of the fuel in storage should be kept at least 5-10°C above the pour point to ensure proper flow properties. However, to avoid potential wax formation with low viscosity VLSFO RM fuel grades, this fuel should be maintained at 15°C above the pour point.

Catalyst fines

The average concentration of catalyst fines in the VLSFO is only slightly lower than in traditional residual fuels.

Catalyst particles are mainly aluminium oxide (Al_2O_3) and silicon oxide (SiO_2) in an approximate weight ratio of 1:3. It has been demonstrated that Al content in the fuel supplied to the engine above 5-10 ppm will increase the wear rate.

All cat fines that remain in fuel oil after centrifugal separation have the potential to cause abrasive wear and damage to the engine. That is why cat fines levels must be reduced as much as feasibly possible by the fuel treatment system.

Bunker specification

The new VLSFOs are not problem free. The main areas of challenge were predicted and are now evident. The message to ship operators procuring bunkers is to follow the best available industry guidelines. Whilst vessel operators need to follow the best guidance for storage, cleaning and delivery for combustion. It is recommended that the ship's SIP continues to be used to ensure best practice is observed and implemented.

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