The Impact of Low Sulphur Fuel in SECA

Preface

The pollution problems like global warming and air pollution caused by using petrochemical fuel had significantly impacted our life in the world. People are trying to develop new green energy. However, with cost concern in mind, petrochemical fuel is still the first choice of most industries。

Marine industry using high viscosity and low quality fuel oil is unavoidably driven by low operating cost requirements. But for the interest of taking care of our environment and sustainable development, EU has already enforced that low sulphur fuel (LSF) must be used by vessels, when they are sailing in certain SECAs since August 11, 2007.

SECA stands for SOx Emission Control Area. Basically SOx emission level by vessels is controlled in this area. To meet this requirement, vessel sailing in this area must be using low sulphur fuel or install special equipment to reduce SOx emission. In this article, we will introduce how engine makers cope with the SECA requirements. We will also study the impact and changes needed on the main engine cylinder oil。

IMO – MARPO 73/78 - ANNEX VI Regulation

IMO (Internal Maritime Organization) – MARPOL 73/78 – ANNEX VI regulation is designed for air pollution controlling in the marine industry，the major contents are：

1. Define “SECA”.
2. Max sulphur content is 4.5% for marine industry in the world (ISO 8217, 2005)。
3. BDN ; Bunker Delivery Note。

Currently all SECAs are located in Europe only. The 1st SECA is in BALTIC SEA which was enforced on 19th of May, 2006；2nd SECA are in NORTH SEA and ENGLISH CHANNEL which was enforced on 11th of August, 2007. Now, French Port State Control (PSC) starts to inspect the fuel oil change record and SOx reduction equipment operating conditions in their ports。

All vessels sailing in SECA, must use fuel oil with sulphur content of lower than 1.5%；If the vessel is not using low sulphur fuel oil, it must have SOx reduction equipment in place or to use other ways to reduce SOx emission. Black Sea, USA, Japan and Hong Kong are discussing for establishing SECA in the future.

The IMO regulation for max sulphur content in fuel oil is 4.5%, but the average sulphur content in Heavy Fuel Oil is around 2.6% ~ 2.8% in the world while sulphur content is usually less than 1.5% in Marine Diesel Oil (MDO). If mixing both fuel oils for reducing sulphur content, one should be aware of the changes in compatibility and combustion properties. In the previous article “Fuel Oil and Lubricants”, it had already discussed “changing the structure of resin causes instability in asphalt. When the sources of fuel oils are different, or dissimilar types of oils are blended , asphalt - being instable, will form sludge in the bottom of the fuel oil tank. Sludge in separator will thus increase. Fig.1 shows the sludge collected from separator due to incompatibility of fuel oils.

Fig 1、Hard Sludge from Separator

The application of fuel oil and cylinder oil

In the marine industry, main air pollutions are from NO_X, CO_2, CO, HC, Particles and SO_X。Except SO_X，others are combustion products. Their formations are directly related to the combustion conditions, for example temperature, heat efficiency and Oxygen content etc. Limiting one pollutant may increase another. Thus only engine makers can control the methods and the effectiveness of this pollution reduction. In contrast, the amount of SO_x emission is governed by the sulphur content in fuel oil. Therefore using low sulphur content fuel oil will reduce SO_x emission directly.

Under certain temperature and pressure conditions, sulphur in fuel oil after combustion will become acidic, the typical reaction process is as below in Fig.2.

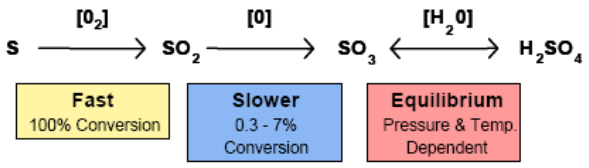

Fig.2、Typical acid formation.

The major 2 stroke engine makers in the market now are MAN B&W, MHI and Wartsila. According to makers' recommendation, one must select a high base number (BN) cylinder oil when burning high sulphur fuel oil (HSF) in order to neutralize the acid formed from combustion. BN 70 cylinder oil is normally used in the marine industry such as TOTAL Lubmarine TALUSIA HR 70.

The major component of BN in cylinder oil is calcium carbonate (limestone - $CaCO_3$)). After reacting with acid, it becomes calcium sulphate (gypsum – $CaSO_4$). Most of this calcium sulphate will be exhausted, with the unreacted calcium carbonate. But some will form hard deposits on piston crown and piston top land. Fig.3 shows the deposits on the piston top land. The deposits will act like a sandpaper which polishes on the cylinder liner. After a certain period of time, the oil film on the cylinder liner will be worn out. Fig.4 shows the polished effect on the cylinder liner.

Fig.3、Deposit on piston top land.

Fig.4、Polish on cylinder liner.

On the contrary, when burning low sulphur fuel, BN 70 cylinder oil will lead to excess unreacted calcium carbonate. Same problem will occur as discussed earlier. Therefore engine makers recommend to use BN 40 cylinder oil (such as TOTAL Lubmarine TALUSIA LS 40) when burning LSF in a long term. In conclusion, combinations of fuel oil with cylinder oil are as follows：

HSF (1.5 < S% < 4.5) ： BN 70 cylinder oil
LSF (0.5 < S% < 1.5) ： BN 40 cylinder oil

Cylinder oil feed rate determines the amount of deposit. Installing a “Lubricator” will save around 20% of cylinder oil consumption. Fig.5 presents the feed rate setting for the new Alpha ACC lubricator. No matter using HSF with BN 70 cylinder oil or LSF with BN 40 cylinder oil, each engine maker has their own cylinder feed rate recommendation. Chief engineer simply follows this recommendation. It’s better not to increase feed rate for the sake of safety margin. Because too high feed rate will not protect the cylinder oil but, on the contrary will cause cylinder wear.

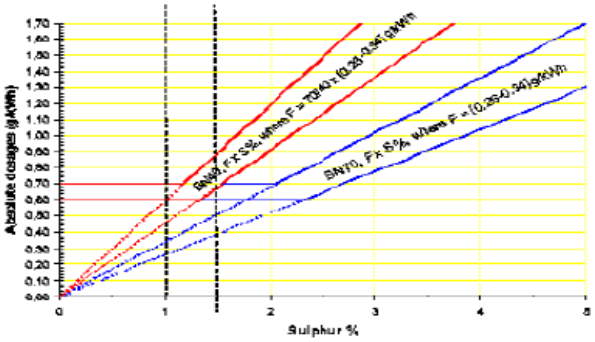

Fig.5、Newly Alpha ACC lubricator setting

HSF and LSF alternating usage

LSF is used only in SECA. However a lot of ship-owners are still using HSF under the concern of operating cost. If the vessel sails into SECA, it is necessary to have both HSF and LSF on board, with two kinds of cylinder oil (BN 70 and BN 40) to match with. (note：Engine makers suggest that if the vessel sails in SECA less than a week, BN 70 cylinder oil can be used. But one has to regularly check the wear condition of cylinder liner and piston through the scavenge port. If necessary, one may adjust the feed rate accordingly.). Keeping two fuel oils and two lube oils on board may meet the environmental regulation. But more problems could evolve：

1. 2 cylinder oil storage tanks on board.
2. Changing pipe system.
3. Crew training.
4. More cylinder oil on board.
5. More expense for storage and management cost.

Although, in recent year, new vessels are often designed and equipped with two sets of fuel and cylinder oil systems, it will take up a substantial storage space. Thus not all vessels are eligible for such design. For vessels built earlier, there is no consideration for extra

space. It will be a challenge for them. To help ship-owners solve this practical problem, TOTAL Lubmarine started to research in a few years ago. After various laboratory tests and bench tests, Total Lubmarine patented a new formula in November 2006. Lubmarine also received positive feedbacks from the engine makers. Currently, some field tests have completed and some are near completion. Engine types on tests include MAN B&W K98MC-C and Wartsila RTA 96C, and MAN B&W 12K80MC-S in Macau Power Plant. Lubmarine is expecting to complete the 6,000 hours test in early 2008. TOTAL Lubmarine names this new product as "TALUSIA UNIVERSAL" (Viscosity is SAE 50, BN is 57). The name tells it all. It is a versatile cylinder oil, irrespective of HSF or LSF. Fig.6 shows the comparison of cylinder oil with BN 40 (TALUSIA LS 40) and TALUSIA UNIVERSAL using same LSF after 600 hours.

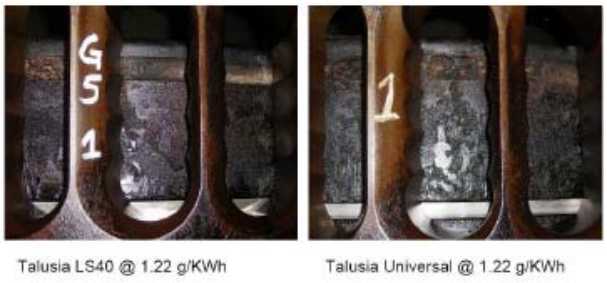

Fig.6、Talusia LS40 and Talusia Universal using LSF。

Conclusion

Although the BN of TALUSIA UNIVERSAL is only 57, even lower than the current BN 70 cylinder oil (TALUSIA HR 70), the formulation of this new product is developed in the light of improving the BN neutralization efficiency. The neutralization reaction (base and acid) releases heat. The more heat released, the higher the reaction efficiency. The new formulation also maintains the advantage of TALUSIA HR 70, for example heat stability and oxidation resistance. Fig.7 shows how neutralization efficiency functions. As a result, even the BN is only 57, it can also be used with HSF. In addition, TALUSIA UNIVERSAL has less calcium carbonate than the current widely used BN 70 cylinder oil. Therefore when it is used with LSF, less unreacted calcium carbonate can be formed.

In conclusion, TALUSIA UNIVERSAL can be used on both LSF and HSF. There is no need to add storage tank or change the piping system. There is no need to waste money on stocking different kinds of cylinder oil on board. Furthermore, there is no need to worry about machine damage sometimes caused by mistakes made by the crew .

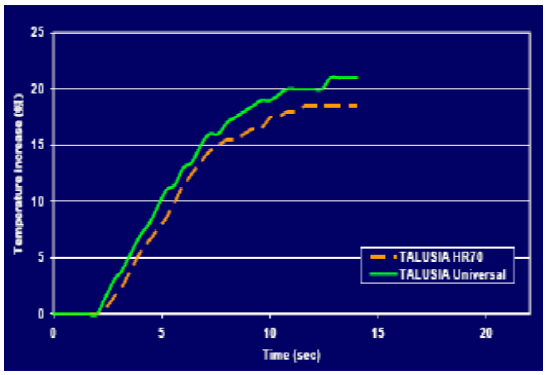

Fig.7、Improve reaction efficiency。

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