

MARINE ENGINE LUBRICATION 2020:

A LUKOIL PERSPECTIVE

INTRODUCTION

With over 80% of global trade by volume and more than 70% by value being carried on board ships, the importance of maritime transport for trade and development cannot be overemphasized.

IMO has been working to control and minimize the harmful impacts of shipping on the environment since the 1960s. The impact of air pollution was addressed by the MARPOL Convention adopted in 1997. Its Annex VI seeks to control emissions of Ozone depleting substances (ODS), Nitrogen oxides (NO_x), Sulphur oxides (SO_x), Volatile Organic Compounds (VOC), Particulate matters etc.

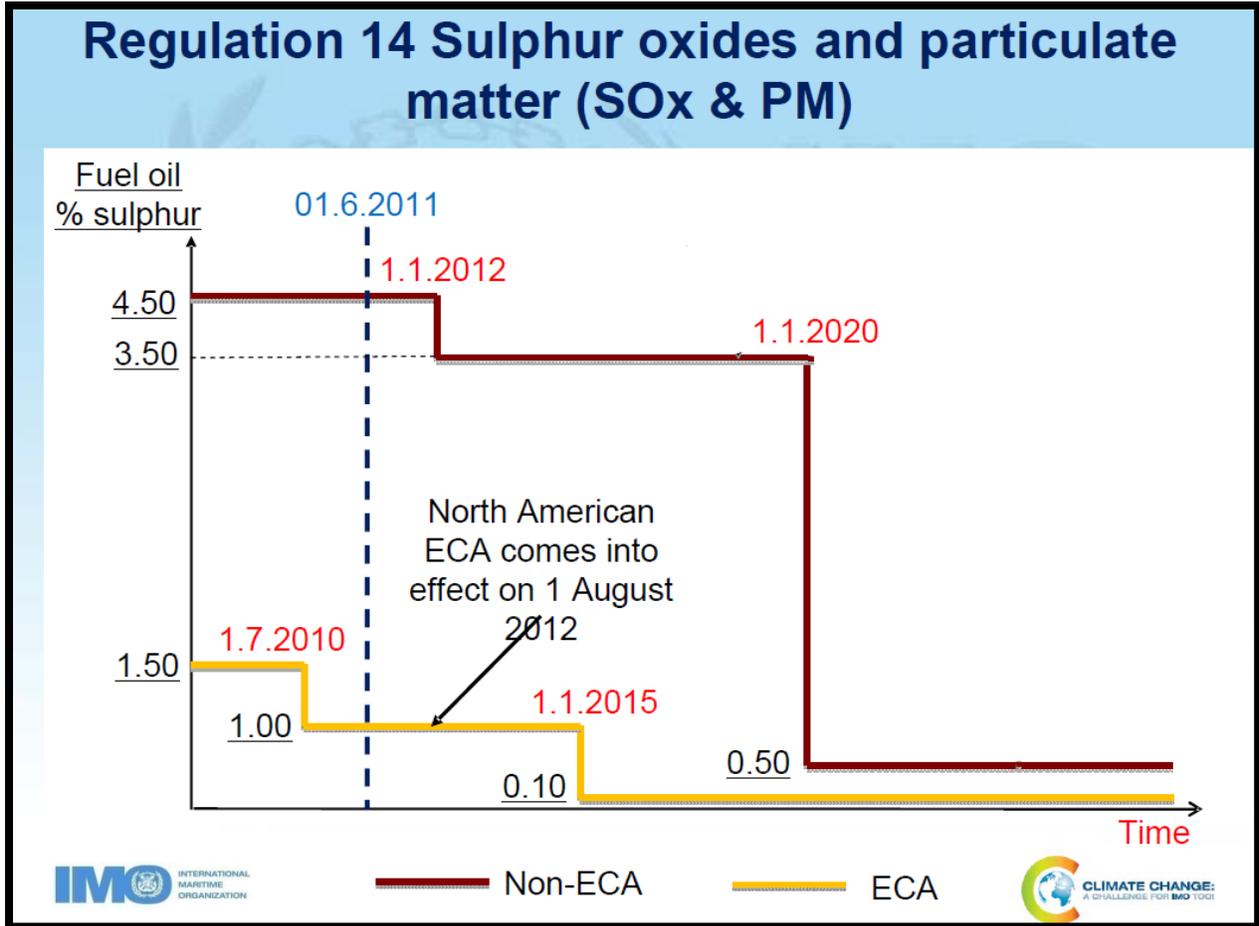
Since 1 January 2015 the sulphur limit for fuel oil used by ships in SO_x Emission Control Areas (ECAs) established by IMO has been 0.10% (Fig.1). Besides, Local sulphur limits have been specified in some areas (e.g. China)

Fig.1: MARPOL Annex VI Emission Control Areas (ECAs)



Outside of ECAs, under a new global cap, ships will have to use fuel oil on board with a sulphur content of no more than 0.50%, against the current limit of 3.50% (Fig.2). Ships may also meet the SO_x emission requirements by using approved equivalent methods, such as exhaust gas cleaning systems (EGCS) or “scrubbers”, which “clean” the emissions before they are released into the atmosphere.

Fig.2: IMO Timeline for reduction in fuel Sulphur content



2020 SULPHUR LIMIT – A GAME CHANGER

The shipping industry currently uses heavy fuel oil (HFO – sulphur <3.5%) and marine gas oil (MGO – sulphur <0.1%) as fuels. The energy demand of the shipping sector is projected to be approximately 320 Million Tonnes per year in 2020 (1). With the year 2012 fuel mix, this would equate to 250 Million Tonnes of HFO (78 per cent) with an average sulphur content of 2.5% and 70 Million Tonnes of MGO (22 per cent).

The decision to limit the sulphur content of marine fuel, to 0.5 per cent worldwide, w.e.f 1 January 2020 has the potential to become a game changer, because only vessels equipped with SO_x scrubbers will be allowed to consume HFO (>0.5% sulphur content).

In the near term (2020-2030), petroleum fuels and LNG are expected to be the predominant energy sources for marine propulsion (1) (Fig. 3). These would comprise of type

- I. Petroleum fuels with sulphur content $\leq 0.10\%$
- II. Petroleum fuels with sulphur content $>0.10\%$ but $\leq 0.50\%$
- III. Petroleum fuels with sulphur content $> 0.50\%$.
- IV. LNG

Fig.3: Projected marine fuel demand 2020

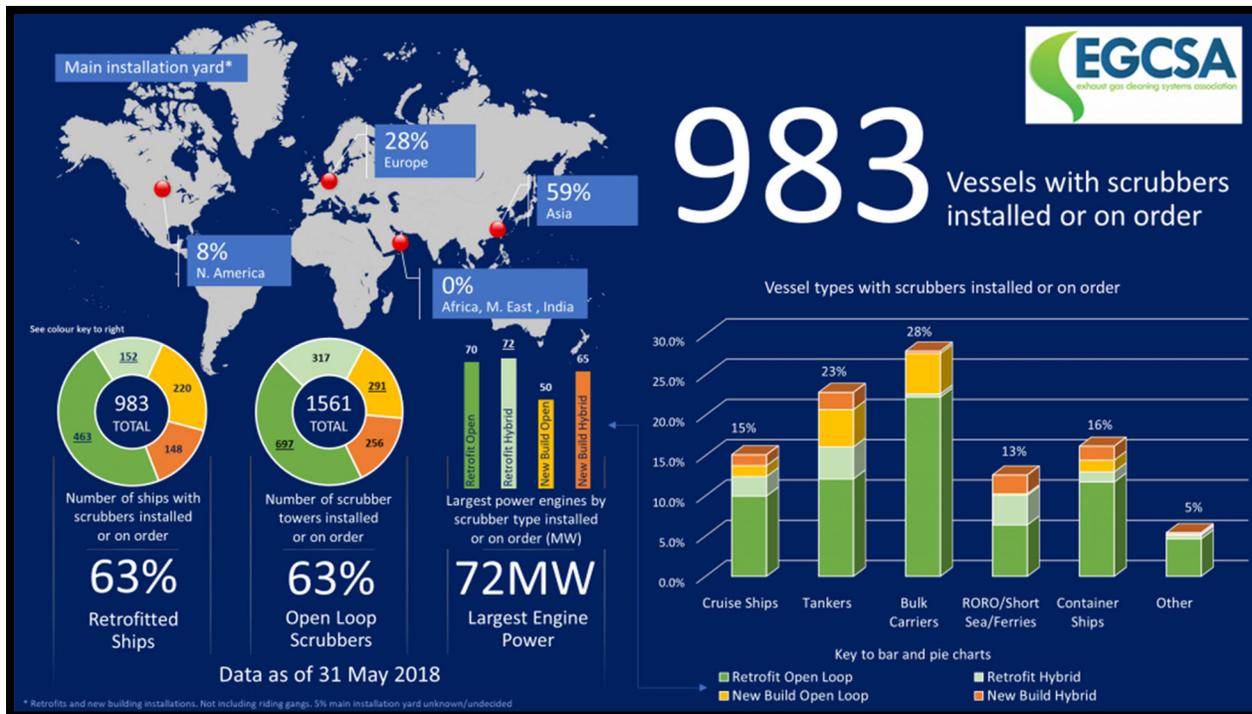
Sulphur (% m/m)	Petroleum derived fuels			LNG
	<0.10%	0.10%-0.50%	>0.50%	
Million tonnes per year				
Base case	39	233	36	12
High case	48	290	14	12
Low case	33	198	38	13

After 1/1/2020 fuel type III can be used only in combination with an EGCS. In ECA fuel type II & III only with EGCS.

A recent survey by EGCSA concluded that scrubber uptake is rapidly accelerating, with the number of ships with EGCS installed or on order standing at 983 as of 31 May 2018 (Fig 4)

Many big Tanker, Bulker, & Container operator have opted for or confirmed that they shall be using scrubbing as part of their 2020 compliance strategy (2).

Fig 4: EGCSA numbers for installed/ordered Scrubbers (2)



LUKOIL CYLINDER OILS FOR 2020

Fuel type I and IV: With the advent of ECA areas in 2015, where Sulphur content was restricted to under 0.1%, LUKOIL recognized that the nature of ULSFO (predominantly distillate origin) was markedly different from conventional LSFO (predominantly residual origin). A mere down-dosing of conventional Low BN cylinder oils (≤ 40 BN) would not meet the product requirements. Hence LUKOIL introduced the NAVIGO MCL Ultra, 20 BN cylinder oil specially formulated for ultra-low sulphur fuel oil. The product has performed exceedingly well in the succeeding years.

Fuel type III: Vessels fitted with EGCS would be able to freely use conventional HFO ($>0.5\%$ S). Depending on the engine corrosiveness characteristics, LUKOIL's current portfolio of NAVIGO 70 MCL, NAVIGO 100 MCL or NAVIGO 140 MCL is very well suited for this requirement.

Fuel type II: In order to offer the best possible lubricant solution in the years leading up to 2020 and beyond, LUKOIL developed and after extensive trials, launched NAVIGO MCL Extra in May 2017, a 40 BN marine cylinder oil for distillate, ultra-low Sulphur fuel oil ($\leq 0.1\%$ S) and very low Sulphur heavy fuel oil ($\leq 0.5\%$ S) applications (Fig 4).

Fig. 4: NAVIGO MCL Extra shows excellent piston cleanliness on M.V. E.R. TALINN at end of trial inspection



With NAVIGO MCL Extra LUKOIL Marine Lubricants was the first marine lubricant supplier in the market to realize and react to a new concern that engine manufacturers see as well viz. The 40 BN lubricants which are available in the market do not seem to provide sufficient detergency to handle <0.1 and any 0.5% fuels as one single cylinder oil. This would create not only the need to have both 20 and 40 BN cylinder oils in 2020, but vitally there is also a need for a rebalanced 40 BN cylinder oil to cover the future needs. LUKOIL MCL Extra is such a rebalanced 40 BN product.

All the above-mentioned LUKOIL Navigo cylinder oils are approved by the major 2-stroke engine OEMs.

LUKOIL ICOLUBE® FOR 2020

LUKOIL Marine Lubricants developed, tested and launched the iColube® intelligent Cylinder Oil lubrication system in 2014. The iColube system is based on the principle of mixing fresh or

Fig 5: LUKOIL iColube unit



used main engine system oil with a high BN Cylinder oil to produce required cylinder oil on board. This provides a flexible composition of cylinder oil meeting varying fuel sulphur levels and engine requirements at all times, which allows for not only significantly reduced cost, but also optimised cylinder-oil feed rate, supply security, and reduced environmental impact.

In the fuel regime prevailing after 2020, the iCOLube unit for vessels burning fuel type III the iCOLube can be used in the same manner as before, mixing one of the high BN Cylinder oils (70BN/100BN/140BN) with fresh or used main engine system oil or NAVIGO MCL Ultra (20BN) to produce the required cylinder oil on board. Vessels burning fuel type I & II can use the iCOLube to mix NAVIGO MCL Extra (40 BN) with fresh or used main engine system oil to produce the required cylinder oil on board.

The LUKOIL iCOLube system is approved by the major 2-Stroke OEMs. Since introduction in 2013, more than 80 units have been installed/ordered.

LUKOIL TRUNK PISTON ENGINE OILS (TPEO) FOR 2020

Over the years LUKOIL have introduced a wide range of TPEO grades. Products from this extensive range are expected to meet the requirements of the variety of fuels expected to be burnt in these engines.

For fuel type I & II: Navigo TPEO 40 Ultra (SAE 40, BN 10 – approvals ongoing), Navigo TPEO 15/40 & 20/40 (SAE 40 & BN 15 & 20 respectively)

For fuel type III: Navigo TPEO 30/40, 40/40 & 50/40 (SAE 40, BN 30, 40 & 50 respectively)

For fuel types IV: Efforse 4004 (SAE 40, BN 4)

OTHER POTENTIAL SOURCES OF FUEL FOR MARINE PROPULSION

Other potential energy sources that are currently under development and small scale adoption in the marine sector are (1)

- i. LPG
- ii. Methanol
- iii. Biofuels
- iv. Hydrogen/Fuel Cells
- v. Wind assisted propulsion
- vi. Batteries

These fuels & technologies are expected to become more prevalent only in the medium to long term (>2030)

CONCLUSIONS

Petroleum based fuels shall continue to play a significant role in powering oceangoing vessels into the foreseeable future.

Beyond 2020 there will a sharp differentiation between using of compliant fuels (I, II, IV) and using non-compliant fuel (III) along with EGCS.

Type I fuels (< 0.1% S) are mainly of distillate origin. LUKOIL have developed & introduced the NAVIGO MCL Ultra for meeting the cylinder lubrication requirements of these fuels

Type II Fuels (>0.1% but <0.5%) may be formulated from a wide range of distillate, heavy, refinery cutter stocks, etc to meet the S requirement. LUKOIL have developed & introduced the Navigo MCL Extra to meet the cylinder lubrication requirements for engines burning these fuels.

Type III Fuels (>0.5%) are the present conventional HFOs & LUKOIL range of Navigo 70 MCL, 100 MCL 140 MCL shall meet the cylinder lubrication requirements of engines burning these fuels

LUKOILs pioneering iCOLube intelligent cylinder lubrication system shall continue to provide on board cylinder oil perfectly matched with the fuel S content.

References

- (1) IMO MEPC Assessment of fuel oil availability – final report, 25/Jul/2016
- (2) Exhaust Gas Cleaning System Association (EGCSA) Website

AUTHORS:

STEFAN CLAUSSEN, Technical and Marketing Director at LUKOIL Marine Lubricants

SANJIV WAZIR, Technical Manager LUKOIL Marine Lubricants