OVERVIEW OF IMO REGULATIONS

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Responsible traffic.
Bravely together.
Contents of the Presentation

IMO regulations, which have an effect on fuel oil quality:

• MARPOL Annex VI, regulation 14, Sulphur oxides (SOx) and particulate matter

• MARPOL Annex VI, chapter 4, Energy efficiency of ships
Why new Regulations for Sulphur Content of Fuel Oil?

- Emission of particulate matter are harmful to human health

Sulphur Content of Fuel Oil (HFO) Currently in Use by Ships

- Sulphur content of heavy fuel oil grades used by ships in global marine traffic (IMO, MEPC 68/3/2)

**Sulphur Distribution for Residual Fuel**

Average Sulphur Content 2.46% m/m
The Effect of Sulphur Content on Emissions of Particulate Matter

New MARPOL Annex VI

• In 2008, the International Maritime Organization (IMO) revised its standards on the sulphur content of marine fuels.

• Annex VI, regulation 14, SOx and PM

General requirements

• The sulphur content of any fuel oil used onboard ships shall not exceed the following limits:
  • 4.5% m/m prior to 1 January 2012;
  • 3.5% m/m on and after 1 January 2012; and
  • 0.5% m/m on and after 1 January 2020.

Review provision

• A review of the final 0.5% regulation shall be completed by 2018 to determine the availability of fuel oil to comply with this standard.

• If a decision is taken by the Parties that it is not possible for ships to comply, then the 0.5% standard shall become effective on 1 January 2025.
New MARPOL Annex VI

• Annex VI, regulation 14, SOx and PM

Requirements within Emission Control Areas

• While ships are operating within Emission Control Areas, the sulphur content of fuel oil used onboard ships shall not exceed the following limits:
  • 1.5% m/m prior to 1 July 2010;
  • 1.0% m/m on and after 1 July 2010; and
  • 0.1% m/m on and after 1 January 2015.

Emission Control Areas are:

• The Baltic Sea area (SOx, 2005)
• The North Sea (SOx, 2005/2006)
• The North American Emission Control area (NOx & SOx, 1 August, 2012)
• The United States Caribbean sea area (NOx and SOx, 1 January, 2014)
The Baltic Sea and the North Sea SOx Emission Control Areas

- The Baltic Sea
- North Sea (latitude 62° north and longitude 4° west) and the English Channel
The North American ECA

- The North American Emission Control areas applies generally approximately 200 nm from the Atlantic, Gulf and Pacific coasts and some Hawaiian islands.
- The SOx emission regulations in North American Emission Control area have been in effect since 1 August, 2012.
The United States Caribbean Sea ECA

- The SOx emission regulations in the United States Caribbean Sea ECA in have been in effect since 1 January, 2014.
Compliance Methods

• Use of low sulphur fuel oil, like:
  • Marine Gas Oil or Marine Diesel Oil
  • Low sulphur Heavy Fuel Oil
  • Methanol
  • Biofuels

• Use of gas fuel
  • Liquefied Natural Gas (LNG)

• Use of high sulphur fuel oil and exhaust gas cleaning systems (scrubbers)
  • Open loop scrubber, closed loop scrubbers, hybrid scrubbers and dry scrubbers
Greenhouse Gas Emissions

• According to United Nations Framework Convention on Climate Change (UNFCCC), the following emissions are Greenhouse Gas (GHG) emissions:

• **Carbon dioxide (CO₂)**, methane (CH₄), nitrous oxide (N₂O), HFC, PFC and SF₆ emissions. About 96 % of the GHG emissions are CO₂ emissions.

• Maritime traffic causes 850 million tons of GHG emissions per year (IMO Study on Greenhouse Gas Emissions, 2007), which is about 3.5 % of the total GHG emissions of the mankind.

• The GHG emissions of shipping have doubled since 1990.
Why Measures are needed to reduce CO$_2$ Emissions from Shipping?
The Measures Considered of the IMO to Reduce GHG Emissions

- **Technical measures**
  - Voluntary Energy Efficiency Operational Index (EEOI), see MEPC.1/Circ.684
  - Mandatory Energy Efficiency Design Index (EEDI) and baseline, see MEPC.1/Circ.681
  - Mandatory Ship Energy Efficiency Management Plan (SEEMP), see MEPC.1/Circ.683

- **Economic incentives have been discussed at IMO**
  - A global bunker levy and International Compensation Fund for GHG Emissions from Ships
  - International Emission Trading Scheme (ETS) for shipping
Energy Efficiency Design Index in Chapter 4 to MARPOL Annex VI

• EEDI = (Cost for the Environment) / (Benefit for the Society)
  = theoretical CO₂ emissions from ship / total transport capacity
  [g CO₂/ t nm]

• The formula for calculation of EEDI is

\[
\frac{1}{f_i \cdot \text{Capacity} \cdot V_{\text{ref}} \cdot f_w} \left( \prod_{j=1}^{M} f_j \left( \sum_{k=1}^{N} P_{\text{ME}(k)} C_{\text{FAE}(k)} \cdot C_{\text{FCME}(k)} \right) + \left( \prod_{j=1}^{M} f_j \right) \left( \sum_{k=1}^{N} P_{\text{TR}(k)} - \sum_{j=1}^{N_{i \text{eff}}} f_{\text{eff}(j)} \cdot P_{\text{AE}(j)} \right) C_{\text{FAE}} \cdot C_{\text{FCME}} \right)
\]

where \( C_F \) is a non-dimensional conversion factor between fuel consumption measured and CO₂, \( V_{\text{ref}} \) is the ship speed, \( \text{Capacity} \) is deadweight or gross tonnage of the ship depending on the ship type, \( P \) is the power of the main and auxiliary engines, \( SFC \) is the certified specific fuel consumption, \( f_j \) is a correction factor to account for ship specific design elements, \( f_i \) is the capacity factor for any technical/regulatory limitation on capacity and \( f_w \) is an non-dimensional coefficient indicating the decrease of speed in representative sea conditions.
Example of Calculation of EEDI for Tankers

Ice class IA

Tankers, ice class IA

Baseline GHG-WG 2/2/7
- EEDI
- Ice class corrected EEDI

EEDI [g CO₂/(t x nm)]

DWT

0 25x10³ 50x10³ 75x10³ 100x10³ 125x10³ 150x10³
# Tightening of the EEDI Reference Lines in the Future

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Measures to comply with Energy Efficiency Regulations

- Better hull form
- Better propulsion efficiency
- Innovative energy efficiency technologies
  - Hull air lubrication
  - Wind assistance
  - Waste heat recovery etc.
- Use of LNG as fuel, since the non-dimensional conversion factor \( C_F \) between fuel consumption measured and \( CO_2 \) is smaller for LNG than for fuel oils.
Economic Factors

- In addition to regulations and technical solutions, fuel oil prices have an effect on the choice of ship fuel type.

Picture courtesy of Wärtsilä.
Conclusions

• Fuel types, which meet the new regulations on sulphur content of fuel oil are for example:
  • Marine Gas Oil or Marine Diesel Oil
  • Low sulphur Heavy Fuel Oil
  • Methanol
  • Biofuels
  • Liquefied Natural Gas (LNG)
• Use of LNG also improves energy efficiency of shipping.
• LNG has many benefits from environmental point of view:
  • LNG reduces SOx emissions and emissions of particulate matter, NOx emissions as well as CO₂ emissions from marine diesel engines.
Thank you for your attention

More information:
www.imo.org

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