Chapter 2 - Types, composition, and characteristics of existing and alternative IMO 2020 compliant marine fuels - Issues and Problems

(Partial Content)
Types, composition, and characteristics of existing and alternative IMO 2020 compliant marine fuels

Heavy fuel oils (HFO)
- The existing fuels are the heavy fuel oils which are mainly used as the marine fuel.
- Heavy fuel oil is a residual fuel incurred the distillation of crude oil.
- They are classified and named according to their viscosity.
- The most commonly used types are IFO 180 and IFO 380, with viscosity of 180 mm²/s and 380 mm²/s, respectively.

Introducing ULSFO in 2015
- In 2015, when the Emission Control Area (ECA) regulations kicked in a new type of residual fuels called Ultra Low Sulfur Fuels (ULSFO) were introduced to meet the 0.1 wt % sulfur requirements.
- These were complex blends and not traditional residual fuels (residue + cutter)
- These fuels that were made using feedstocks that were never used as bunker fuel.
- Examples involve Marine Gas Oil (MGO), Vacuum Gas Oils and Pyrolysis Gas Oils etc.

Introducing VLSFO in 2020
- For 2020 fuels, the industry has started formulating fuels using such uncommon blend stocks to produce new 2020 fuels (VLSFO).
- There is no newly released ISO grade for VLSFOs, but they can be categorized based on the available ISO-8217 (2017 is the recommended version but totally is related to the charterers and ship fellows have a choice to choose between 2005, 2010, 2012, 2017)
Viswa Lab has tested several VLSFO’s with varying quality between different ports

Most interestingly in the same port even they show high variability – as shown below, as well making the overall composition of these fuels very complex.

In Table 2-1 you can find a comparison of the characteristics of HFO, LSFO & LSMGO

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Heavy fuel oil (HFO)</th>
<th>Very low sulfur fuel (VLSFO)</th>
<th>Low Sulfur marine gas oil (LSMGO)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min</td>
<td>max</td>
<td>Average</td>
</tr>
<tr>
<td>Density @ 15°C</td>
<td>873</td>
<td>1010</td>
<td>983</td>
</tr>
<tr>
<td>Viscosity @ 50°C/40°C</td>
<td>51</td>
<td>700</td>
<td>302</td>
</tr>
<tr>
<td>CCAI</td>
<td>779</td>
<td>875</td>
<td>845</td>
</tr>
<tr>
<td>Pour point °C</td>
<td>-12</td>
<td>27</td>
<td>9</td>
</tr>
<tr>
<td>Cat fine (Al+Si) ppm</td>
<td>0.2</td>
<td>75</td>
<td>23</td>
</tr>
</tbody>
</table>

[1] Result for HFO and VLSFO is at 50°C.
[2] For distillate the result is reported at 40°C.
Existing Fuels – HFO - Heavy Fuel Oils (IMO 2020 compliant only when using scrubber)

In order to better understand the important effect of fuels on the engine.....

- It is important to have a basic understanding of fuel characteristics, properties and contaminants which impact the operation of an engine and its fuel handling and fuel treatment systems.

**Viscosity:**
- It is a measure of a fuel’s resistance to flow.
- Viscosity is used principally to give information about the handling, treatment and atomization of the fuel.

**Catfines:**
- These are hard, abrasive particles, such as alumina/silica catalyst carry-over
- They originate in the refinery when this powdered catalyst is added to the charge stock of a fluidic catalytic cracking (FCC) unit.

**Compatibility:**
- Residual fuel can be a colloidal dispersion of high molecular weight substances held in chemical and/or physical equilibrium in heavy fuel oil.
- If heavy fuels are mixed with lighter fractions, the asphaltene precipitate out of the solution and causes incompatibility issues.

**Flash point:**
- The flash point of a fuel is the temperature at which fuel vapors can be ignited when exposed to a flame.

**Pour point:**
- Pour point is a temperature that the fuel stops flowing.
For pumping and handling purposes, it is often necessary to know the minimum temperature at which a particular fuel oil loses its fluid characteristics.

**Heat value:**
- The heating value of a fuel is important as it affects the overall engine efficiency.
- The heat value increases the specific gravity, in a highly positive correlation.

**Ignition combustion:**
- For HSFO, ignition quality is indicated by estimated cetane number (ECN)
- It is dependent on the unique nature of hydrocarbon composition of the fuel (4).
Very low sulfur fuel, VLSFO
(2020 Fuels)

In this section we will cover the below topics:

- Three available options for VLSFO
  a) Paraffinic blend
  b) Aromatic blend
  c) Hybrid blend
- Composition of VLSFO
- Characteristics of VLSFO
- VLSFO properties
  - Fuel Stability
  - Fuel Compatibility
  - Cold Flow Properties – Cloud Point, Cold Filter Plugging
    Point, Pour Point; Issues related to Wax (filter blocking, Tank Storage)
  - Acidity – TAN, pH
  - Catfines
  - Flashpoint
  - Ignition/Combustion

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