

# **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 mm<sup>2</sup>/s and 380 mm<sup>2</sup>/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 2-1 HFO, VLSFO and LSMGO characteristics, Based on Viswa Lab result*

Characteristics	Heavy fuel oil (HFO)			Very low sulfur fuel (VLSFO)			Low Sulfur marine gas oil (LSMGO)		
	min	max	Average	min	max	Average	min	max	Average
Density @ 15°C	873	1010	983	870	1010	947	818	894	858
Viscosity @ 50°C <sup>1</sup> /40°C <sup>2</sup>	51	700	302	3	418	159	1.8	8.5	3.8
CCAI	779	875	845	784	883	821			
Pour point °C	-12	27	9	-12	27	12	-30	12	-10
Cat fine (Al+Si) ppm	0.2	75	23	0.2	60	25	0.02	8.5	1.1

[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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