

The VLSFOs variability in viscosity and cold flow properties require appropriate temperature management.

- **Viscosity is temperature dependent.**

The injection viscosity of the fuel is vital in ensuring smooth combustion. If the viscosity is too high, it will result in improper atomisation and incomplete combustion. If however, the viscosity is too low, internal leakages in the fuel pump may result in difficulties maintaining sufficient power – especially at low loads and during maneuvering. When it comes to centrifuging, Stoke's law – which applies for centrifugal separation - highlights the importance of viscosity. The separation efficiency drops with lower temperature because the viscosity increases (keeping all other factors - e.g. flow rate- equal). According to Stoke's law, for a 380 cSt fuel, a reduction in separation temperature from 98°C to 90°C, will require a 26% reduction in flow rate to maintain the same separation efficiency.

- **Managing cold flow properties is temperature dependent.**

Managing cold flow properties is very important for distillates as well as VLSFOs.

Cold flow properties are about wax precipitation. Despite having excellent ignition and combustion properties and a high-energy content, wax can be a challenge to operation as its crystals could plug filters and centrifuges and in the worst case, solidify in the tanks. The Cloud Point (CP) and Cold Filter Plugging Point (CFPP) are used to evaluate the risk of filter plugging and the Pour Point (PP) provides guidance on the risk of solidification in the tanks [1].

The key is temperature management. It is recommended that fuels are stored at temperatures at least 10 °C above the PP and that the fuel system (filters/centrifuges) is heated to the CFPP as a minimum.

Heating capabilities differ from ship to ship and each operator should be aware of each ship's capabilities. In addition, the operational pattern (warm / cold climate) needs to be taken into account when purchasing fuels to avoid experiencing issues related to cold flow properties.

More details about cold flow properties can be found in CIMAC Guideline 01/2015 "Cold flow properties of marine fuel oils" [2].

[1] CFPP/CP apply for C&B distillates

[2] CIMAC Guideline 01/2015" Cold flow properties of marine fuel oils",
https://www.cimac.com/cms/upload/workinggroups/WG7/CIMAC_WG7_2015_01_Guideline_Cold__Flow_Properties_Marine_Fuel_Oils_final.pdf

Today's status – Automatic pilot

Most Chief Engineers are familiar with operating on RMG 380 or RMK 500, the most commonly used fuel grades. Routinely consuming these fuels does not require many changes in the operational settings when it comes to temperature management. The viscosity controllers assist the crew by maintaining correct injection viscosities.

Post 2020, the fuels are expected to vary more, even within the same grade. Some examples of the Very Low Sulphur Fuels (VLSFOs) are listed in below table:

Products	A	B	C	D	E
Density (kg/m ³)	911.6	955.2	942.3	909.6	950.4
Viscosity (cSt)	35.4	72.0	232	6.77	328
Pour Point (°C)	24	15	9	<21	<21
Min. storage temp (°C)	34	30	35	30	40
Separation temp (°C)	60	98	98	40	98
Injection temp (°C) (for 12.5 cSt)	82	100	126	28	133

As can be seen from Table 1, the viscosities and pour points vary greatly between the five fuels which are also reflected in the temperature recommendations. It is therefore important to check that:

- The ship has heating capabilities in tanks, fuel system and separators
- The viscosity controllers function as expected

Temperature management is of paramount importance to VLSFOs and operators need to take the appropriate steps in setting up procedures for segregation, handling, treatment and use of any new fuel. The shipping company should study the Certificate of Quality (COQ) before the bunker operation in order to get an indication of the fuel characteristics of the fuel they intend to bunker.

Ideally, standard instructions should be not to use any fuel before results of fuel analysis are known. In the event that a ship will have to use a new fuel batch before the analysis results are known, a proactive approach and routines should be in place.

Due to the variety of fuels post 2020, the key message is: "Know Your Fuel". Proper temperature management is essential and with effective preparation, planning and training, the technical and operational challenges can be managed.

Contributed by B. Stamatopoulos, 19 Sep 2019.