CIMAC
INTERNATIONAL COUNCIL ON COMBUSTION ENGINES

CIMAC INDIA WEB-SEMINAR

MARPOL 2020 Implementation Scenario

VeriFuel
Understanding Marine Fuel

Myth No 1: We will experience problems because VLSFOs are blended fuels

Fact : HFOs (e.g. RMG380) are – and have always been - blended fuels

Myth No 2: Compliance is a 2020 problem

Fact : It is not a 2020 problem, it is a 2019 challenge because when we get to 2020 it is too late. Preparation is the key to success

Myth No 3: There is no specification for the VLSFOs

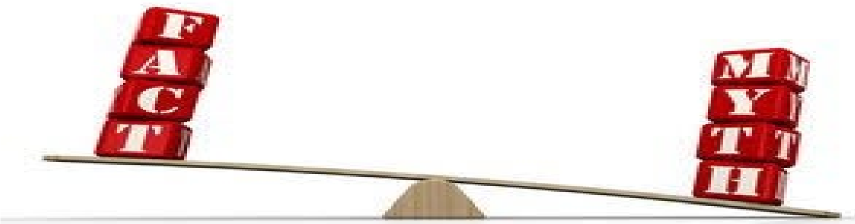
Fact : ISO 8217 applies to VLSFOs as well as to ULSFO, distillates (e.g. MGO) and HFO

Myth No 4: The 2018 fuel incidents were a pre-warning for 2020

Fact : Endemic cases occur with regular intervals of some 2-3 years. The one in 2018 were all high sulphur fuel and the cause still remains to be found. There was no indication of deliberate blending of deleterious species

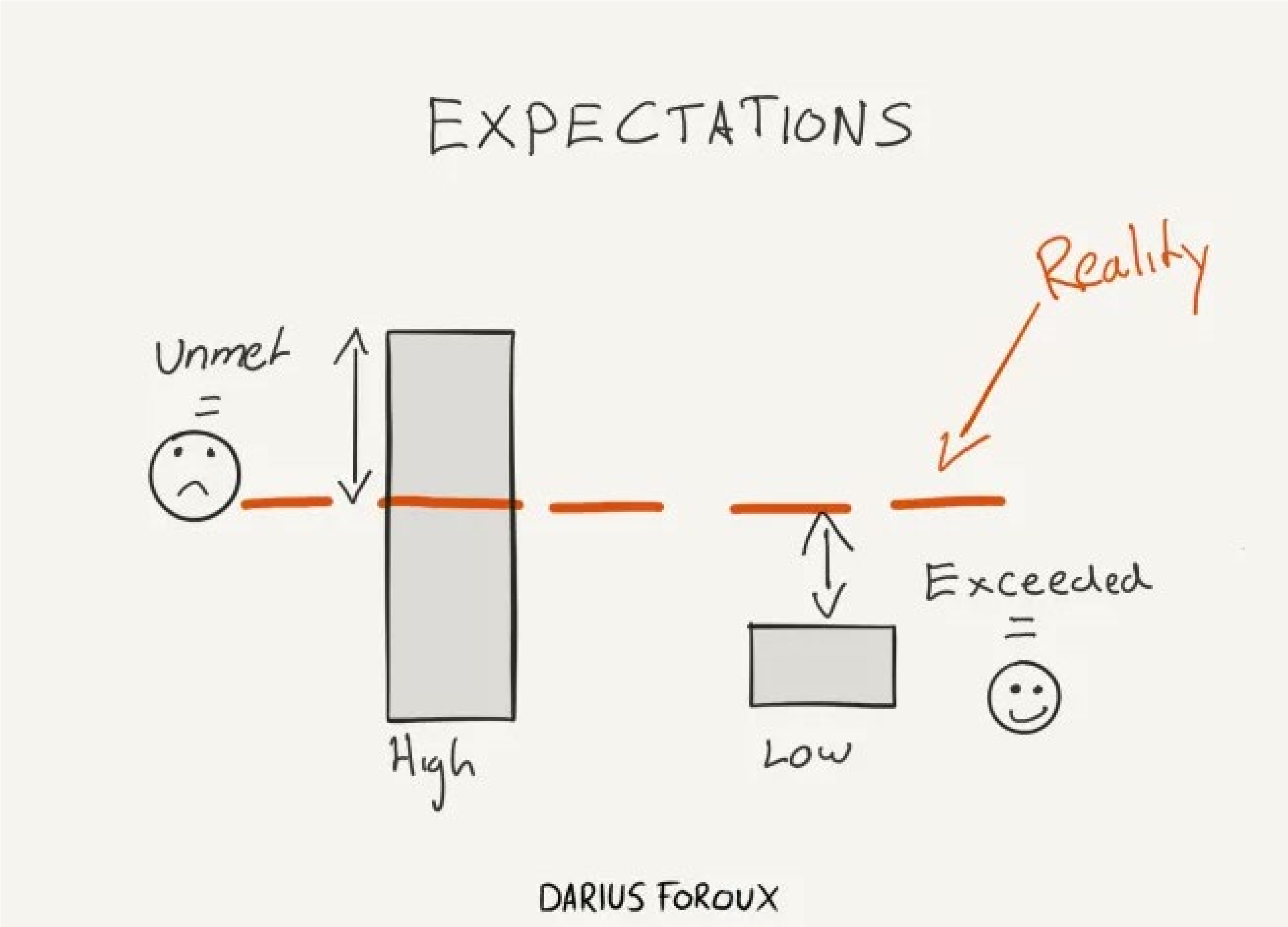
Myth No 5: Cat fines will be a big problem for the VLSFOs

Fact : The max 1.00% S fuels contained more cat fines on average than the HSFOs.
Data so far shows that the VLSFOs, on average, contain same amount of cat fines as the HSFOs but the density and viscosity is lower, ie. Easier removal of cat fines.



VLSFO
PRE-2020 EXPECTATIONS

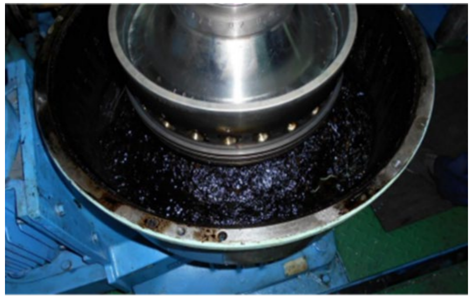
- More paraffinic fuels
- Larger variation in viscosity
- Geographical variations
- Stability could be an issue



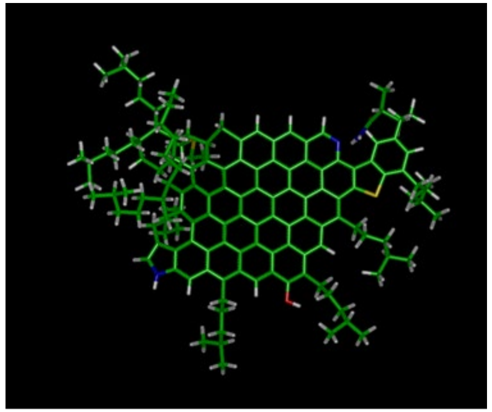
2020 FUELS
STABILITY

VeriFuel
Understanding Marine Fuel

- Asphaltenes are present in residual fuels in a colloidal suspension
- Stability of fuels typically refers to the fuels ability to keep the asphaltenes suspended, i.e. the resistance of the fuel to precipitate asphaltenic sludge
- In the fuel, aromatic components keep the asphaltenes apart;
  - ✓ Prevent agglomeration
  - ✓ Prevent precipitation
- Unstable fuels cause sludging due to asphaltenes coming out of solution
- Stability Reserve is a measure of the ability of an oil to maintain asphaltenes in suspension



- Stability can be upset by :
  - ✓ Thermal stress
  - ✓ Adding paraffinic material / reducing aromatics
  - ✓ Mixing with other fuel



Courtesy of Prof. J. Murgich

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2020 FUELS
FUEL BLENDING

VeriFuel
Understanding Marine Fuel

Aromatics:

- Improves stability
- Keeps asphaltenes dispersed

Paraffines

- Wax
- Does not improve stability
- (Excellent ignition/combustion properties)

The balance between asphaltenes, aromatics and paraffines must be right to get a stable blend

2020 FUELS
STABILITY VS COMPATIBILITY

VeriFuel
Understanding Marine Fuel

- Although correlated, stability and compatibility are different
- Similarities:
  - ✓ Stable and compatible fuels keeps asphaltenes in suspension
  - ✓ Unstable and incompatible fuels result in asphaltene precipitation
- Dissimilarities:
  - ✓ Stability is covered by ISO 8217 Table 2 parameters - supplier responsibility
  - ✓ Compatibility is an operational issue – operator responsibility – no supplier will guarantee compatibility

Stability	**Compatibility**
Fuel as supplied	Handling and storage
Supplier responsibility	Operator responsibility
ISO 8217	Additional testing

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2020 FUELS
COLD FLOW PROPERTIES

Typical Δtemp (Untreated fuel)

°C

3 - 5 °C

3 - 5 °C

Cloud Point

The temperature at which wax crystals first appear during the cooling of a product under a controlled cooling process.

Cold Filter Plugging Point

The lowest temperature at which a given volume of fluid still passes through a standardized filtration device in a specified time when cooled under certain conditions.

Pour Point

The lowest temp at which the surface of the fluid can be seen to move or flow

VLSFO
HOW DO THEY LOOK (JAN-OCT 2020) ?

VeriFuel
Understanding Marine Fuel

Parameter	VLSFO			HS HFO	LS MGO
	Average	Min	Max	Average	Average
Visc@50°C (cSt)	106.7	2.239	678.6	296.1	3.769
Dens@15°C (kg/m^3)	935.6	828.8	1000.3	981.7	855.7
Sulphur (% m/m)	0.46	0.05	3.03	2.75	0.06
Sediments (% m/m)	0.03	<0.01	Unfilterable	0.04	
MCR (% m/m)	5.35	<0.10	16.66	13.24	
Al+Si (mg/kg)	18	<1	121	24	
Ash (% m/m)	0.020	<0.010	0.104	0.041	
Pour Point (°C)	79%*	<-33	39	97.1%*	84.3% / 98.4%**
CFPP (°C)					83.9% / 93.4%***

* Number of samples with PP < 21°C
** Number of samples with PP <= -6 °C / PP <= 0 °C
*** Number of samples with CFPP <= 6 °C / CFPP <= 12 °C

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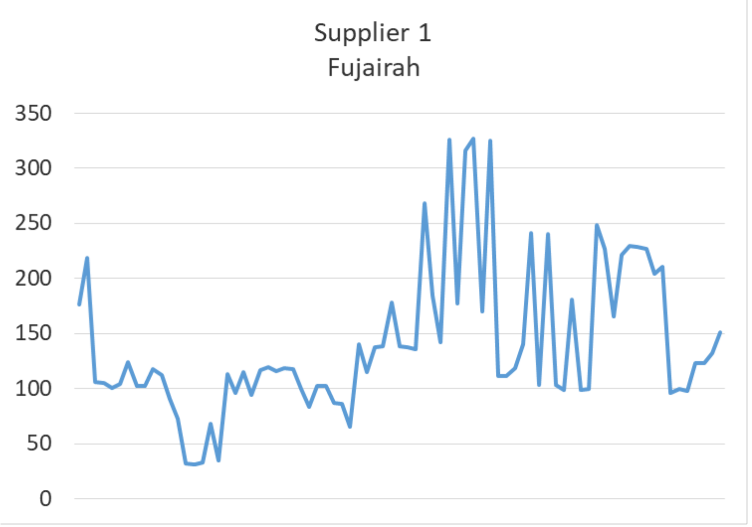
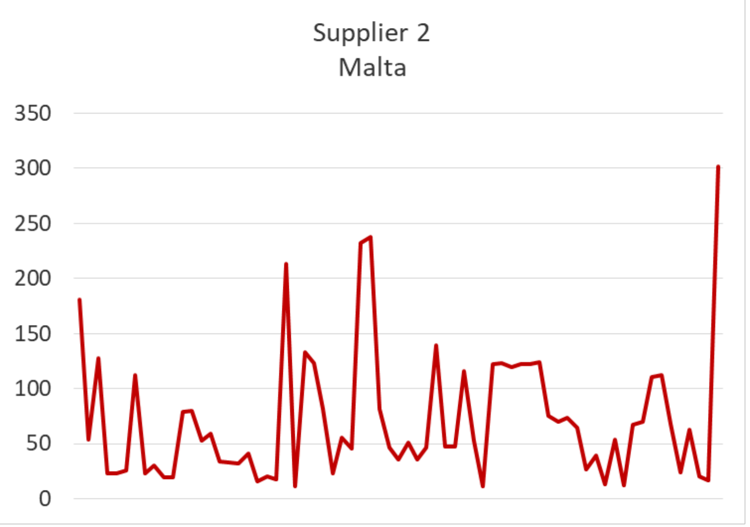
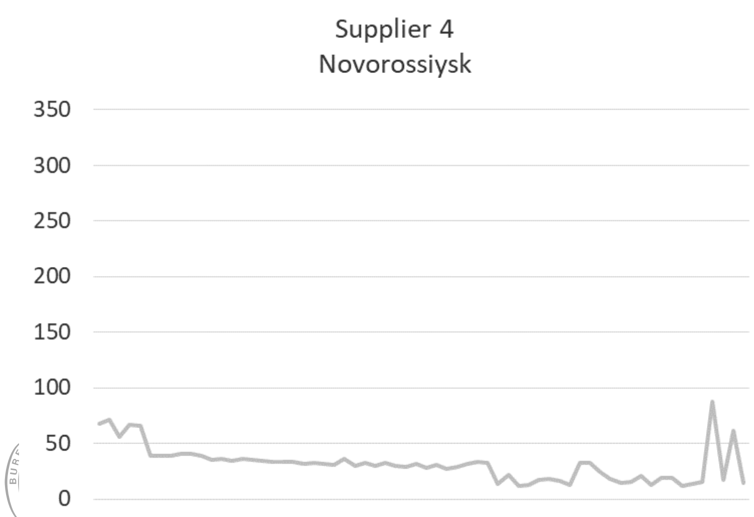
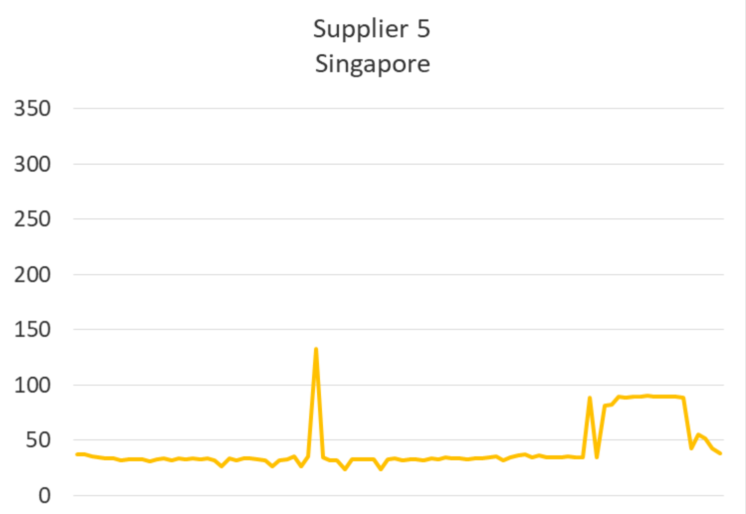
VLSFO – JAN-SEP / 2020
VISCOSITY @ 50 °C

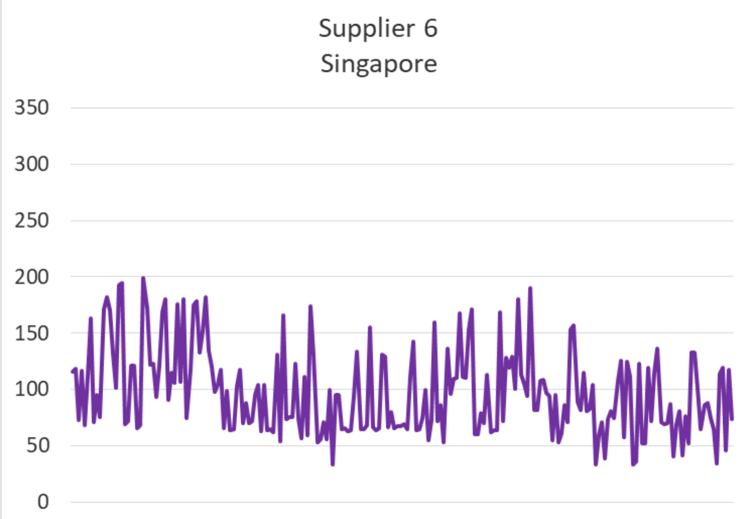
VeriFuel
Understanding Marine Fuel











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VLSFO
TEMPERATURE CONSIDERATIONS

VeriFuel
Understanding Marine Fuel

PRODUCTS	A	B	C	D	E
Visc@50°C (cSt)	35.4	72.0	232.0	13	327.8
Dens@15°C (kg/m^3)	911.6	955.2	942.3	920.5	950.4
Pour Point (°C)	24	15	9	<21	<21
Min Storage temp (°C) for 800 cSt or lower	34	30	35	30	40
Temp (°C) separator	60	98	98	40	98
Temp (°C) for 12.5 cSt injection viscosity	82	100	126	51	133

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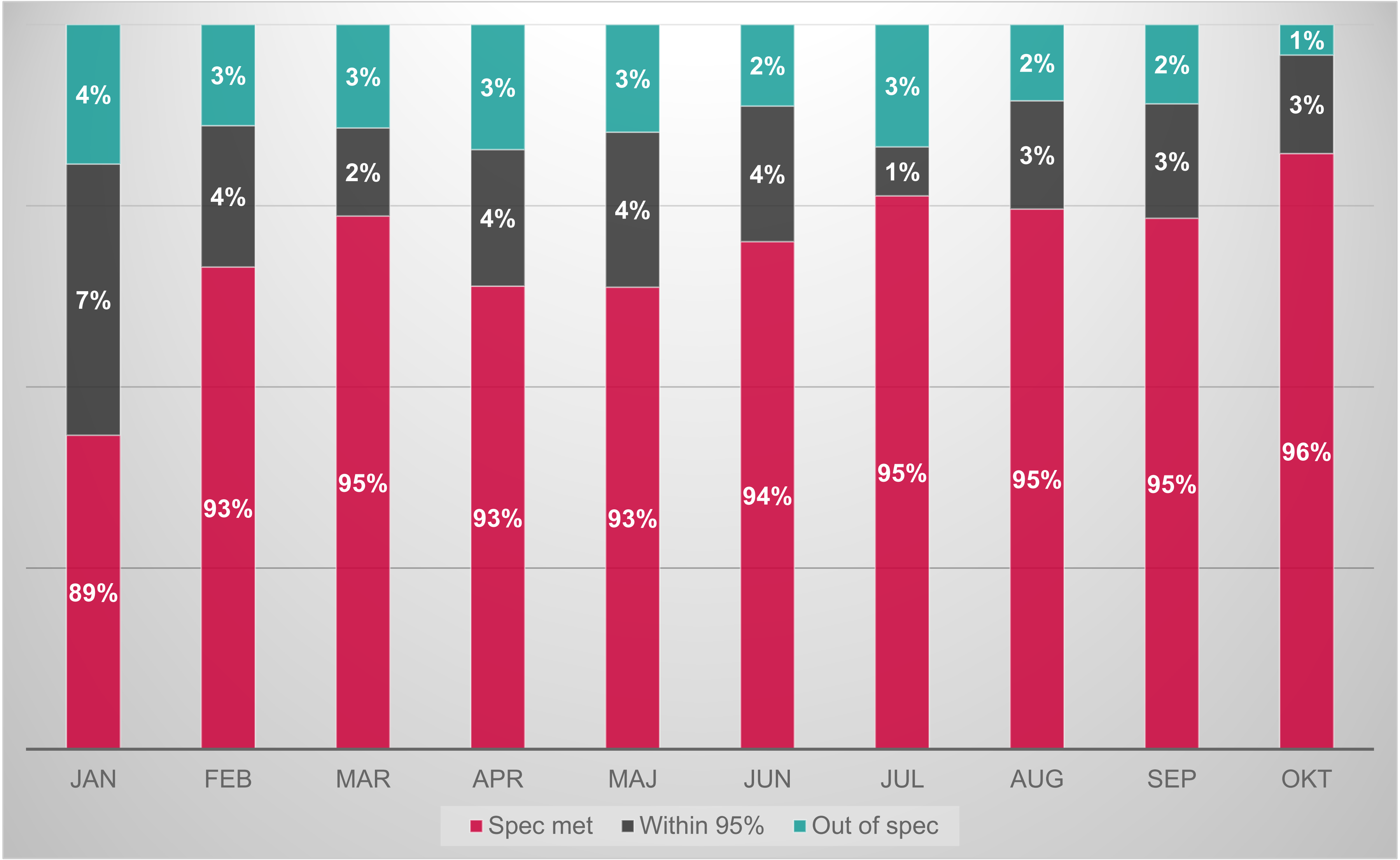
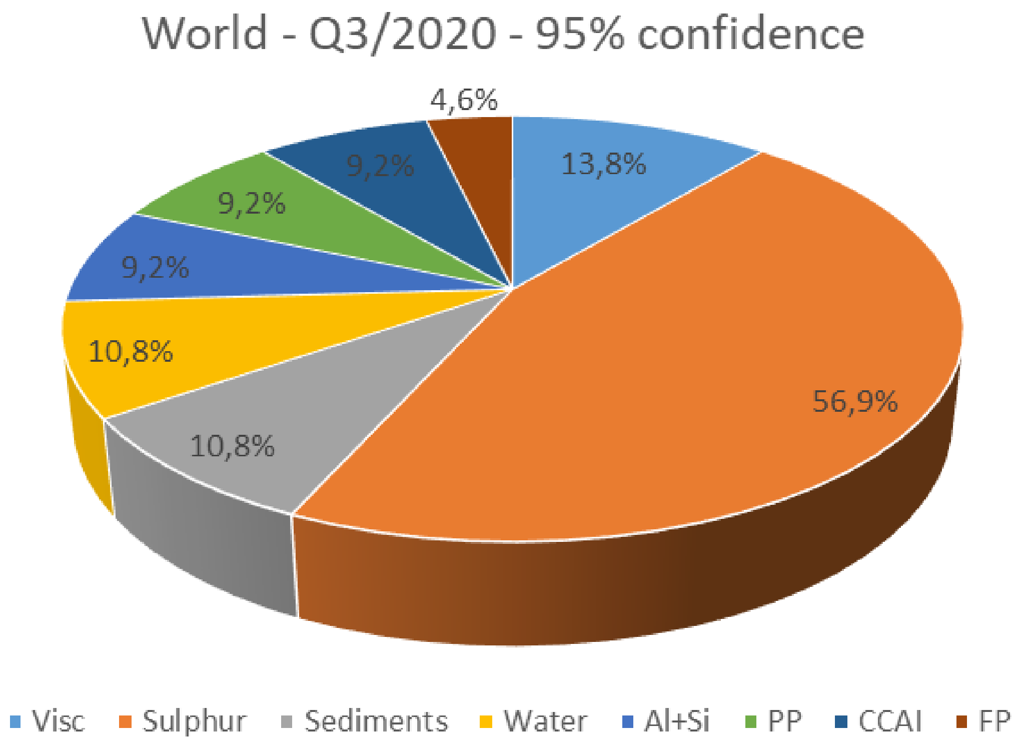
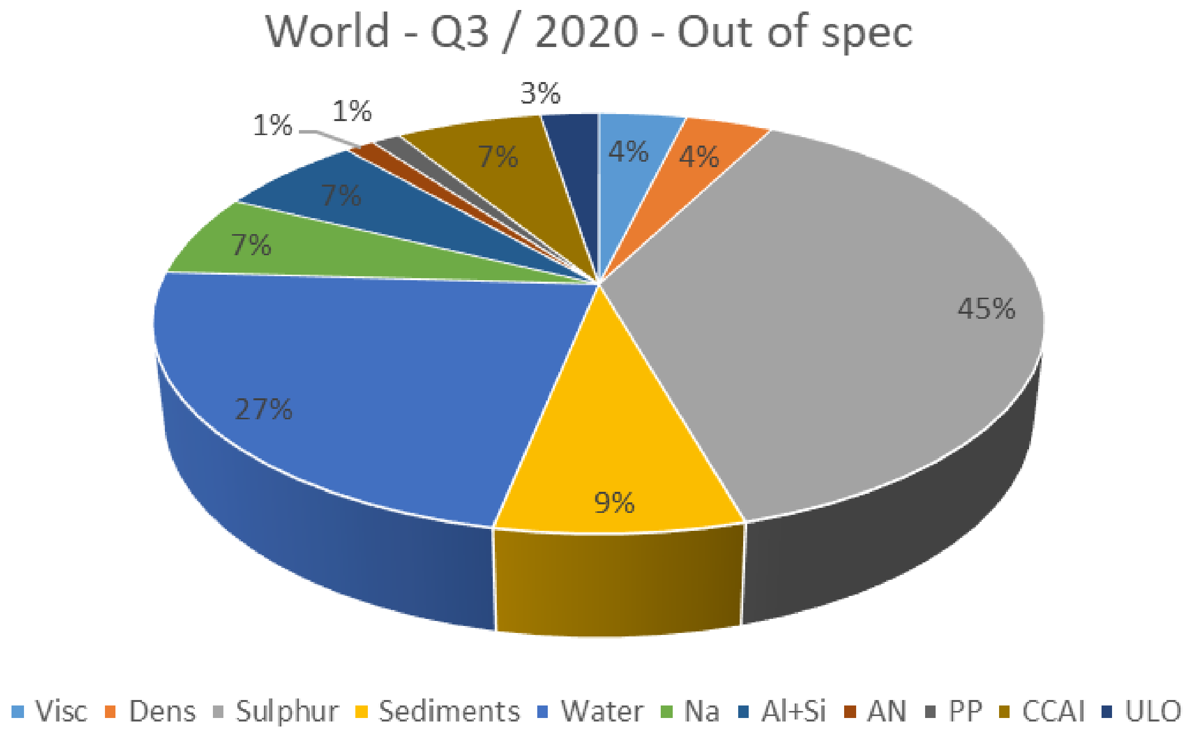
VLSFO – JAN-OCT
SPEC REPORTS



WORLD – Q3 / 2020
VLSFO – EXCEEDING SPEC LIMITS





VLSFO- Q1-Q3 / 2020
SEDIMENTS

VeriFuel
Understanding Marine Fuel

	Q1		Q2		Q3	
Visc @ 50°C (cSt)	Average TSA (% m/m)	Sediments >0.10% m/m	Average TSA (% m/m)	Sediments >0.10% m/m	Average TSA (% m/m)	Sediments >0.10% m/m
<10 cSt	0.06	11.2%	0.03	3.6%	0.05	6.7%
10 - 30 cSt	0.04	3.3%	0.03	2.1%	0.03	1.4%
31 - 60 cSt	0.04	2.4%	0.04	3.8%	0.04	0.6%
61 - 100 cSt	0.03	1.9%	0.04	1.3%	0.03	0.9%
101 - 150 cSt	0.03	1.0%	0.03	0.6%	0.03	0.2%
>150 cSt	0.03	0.3%	0.03	1.3%	0.03	0.0%

* 0.50% m/m was used for tests above 0.50% m/m and unfilterable results

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VLSFO – JAN-SEP / 2020
PROBLEMS ENCOUNTERED

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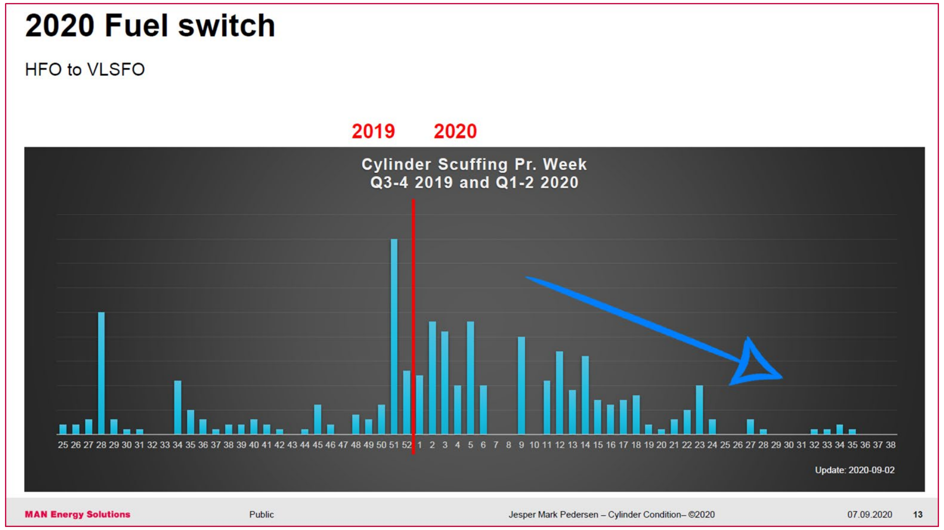
Understanding Marine Fuel

1. Unstable fuels affecting separators and filters
   - Incompatibility
   - Instability (at delivery or due to long term storage)
2. Dirty fuels (grit, clay, sand) affecting separators and filters
3. Unusual odour (ARA, Sweden and Fujairah, no H_2S presence)
4. Cylinder condition issues
   - Cat fines (inadequate tank cleaning, tank bottoms)
   - Lubrication (overlubrication)
   - Missing cermet coated piston rings (MAN engines)



Courtesy of MAN

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VLSFO – JAN-OCT / 2020
SUMMARY

VeriFuel
Understanding Marine Fuel

- VLSFO is widely available
- Geographical variations
- Viscosity variations
- More paraffinic fuels
- Importance of preparation (lubrication, tank cleaning)
- Some unstable fuels
- Some bumbs on the way but it seems the industry is stabilising post IMO2020

BUREAU VERITAS

Thank you

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VLSFO – JAN-OCT / 2020
AVERAGES BY PORT

VeriFuel
Understanding Marine Fuel

Port	Q	Viscosity	Density	Sulphur	Sediments	Al+Si	Acid Number	MCR	CCAI	NSE	% Off Spec
Algeciras	Q1	205	947.0	0.49	0.03	16	0.16	6.7	817	41.61	0
	Q2	203	951.9	0.48	0.03	24	0.21	6.6	822	41.55	0
	Q3	177	952.5	0.48	0.03	22	0.31	5.43	824	41.52	5
Antwerp	Q1	59	935.8	0.49	0.05	20	0.24	4.6	827	41.76	13
	Q2	88	947.1	0.49	0.05	23	0.60	5.3	831	41.58	0
	Q3	63	948.2	0.49	0.05	26	0.76	4.92	834	41.55	2
Balboa	Q1	71	930.6	0.47	0.05	23	0.20	3.9	818	41.81	3
	Q2	82	935.0	0.47	0.06	22	0.23	4.6	819	41.76	10
	Q3	80	938.6	0.48	0.05	34	0.35	4.8	821	41.67	4
Busan	Q1	74	934.1	0.44	0.02	6	0.41	3.5	823	41.81	11
	Q2	76	922.6	0.45	0.02	5	0.24	4.4	804	41.95	0
	Q3	132	941.4	0.47	0.04	15	0.81	5.0	816	41.65	0
Fujairah	Q1	143	930.9	0.47	0.03	16	1.28	6.6	805	41.79	1
	Q2	128	928.2	0.48	0.04	14	1.19	6.3	803	41.80	0
	Q3	154	926.1	0.50	0.03	11	1.46	6.5	799	41.81	4
Gibraltar	Q1	135	940.1	0.48	0.02	17	0.21	5.7	816	41.70	0
	Q2	138	934.0	0.47	0.03	17	0.21	4.9	811	41.79	0
	Q3	160	944.0	0.48	0.04	21	0.25	5.81	818	41.65	0

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VLSFO – JAN-OCT / 2020
AVERAGES BY PORT

VeriFuel
Understanding Marine Fuel

Port	Q	Viscosity	Density	Sulphur	Sediments	Al+Si	Acid Number	MCR	CCAI	NSE	% Off Spec
Hong Kong	Q1	105	951.2	0.47	0.03	29	0.94	5.9	829	41.56	1
	Q2	74	938.7	0.48	0.03	27	0.44	5.6	823	41.69	2
	Q3	72	937.0	0.47	0.03	25	0.57	4.9	819	41.71	0
Houston	Q1	74	925.1	0.42	0.05	18	0.32	3.2	812	41.90	6
	Q2	62	929.4	0.44	0.05	24	0.32	3.0	815	41.86	0
	Q3	47	944.0	0.46	0.05	32	0.20	3.1	834	41.67	6
Rotterdam	Q1	61	942.0	0.49	0.05	23	0.42	4.6	834	41.66	8
	Q2	65	941.1	0.48	0.07	21	0.51	4.8	827	41.66	7
	Q3	70	952.1	0.47	0.04	23	0.76	5.1	835	41.50	4
Santos	Q1	19	921.2	0.43	0.01	11	0.25	2.6	826	42.00	0
	Q2	20	919.7	0.42	0.01	12	0.41	2.3	823	42.02	0
	Q3	36	928.6	0.41	0.02	12	0.28	3.2	821	41.91	0
Singapore	Q1	98	941.5	0.47	0.03	23	0.74	5.5	821	41.64	1
	Q2	90	938.3	0.47	0.03	21	0.73	5.2	818	41.68	1
	Q3	88	939.1	0.47	0.03	18	0.75	5.0	819	41.67	1

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GCMS ANALYSIS - EXPLORING THE CHALLENGES
THE NEED FOR TRANSPARENCY

VeriFuel
Understanding Marine Fuel

Suppliers side

- ✓ Clarity on the supply chain
- ✓ Tracebility of the supply chain
- ✓ Adequate procedure
- ✓ Quality control...

Vessel / operator

- ✓ Provide objective feedback
  - Is the bunker fuel responsible?
  - Is poor household responsible?
  - Combination of both?
- ✓ Real onboard experience once fuels are being consumed

Testing agencies

- ✓ Standard test methods that are recognized by industry -vs- in-house ”**top secret**” test methods
- ✓ Reference samples have to be tested to evaluate cause and effect – who pays?
- ✓ Share data with engine makers or organizations like CIMAC

	Indene	C16 FA	C18 FA	C18:0 FA	C18:1 FA	4-cumyl-phenol
Nos	19%	30%	18%	10%	10%	20%
Average	335	61	192	240	105	312
Median	94	29	88	29	35	30
Min	-	-	-	-	-	-
Max	3230	984	3099	6563	1975	4400
Confirmed probs	22%	26%	41%	0%	0%	20%
Confirmed no probs	18%	16%	14%	19%	19%	18%
Unknown if probs	60%	59%	45%	81%	81%	62%
Average if probs	105	66	131	-	-	277
Average if no probs	656	38	137	28	65	606
Average if unknown	320	65	262	288	115	230

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