CIMAC Webinar on the Global Sulphur Cap

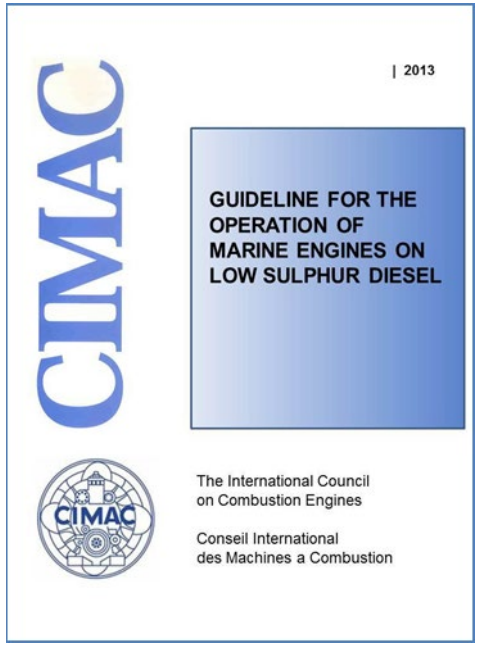
WG7 ‚Fuels‘

CIMAC Webinar - The Global Sulphur Cap 2020

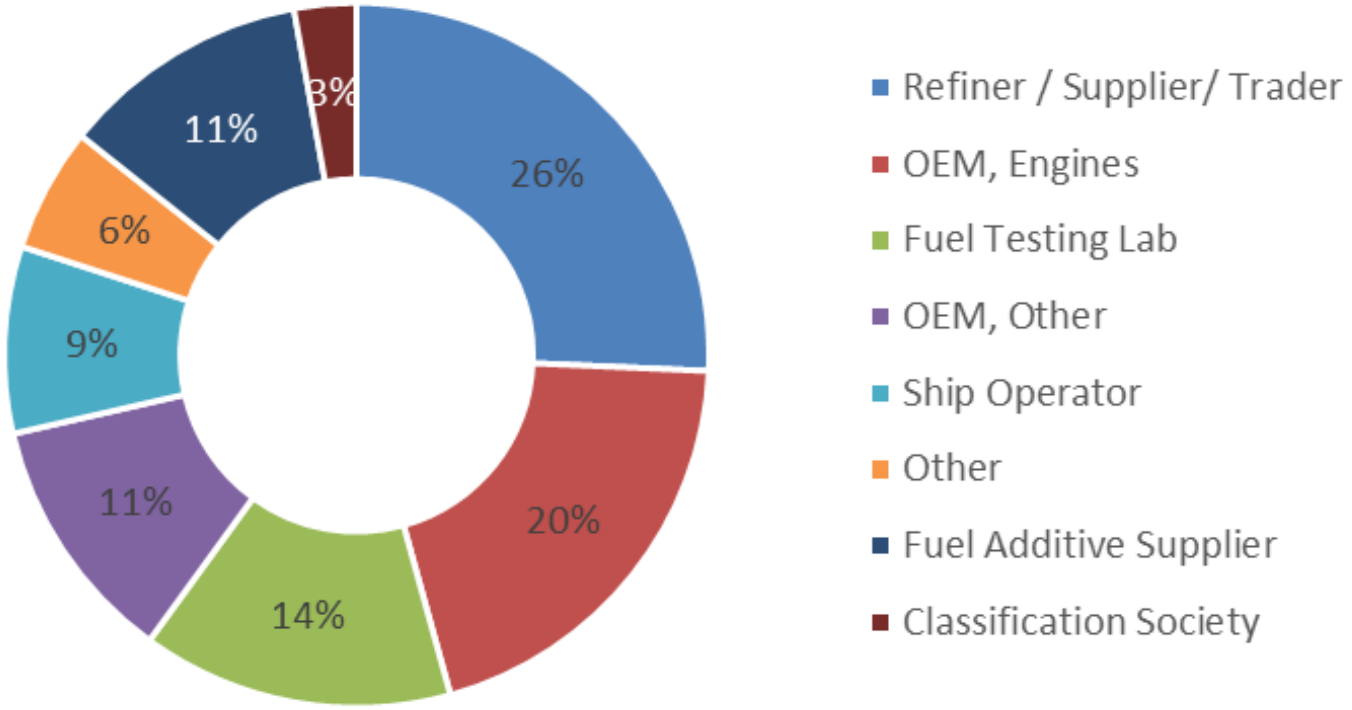
Kjeld Aabo
Sales and Promotion Two stroke Marine MAN Energy Solutions
Member of WG ISO 8217 & Chairman CIMAC Fuels

WG7 ‚Fuels‘

- 35 members
  - 15 on waiting list
- Represented stakeholders
  - Refiners, Suppliers, OEMs, Ship Operators, Fuel Testing Labs, Classification Societies and others
- Co-operation with
  - All CIMAC WGs in case of common topics
  - ISO8217 fuels group (very close relationship)
- Latest Publications
  - Guideline providing answers to FAQ from ISO 8217:2017 (Mar 2017)
  - Guideline on the Interpretation of Marine Fuel Analysis Test Results (Feb 2016)
  - Guideline on Filter Treatment of Residual Fuel oil (Dec 2015)
  - Position paper: New 0.10% sulphur marine (ECA) fuels (June 2015)
  - Guideline: Cold flow properties of marine fuel oils (Jan 2015)



Representation in WG7 by sector



WG7 ‚Fuels‘

Recent and upcoming meetings

- No 76: Apr 2017, Switzerland
- No 77: Sep 2017, Frankfurt
- No 78: Apr 2018, Copenhagen
- No 79: Sep 2018, Philadelphia, US
- No 80: Mar 2019, Lisbon
- No 81: Oct. 2019, Oslo

Current activities, subgroups

<u>High priority SGs</u>

SG 1-1 CFR (centrifuges and efficiency)
SG4 Guideline on stability/compatibility
SG5 LNG quality
SG6 Ignition/Combustion, 2020 fuels
SG9 “How to order and use 2020 fuels”

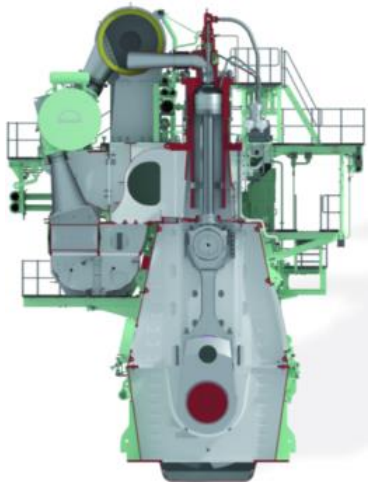
<u>Low priority SGs</u>

SG 1-2 Separators
SG 3 pH / Corrosivity
SG 7 Emulsion fuels
SG10 Niche fuels

What Fuel will be used in 2020 and beyond?

Compliant fuel

MC/ME/-C engine
Single Fuel: 0.10%S fuel, 0.50%S fuel



ME-GI/ME-LGI engine
Dual Fuel: LNG, Ethane, LPG, MeOH

High sulphur fuel

MC/ME/-C engine
0 – 5%S fuels:
HFO/MDO + Scrubber

ULSFO < 0.1% Sulphur but what about level of Cat fines for VLSFO < 0.5% ?

	Supplier A	Supplier B	Supplier C	Supplier D	Supplier E	Supplier F	Supplier G	Supplier H	Supplier I
Density (kg/m3 @ 15 C)	895-915	910	857	868	932	845	868	928	870-930
Viscosity (cSt @ 40 or 50 C)	40-75 (40ºC)	65 (50ºC)	17.6 (50ºC)	8.8	22.6 (50ºC)	8.8	8.5 (50ºC)	40C: 45-65. 50C 30-40	8-25 (50ºC)
Sulphur (% m/m)	0.1	0.095	0.08	0.05	0.1	0.03	0.09	0.1	<0.1
Pour Point (C)	15-30	20	<-12	-12	30	21	27	20-25	18-21
Flash Point (C)	>70	60	>200	72	90	>70	>70	70	60-80
Water (% v/v)	0.05	0.1	<0.2	0.004	<0.05	0.01	0.05	0.2	0.05-0.1
Acid Number (mg KOH/g)	<0.1	2.5	0.3	0.27	0.06	0.04		2.5	0.1-0.2
Al+Si (ppm m/m)	<0,3	17	<15	?	34	<1	<3	10-20	12-15
Lubricity (µm)	<320	520	-	410	-	326	-	-	-
CCAI	795-810	860	762	-	-	765	789	790-800	790-810

What may / will happen in 2020?

Key parameters for 0.50% Marine Fuel Oil blending will be:

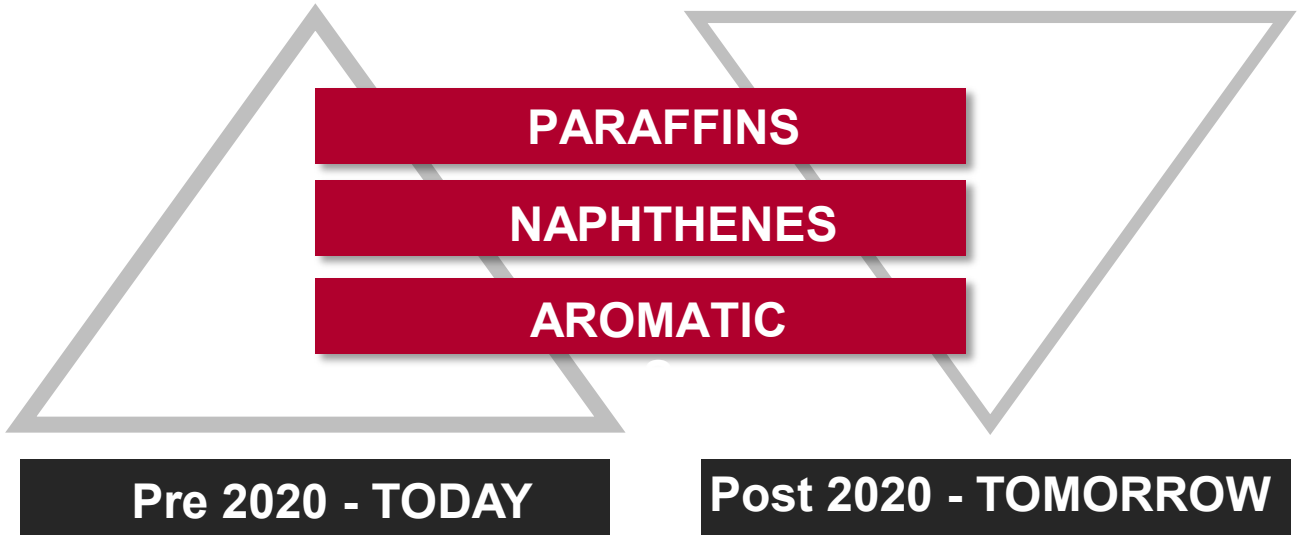
Stability (Total Sediment)
- Paraffinic vs Cracked blend components

Pour Point
- ULSFO /VLSFO close to PP limits

Acidity
- Sweet crude sources with high AN (e.g. DOBA)

Viscosity
- No minimum limit in ISO 8217, Table 2

CCAI
- Larger difference between viscosity and density



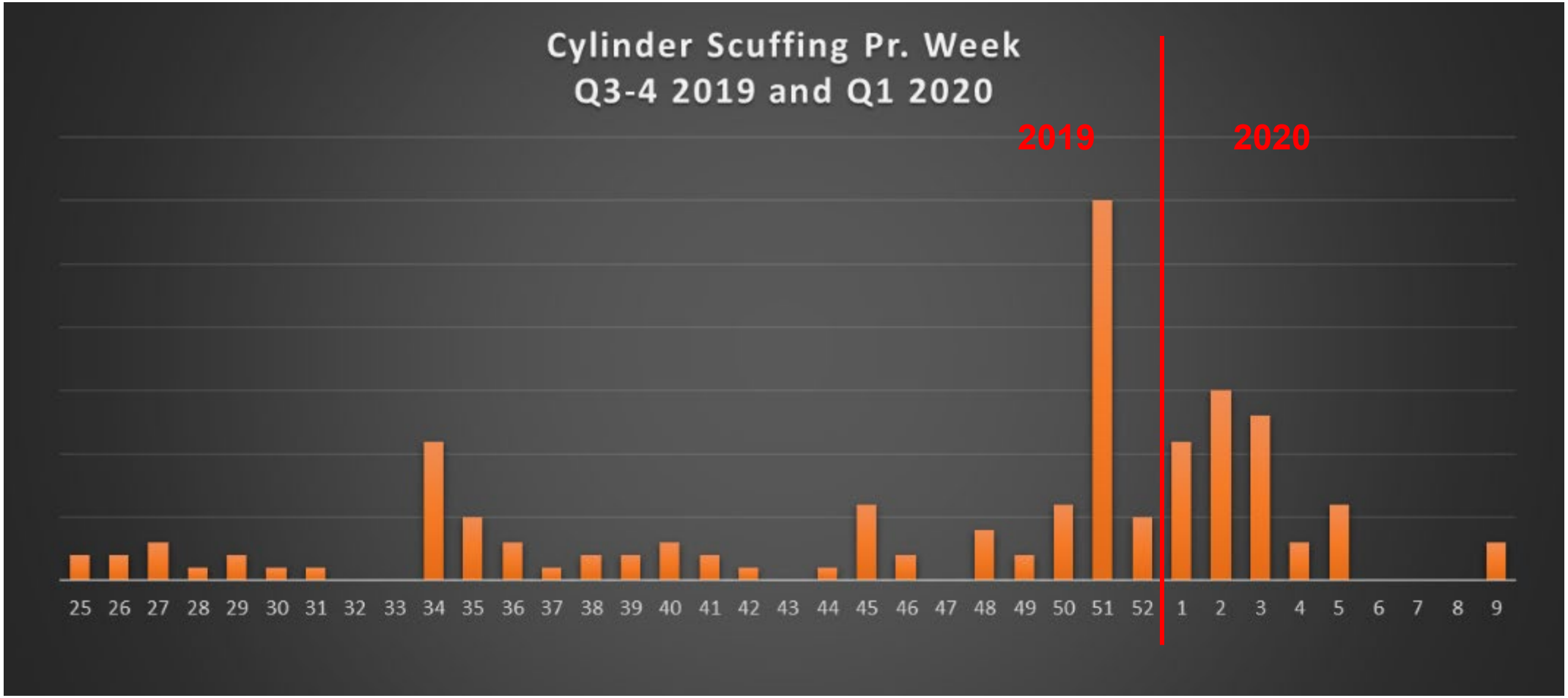
Ref: KBC/Mel Larson

VeriFuel
Understanding Marine Fuel

0.50% S VLSFO – First feedback from the field

List of observations - PRELIMINARY

Sporadic cases of scuffing and high wear



0.50% S VLSFO – First feedback from the field

List of observations - PRELIMINARY

Several cases of scuffing and high wear

- **Cat fines** – from cleaning of tanks
- **No cermet on the piston rings**
- **Lubrication feed rate too low**
- **High wear due to cold corrosion**

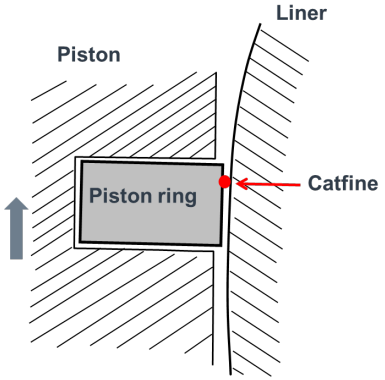
Fuel system

- **Stuck high pressure fuel pumps**
- **Gasification of low viscosity fuel**

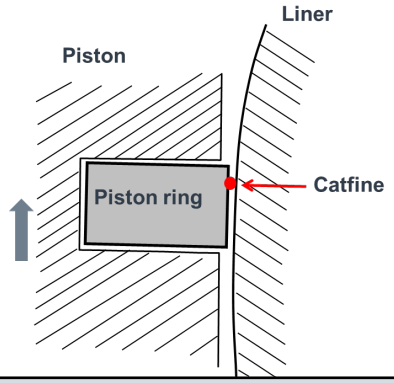
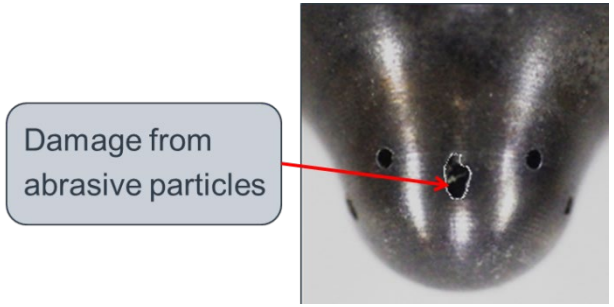
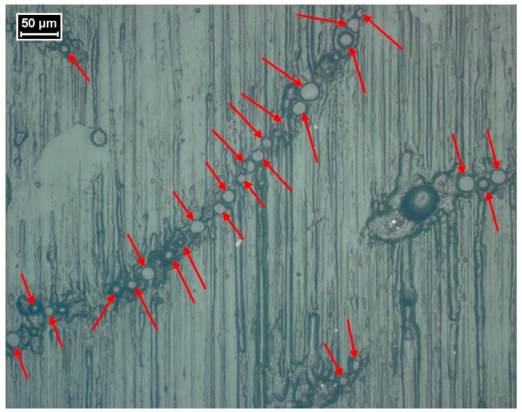
Cold flow properties

- **Temperature control**

Incompatibility between fuels



Overview of damages
Found in two-stroke engines and small four-stroke Gensets

Damages found in two-stroke engines	Damages found in small four-stroke Gensets
Wear in combustion chamber parts	Wear in fuel equipment
	
Resulting in high wear	Resulting in poor combustion
	

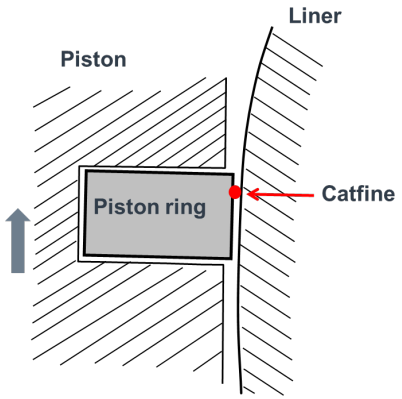
0.50% S VLSFO – First feedback from the field

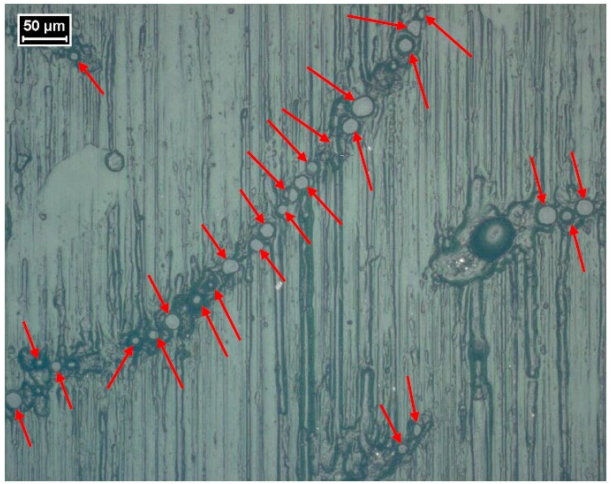
List of observations - PRELIMINARY

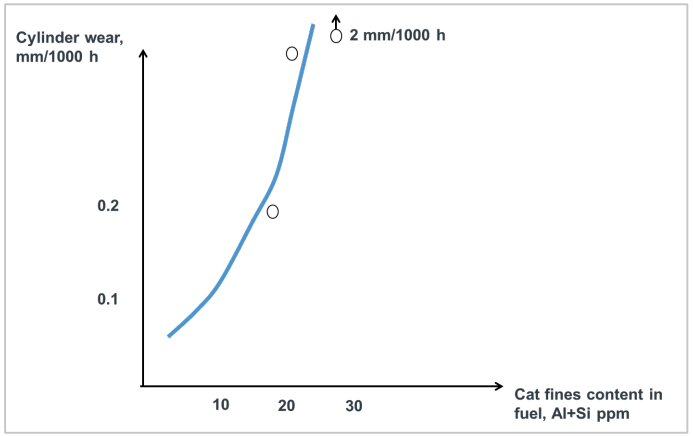
Sporadic cases of scuffing and high wear

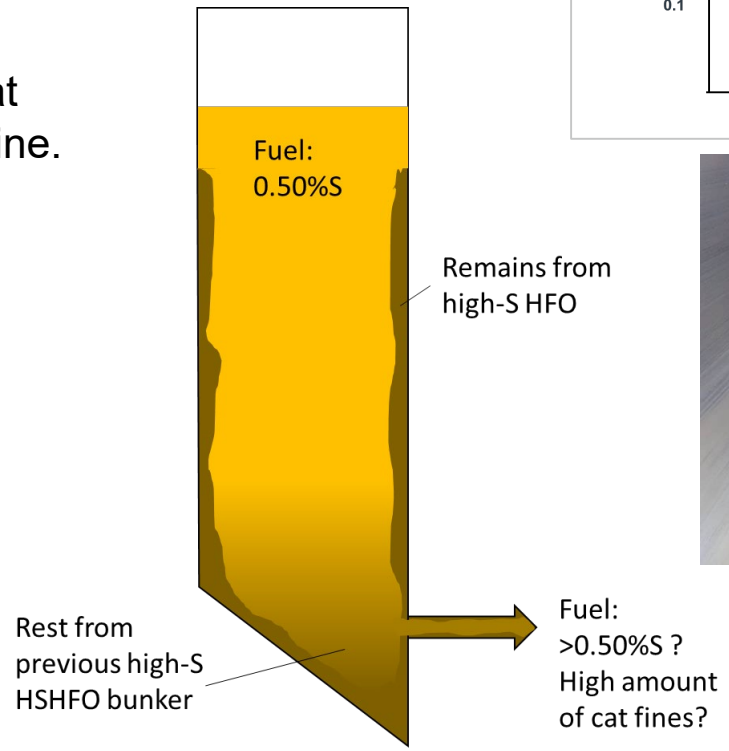
Cat fines – from cleaning of the tanks. **(Refer to SL2019-674)**

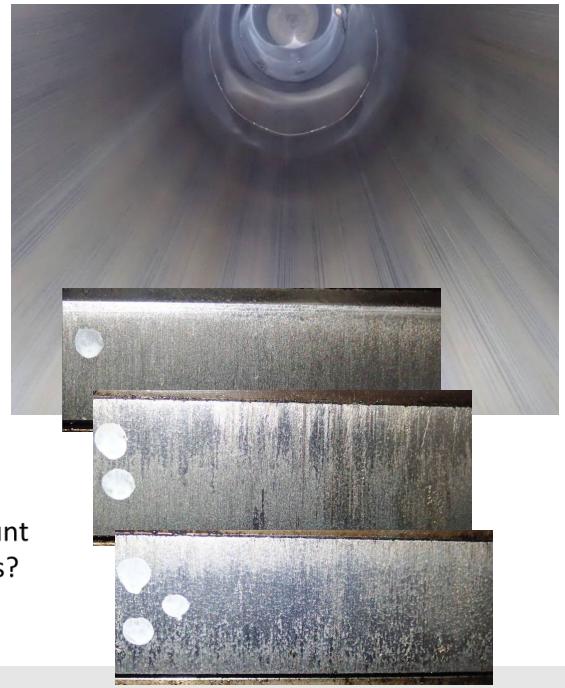
- Dissolving of the old sludge in tanks -> if too much, it cannot be removed in the separators.
- Fuel additives are very effective in cleaning, but they reduce the cleaning efficiency of the separator -> the cat fines from the remains in the tank go directly to the engine.











0.50% S VLSFO – First feedback from the field

List of observations - PRELIMINARY

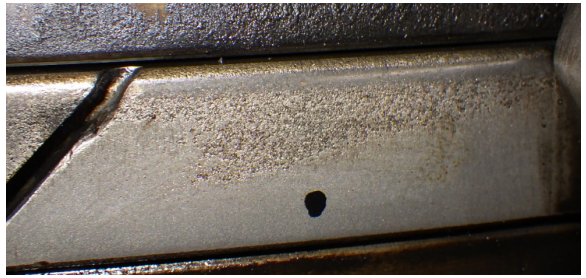
Sporadic cases of scuffing and high wear

No cermet on the piston rings. (Refer to SL2019-685)

- Cermet coating must be measured and the wear must be recorded.
- Once 100 µm is reached, the rings should be replaced.

Cermet-coating thickness action table

Above 100 µm	No action
100-50 µm	Plan the overhaul of the piston ring pack
50-20 µm	Overhaul at first opportunity



Service Letter SL2019-685/KAMO

MAN Energy Solutions

SL2019-685

Action code: WHEN CONVENIENT

Condition-based overhaul
Cermet-coated piston rings

SL2019-685/KAMO
November 2019

Concerns
Owners and operators of MAN B&W two-stroke marine diesel engines.
Type: All MAN B&W engines fitted with cermet-coated piston rings.

Summary
The overhaul criteria for cermet-coated piston rings are defined, and guidance on how to estimate the remaining lifetime of a cermet-coated piston ring is given based on the remaining coating thickness and wear rate.

Other relevant Service Letters are:
SL2018-659/JAP
SL2019-671/JAP
SL2019-681/SRJ

Dear Sir or Madam

This Service Letter defines the overhaul criteria for cermet-coated piston rings, and it provides guidance on how to estimate the remaining lifetime of a cermet-coated piston ring based on the remaining coating thickness.

Cermet-coated piston rings were introduced as a scuffing preventive countermeasure. The cermet-coated piston rings are now standard on most large-bore engines and are recommended for all engines operating on 0.5% S fuel or lower, as described in Service Letter SL2018-659/JAP.

The overhaul criteria in this Service Letter apply to all engines fitted with cermet-coated piston rings.

Yours faithfully

Mikael C Jensen
Vice President, Engineering

Stig B Jakobsen
Senior Manager, Operation

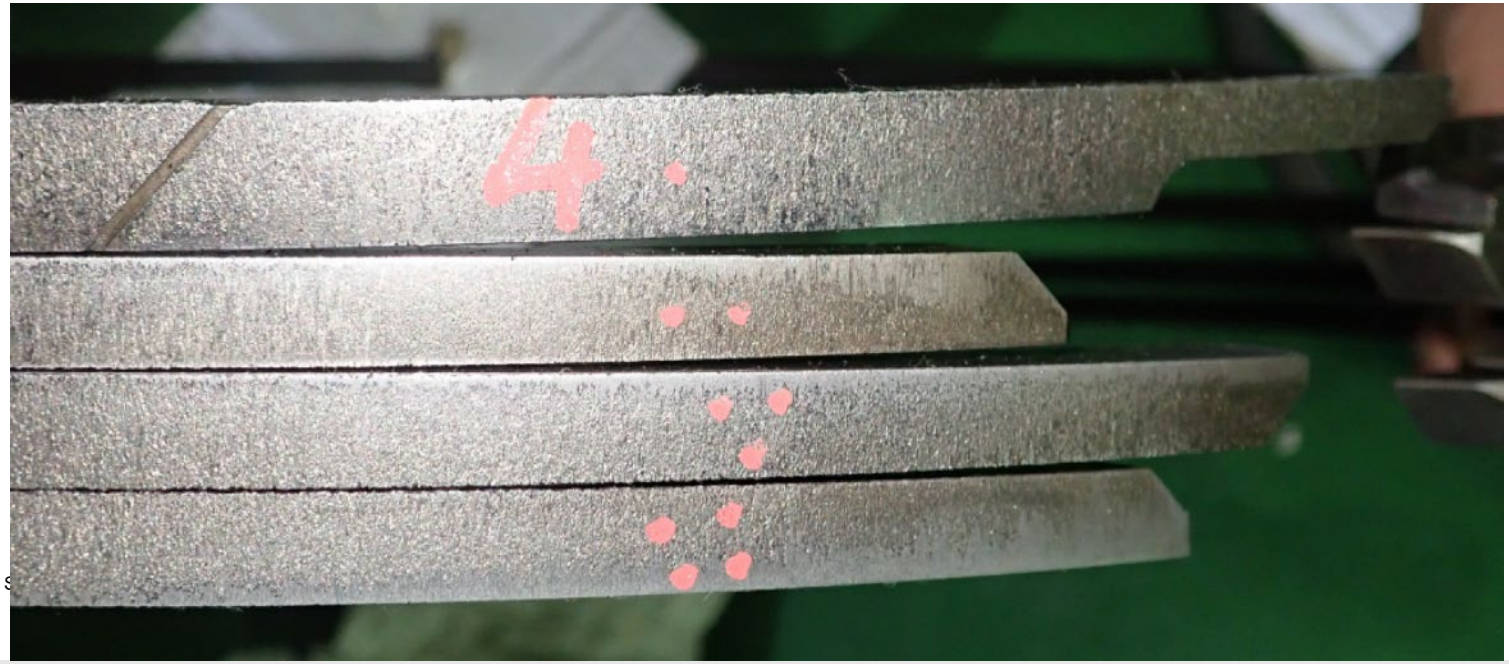
0.50% S VLSFO – First feedback from the field

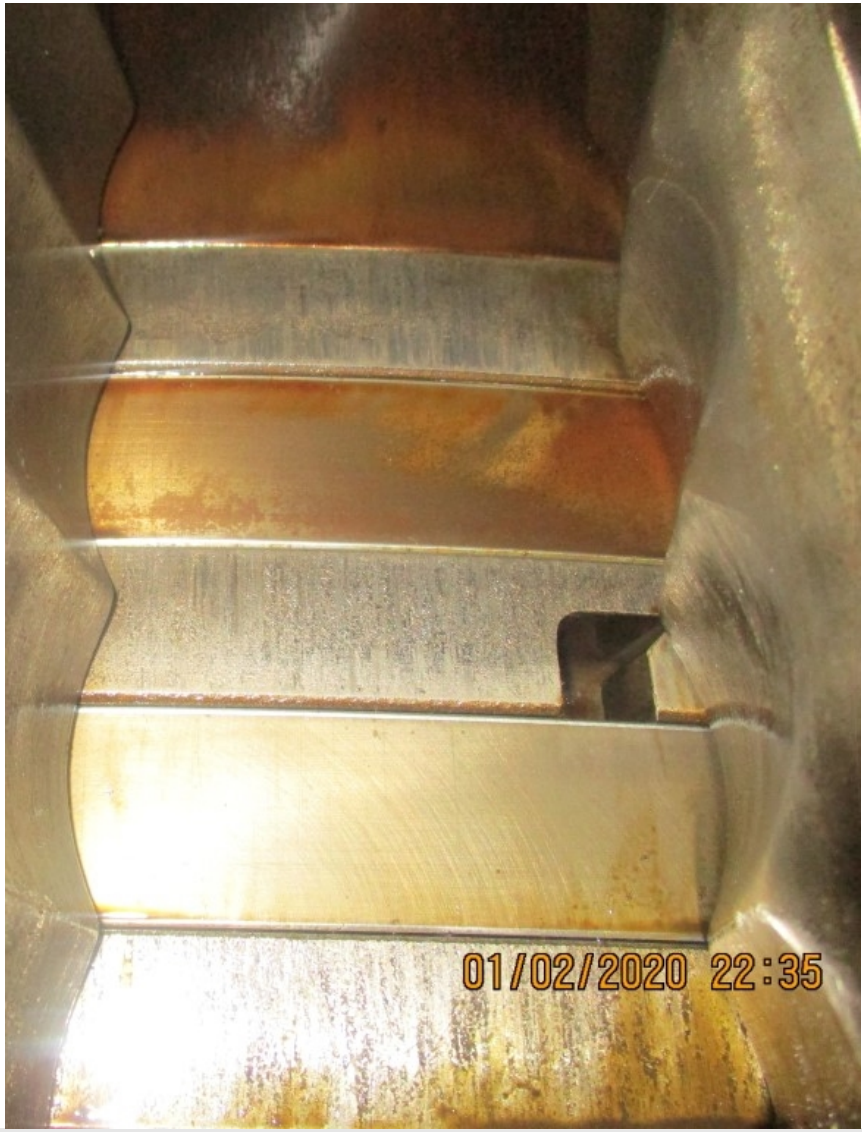
List of observations - PRELIMINARY

Sporadic cases of scuffing and high wear

No cermet on the piston rings. (Refer to SL2019-685)

- Cermet coating is recommended on all piston rings for operation on low-S fuel.
- Contact between liner surface to cast iron piston ring is more sensitive to seizure and scuffing than liner to cermet.

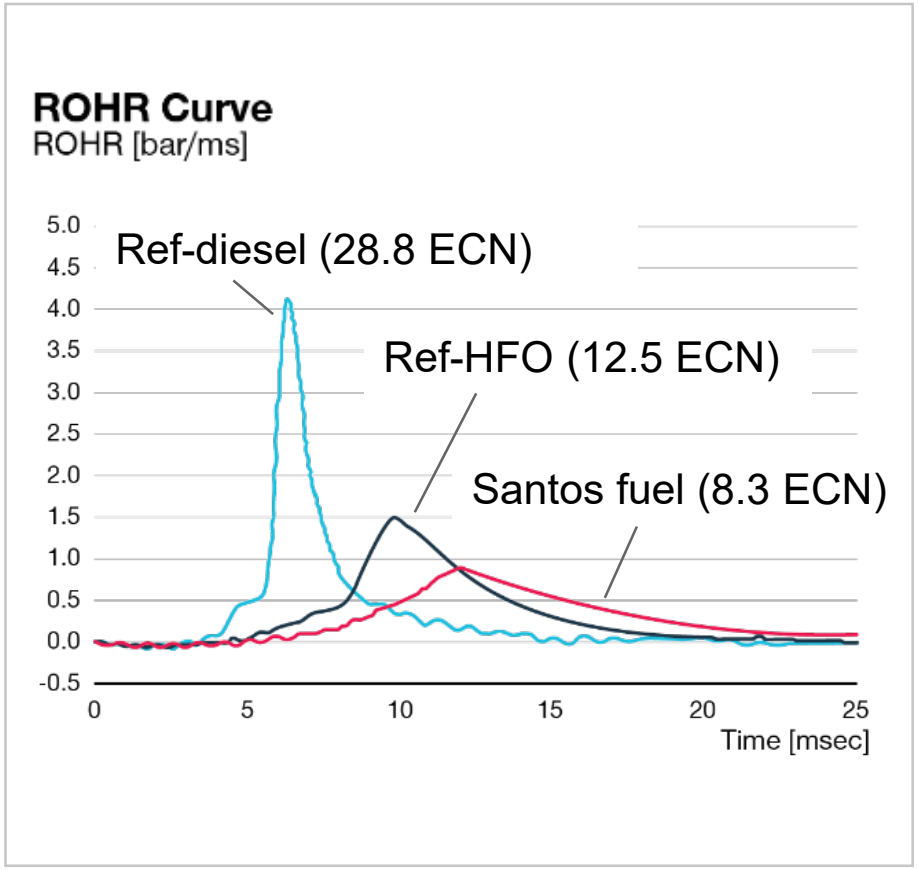


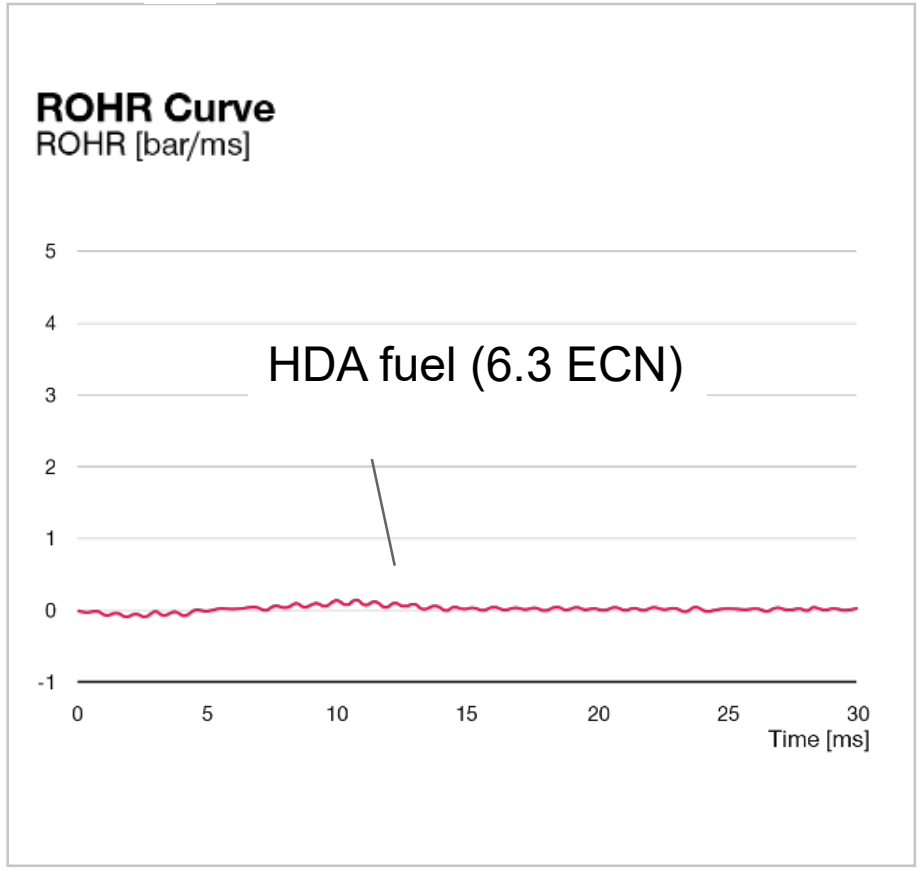


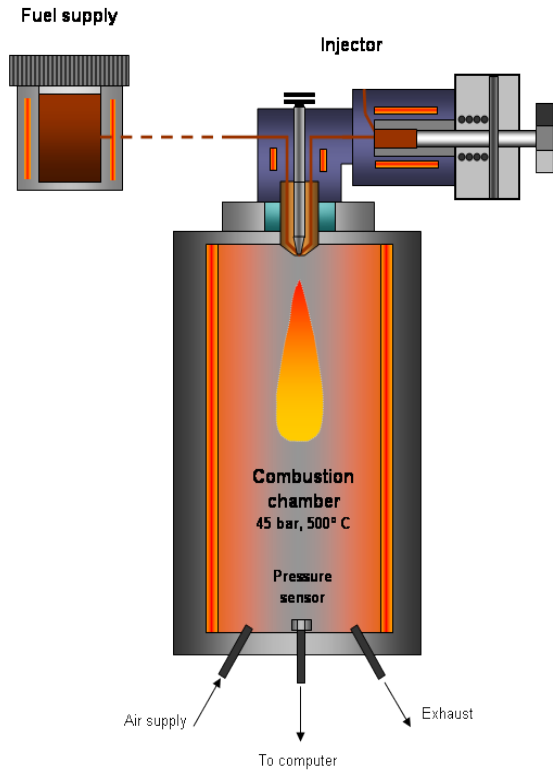
Cold flow properties - wax

Combustion test – Lab test

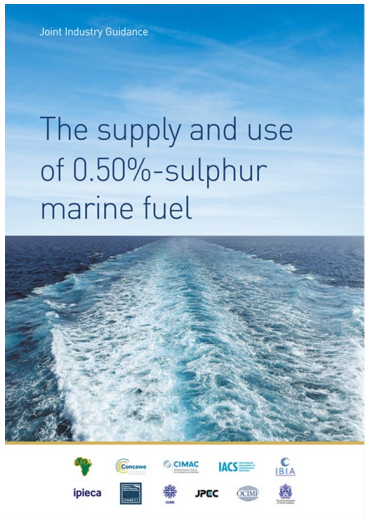
FIA test IP 541: Constant volume combustion chamber method



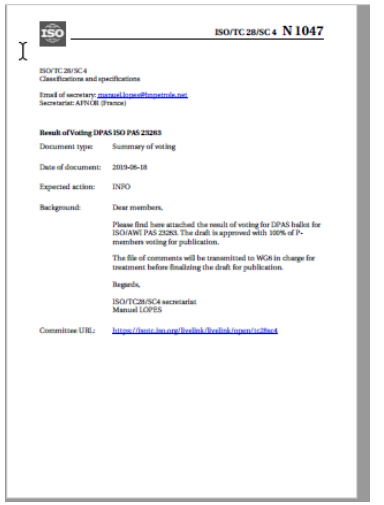




Latest Publications about the coming fuels 2020

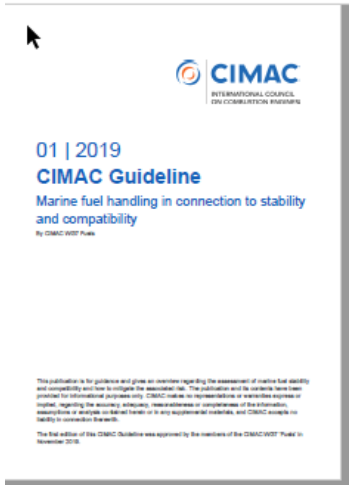


Joint Industry Project



ISO 8217 PAS

Concawe



CIMAC WG 7

CIMAC Guideline

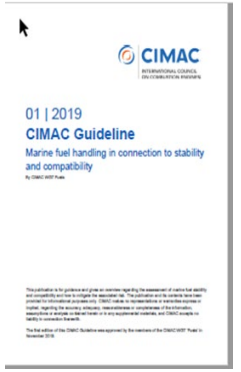
Several test methods to evaluate fuel stability exist have been highlighted in this paper, however, their applicability and accuracy varies.

Only one method (ASTM D4740) is available as providing a useful onboard screening tool for compatibility between two fuels of which one must be of a residual (RM) nature. Fuels which are actually compatible may be deemed less compatible or incompatible by the method.

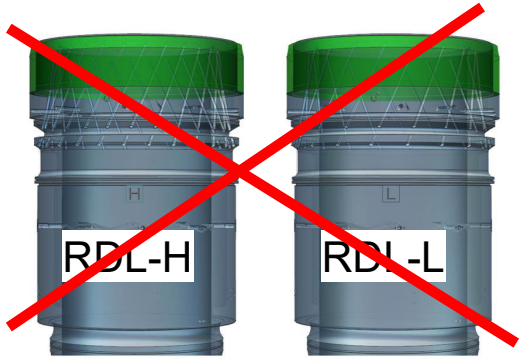
The most effective way to determine a fuel's stability or compatibility between two or more fuels, is using test methods that can only be applied in a controlled laboratory setting.

The test method ISO 10307-2 Potential Total Sediment (TSP) is used as the definition for a stable fuel in ISO 8217:2017 when the TSP is below 0.10% m/m.

The three test methods: ASTM D7157, D7112 and D7060 with the prediction model offer a tool to evaluate the degree of compatibility of fuels without the need to test the fuels mixed together.



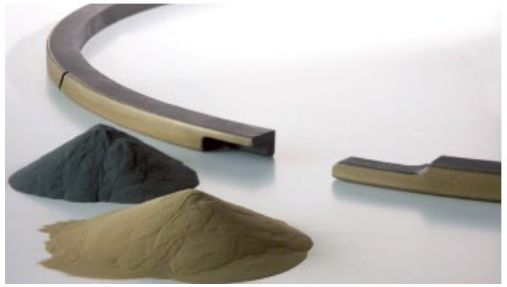
Engine updates – for 0.50% S Fuel

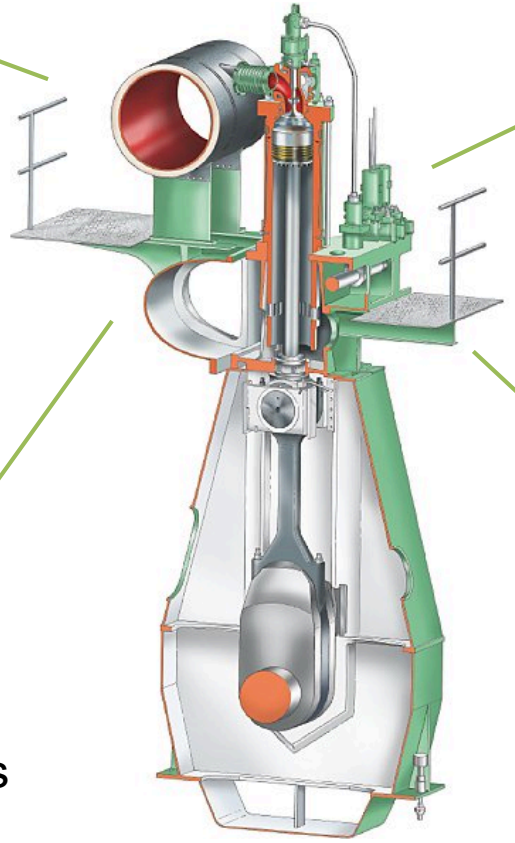


CIMAC

What to consider?

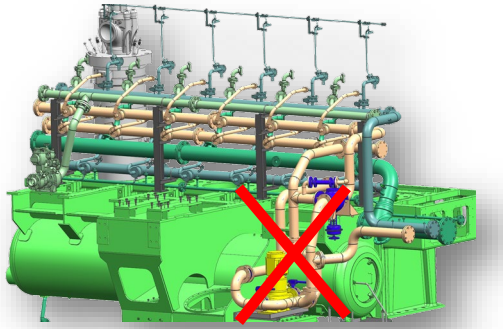
Piston rings:
Full cermet coated ring-pack





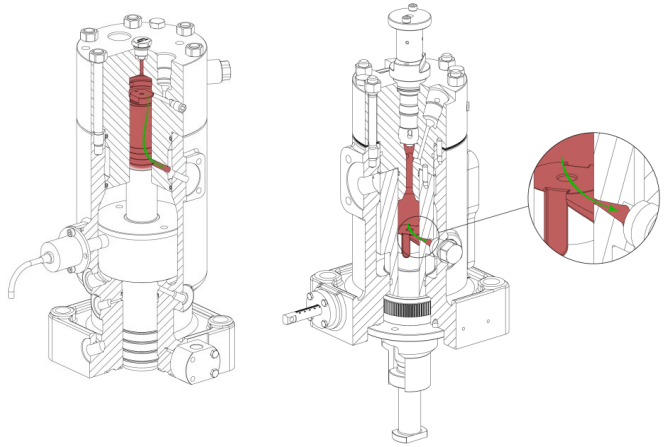
Liner cooling:
- Reduced temp.: 80 C
- No LDCL
- No RDL

LDCL



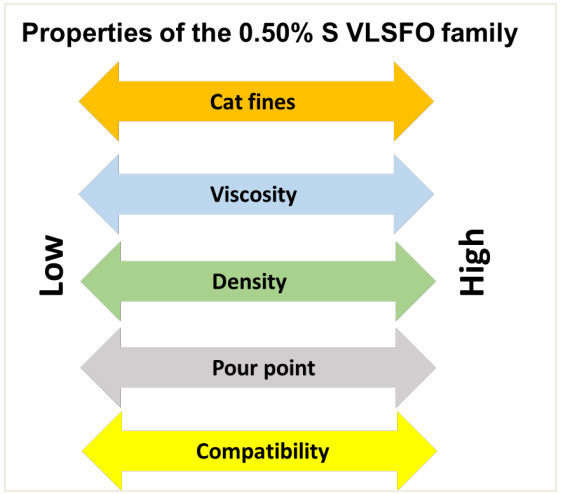
Cylinder oil:
- 40 BN
- No deposits

High-pressure fuel pumps:
- Low viscosity fuel
- High viscosity fuel
- Change-over

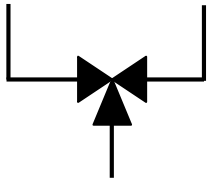


Summary: 0.50% S fuels

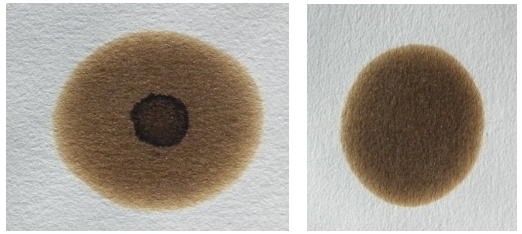
What to consider – for the ship?



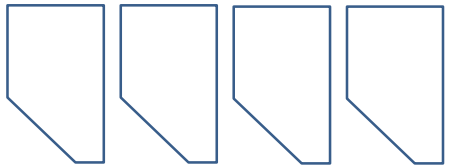
Fuel change-over



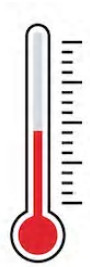
Compatibility of mixed fuels



Fuel tank system considerations

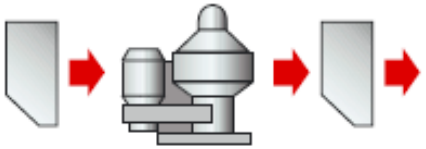


Temperature

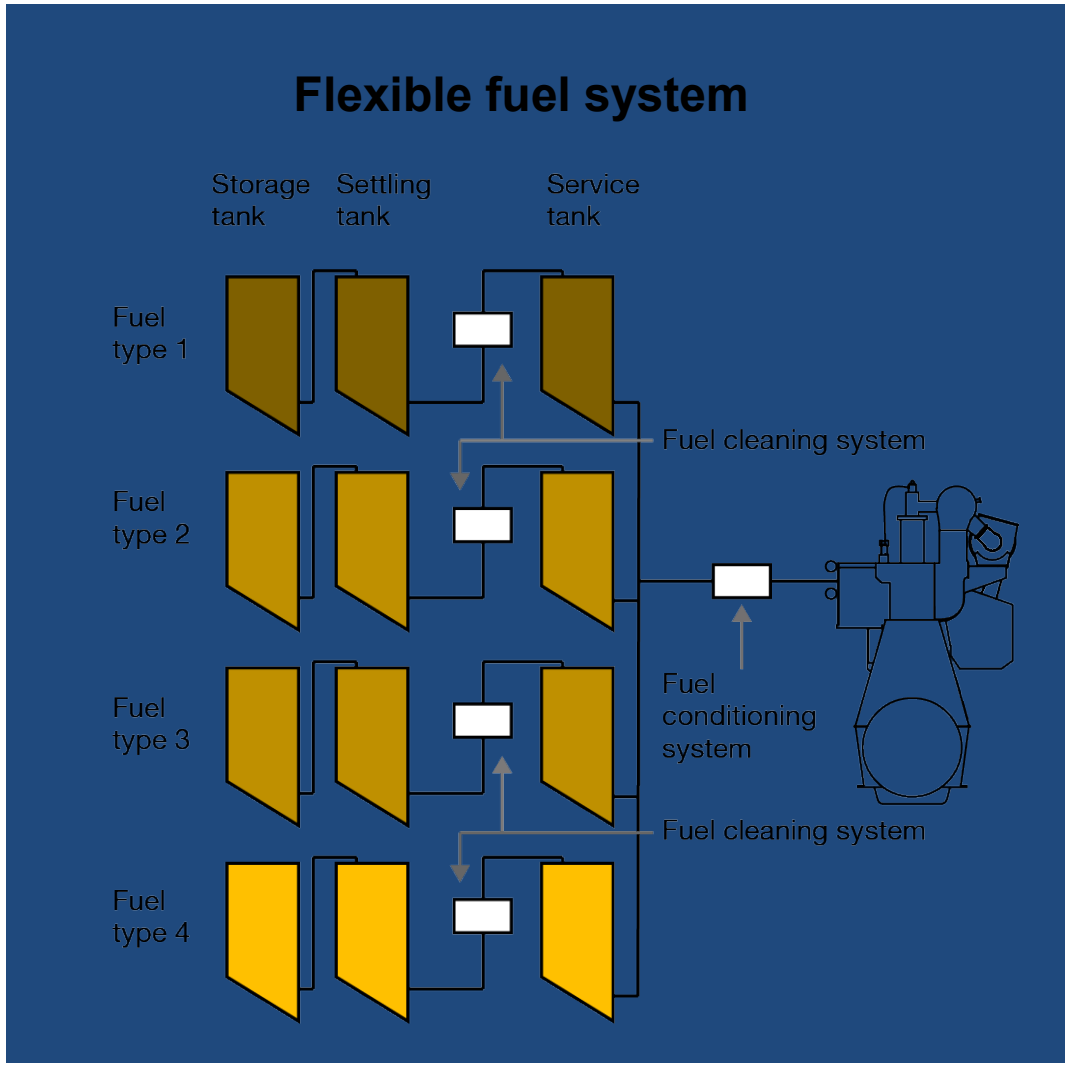


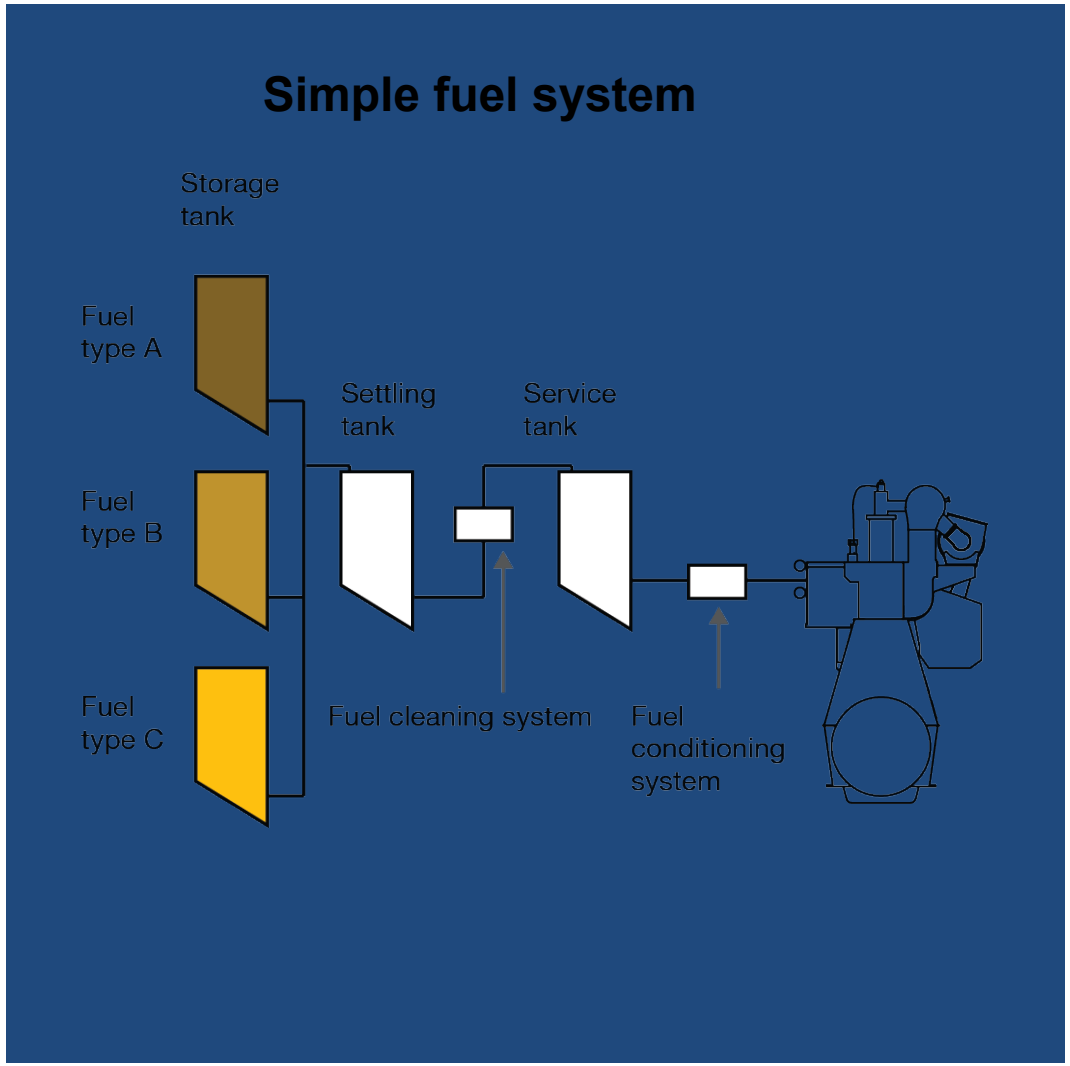
Viscosity

Clean the fuel



Fuel system – schematic examples





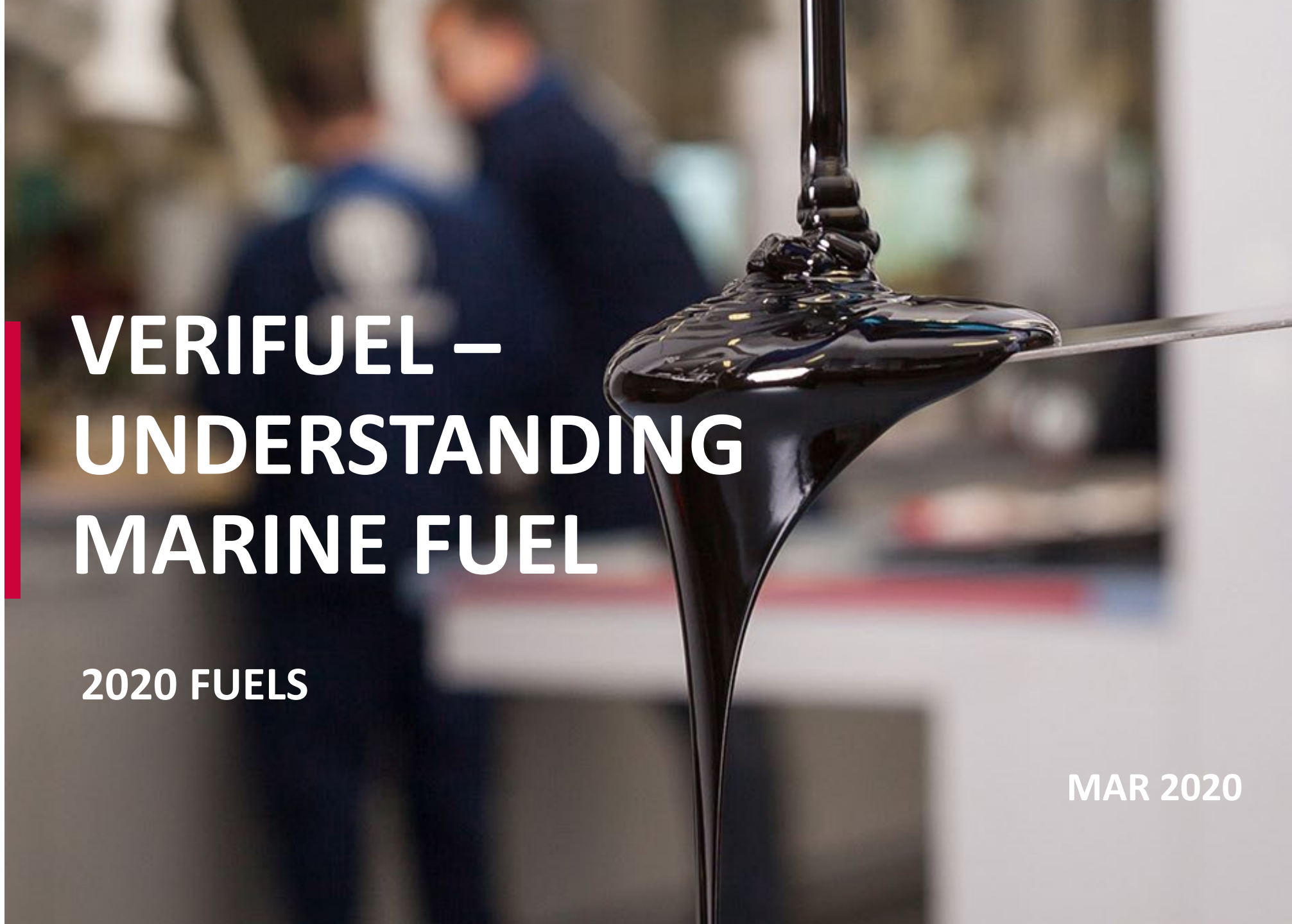
Disclaimer

All data provided in this document is non-binding.
This data serves informational purposes only and is especially not guaranteed in any way.
Depending on the subsequent specific individual projects, the relevant data may be subject to changes and will be assessed and determined individually for each project. This will depend on the particular characteristics of each individual project, especially specific site and operational conditions.

WG7 ‚Fuels‘ CIMAC Webinar - The Global Sulphur Cap 2020

Thank you very much!

Kjeld Aabo
Sales and Promotion Two stroke Marine MAN Energy Solutions
Member of WG ISO 8217 & Chairman CIMAC Fuels



VERIFUEL – UNDERSTANDING MARINE FUEL

2020 FUELS

MAR 2020

MYTHBUSTERS

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

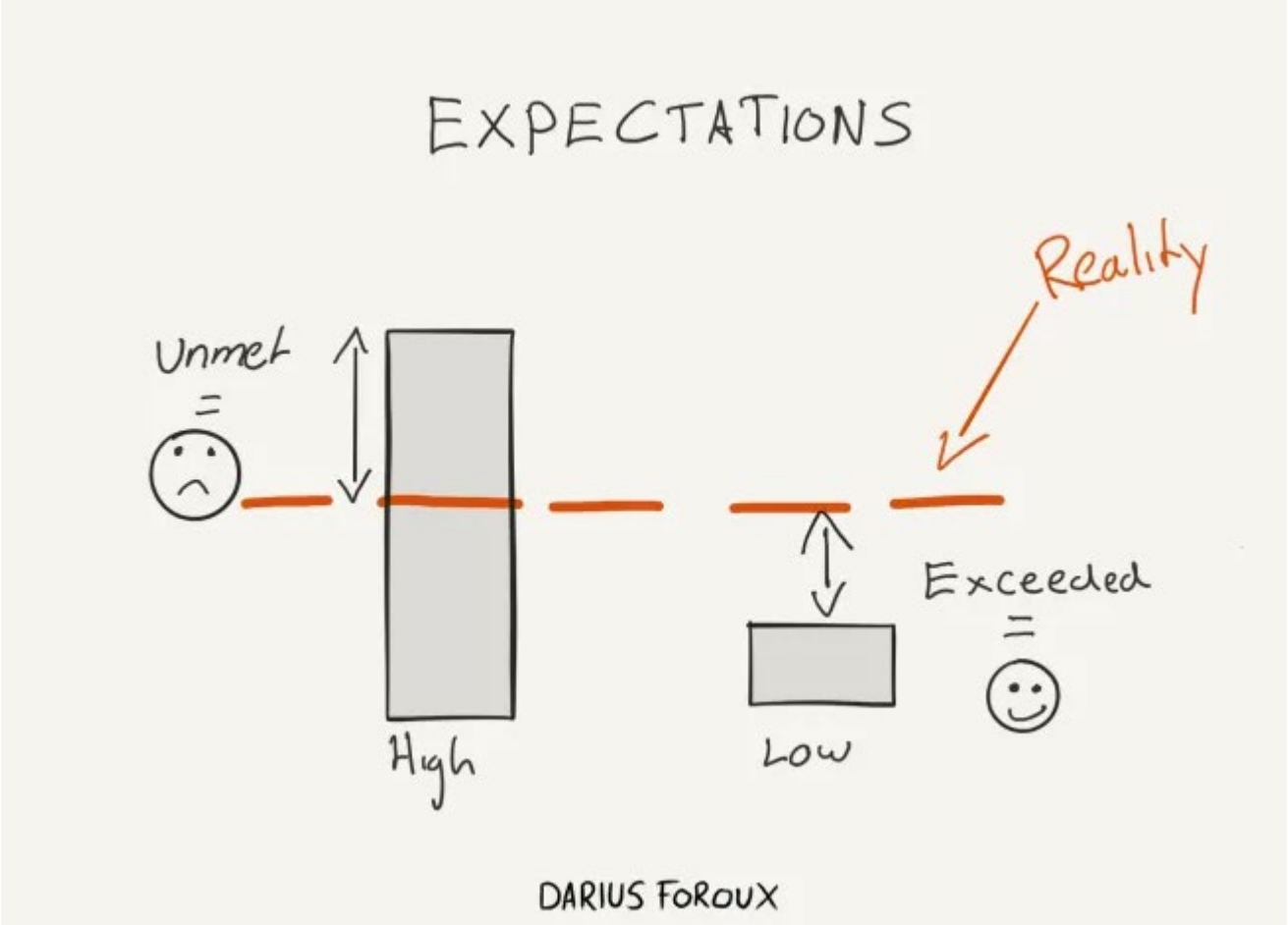
Myth No 5: Cat fines will be a big problem for the VLSFOs

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.

BUREAU VERITAS

VLSFO
PRE-2020 EXPECTATIONS

- More paraffinic fuels
- Larger variation in viscosity
- Geographical variations



VLSFO
HOW DO THEY LOOK?

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Understanding Marine Fuel

Parameter	VLSFO (Jan-Apr 2020)			HS HFO (Jan-Apr 2020)
	Average	Min	Max	Average
Visc@50°C (cSt)	110.6	2.239	600.0	291.7
Dens@15°C (kg/m^3)	935.4	828.6	989.4	980.6
Sulphur (% m/m)	0.46	0.06	0.73	2.66
Sediments (% m/m)	0.03	<0.01	Unfilterable	0.04
MCR (% m/m)	5.43	<0.10	15.82	13.18
Pour Point (°C)	76%*	<-33	33	99.9%*
Al+Si (mg/kg)	19	<1	66	23
Ash (% m/m)	0.021	<0.010	0.099	0.043

* Number of samples with PP < 21°C

BUREAU VERITAS

ALL FUELS
AVERAGE ENERGY CONTENT

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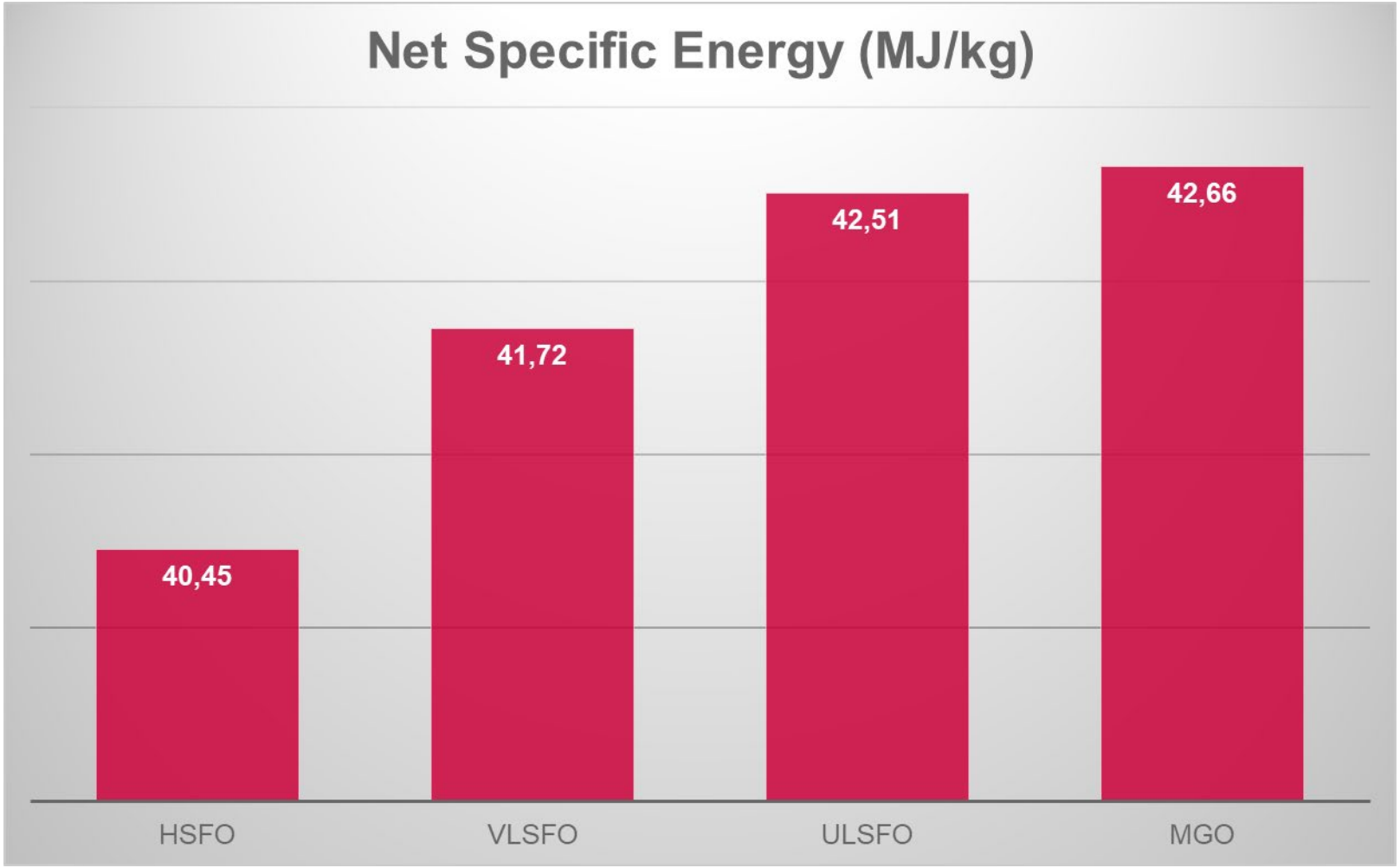
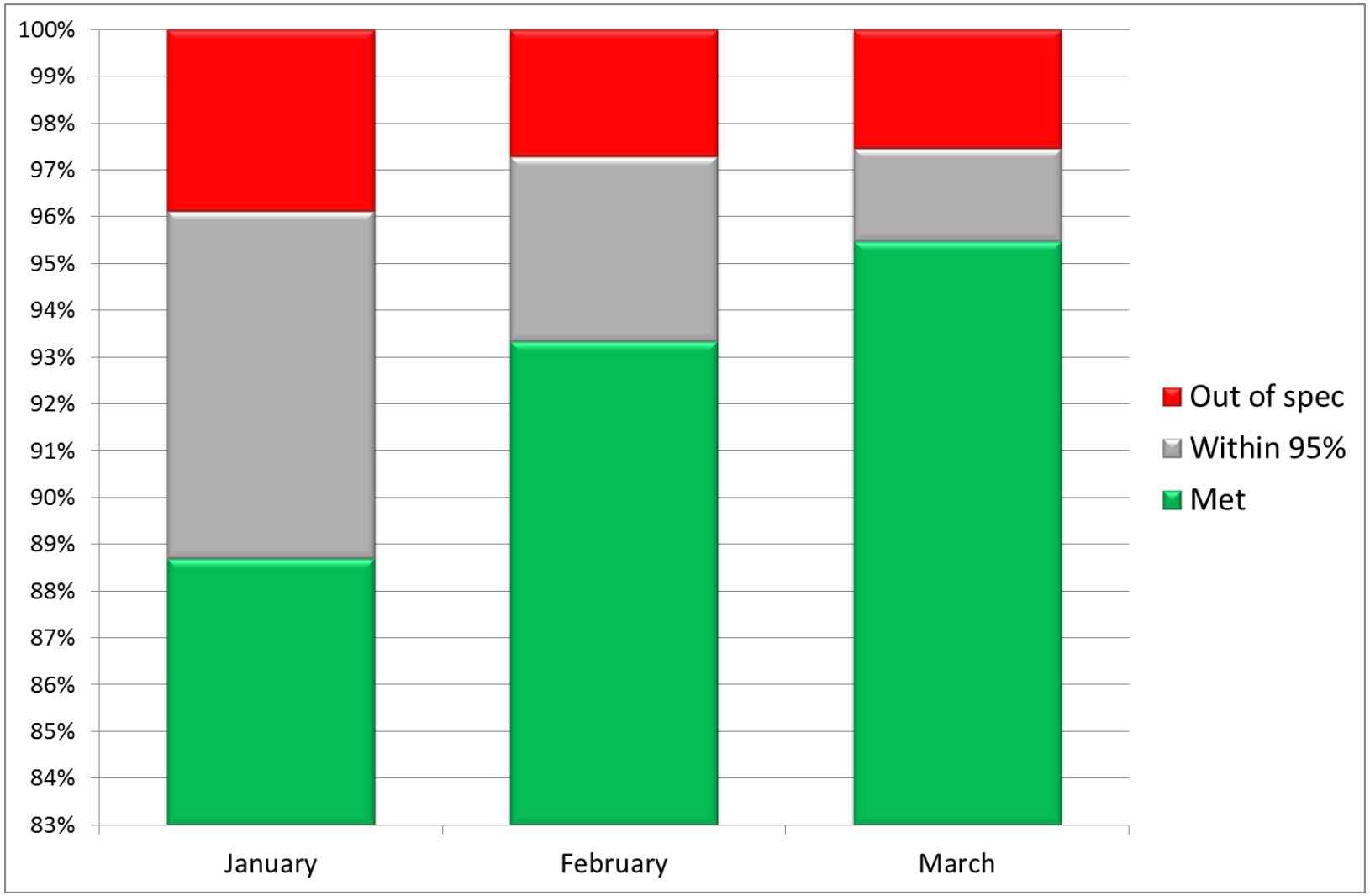
Understanding Marine Fuel



BUREAU VERITAS

VLSFO – Q1 2020
SPECIFICATION REPORTS



VLSFO – Q1 2020
AVERAGE BY PORT

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Understanding Marine Fuel

Port	Visc@50			Dens@15	Sulphur	TSA	Al + Si	AN	MCR	CCAI	NSE	% Off Spec	Main reason for Off Spec
	Min.	Max.	Avg.										
Algeciras	46	367	205	947.0	0.49	0.03	16	0.16	6.7	817	41.61	0	
Antwerp	8	372	59	935.8	0.49	0.05	20	0.24	4.6	827	41.76	13	Sulphur and Sediments
Balboa	12	321	71	930.6	0.47	0.05	23	0.20	3.9	818	41.81	3	Sediments
Busan	4	209	74	934.1	0.44	0.02	6	0.41	3.5	823	41.81	11	CCAI
Fujairah	23	329	143	930.9	0.47	0.03	16	1.28	6.6	805	41.79	0.6	Sulphur
Gibraltar	16	356	135	940.1	0.48	0.02	17	0.21	5.7	816	41.70	0	
Hong Kong	20	291	105	951.2	0.47	0.03	29	0.94	5.9	829	41.56	1	Sulphur
Houston	6	338	74	925.1	0.42	0.05	18	0.32	3.2	812	41.90	6	Sodium
Las Palmas	22	352	106	954.5	0.48	0.04	25	0.19	6.6	835	41.51	0	
Malta	11	340	84	931.3	0.49	0.03	23	0.31	6.1	816	41.80	5	Sulphur
Novorossiysk	8	78	39	910.2	0.47	0.03	4	0.12	2.2	804	42.11	6	Sediments
Piraeus	9	232	36	918.8	0.45	0.04	10	0.05	4.9	816	41.91	6	Water
Rotterdam	7	266	61	942.0	0.49	0.05	23	0.42	4.6	834	41.66	8	Sediments
Santos	9	56	19	921.2	0.43	0.01	11	0.25	2.6	826	42.00	0	
Singapore	9	366	98	941.5	0.47	0.03	23	0.74	5.5	821	41.64	1	Water

BUREAU VERITAS

VLSFO
Q1 2020

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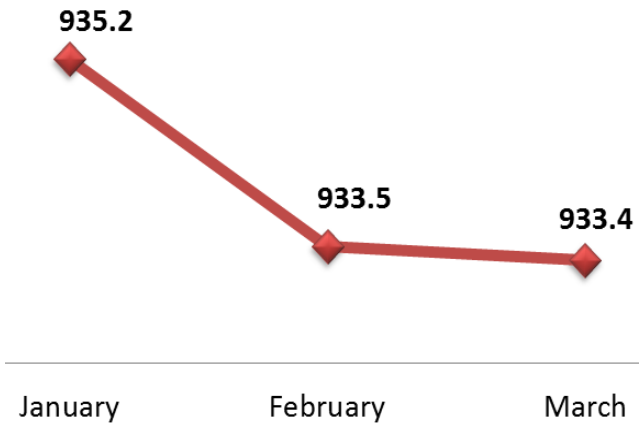
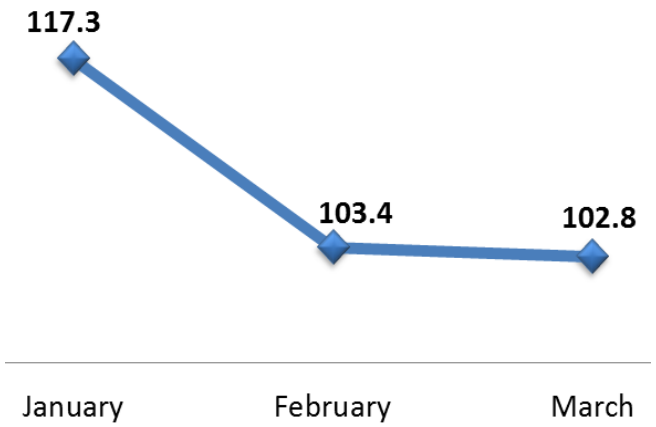
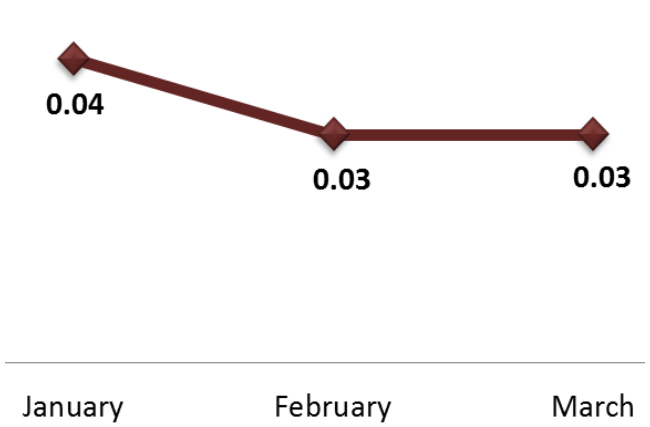
Dens@15°C (kg/m3)



Visc@50°C (cSt)

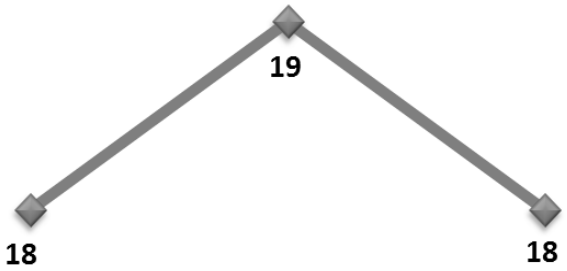


Total Sediments (% m/m)

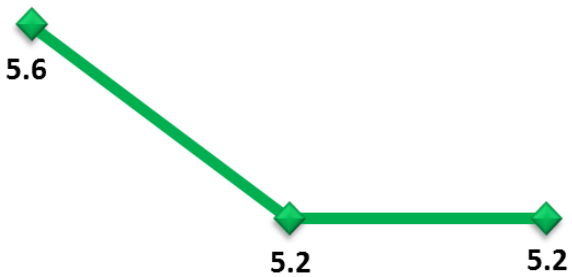


Sulphur (% m/m)

Al+Si (mg/kg)



MCR (% m/m)



BUREAU VERITAS

VLSFO
Q1 2020

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Visc @ 50°C (cSt)	Average TSA (% m/m)	TSA and/or TSP >0.10% m/m
<10 cSt	0.05	12.2%
10 - 30 cSt	0.04	4.7%
31 - 60 cSt	0.04	3.1%
61 - 100 cSt	0.03	2.6%
101 - 150 cSt	0.03	1.1%
>150 cSt	0.03	0.15%

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

BUREAU VERITAS

2020 FUELS
PROBLEMS ENCOUNTERED

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Below cases are confirmed meaning that barges‘ samples have also been tested in joint analyses:

1. Unstable fuels affecting separators and filters (7 cases)
2. Dirty fuels (grit, clay, sand) affecting separators and filters
3. Unusual odour (ARA, Sweden and Fujairah, no H_2S presence)

2020 FUELS
HOW MUCH TESTING IS REQUIRED?

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Understanding Marine Fuel

Otoscope cones &

Additional tests required

ISO 8217 scope is the Otoscope cone,
i.e. the starting point and usually enough

BUREAU VERITAS

Move Forward with Confidence

Charlotte Røjgaard – Global Head of Marine Fuel Services
Charlotte.rojgaard@dk.bureauveritas.com