



**BUREAU  
VERITAS**

# IMO2020 OVERVIEW

## FUEL QUALITY AND PROBLEMATIC CASES

IUMI

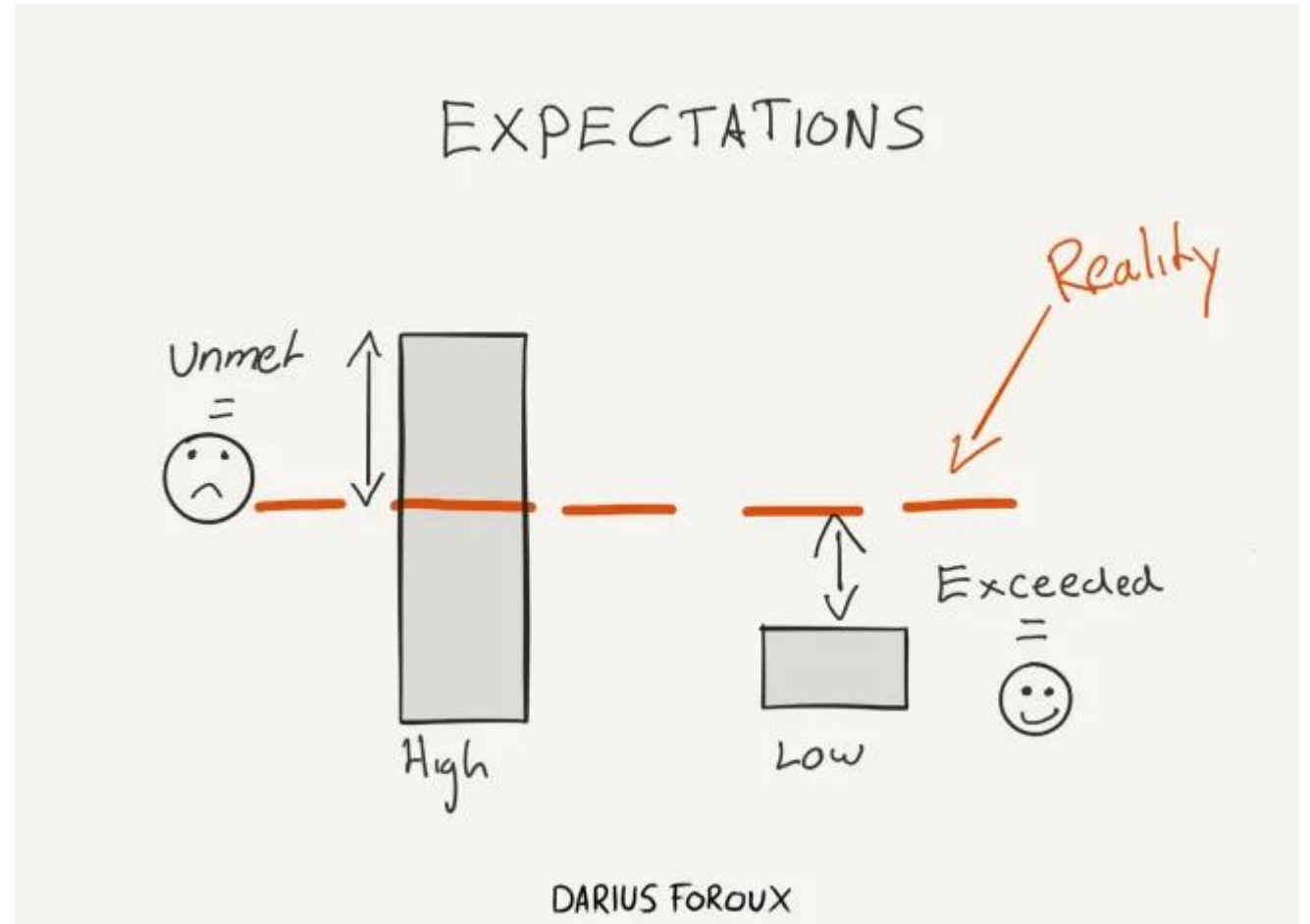
27 Jan 2021

Verifuel - understanding Marine fuel

# VLSFO

## PRE-2020 EXPECTATIONS

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



# VLSFO

## HOW DO THEY LOOK ?

Parameter	VLSFO			HS HFO	LS MGO
	Average	Min	Max	Average	Average
Visc@50°C (cSt)	107.7	2.233	692.5	299.7	3.701
Dens@15°C (kg/m <sup>3</sup> )	936.4	828.6	1055.5	981.3	854.7
Sulphur (% m/m)	0.46	0.05	3.03	2.74	0.06
Sediments (% m/m)	0.03	<0.01	Unfilterable	0.04	
MCR (% m/m)	5.44	<0.10	16.66	13.20	
Al+Si (mg/kg)	18	<1	121	23	
Ash (% m/m)	0.021	<0.010	0.104	0.041	
Pour Point (°C)	77%*	<-33	39	97.1%*	84.3% / 98.4%**
CFPP (°C)					83.9% / 93.4%***

\* Number of samples with PP < 21°C

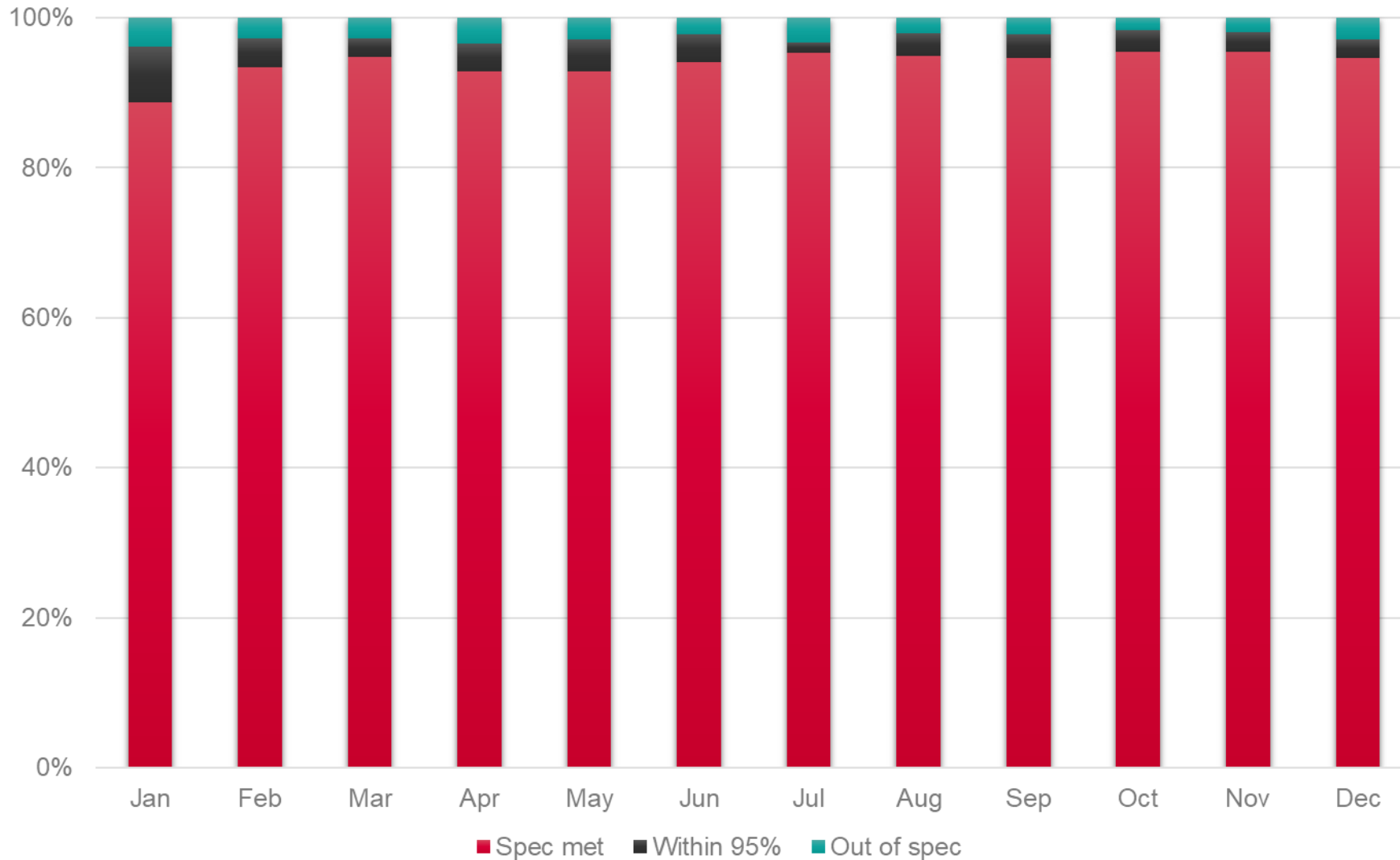
\*\* Number of samples with PP ≤ -6 °C / PP ≤ 0 °C

\*\*\* Number of samples with CFPP ≤ 6 °C / CFPP ≤ 12 °C

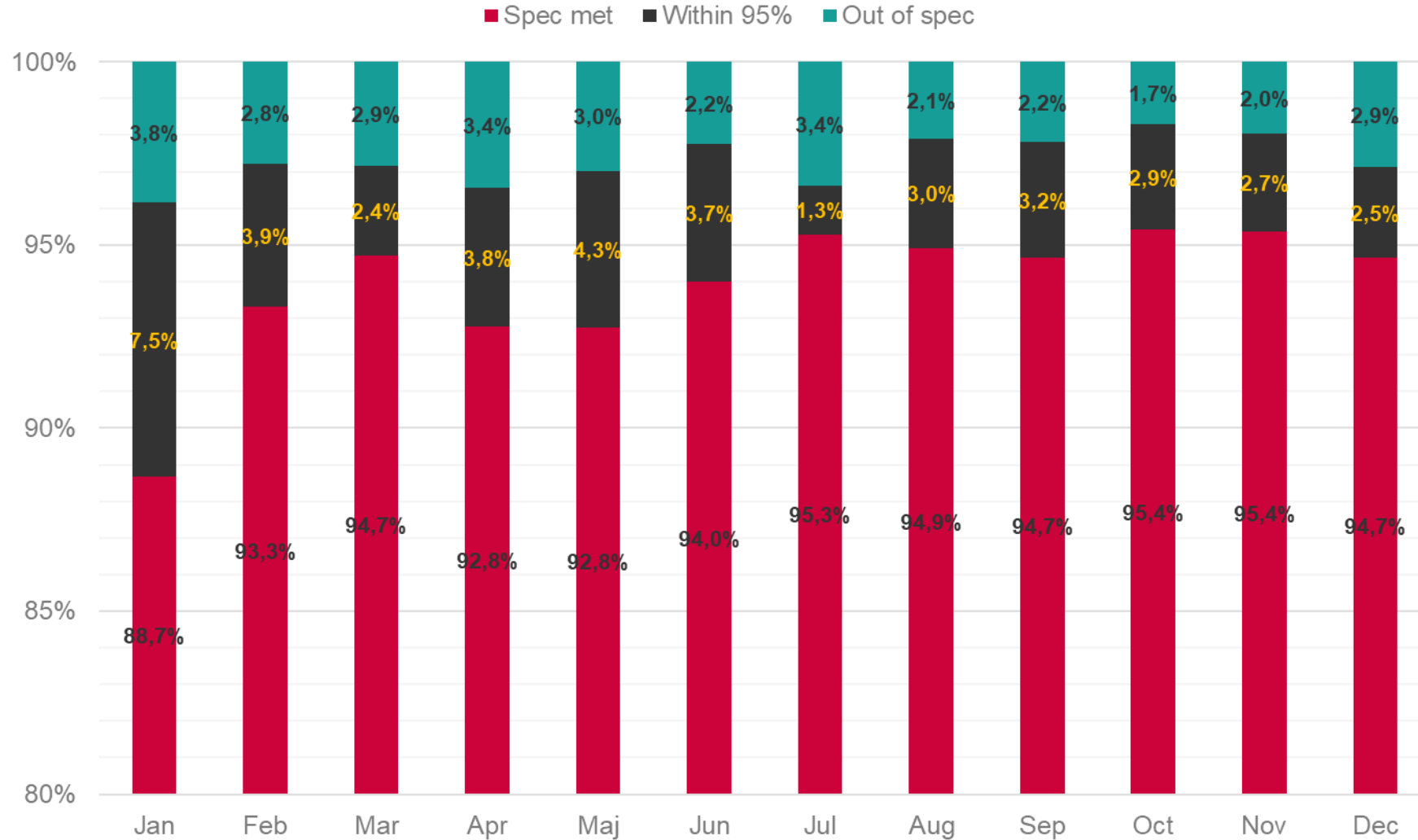
# VLSFO - 2020 AVERAGES

Port	Q	Viscosity	Density	Sulphur	Sediments	Al+Si	Acid Number	MCR	CCAI	NSE	% Off Spec
Global	Q1	108	933.9	0.46	0.03	18	0.50	5.3	816	41.77	3
	Q2	105	934.8	0.46	0.03	17	0.53	5.3	816	41.76	3
	Q3	106	937.3	0.46	0.03	18	0.55	5.4	818	41.72	3
	Q4	112	940.0	0.46	0.03	19	0.60	5.9	819	41.68	2
Houston	Q1	74	926.1	0.42	0.05	19	0.34	3.2	813	41.90	6
	Q2	62	929.4	0.44	0.05	24	0.34	3.0	815	41.86	0
	Q3	48	944.9	0.46	0.05	34	0.18	3.0	835	41.65	7
	Q4	48	945.8	0.44	0.06	40	0.12	3.1	834	41.65	7
Rotterdam	Q1	62	942.3	0.49	0.05	23	0.42	4.6	834	41.65	7
	Q2	65	941.1	0.48	0.07	21	0.51	4.8	827	41.66	7
	Q3	70	952.1	0.48	0.04	23	0.77	5.1	835	41.50	6
	Q4	67	953.1	0.47	0.04	24	0.52	5.7	838	41.52	4
Fujairah	Q1	143	931.0	0.47	0.03	16	1.28	6.6	805	41.79	1
	Q2	129	928.2	0.48	0.04	14	1.20	6.3	803	41.80	0
	Q3	154	925.8	0.49	0.03	11	1.48	6.6	798	41.82	4
	Q4	132	919.9	0.48	0.03	9	1.48	6.2	795	41.93	0
Singapore	Q1	98	941.5	0.47	0.03	23	0.74	5.5	821	41.64	1
	Q2	91	938.3	0.47	0.03	21	0.73	5.2	818	41.68	1
	Q3	90	939.6	0.47	0.03	19	0.76	5.0	819	41.66	1
	Q4	95	942.1	0.47	0.03	19	0.97	5.5	821	41.62	1

# WORLD 2020 VLSFO SPEC REPORTS



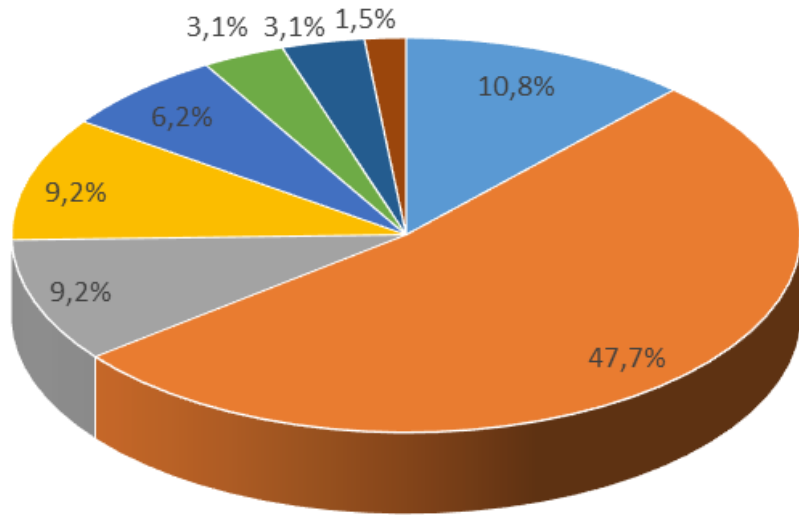
# WORLD 2020 VLSFO SPEC REPORTS



# WORLD 2020

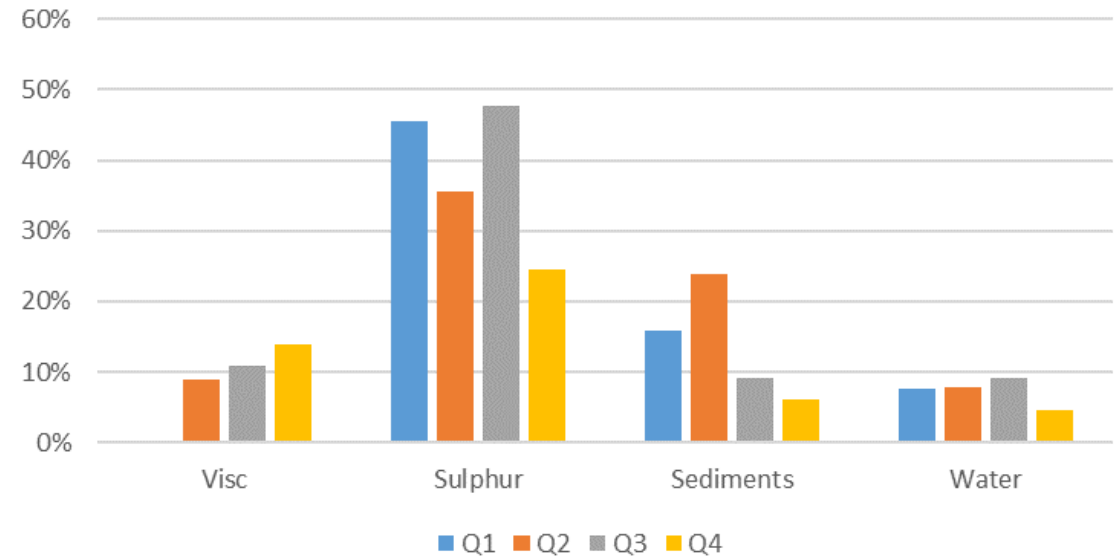
## VLSFO: 95% CONFIDENCE INTERVAL

World 2020 - 95% confidence



■ Visc ■ Sulphur ■ Sediments ■ Water ■ Al+Si ■ PP ■ CCAI ■ FP

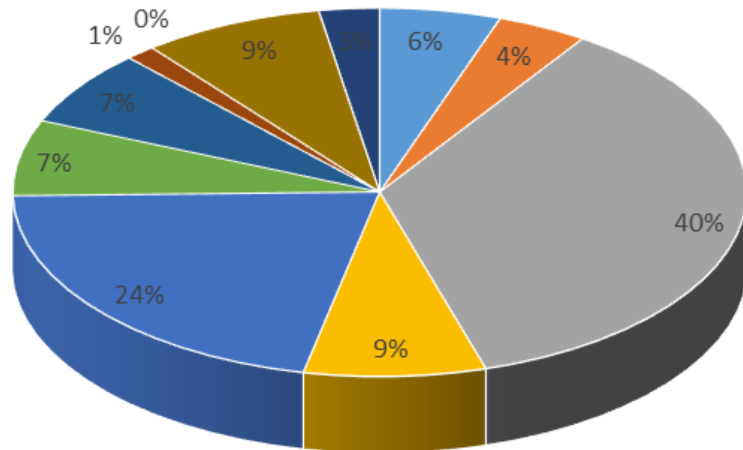
World 2020 - 95% confidence



# WORLD 2020

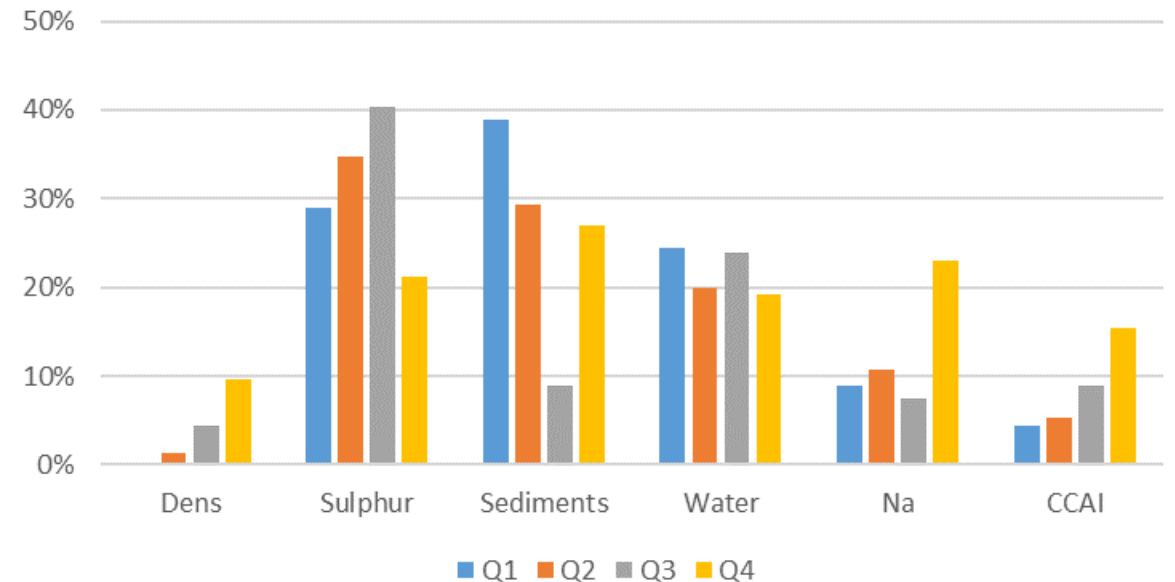
## VLSFO: OUT OF SPECIFICATION

World 2020 - Out of spec



■ Visc ■ Dens ■ Sulphur ■ Sediments ■ Water ■ Na ■ Al+Si ■ AN ■ PP ■ CCAI ■ ULO

World 2020 - Out of spec

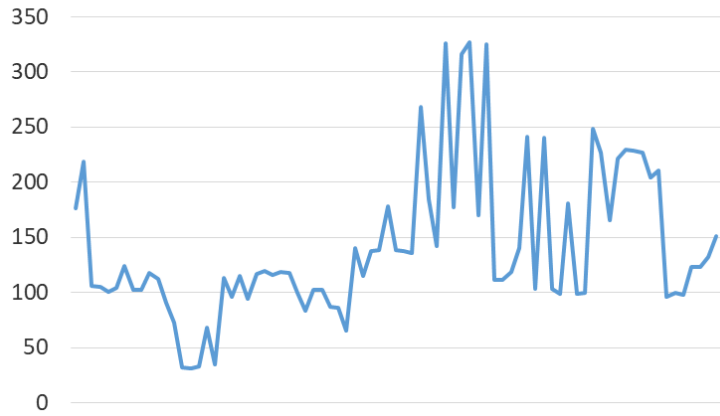




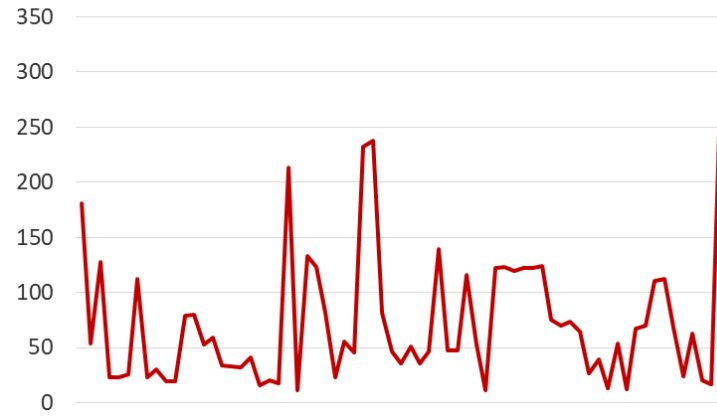
# VLSFO – 2020

## VISCOSITY @ 50 °C

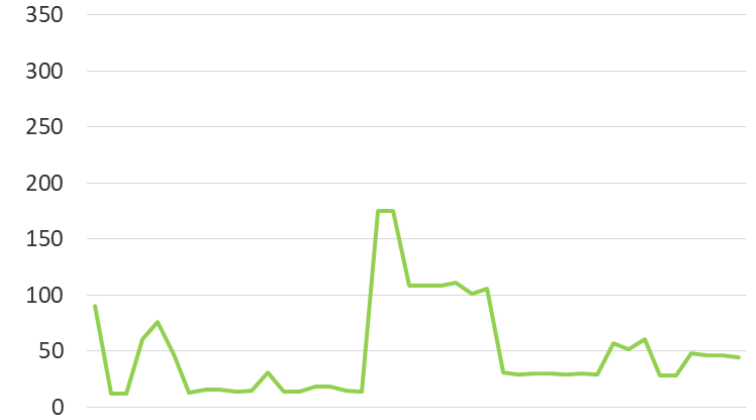
Supplier 1  
Fujairah



Supplier 2  
Malta



Supplier 3  
Balboa



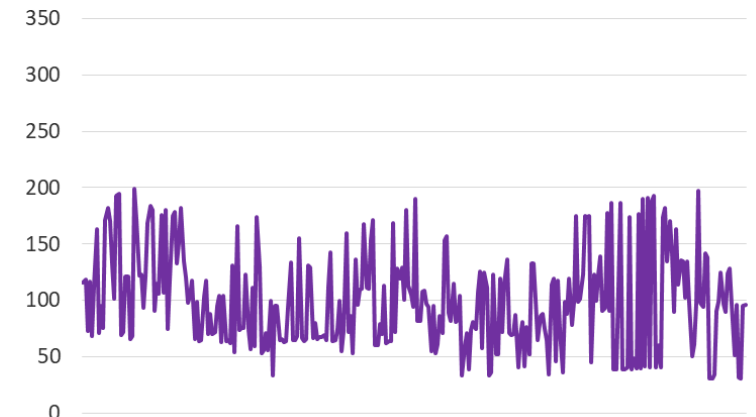
Supplier 4  
Novorossiysk



Supplier 5  
Singapore



Supplier 6  
Singapore



# VLSFO

## TEMPERATURE CONSIDERATIONS

PRODUCTS	A	B	C	D	E
Visc@50°C (cSt)	35.4	72.0	232.0	13	327.8
Dens@15°C (kg/m <sup>3</sup> )	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



**VLSFO**

**SERVICE EXPERIENCE**

# VLSFO 2020

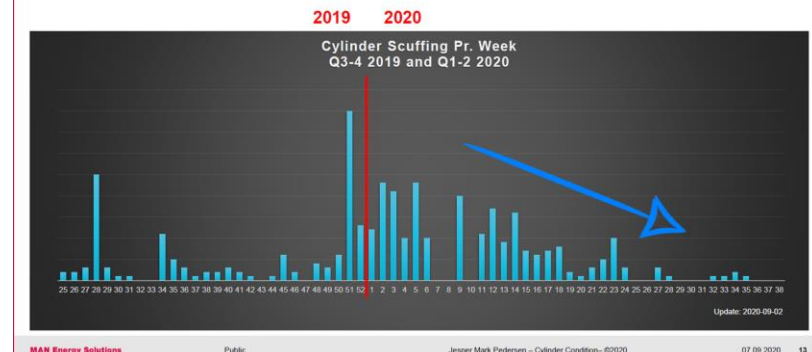
## MORE COMMON PROBLEMS ENCOUNTERED

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. Cylinder condition issues
  - Cat fines (inadequate tank cleaning, tank bottoms)
  - Lubrication
  - Missing cermet coated piston rings (MAN engines)

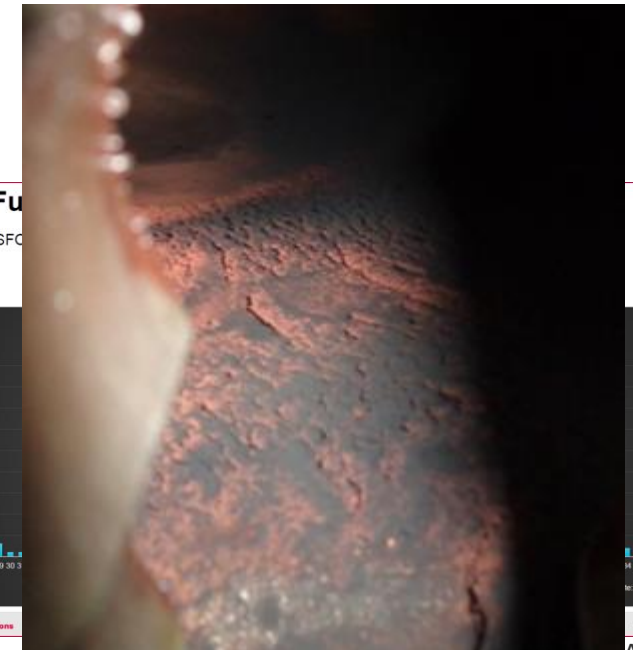


### 2020 Fuel switch

HFO to VLSFO

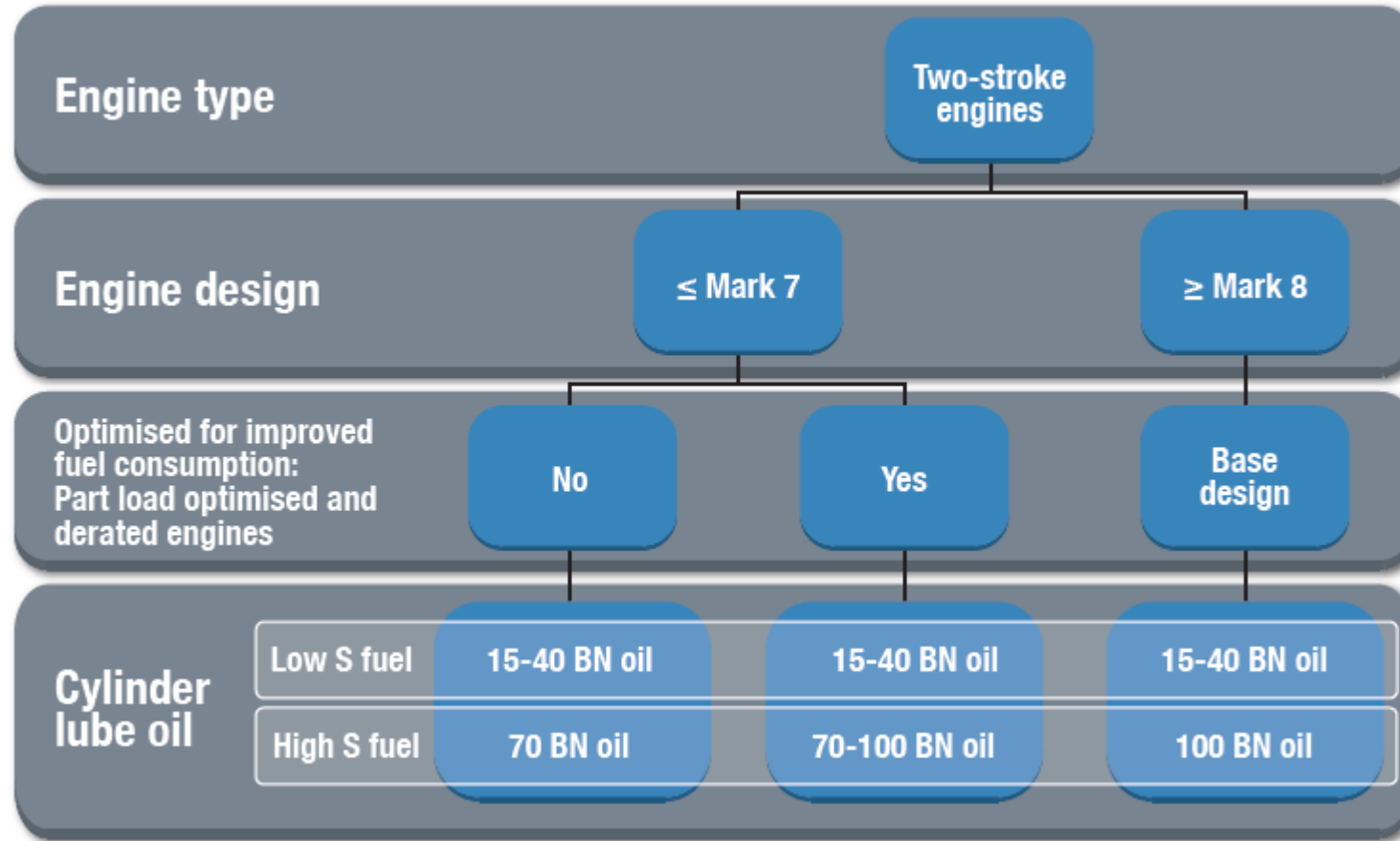


1. Unstable fuels affecting separators and filters
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3. Cylinder condition issues
  - Cat fines (inadequate tank cleaning, tank bottoms)
  - Lubrication
  - Missing cermet coated piston rings (MAN engines)
4. Unusual odour (ARA, Sweden and Fujairah, no H<sub>2</sub>S presence)
  - Xylenes, styrenes, cresols, limonene
  - No operational problems but HSE issue



# 2020 FUELS

## CHOOSING THE RIGHT CYLINDER LUBRICANT



Source: MAN Energy Solutions, SL2014-593

# 2020 FUELS

## IMPORTANT FOCUS POINTS

### ✓ Temperature management:

- Viscosities differ (e.g. 187 cSt in port A, 23 cSt in port B)
- Cold flow properties (if tanks, fuel lines and filters can be heated, then cold flow properties can be managed)
- Avoid heating fuels more than required to avoid disruption of stability reserve

### ✓ Compatibility

- Segregate each fuel to avoid mixing unless compatibility is guaranteed by supplier or by VeriFuel

### ✓ Do not burn the fuel until the analysis is available, if possible

### ✓ Study Certificate of Quality (CoQ) carefully before bunker operation



# VLSFO CASE STORY

## COQ VS TESTED

Parameters	Shore Tank (CoQ) Sample date: 14/12/20	Bunker sample Sample date: 01/01/21
Viscosity @ 50°C (cSt)	93.13	90.34
Density @ 15°C (kg/m <sup>3</sup> )	973.4	973.5
Sulphur (% m/m)	0.49	0.48
MCR (% m/m)	4.91	4.33
Vanadium (mg/kg)	2	3
TSA (% m/m)	0.01	0.18 (TSP 0.20)
Al+Si (mg/kg)	45	65

- Did the vessel receive fuel from bottom of the storage tank?
- Is the test result a consequence of poor sampling?
- Are the elevated sediments most likely due to "dirty" fuel?



# 2020 FUELS

## SLUDGING / FILTER CLOGGING

- ✓ Sludging is in many cases a consequence of the change over. Tanks and especially settling and service tank cannot be fully drained during a change over. This may lead to compatibility issues.
- ✓ Some cases of sludging is due to sediment levels increasing over time (the fuel has a poor stability reserve)

### Precautionary measures to avoid issues and/or to minimize impact when issues have occurred:

- ✓ Strip tanks in order to minimize the compatibility risk when bunkering a new fuel
- ✓ In case of bunkered fuel with sediments  $\geq 0.07\%$ , secure samples from tanks and before/after separator
- ✓ Adjust storage temperature to the lowest possible (based on viscosity and Pour Point) to minimize thermal ageing
- ✓ Drain settling tank and - during change over - fill it to 40-50% volume so that changeover is carried out faster
- ✓ Maintain lowest possible settling tank preheating temperature
- ✓ Based on experience, adjusting separator temperature up to +15 °C of recommended temperature may help (Note: Temperature should not exceed 98 °C)
- ✓ Maintain service tank to a low - safe margin - level in order to reduce change over time



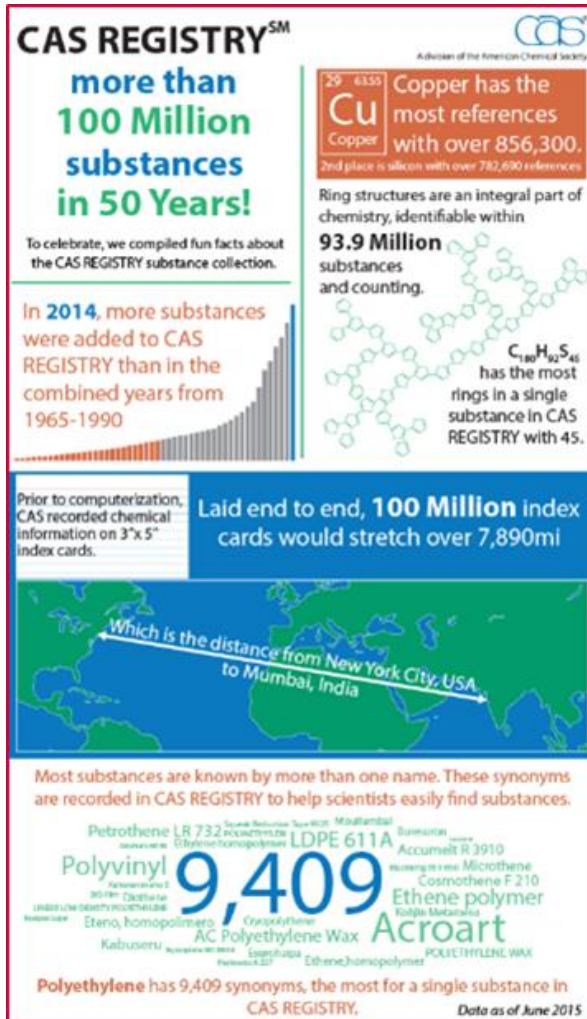


# INVESTIGATIVE TESTING

WHEN IS IT USEFUL

# VLSFO 2020

## CONTAMINATION OR NOT ?



Marine fuels:

- No one can tell you which chemical species are normal – and in which concentration
- No one can provide you with a full list of harmful chemical species – and in which concentration – or in which combination
- No endemic case has been detected by HS GCMS

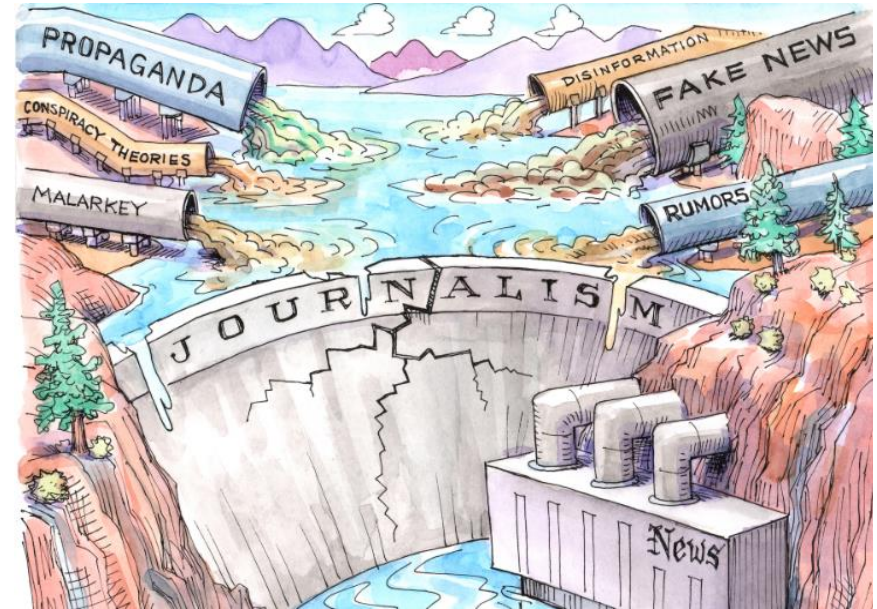
Cases where investigative testing has been useful:

- Polymers
  - ✓ Polystyrenes (2004?)
  - ✓ Polymethacrylates (2010-2011)
- Corrosive Russian fuels (2015) – oxidation testing
- Chlorinated hydrocarbons (2004)
  - ✓ But....
- Smelling fuels (2019-2020)

# 2018 FUEL INCIDENTS, THE AFTERMATH

## SCALING OF INFORMATION

- ✓ Role of media
- ✓ Role of social media
- ✓ Constant flow of updates from testing agencies
- ✓ Constant flow of the Culprit findings



Tall oil

Phenols

Shale oil

Fatty acids

None of it

# EXPLORING THE CHALLENGES THE NEED FOR TRANSPARENCY

## Suppliers side

- ✓ Clarity on the supply chain
- ✓ Traceability 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

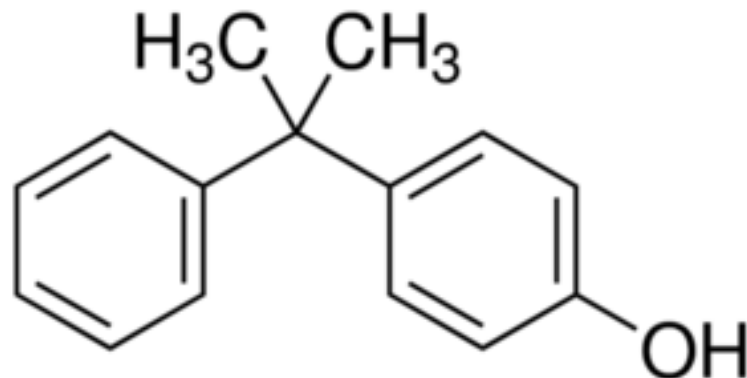
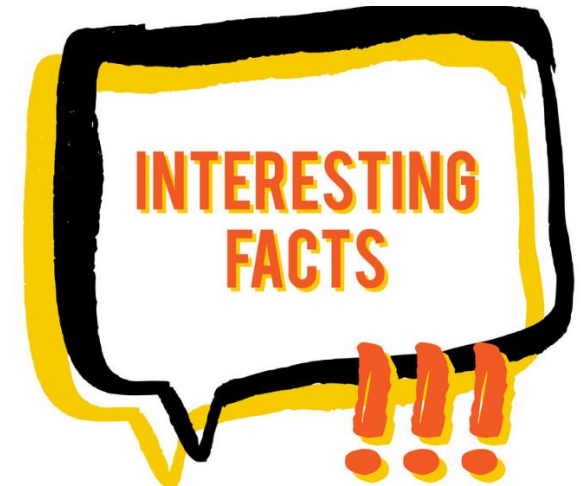
	Indene	C16 FA	C18 FA	C18:0 FA	C18:1 FA	4-cumyl-phenol
Nos	19%	30%	18%	10%	10%	20%
Average	335	61	192	240	105	312
Median	94	29	88	29	35	30
Min	-	-	-	-	-	-
Max	3230	984	3099	6563	1975	4400
Confirmed probs	22%	26%	41%	0%	0%	20%
Confirmed no probs	18%	16%	14%	19%	19%	18%
Unknown if probs	60%	59%	45%	81%	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

## ARE PHENOLS WELL UNDERSTOOD ?

From a marine fuel perspective - no, they are not...

Did you know:

- ✓ 4-cumyl-phenols were found in some of the 2018 fuels
- ✓ 4-cumyl-phenols were also found in harmless 2018 fuels from the US Gulf
- ✓ 4-cumyl-phenols are regularly found in fuels supplied in e.g. Fujairah
  - Concentrations as high as 4000 ppm (= 0.4%)
  - The operators burn these fuels with no problems...



# 2020 FUELS

## HOW MUCH TESTING IS REQUIRED?



Otoscope cones &

Additional tests required



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

# VLSFO 2020 SUMMARY

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







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# SHAPING A WORLD OF TRUST

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