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Oops! fuel oil sulphur content is out of limit.

It would be 9 months since the Sulphur max limit in fuel was implemented world-wide, starting from 1st Jan 2020, satisfying IMO regulation. New global sulphur limit has been reduced from 3.5% m/m to 0.5% m/m and for Emission Control Area (ECA) it is the same as before 0.1 % m/m.

Vessels are complying with this new regulation using either of two methods as stated below

- 1) Using compliant fuel, that is, sulphur limit meeting the requirements of IMO regulations.

or

- 2) Using alternative provision. where vessels can use fuel having more than 0.5% m/m sulphur provided fitted with approved scrubber system (EGCS-Exhaust gas cleaning system)

Bunkering process in brief:

As a normal practice the sulphur limit of a bunker is verified first in certificate of quality (COQ) provided by bunker supplier along with bunker nomination before the start of bunkering operation. The acceptance of bunker is granted if sulphur percentage and other parameters mentioned in COQ satisfy the requirements of IMO standards (MARPOL annex VI).

During bunkering, representative bunker samples are drawn and sealed in the presence of supplier and vessel’s representative. At least 4 samples are drawn, these are

1. Vessel Retention
2. Lab analysis
3. MARPOL
4. Bunker Barge

Depending upon further requirements more samples can be drawn such as MARPOL(Barge), Surveyor’s Sample etc

This article is concerning verification of sulphur percentage in fuel and it’s compliance hence the focus will only be on sulphur percentage of fuel not on other parameters.

Verification of sulphur percentage by vessels:

In my knowledge, right now, there is no approved onboard test method which could give, vessel’s representative, right to reject the bunker nomination on the basis of the result of the test.

Some vessels are provided with portable sulphur analysers but I doubt that can be used for rejecting the bunker nomination even if the results of it shows more than the limit (off spec). This is because the accuracy of onboard analyser can always be questioned and rejecting a bunker nomination without a solid ground may invite monetary disputes between supplier and vessel. In such situation vessel can safeguard her interest by giving a note of protest to the bunker supplier.

Following method is followed largely, onboard, for the verification of sulphur percentage in bunkered fuel.

The sample labelled as "Lab" is sent to shore-based lab for analysis. The lab analysis report is then used to verify the sulphur limit along with other parameters.

If the report shows sulphur percentage within limit vessel will continue to use it.

If the report shows off limit (off-spec) sulphur percentage, vessel will report this matter to all concerned parties and bunker supplier will be notified.

Case History

In a known incidence, a vessel bunker sulphur content mentioned in BDN was 0.49 % m/m. The representative sample of this bunker was tested at a shore-based laboratory. The sulphur content by lab was verified as 0.51%.m/m.

Vessel reported this matter to office/owners/charterers, supplier was notified. Supplier came up with following explanation

Quote

As far as Sulphur is concerned a result of 0.51% from a ships own sample is within the 95% confidence for the test and is therefore considered on spec. The test report as supplied should state that the result is within the 95% confidence interval and is therefore not deemed to be off spec.

I have enclosed a graph which demonstrates this as well as the CIMAC guidelines for interpretation of analysis results and Verifuel understanding ISO 4259 document.

As you can see the owners vessel tested sample can't be seen to be off spec until its outside the 95% confidence at 0.51 (i.e. 0.54%) (if it's in the grey, it's OK)

As such, 0.51, 0.52. 0.53% S on a vessel tested sample is on spec and the customer has no claim.

IF the vessel tested sample test outside the 95% confidence, i.e. 0.54% or over (the right side red colour), then that initiated the testing of the official, barge retained, BDN listed suppliers sample.

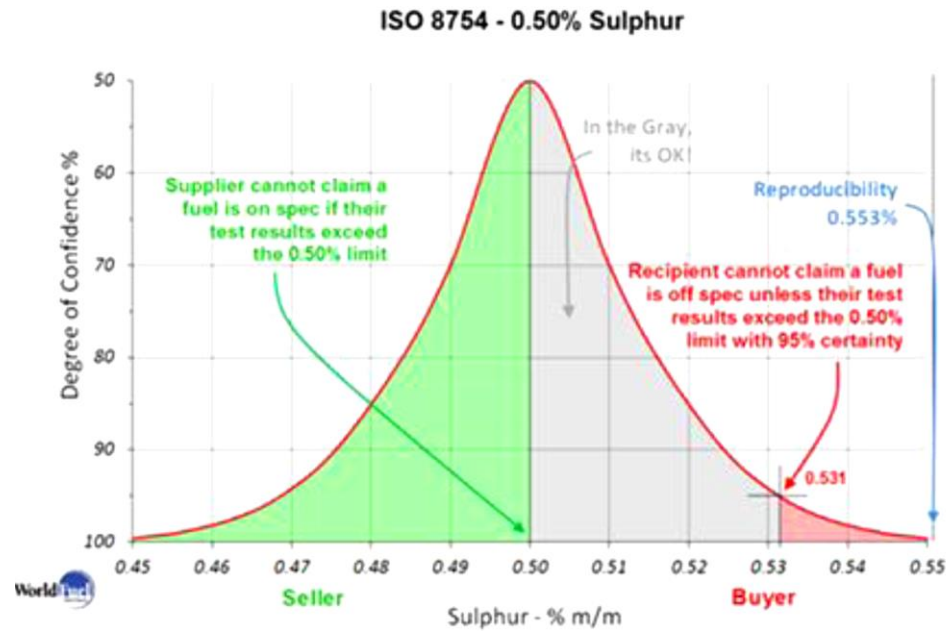
At that stage the supplier has a responsibility to deliver to the spec, so his official sample results must be at, or below the 0.50% specification.

All the above and the picture are representation of the CIMAC guideline – explaining how all the industry experts (including ISO 4259 Chairman) have interpreted ISO 4259, which is inherent in ISO 8217.

These principles apply to all test methods, not only Sulphur

Unquote

Quote



Unquote

Need to be understood

What is this 95% confidence?

In the simplest way it can be defined as the Statistical terminology used to provide a marginal deviation, variation, allowance or tolerance to the test results.

To understand further the 95% confidence principle following need to be understand

Repeatability – expressed as 'r' Is the closeness of agreement, usually found, between independent results obtained in the normal and correct operation of the same method on identical test material, in a short interval of time, and under the same test conditions (same operator, same apparatus, same calibration standard and same laboratory).

Reproducibility – expressed as 'R' Is the closeness of agreement, usually found, between individual results obtained in the normal and correct operation of the same method on identical test material but under different test conditions (different operators, different apparatus, different calibration standards and different laboratories).

The supplier and vessel test results come from two different labs hence reproducibility (R) of the test is used to define the acceptance limits of parameters (e.g. Sulphur percentage) causing disputes. The acceptance limits so defined will satisfy ISO 4259 this in turn helps in avoiding the unnecessary disputes generated from the marginal variation in test results.

For commercial marine fuel transactions, the 95% confidence testing boundary is given by ISO 4259 which is 0.59 times the reproducibility value (R); hereafter expressed as 0.59R. Whereas, in the usual case, there is a single test result, the value of R is that which is stated in the relevant test method. However, where multiple tests have been undertaken or where more than one laboratory has been involved in the testing this given R value is modified by the relevant equations as given in ISO 4259. It is to be noted that the confidence testing boundary for a characteristic is not an error margin; it is the direct result of the inherent reproducibility of the fuel test method.

How to arrive the upper acceptance limit?

As per ASTM D4294. Repeatability (r) in weight percent (wt. %) according to ISO 8754 for sulphur in concentration range of 0.03 to 0.05 wt. % (a) and greater than 0.05 wt. % (b). The target concentration is represented as S.

For a marine fuel the later equation is applicable as the target concentrations are 0.1% s m/m, 0.5 % s m/m and 3.5 % S m/m.

$$R=0.1781 \times (S+0.05)$$

$$R=0.0812 \times (S+0.15) \text{ – applicable for marine fuels}$$

Sulphur Limits (% m/m)	Target concentration (S)	Reproducibility $R=0.0812 \times (S+0.15)$	Upper acceptance limit = Sulphur limit+0.59 R
0.1	0.1	0.02	0.11
0.5	0.5	0.05	0.53
3.5	3.5	0.29	3.67

Reference to implications of ISO 4259 requirements, the recipient with a single test result above the specification limit but below the 'limit plus 0.59R' cannot claim that the specification has not been met and consequently has to accept that the product has met the specification and there is no requirement to carry out additional testing. The recipient can only consider that a maximum specification limit value has been exceeded if their test result exceeds the limit plus 0.59R.

Is it legally acceptable to use 95% confidence interval terminology for judging fuel samples having minor variation in sulphur percentage?

As per MEPC circular MEPC.1/Circ.882, 16 July 2019, "EARLY APPLICATION OF THE VERIFICATION PROCEDURES FOR A MARPOL ANNEX VI FUEL OIL SAMPLE (REGULATION 18.8.2 OR REGULATION 14.8)"

There are three types of samples.

1. MARPOL delivered sample means the sample of fuel oil delivered in accordance with regulation 18.8.1 of MARPOL Annex VI.
2. In-use sample means the sample of fuel oil in use on a ship.
3. On board sample means the sample of fuel oil intended to be used or carried for use on board that ship."

Representative samples provided with BDN in accordance with MARPOL, Annex VI, regulation 18.8.1 comes under "MARPOL delivered fuel oil sample" and the acceptable range for this is in accordance with table 1 as mentioned in the circular.

Table 1: Summary of Part 1 MARPOL delivered fuel oil sample procedure

On the basis of the test method referred to in regulation 2.52 of this Annex		
Applicable limit % m/m: V	Result 2.5.1: $X \leq V$	Result 2.5.2: $X > V$
0.10	Met the requirement	Not met the requirement
0.50		
Result "X" reported to 2 decimal places		

“in use sample” and “onboard samples” are tested in accordance with table 2 as mentioned in MEPC circular MEPC.1/Circ.882.

Table 2: Summary of in-use or onboard fuel oil sample procedure¹²

On the basis of the test method referred to in regulation 2.52 of this Annex				
Applicable limit %m/m: V	Test margin value: W	Result 4.5.1: $Z \leq V$	Result 4.5.2: $V < Z \leq W$	Result 4.5.3: $Z > W$
0.10	0.11	Met the requirement	Met the requirement	Not met the requirement
0.50	0.53			
Result "Z" reported to 2 decimal places				

It is evident from table 1 and table 2 that samples delivered with BDN (MARPOL delivered samples) are not given any allowance. Hence 95 % Confidence limit explanation cannot hold good to justify a marginal increase of sulphur content in bunker fuel sample from the limit ‘V’ mentioned in table-1.

95% confidence, or 0.59R (where R is the reproducibility of the test method) does not apply to MARPOL delivered samples as per table 1, the average test result from one laboratory must be at or below the applicable limit, e.g.0.10% or 0.50% sulphur, to be considered to have met the requirement of the regulation.

Reference to table 2 as shown above, 95% confidence principle can be applied to “in use sample” and “onboard samples”. meaning an average test result up to the limit +0.59R will be considered to have met the regulatory requirement. This means 0.50 % m/m sulphur VLSFO can go up to 0.53% m/m and LSMGO, 0.1% m/m sulphur can go up to 0.11. Please refer table 2 as mentioned above.

MARPOL Annex VI, Appendix VI, paragraph 2.2

If the result of X is greater than the applicable limit required by annex VI, Verification Procedure Stage 2 should be conducted; however, if the result of “X” is greater than the specification limit 0.59R (where R is reproducibility of test method), the fuel oil shall be considered non-compliant and no further testing is necessary.

This would mean, if Average test result of 2 MARPOL delivered samples is more than the limit (0.1, 0.5 %) required by annex VI the sample is still not considered off spec till the average is more than 0.59R that mean a for a 0.5% Sulphur fuel, average of test results cannot be considered off spec till it is more than 0.53%, in the same way for a 0.1% sulphur fuel, average of test results cannot be considered off spec till it is more than 0.11%

Summary:

1. Reference to **MEPC.1/Circ.882, 16 July 2019, table 1**, for a **MARPOL delivered sample**, test results have not given any allowance from its limits and fuel is considered to be not meeting the requirements if test results are greater than the specified limits 0.1 or 0.5. that mean 95% confidence principle cannot be applied for MARPOL delivered samples.

On the other hand, **MARPOL Annex VI, Appendix VI, paragraph 2.2** test results have been given allowance 0.59R from its limits and fuel are considered to be not meeting the requirements only when the test results are greater than test margin value 0.11% or 0.53%. more over MARPOL Annex VI, recommend the use of fuel satisfying ISO 8217 standards. ISO 8217 in turn uses ISO 4259:2017-2 and ASTM D4294 standards for the verification of test results as per 95% confidence principles hence can say that MARPOL Annex VI allows the use of 95% confidence principles for the verification of test results.

It is quite clear from above explanations that 95% confidence principles can legally be accepted for the verification of test results when the results show a marginal increase in the sulphur percentage from its limits.

2. Reference to **MEPC.1/Circ.882, 16 July 2019, table 1 and table 2** there are two different approaches of verification of test results. It is different for MARPOL delivered samples from "in use sample & onboard samples" which may cause confusion. Organisations like CIMAC, IBIA etc have raised concerned for not having the same principle in place for MARPOL delivered samples as it is used for in use sample & onboard samples. Some organisation has already recommended that IMO should be invited to re-consider the Annex verification procedure, taking into account the technical facts and the established commercial practice. If there is to be a robust and reliable enforcement of the sulphur limits, there needs to be a single universal unambiguous approach.
3. Incidence where a test result of a MARPOL delivered sample having minor variation in sulphur percentage from the limits specified by IMO and considered on spec basis 95% confidence still may invite an unwanted PSC extended inspection if not properly explained by vessel responsible staff/representative/chief engineer and PSC inspector may start suspecting it as a potential noncompliance. It is the responsibility of ship staff to explain their part in all respect so that an unwanted extended PSC inspection could be avoided.
4. Such incidences give rise to unwanted communication and documentation, waste lot of positive energy and snatch the peace of the mind of vessel staff. Hence it is the responsibility of the vessel staff to take a proactive approach in critical operations like bunkering and take all necessary precautions throughout the whole operation. In case of doubt, it is best to communicate with office. A proper planning, execution, monitoring and exercising due diligence during operation can save vessel staff from getting trapped in such Oops moments.

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- 15) Sulphur inspection guidance - European Maritime Safety Agency

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