Fuel Testing – no easy answers

Presentation documents:
Page 2: Charlotte Røjgaard, Bureau Veritas VeriFuel
Page 12: Steve Bee, Veritas Petroleum Services
VERIFUEL
UNDERSTANDING MARINE FUEL

Fuel Testing – no easy answers
(part of the Marine Fuels Webinar Week)
**Summary of alternative fuels basis design and fuel availability as well as IMO compliance potential:**

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Ship and engine design</th>
<th>Retrofit CAPEX</th>
<th>Availability 2020</th>
<th>IMO2030 compliant</th>
<th>IMO2050 compliant</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNG</td>
<td>Existing</td>
<td>Significant</td>
<td>Yes</td>
<td>Yes(^1)</td>
<td>Depends(^1)</td>
</tr>
<tr>
<td>LPG</td>
<td>Existing</td>
<td>Significant</td>
<td>Limited</td>
<td>Yes(^1)</td>
<td>Depends(^1)</td>
</tr>
<tr>
<td>MeOH and EtOH</td>
<td>Existing</td>
<td>Some</td>
<td>Limited</td>
<td>Yes(^1)</td>
<td>Depends(^2)</td>
</tr>
<tr>
<td>Biofuel</td>
<td>Existing</td>
<td>Little/None</td>
<td>Limited</td>
<td>Yes(^1)</td>
<td>Depends(^2)</td>
</tr>
<tr>
<td>Ammonia</td>
<td>Being developed</td>
<td>Likely significant</td>
<td>No</td>
<td>Yes</td>
<td>Yes(^2)</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>Being developed</td>
<td>Likely significant</td>
<td>No</td>
<td>Yes</td>
<td>Yes(^2)</td>
</tr>
</tbody>
</table>

\(^1\) In combination with ship energy efficiency gains  
\(^2\) Depends on the production and source

**Strategy…**

- Short term?
- Long term?
### VLSFO HOW DO THEY LOOK?

<table>
<thead>
<tr>
<th>Parameter</th>
<th>VLSFO (Jan-June 2020)</th>
<th>HS HFO (Jan-June 2020)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>Min</td>
</tr>
<tr>
<td>Visc@50°C (cSt)</td>
<td>107.4</td>
<td>2.239</td>
</tr>
<tr>
<td>Dens@15°C (kg/m³)</td>
<td>934.3</td>
<td>828.6</td>
</tr>
<tr>
<td>Sulphur (% m/m)</td>
<td>0.46</td>
<td>0.06</td>
</tr>
<tr>
<td>Sediments (% m/m)</td>
<td>0.03</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>MCR (% m/m)</td>
<td>5.32</td>
<td>&lt;0.10</td>
</tr>
<tr>
<td>Pour Point (°C)</td>
<td>78%*</td>
<td>&lt; -33</td>
</tr>
<tr>
<td>Al+Si (mg/kg)</td>
<td>18</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Ash (% m/m)</td>
<td>0.020</td>
<td>&lt;0.010</td>
</tr>
<tr>
<td>AN (mg KOH/g)</td>
<td>0.56</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

* Number of samples with PP < 21°C
VLSFO

"ISO 2010 OR ISO 2017 OR TIME FOR ISO 2020"

- ISO8217 applies to:
  - MGO
  - ULSFO
  - VLSFO
  - HSFO

- PAS was released in 2019 providing guidance to the industry
- The ISO8217 committee has initiated the work of the next revision
- It takes min. 3 years to develop an ISO standard
“STREAMLINING THE TESTING PROCEDURE”

“WHEN DIFFERENT LABORATORIES PRODUCE CONFLICTING RESULTS”

- Are the samples representative of the same fuel?
  - The test results are only as good as the sample received...
- Is the lab ISO17025 accredited?
- Do the labs use the same test method?
  - Compare apples and apples – or apples and oranges?
- Is the test method standardised or proprietary?
  - Transparency – does the lab accept witnesses?
- All test methods have an inherent level of test variability
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
  - 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
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

---

<table>
<thead>
<tr>
<th></th>
<th>Indene</th>
<th>C16 FA</th>
<th>C18 FA</th>
<th>C18:0 FA</th>
<th>C18:1 FA</th>
<th>4-cumylphenol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nos</td>
<td>27%</td>
<td>49%</td>
<td>29%</td>
<td>15%</td>
<td>19%</td>
<td>36%</td>
</tr>
<tr>
<td>Average</td>
<td>296</td>
<td>65</td>
<td>188</td>
<td>316</td>
<td>137</td>
<td>303</td>
</tr>
<tr>
<td>Median</td>
<td>78</td>
<td>30</td>
<td>85</td>
<td>28</td>
<td>35</td>
<td>31</td>
</tr>
<tr>
<td>Min</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max</td>
<td>3230</td>
<td>984</td>
<td>3099</td>
<td>6563</td>
<td>1975</td>
<td>4400</td>
</tr>
<tr>
<td>Confirmed probs</td>
<td>26%</td>
<td>29%</td>
<td>40%</td>
<td>0%</td>
<td>0%</td>
<td>22%</td>
</tr>
<tr>
<td>Confirmed no probs</td>
<td>22%</td>
<td>17%</td>
<td>14%</td>
<td>22%</td>
<td>24%</td>
<td>18%</td>
</tr>
<tr>
<td>Unknown if probs</td>
<td>52%</td>
<td>55%</td>
<td>46%</td>
<td>78%</td>
<td>76%</td>
<td>60%</td>
</tr>
<tr>
<td>Average if probs</td>
<td>105</td>
<td>66</td>
<td>131</td>
<td>-</td>
<td>-</td>
<td>277</td>
</tr>
<tr>
<td>Average if no probs</td>
<td>656</td>
<td>40</td>
<td>137</td>
<td>30</td>
<td>77</td>
<td>431</td>
</tr>
<tr>
<td>Average if unknown</td>
<td>240</td>
<td>71</td>
<td>253</td>
<td>395</td>
<td>156</td>
<td>269</td>
</tr>
</tbody>
</table>
"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
Move Forward with Confidence

Charlotte Røjgaard – Global Head of Marine Fuel Services
Charlotte.rojgaard@dk.bureauveritas.com
Marine Fuel Quality Testing: Recent Frequently Asked Questions?

• Steve Bee
• Group Commercial & Business Development Director
Fuel Types Are Proliferating….Is this the Right Strategy?

- Suppliers are simply trying to meet Market Demand driven mainly by Environmental Legislation.
- ISO8217: 7 x Distillate Grades, 11 x Residual Grades
- VLSFOs: 0.50% Sulphur with many composition variations
- Other Fuels:
  - ULSFOs
  - LNG - Methane, Ethane, Propane
  - Methanol, Ethanol
  - Bio-fuel
- **Jan-May 2020**: VLSFO most popular fuel choice in fuel supply mix.
- Bunkered Fuel Tested by VPS:
  - VLSFO - 67%, MGO - 16%, HFO - 15%, ULSFO - 2%
- The Future Demand:
  - Ammonia, H2: “Carbon-Free” - Future GHG & CO2 legislation
  - Other Power Sources: Solar, Wind, Fuel Cells

• VPS would always advocate “Use the latest revision of ISO8217”

• At this time, YTD:
  • 24% of samples tested to ISO8217:2005
  • 66% of samples tested to ISO8217:2010/12
  • 10% of samples tested to ISO8217: 2017

• ISO8217:2020
  • ISO WG working hard at present on the next revision of ISO8217
  • Don’t expect the revision before 2022.
Should Fuel Testing be Streamlined?

• Due to the more complex nature of today’s fuels, increased blending operations, wider variation in components...................... More testing is actually required, to ensure vessel protection, not less!!

• Jan-May 2019 v Jan-May 2020
  - 12 Bunker Alerts v 28 Bunker Alerts
  - 2020 Quality issues MGO/HFO/VLSFO

• 2020 Bunker Alert Parameters:
  - MGO - Flash Point (8), Viscosity (2)
  - HFO - Flash Point (3), Density (3), Catfines (1), Sediment (2), Potassium (1)
  - VLSFO - Sediment (5), Flash Point (2), Potassium (1)

• VPS “Additional Protection Service” includes ISO8217:2017, plus further vessel protection tests.
How Can Different Laboratories Produce Different Results?

- Sample Quality?

- Consistent Laboratory Results obtained when:
  - Reputable Laboratories: Participate in regular independent inter-lab correlation programmes
  - **VPS is ISO17025 accredited for every ISO8217 test method in all 4 laboratories**......Confidence + PoM !!
  - ISO8217 contains Internationally Recognised Test Methods: ISO, ASTM, IP
  - For ISO17025 accredited laboratories, testing samples to international test methods:
    - Any Variation between results should be within the **Reproducibility of the Test Method**.
      - “The Robustness of a Test Method” determined through “Round Robin” programmes
      - 95% confidence limits: +/- 0.59 x Reproducibility (R)
Is Fuel Contamination and Phenol in particular still a concern?

- VPS identified 1-4 Cumyl Phenol as the contaminant in Houston fuel in 2018
- Huge issue with over 200 vessels affected.
- No cases recorded from Q3-2018, possible it won’t happen again.

- Fuels can contain many chemical entities, but usually at very low concentrations. No issue.
- Occasionally “spike” in a chemical component.
- Recommend vessels undertake chemical contamination screening via GCMS-HS
  - Pre-burn test.
  - Detects 70% of chemical contaminants

- **Increased levels of blending fuels opens up more potential for contamination**

- Recently:
  - Vessel in US burnt a DMA fuel, which was clear, bright and on-spec to ISO8217
  - Within 20 mins of using this DMA, vessel suffered major failure due to severely blocked filters
  - **VPS investigative analysis identified cause to be Polyethylene in the DMA.**
Thank you for your attention!

YOUR FUEL MANAGEMENT PARTNER

Steve.bee@v-p-s.com
+44 7500 848351