Fuel Testing – no easy answers

Webinar Q&A summary:
CR | Charlotte Røjgaard, Bureau Veritas VeriFuel
SB | Steve Bee, Veritas Petroleum Services
Congrats Steve and Charlotte for the great presentation! When it comes to contaminants, what are your opinions on pyrolysis oil?

CR | Pyrolysis is a process to convert the chemical composition through heating under anaerobic conditions. It can be used on various materials, e.g. biomass, plastic or rubber to convert these into liquid components. After the pyrolysis process, the oil can be refined in a refinery. Pyrolysis oil consists of various organic components and the composition depends on the source. Although pyrolysis components are likely present in many marine fuels without us knowing about it, it does not always go well. Some years back tyre oils were used as blend component in a fuel supplied in Singapore. How did we know? Because it contained small tyre pieces that blocked the filters.

SB | Pyrolysis oil is a biocrude obtained by heating dried biomass without oxygen in a reactor at a temperature of about 500 °C with subsequent cooling. Pyrolytic oil is a kind of tar and normally contains levels of oxygen too high to be considered a hydrocarbon. This high oxygen content results in non-volatility, corrosiveness, immiscibility with fossil fuels, thermal instability, and a tendency to polymerise when exposed to air. As such, it is distinctly different from petroleum products. As such it would be considered a contaminant under Section 5 of ISO8217 as it is not derived from petroleum products.
Who has to do the testing? The fuel supplier or customer (due to obligation by law or protection of own equipment?) what are the costs for it?

CR | Fuels are being tested in various locations of the supply chain basis request from suppliers/buyers. There are no mandatory requirements for testing.

SB | ISO8217 is a commercial standard allowing an agreement between the buyer and the seller in terms of the quality specification. It is not a mandatory requirement. Therefore, it is normally the receiving vessel, who pays for testing in order to protect the vessel, crew and environment. Pricing can vary depending upon the tests required and the volume of tests per vessel per year.
Talking about the quality of LNG, what is the (worldwide) minimum methane number to be expected when bunkering?

CR | The methane number depends on the actual LNG and there are regional differences. As such, the minimum methane number would depend on the bunker port.

SB | Methane Number of LNG can vary across the globe falling anywhere from 70-100. Knowledge of engine knock characteristics, characterised by methane number of LNG is crucial for suppliers to provide reliable, efficient product and for the end user to secure optimal engine operations.
What about quality standards for "future" fuels such as LNG, Bio-LNG, hydrogen

CR | Addressed during the webinar.

SB | ISO are currently working on the LNG standards. As for hydrogen as a marine fuel, it is still very early days in the development of this fuel as a viable option for ships.
How far away are we from a "future" fuel ISO quality standard

CR | As mentioned, it takes min 3 years to develop an ISO standard. The ISO 8217 committee has kicked the work on the next revision off.

SB | The next revision of ISO8217 is expected around 2023, hopefully it will include many more fuel types. Plus the ISO standard for LNG will separately go alongside the new ISO8217.
To Charlotte, as an ISO wg member can you indicate when the new ISO8217 is to be expected? And how does it cope with the challenges/requirements the VLSFO has brought to market?

CR | See answer above. The ISO 8217 committee is currently evaluating the VLSFOs in the market and this information will be used in the work revising the specification.
WRT the phenol and your statement on 4,000 ppm not causing issues: did you also look into the combination of (phenolic) compounds found in GCMS?

CR | Addressed during the webinar.
Why aren't the global authorities making the latest ISO8217 mandatory for the industry?

CR | ISO 8217 is a voluntary commercial standard. It can be mandated if the authorities apply it in their legislation.

SB | Good question and maybe one for the IMO to answer? Of course all testing companies would welcome mandatory testing.
How does one come to the casual relationship between the component(s) found and issues taking into account temperatures, pressures, pressure drops, other products in the tanks etc?

CR | I assume this refers to establishing a link between components found and operational issues. It is a big work as the question indicates. In addition to look at the vessels that experienced problems and the actual fuel composition, it is necessary to collect information from non-harmful fuels. Is that specific component present in non-problematic fuels? Which concentrations are we looking at. Then this information must be compared to operational data from the vessels. Overall it is a large and expensive task. That is part of the reason that so few components have been fully evaluated. Few companies are willing to spend the money making the full investigation.

SB | This is achieved by the testing company having a high level of both chemistry and marine engineering expertise and experience. VPS introduced marine fuel testing to the world back in 1981 and have 40 years of experience, during which time we’ve tested millions of samples from all over the world. VPS have also developed many tests to assist in detailed fuel investigations, which have helped many customers make successful claims, based on our validated forensic findings.
Why are so few selling/buying to ISO 8217 : 2017 standard?

**CR** | Addressed during the webinar.

**SB** | A combination of availability and price. However, ISO8217:2017 will provide the best protection with regard to the purchase and use of today’s fuels.
What do the GCMS tests really mean? We have had many tests with the same results with different outcomes.

CR | I assume the question is : We find the same component in various fuels but the operational experiences are different? It is likely that the observed operational difficulties are not linked to the specific component. Or there may be a concentration/combination aspect that is not being addressed. Please also see the answer to question 10.

SB | This is quite a complex question to answer. Firstly, you need to know the chemistry of the contaminant you are looking for, in order to apply the correct sample preparation technique prior to GCMS in order to identify the chemical entity in question. For example, GCSM-Head space analysis will see volatile chemical groups such as chlorinated compounds, styrene, DCPD, but it will not detect acids. Whereas, GCMS-Acid Extraction, will detect acids and phenols and only these acidic compounds. GCMS-Vacuum distillation, will identify chemicals over specific boiling ranges. Therefore you need to use a testing company with experience and expertise in GCMS in order to be sure they apply the correct GCMS technique.
What can we do to help the ships staff to get the cylinder lube oil correct? Every fuel seems to need a different approach?

CR | Addressed during the webinar.

SB | The sulphur level of the fuel is key in helping determine the appropriate lube oil, as the lube oil is there to neutralise the acidic effects of the sulphur oxides produced when burning the fuel. A combination of “Sweep Tests” on the lubricant in order to help ascertain the correct feed rates and then Scrape Down Analysis of the cylinder lubricating oil will be key, along analysis of the fuel itself. Use a fuel testing company which can test both fuel and oils and give an overall assessment of the condition of both.
Bunker suppliers to not want to supply to latter standards

SB | To be a little fairer, it's all about supply and demand. If the buyer of fuel insisted on only the latest standard, then I am sure the supply chain would accommodate the demand in order to retain business. However, as with all things, the more work which goes into producing a product, usually the higher the cost. What brings costs down is usually higher demand and the greater levels of production.
Are owners using the GCSM test as a way out of off hire?

CR | Is the question that GCMS is used on a proactive basis to prevent problems? If so, it was addressed during the webinar.

SB | Not to my knowledge.
I would love to hear the views on LPG as fuel

CR | The technology for using LPG as fuel is there. LPG can be used. It is still a niche fuels used by relatively few operators with success, I believe.

SB | No comment.
The effect of DHDCPD and THDCPD is as harmful as DCPD? If not why?

CR | There is no link between these components and operational problems. In fact, according to VeriFuels database, DCPD can be found in 4% of the tested fuels. Of these 4%, in only 8% of the cases were the fuel associated with operational problems. The remaining 92% of the fuels were consumed with no problems.

SB | There are many forms of Diene, ie a specific chemical group. Diene’s all contain a chemical double bond which allows them to react and form polymers, irrespective of the specific diene in question. It is the formation of these long-chain polymers which can block ship’s filters, fuel pumps etc, causing operational problems. The temperatures, pressures and other conditions can all affect diene reactivity, with specific dienes reacting differently depending upon these conditions, but ultimately in a similar fashion to each other.
Optimum value of phenol and resorcinol in Bunker fuel

CR | There is no link between these components and operational problems. Only once a link between the components and operational problems have been established, it will make sense to look for a correlation between concentration and risk of operational problems.

SB | I am not sure of the question. But just to say, in general the concentrations of chemicals within fuels can all react differently depending upon storage and handling conditions of the fuel, temperatures, transfer rates, engine types, etc.
ISO8217 cannot reveal chemical contaminant. So why GCMS not to be added as compulsory test?

CR | There are two aspects of this question:

1) ISO 8217 cannot add a test method if it is not standardised. ASTM D7845 is the only industry acknowledged GCMS standard, however, the number of components covered by ASTM D7845 is limited. All other GCMS methods are in-house / proprietary methods which cannot be included in ISO 8217.

2) Once a standardised method is available, you need clear links between the concentration of a specific component and operational problems in order to include that component in ISO 8217 with a limit. However, these correlations are not established by the industry.

SB | There are literally hundreds of thousands of chemicals, all with different behaviours and reactivity. GCMS is not a single test, but a detection technique at the end of a sample preparation and analysis process. As there is such a huge range of chemicals, each of these will require a certain level of sample preparation which will differ dependent upon the chemistry. So in essence there is not one single GCMS test method, but many options and variations which can be used.
Time bars are an issue for lodging complaints so waiting for operational feedback is problematic as it may be too late? Hence screening could be helpful in this regards.

CR | Perhaps. However, if there are no links between the risk of experiencing problems and specific components, how good is the screening? I would reverse the question: How often did you experience problems with a fuel where screening had indicated "unusual components"?

SB | Absolutely true. VPS can include and return a chemical screen result, with the other ISO8217 tests within 24 hours of receipt of sample. This then provides a greater level of protection to the vessel.
Why do shipowners still rely on older ISO8217 standard, i.e. 2010/12 instead of newer version - is it due to the shortage of availability?

CR | Charter party agreements may refer to older spec versions. Suppliers may not guarantee the latest spec.

SB | It is a mixture of availability in certain ports/suppliers, customer choice, charter party agreement contracts.
Is it possible to buy a fuel for ISO8217:2017 and still test it for ISO8217:2010?

CR | Yes - VeriFuel reports are set up for this. In fact, Table 1 and Table 2 parameters / limits are the same for ISO 8217:2010/2012 and ISO 8217:2017.

SB | It is always recommended to test the fuel against the specification to which it was purchased. This then helps in terms of any claims case.
Are you seeing any issues in relation to flashpoint with the new VLSFOs?

CR | No.

SB | No unduly high cases of off-spec flashpoint is being seen with VLSFOs at this time. The main concern with VLSFOs is regarding stability and cold-flow properties. It is distillate fuels which show greater numbers of flashpoint problems.
Is the use of shale oil in VLSFO blends a cause for concern?

CR | Addressed during the webinar.

SB | Shale oils are now very much in the general fuel supply chain. The components will vary depending upon the geographical location in which they are originally sourced, just as crude oil varies. Shale oil usually contains large quantities of olefinic and aromatic hydrocarbons. Shale oil can also contain significant quantities of heteroatoms. A typical shale oil composition includes 0.5–1% of oxygen, 1.5–2% of nitrogen and 0.15–1% of sulphur and some deposits contain more heteroatoms. Mineral particles and metals are often present as well. If its known, that shale oil is present within a marine fuel, then we can act accordingly in respect of fuel management and handling.
Why the latest revision of ISO 8217 is not always used?

CR | Addressed during the webinar.

SB | Please see the answers above.
How often should contamination screening be carried out? Should it be proactive then reactive?

CR | Addressed during the webinar.

HS GCMS has never prevented an endemic fuel case, like the 2018 fuel incidents. Also, screening is not quantitative. Investigative testing has been used reactively to solve some contamination cases over the past decades.

SB | As chemical screening is relatively inexpensive, VPS would recommend carrying this out proactively, with every bunkering, in order to have the result prior to burning the fuel. This along with your ISO8217 results will enhance your level of protection.
Why ISO 8217-2010/2012 is called so (i.e. two dates?)

CR | ISO 8217:2010 was released in 2010. Shortly after, the test method for H2S was updated. As per ISO regulations this was a significant update which could not be covered by an addendum. Instead the full spec had to be revised. As such, very few items are different between ISO 8217:2010 and ISO 8217:2012. The critical parts of the specifications are identical.

SB | The ISO8217:2010 was the revision with the greatest level of change from the 2005 specification. However, there were some minor amendments made for 2012, including: Pour point limits for DMX gas oil weree removed from Table 1

There was a change in the test method for Hydrogen Sulphide (H2S), which was updated to IP 570-12A (Vapour Phase Processor). This change improves the accuracy of the test. The parameter limit was unchanged at 2.00 mg/kg

Clause 2 “Nominative references” longer stated the reference year for the test methods.
Completely disagree; sulfur content is NOT the only consideration for lubricants; inherent fuel characteristics and combustion phenomena have more relevance.

CR | Well...Happy to discuss lubrication requirements and how the lubricants are designed with whomever sent this question.

SB | This is a comment not a question, but a valid comment. In addition, I would add lubricating oils are present for their detergency properties and protective properties, as well as the neutralisation properties.
Would the revision in fuel legislation only impact fuel quality (as in more refined or not) or its composition also (as in type or amount of additives added to fuels)? Are they also tested in laboratories?

CR | Legislation is what IMO or local authorities do. The ISO 8217 committee evaluates whether the existing spec meets the industry needs, whether new parameters should be added, whether the existing limits need an update etc.

SB | Legislation has affected refining techniques, fuel composition (blend components, diluents, etc) and the use of additives. All of which are and can be tested.
When should the ISO 2020 revision should be expected? Would it be reasonable to assume that all the fuel should be compliant to ISO 2017 for the next 5 yrs at least (since even now not all the fuel tested is not compliant with 2017 but with 2010/12 as sho

CR | Addressed during the webinar.

Fuels are purchased to specification and should met the spec as supplied. However, only way to verify that the fuel meets the spec and that it complies with the IMO sulphur regulations is through testing.

SB | Never assume a fuel is compliant. Whilst ISO8217:2017 is a good standard and is the best we have available at this time in offering protection for today’s fuels, please note the reason why the standard requires regular revision, is because of the evolution of fuels over time.
Would it be possible to resolve the issues with VLSFO by adjusting the additives composition in the fuel?

CR | Depends on the issue. For waxy fuels, pour point and/or CFPP can be suppressed by use of additives. These should preferably be applied at the terminal. A fuel cannot be turned stable once it has broken, i.e. gone unstable. Whether additives can successfully be applied on a preventive basis to prevent incompatibility, i.e. adding them prior to mixing two unstable fuels, is the question. There is no evidence supporting that an instability - once happened - can be reversed by use of additives.

SB | It depends upon the issue and the fuel parameter in question. Of course we have seen stability additives and pour point improvers used in fuels for many years, with good effect in the majority of the cases. Certain VLSFOs will, I am sure also benefit from such treatments in certain scenarios.
Please talk about the "spread" of low sulphur residual fuels (RMA 10, RMB 30, RMD 80) compared to "classic" grades. Wherein lies the most significant variance? combustion quality, contaminants, PM emissions?

CR | Addressed during the webinar.

SB | A very wide-ranging question, but in general, VLSFOs vary greatly in their density, viscosity, cat-fine levels, cold-flow properties and stability, due to the wide variation in their component make-up. The only true commonality is the fact they have a sulphur level of 0.50% sulphur. In addition their energy content tends to be higher than HFO.