innospec

TECHNICAL BULLETIN

TECHNICAL INFORMATION
DILUTING CHEMICAL CONTAMINATION

Chemical contamination of residual Fuel Oil is not a new topic. Blending of waste materials into the fuel has historically been seen as a suitable way to dispose of waste, and it can also happen inadvertently. Either way, this can lead to operational problems on the vessels and environmental contamination. The problem is even more acute with Very Low Sulphur Fuel Oils. Whilst fuel additives cannot resolve the issue directly, they can play an important role in a commonly used solution

What contamination is being observed?

The contamination of the fuel can be with almost any material, so it is impossible to give a comprehensive list. However, below are some examples of contaminants that have been observed by Innospec on a regular basis, along with their associated problems:

Dihydro dicyclopentadiene and tetra hydro dicyclopentadiene – They are very reactive compounds, which can oxidise/polymerise to form sticky gum type deposits in the tanks and engine. (DCPD) with heating polymerizes and make gum solids. These solids causing problems to the fuel pump plunger and barrels as the gap between them is less than 10 microns.

Phenolic compounds – the common source of these compounds are from cashew nutshell oil. This contamination also adds Potassium to the fuel. The Potassium is ash forming which can cause post combustion problems.

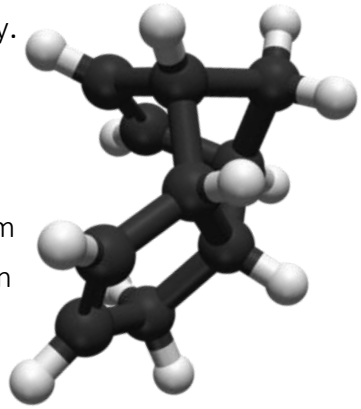
Engine Injector

Chlorinated Compounds – contaminated with Chlorinated compounds can lead to the emission of hazardous materials, such as dioxins from the stack. They can also lead to poor combustion.

Inorganic Acids – Inorganic acids are extremely corrosive to metal surfaces. If this contamination is present, It is likely to accumulate in any water bottoms and then corrode metal that is in contact with this water.

Polymers – common polymers, such as polystyrene, polypropylene and polymethacrylate. Are not soluble in the fuel. They will accumulate on filters and narrow sections of pipework, restricting fuel flow.

How common is chemical contamination?



As a general statistic, fuel testing labs generally find contamination in around 5-10% of all fuel oil samples tested (it varies significantly by time period, and also geographically. Not all of these will cause issues it's important to note. The types, levels, and combinations (and interactions thereof) of contamination are almost infinite, which makes placing specific hard limits by contaminant impossible. However, based on industry experience, in most cases levels of individual contaminants of around 100ppm or less present negligible risk. Bear in mind that high TAN number can be an indication of contamination. Innospec's experience suggests that a TAN of greater than 1.0mgKOH/g can be an indicator of contamination.

How is contamination determined in the laboratory?

The most valuable technique used in laboratory analysis is GC-MS. This is Gas Chromatography combined with a Mass Spectrometer. The Chromatography, separates the fuel into all of its constituent components. The Mass Spectrometer analysis each component, can determine the chemical nature of each and its concentration.

This technique is used by all of the major laboratories to assess chemical contamination of Marine Fuel.

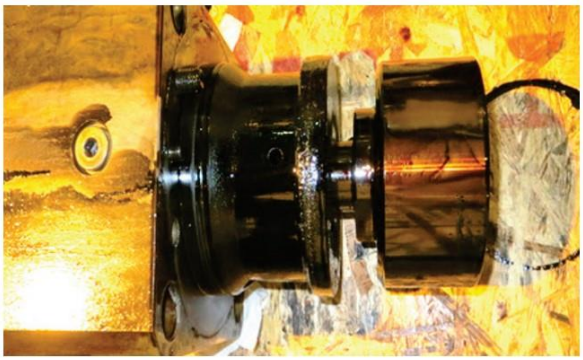
How has this impacted vessels?

Major issues – Major issues have caused engine failure, loss of power and propulsion. Severe damage to the fuel pumps, injectors

Minor issues – fuel stability issues seen with filter clogging & purifier overloading.

Organic Clorides issues reported

- Purifier choking
- Excessive wear of fuel pumps
- Fuel pump pressure drop issues
- Damage to filter candles
- Filter clogging
- Drop in Pmax
- High exhaust gas temperatures



Fuel booster plunger stuck in the barrel

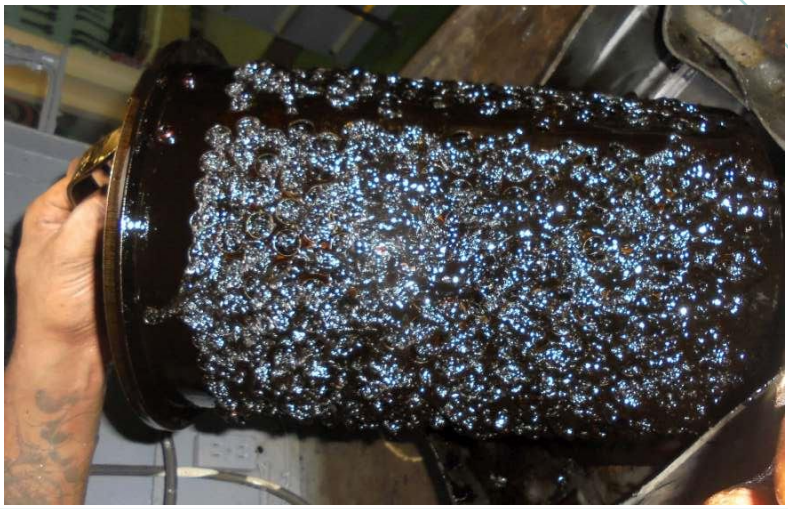
A purifier fouled with hard excessive asphaltene sludge

DCPD issues reported

- Fuel injector performance
- Fuel injector fuel loss
- Wear at fuel pumps
- Cat fines cannot be removed from purifiers
- Loss of power and propulsion

Phenolic compounds issues reported

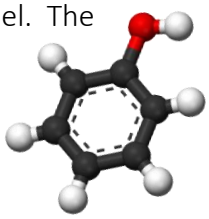
- Fuel becomes viscus and cause issues to moving parts
- Excess sludge due to fuel degradation
- Gummy deposits can chock filters and purifiers
- Fuel injector fuel loss
- Seized fuel pumps



Sticky gum deposits blocking a filter

Can an additive help ?

Fuel additives cannot directly remove or neutralise the contaminants. However, they can be used indirectly to improve stability and compatibility when diluting a contaminated fuel by blending with a clean fuel. The dilution strategy is a common way to overcome contamination cases.

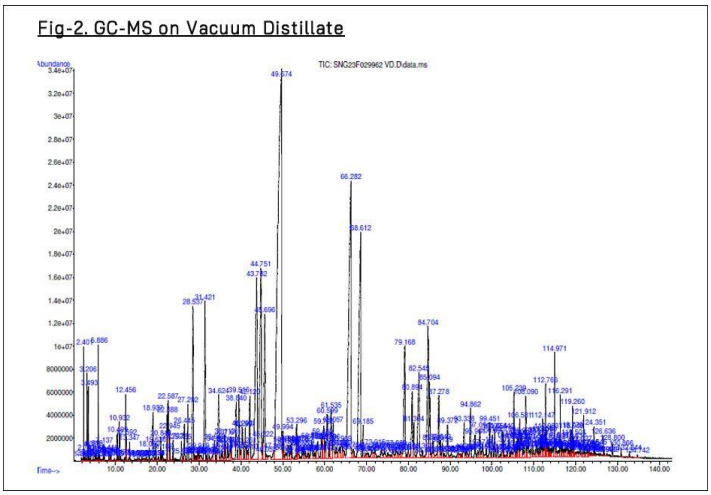


What actions to take ?

- Ask for a GC-MS fuel analysis to define the cause and level of the contamination.
  If the risk posed by the contamination is deemed to be "high" by the testing lab, the recommendation should be to debunker. However, this isn't always an option, and often the vessel is forced to use the fuel, as de-bunkering is impractical or not commercially viable.

- If dilution is the only option, Innospec recommends diluting the contaminated fuel with a "healthy" fuel so that the contaminant contamination is below 100ppm.

- Ask lab to run compatibility check between the two fuels at 90:10 ratio. To some extent this can be predicted by comparing the density and viscosity and assessing TSP's.



GC-MS sample from VPS fuel analysis

- If the two fuels deemed compatible, mix a minimal volume of fuel and the requisite volume of Octamar™ in the settling tank for imminent consumption.

- It is not recommended to mix the fuels in the storage tanks, as this is likely to reside there for an extended period, which dramatically increases the chance of progressive destabilisation.

- To minimise the time fuel(s) remain mixed, any mixed fuel should be consumed as soon as possible.

- If possible, run the diluted fuel in a single auxiliary engine and closely monitor performance. This strategy means the whole engine system is not committed, and the smaller/faster auxiliary engines will tend to highlight any issues more clearly

- If no issues are seen, continue in this fashion, and consider to increase the mixing ratio in small increments to use the fuel up quicker.

For fuel related issues, contact the Innospec Marine Technical Support Team
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