www.bunkerspot.com Volume 13 Number 3 June/July 2016

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GTL JOINS THE MARINE FUEL MIX

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The right stuff?

The use of biodiesel in marine fuel is set to increase, particularly if the proposed revisions to ISO 8217 are implemented. Peter Weide of MarShip UK provides an informed and balanced overview of the benefits – and demonstrable challenges – associated with the use of this 'drop-in' fuel

'Drop-in' fuels is the generic name given to fuels that can be used with minimum modification of the engine, have no impact on engine performance, lower emissions and, of course, which are readily available and safe to use. These fuels, among others, include liquefied natural gas (LNG), methanol and fatty acid methyl ester (FAME), derived from algae and plants, etc.

Although methanol is slowly gaining interest and algae, led by the US Navy, still has some way to go before being commercially viable, it is FAME, or biodiesel, that is best known at present. It is used in automotive diesel fuel (as referenced by the EN590 standard) but not fully accepted yet by the marine industry. Why?

In this article I will look at the implications and effects of using biodiesel.

Biodiesel, or more accurately FAME, has been around for a long time, from concentrations of B7 (7% FAME) up to B100 (100% FAME). it is an easy 'drop-in' fuel, is fully miscible with diesel and proportionately reduces emissions, in particular sulphur oxide (SOx). With a higher flash point than diesel it is safe to handle, readily available and is a natural lubricant that can assist the lubricity additives required in ultra-low sulphur diesel (ULSD), since the process of hydrotreating to remove the sulphur removes the polar and aromatic compounds that give fuel its lubricity.

But all is not rosy. Biodiesel has a high cloud point and the cold filter plugging point (CFPP) can be an issue. In addition, FAME is not compatible with some elastomers on older engines although modern engine materials are now generally fully compatible. Furthermore, FAME can act as a solvent, stripping tanks and fuel systems of deposits, but it is in the storage capability and rapid degradation of the fuel where the real problems lie.

Blended biodiesel degrades rapidly from manufacture, forming acids, peroxides and insolubles, etc. Refineries produce fuel to be burnt, not to be stored, so minimum additives are added to maintain the fuel for a maximum of six months under ideal conditions. Marine storage, however, is far from ideal and by the time the fuel gets to the end user or vessel it could easily be in excess of four months old and out of specification.

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In a modern marine engine this potentially out of spec fuel has to perform a primary and secondary functions. Although the primary purpose is to be injected into the engine, the secondary purpose is fuel injector nozzle cooling. Consider that one molecule of fuel could be subject to heat and pressure tens of times as it circulates between the engine and the tank before it is actually injected. Cooling or heating oil has numerous antioxidant and associated additives to prevent degradation yet the humble diesel has the bare minimum to slow natural degradation and was never designed for such arduous conditions.

Yet as diesel quality gets poorer, engines get more advanced as manufacturers are under ever increasing demands to reduce emissions. Modern common rail injection systems have pressures in excess of 45,000 psi (3,100 bar). Where previously they were operated by solenoids, the demand for better emissions has resulted in these solenoids being too slow. Second generation piezo electric injectors (imagine a BBQ lighter in reverse) have enabled super-fast injection with needle valves which are so light to reduce inertia that you wouldn't even know you were holding them in your hand. And with engine ECUs allowing up to six times more injections as the piston moves through the combustion cycle, injectors are now operating at up to 100 times a second at 2,000 revolutions per minute (rpm).

The classic carbon trumpeting and general coking on injector nozzles has been common for many years and whereas this can still be a problem, the advent of ULSD has brought with it a much greater problem in the form of internal diesel injector deposits (IDID). This modern phenomenon is being associated in particular with ULSD. Modern refinery techniques and methods to remove the sulphur has led to instability of ULSD where microscopic deposits start to coat the inside of the injector and fuel system components,

and is further accelerated with the presence of FAME. With the conditions in a modern engine it is little wonder that the marine sector has been unwilling to take on biodiesel.

Knowing that these deposits exist is one thing, understanding what they are and how they are formed is quite another, a point which is complicated further as there seem to be two distinct types of deposit – 'waxy' or 'soap' like deposits and carbonaceous or lacquered deposits (gumming). The combinations of fuel additives such as mono-acidic lubricity improvers and conventional succinimide deposit control additives have been suggested as a possible cause.

In a test carried out by one of the biggest global chemical manufacturers, no evidence was found that these additives contributed to IDID deposits; when the injectors were disassembled they had completely clean internal parts. There is, however, evidence that the use of biodiesel and ULSD could be a factor to consider. Not only does biodiesel contain trace metals that can intensify injector formation, biodiesel oxidation products can contribute to deposit accumulation.

Carboxylic acid formed during biodiesel oxidation can corrode iron surfaces to yield an iron carboxylic salt layer. This salt layer can then trap other components in the fuel such as polymers that are also formed during biodiesel oxidation. When it comes to coking, temperature can also have an effect. When temperatures exceed 300°C the thermal condensation and cracking reaction of diesel has been shown to accelerate the rate of deposition in the nozzle.

One engine manufacturer will accept biodiesel or FAME but only biodiesel from Rape, commonly known as RME (Rape Methyl Ester). Unfortunately, it is impossible to specify what FAME is in the fuel being delivered which typically contains FAME from many sources.

So is biodiesel a good option as a 'drop-in' fuel for marine applications? Well it does offer the environmental advantages, if you leave out the controversy of the environmental damage caused by growing it, it helps to increase the all-important fuel lubricity, it is readily available and, with additives to counter potential instability and system deposits, it is safe to use and store.

However, biodiesel from algae, or algal biofuel is the one to watch. Like the present biodiesel it can be considered carbon neutral – although it releases carbon dioxide (CO_2) when burnt, it only releases what it absorbed to grow, unlike fossil fuels. But the real advantage is that algae is fast growing and can be grown on wastewater or even saturated saline, so does not require farming land and, with the correct additives to counter the known FAME problem, this really could be the fuel of the future.

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MarShip UK is committed to providing pro-active solutions ensuring engine air, fuel and oil systems are maintained in the best possible condition to maintain efficiency, specific fuel consumption and prolong engine life. The company will be exhibiting at events including Seaworks and METS this year.

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