Biodiesel – new fuels, new challenges

Biofuels may not become the zero-carbon solution of choice in the shipping industry's decarbonization process in the longer term, but could have a significant role to play to accelerate the process. In a recent article DNV GL summarizes the regulatory issues, safety and other operational issues faced by those using these new fuels or fuel blends.

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One of numerous possible ways to comply with the IMO's strategy on the reduction of greenhouse gas (GHG) emissions from ships is to use biofuels or biofuel blends. Biofuels have very low sulphur levels and low CO2 emissions, as such they are a technically viable solution in meeting some of the current and future emission requirements. However, their NOx emissions might be higher than with fossil diesel oils and another immediate challenge is that the shipping sector still have limited knowledge on handling and applying biofuels as part of their fuel supply.

DNV GL is an independent expert in risk management and quality assurance and a frequent collaborator with Gard in in loss prevention and sustainability projects. We are pleased to re-publish their recent information and advice with respect to the increasing use of biodiesel in bunkers.

Types of biofuel

• *FAME (fatty acid methyl aster)*
: FAME is produced from vegetable oils, animal fats or waste cooking oils by transesterification, where various oils (triglycerides) are converted to methyl esters. This is the most widely available type of biodiesel in the industry and is often blended with regular marine diesel. The marine fuel specification standard ISO 8217:2017 includes additional specifications (DF grades) for distillate marine fuels containing up to 7.0 volume % FAME. The FAME used for blending shall meet specification requirements of EN 14214 or ASTM D6751. FAME-diesel blends with up to 30% BTL content are also used in automotive applications and referred to as B20 or B30. (International standards: EN 14214, ASTM D6751, EN 590)

• *BTL (biomass to liquid fuels)*
: BTL is a synthetic fuel produced from biomass by means of thermo-chemical conversion. The end product can be fuels that are chemically different from conventional fuels such as gasoline or diesel but can also be used in diesel engines. (International standards: EN 16709, EN 15940)

• *HVO (hydrotreated vegetable oil*
): HVO or HDRD (hydrogenation-derived renewable diesel) is the product of fats or vegetable oils – alone or blended with petroleum – refined by a hydrotreating process known as fatty acidsto-hydrocarbon hydrotreatment. Diesel produced using this process is often called renewable diesel to differentiate it from FAME biodiesel. The overall production process is typically more costly than for FAME biodiesel, however HVO/HDRD is a drop-in fuel which can be directly introduced in distribution and refueling facilities as well as existing diesel engines without any further modification. (International standards: ASTM D 975)

Regulatory items on biofuels to be observed

MARPOL Annex VI Regulation 18, "Fuel Oil Availability and Qualities", applies to using both fuels derived from petroleum refining and derived by methods other than petroleum refining, e.g. biodiesel. Note that in this context, synthetic fuels according to EN 15940 are not considered to fall under "fuels oils derived by methods other than petroleum refining." These synthetic fuels include the subgroups such as Hydrotreated Vegetable Oil (HVO), Biomass to Liquid (BTL), Gas to Liquid (GTL and Coal to Liquid (CTL) which are different resources converted to fuels though *chemical processes.*

In the case of biodiesel, the fuel shall, among others, not exceed the applicable sulphur content. Moreover, such fuels shall not cause an engine to exceed the applicable NOx emission limits. Meeting the sulphur limits is normally not a challenge for biofuels, however the NOx emissions might be higher than with fossil diesel oils, due to possibly high oxygen content.

To meet the requirements of MARPOL Annex VI, evidence must be made to confirm that the diesel engine complies with the applicable NOx emission limits (which depend on the keel laying date of the vessel and the operational area) also when biofuels are used for combustion purposes. To demonstrate this, depending on the biofuel used, the evidence may be a challenge and it may require on-board emission testing where the results should be presented in g/kWh (not only concentrations in ppm). Due to the complexity of the required tests, DNV GL recommends performing the emission tests on stationary test beds and offers to assist ship operators with obtaining the required exemption from the flag administration.

DNV GL also advices that, as an alternative to the measurements, and in case it can be proven by either analysis or reference to a known international standard that the emission properties of the biofuel are equivalent to that of conventional diesel, this evidence might act as proof that the biofuel does not cause the engine to exceed the applicable NOx emission limits.

If additional alterations, which are beyond the limits in the approved NOx Technical File, the engine(s) are required to optimize the combustion when using the biofuel, and the NOx Technical File needs to be formally amended.

Technical challenges and solutions

Below is a summary of items to be observed for the use of biofuels and a few words on how to prevent damages on board:

• *Microbial growth:*
Bacteria and mould may grow if condensed water accumulates in biodiesel fuel. Microbial growth leads to excessive formation of sludge, clogged filters and piping. Frequent draining of tanks and the application of biocide in the fuel may reduce or mitigate microbial growth.

• *Oxygen degradation:*
Biodiesel can degrade over time, forming contaminants of polymers, and other insolubles. Deposits in piping and engines could form, compromising operational performance. In advanced stages, this could lead to increased fuel acidity, which could result in corrosion in the fuel system and accumulation of deposits in pumps and injectors. It is therefore recommended not to bunker the fuel for long-term storage before use, but to treat the fuel as fresh goods and to use it within a relatively short period of time. Adding antioxidants to the fuel at an early stage may improve the ability of a somewhat longer time of storage without degradation.

• *Low temperature:*
Biodiesels in higher concentration usually have a higher cloud point than diesel (depending on feedstock), leading to poor flow properties and the clogging of filters at lower temperatures. It is therefore important to know the product's cold flow properties and to keep the storage and transfer temperatures above the cloud point.

• *Corrosion:*
This is most critical for biodiesel in higher concentration (B80-B100). Some types of hoses and gaskets could degrade, leading to loss of integrity and interaction with some metallic material such as copper, brass, lead, tin, zinc, etc. It could also result in an increased formation of deposits. Hence, it is important to verify that these components in the fuel system are endurable and can be used together with biofuel.

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• *Conversion:*
Biodiesel has shown to have a solvent property, so when switching from diesel to biofuel it is expected that deposits in the fuel system will be flushed, clogging fuel filters. It is recommended to flush the system and/or to monitor filters during this period.

We thank DNV GL for permitting us to share this information with our readers. The original version of this article, with more information about DNV GL's service offering, can be found on the DNV GL website .