UK P&I CLUB

Carefully to Carry

JULY 2010

Biofuels: Marine transport, handling and storage issues

A major percentage of biofuel is shipped internationally by sea. It is important, therefore, to understand the issues that need to be considered if these products are to be carried safely, without risking damage to either the ship or the cargo

The production and use of biofuels as transport fuels has increased dramatically in recent years. A number of legislative reforms are mandating the integration of fuels derived from renewable sources into the current fuel infrastructure. However, the introduction of biofuels has not been without problems and indeed there is a large amount of research still ongoing into the properties of biofuels and how they behave when blended with conventional fossil fuels. This article will discuss some of the issues surrounding the introduction of biofuels into the present fuel system with particular focus upon the potential implications for those involved in the transportation and storage of these products.

Legislative targets

Biofuels were originally seen by many as an answer to the problems of increasing greenhouse gas emissions and global warming. Unlike transport fuels derived from crude oil, such as diesel and gasoline, biofuels are produced from renewable sources; that is, sources that can be replenished at a rate comparable to or faster than the rate at which they are consumed by humans. Fuels produced from agricultural crops such as corn, wheat, rapeseed and soybean, which could be quickly and easily replenished and, in theory, should have a negative overall impact in terms of carbon dioxide

"The carrier shall properly and carefully load, handle, stow, carry, keep, care for and discharge the goods carried."

Hague Rules, Articles iii, Rule 2

Carefully to Carry Advisory Committee

This report was produced by the Carefully to Carry Committee – the UK P&I Club's advisory committee on cargo matters. The aim of the Carefully to Carry Committee is to reduce claims through contemporaneous advice to the Club's Members through the most efficient means available.

The committee was established in 1961 and has produced many articles on cargoes that cause claims and other cargo related issues such as hold washing, cargo securing, and ventilation.

The quality of advice given has established Carefully to Carry as a key source of guidance for shipowners and ships' officers. In addition, the articles have frequently been the source of expertise in negotiations over the settlement of claims and have also been relied on in court hearings.

In 2002 all articles were revised and published in book form as well as on disk. All articles are also available to Members on the Club website. Visit the Carefully to Carry section in the Loss Prevention area of the Club website www.ukpandi.com for more information, or contact the Loss Prevention Department.

emissions, seemed an ideal solution for governments facing increasingly difficult decisions with regard to the links between pollution and climate change, and legislative targets were quickly put in place mandating the integration of biofuels into the current transport fuel infrastructure.

However, it was not long before serious questions were raised with regard to the environmental credentials and overall sustainability of the commercially available biofuels. Issues included the use of crops which would normally be used for food being put into biofuel production, the questionable carbon dioxide emissions savings when considering the overall production process ('wells to wheels'), deforestation to make way for biofuel crop plantations and the use of environmentally harmful fertilisers and pesticides employed in growing the crop feedstock. Indeed it was suggested by some parties that biofuels could in reality be causing more harm than good to the environment.

Amid these growing concerns, the UK Government has recently decided to amend the targets set out in the Renewable Transport Fuel Obligation (RTFO), a directive aimed at reducing greenhouse gas emissions from road transport. The RTFO requires that by 2013/14, 5% by volume of all fuel sold in UK forecourts is to come from renewable sources, with intermediate targets of approximately 3.5%, 4% and 4.5% for the periods 2010/11, 2011/12 and 2012/13 respectively.

These targets represent a slowdown in the required biofuels targets, but they are likely to be reviewed in 2013/14 in order to assess the progress of the UK RTFO in complying with the wider EU initiative to reduce carbon emissions, the Renewable Energy Directive. This directive was recently reviewed and agreed in December 2008, and mandates that by 2020, 10 per cent of all automotive fuel consumption by energy content should be sourced from renewable energy sources.

Amid all the uncertainty, it appears likely that the worldwide push for increasing biofuel use as a means of reducing overall carbon dioxide emissions will continue, and one can reasonably expect the biofuels market to continue to grow. Much of the biofuel is shipped internationally by sea. For example, first half figures for the 2008/2009 period indicate that 670 million litres of biofuels were supplied to the UK transport market. Only 8% of the biofuel supplied was produced from within the UK, such that 92% (approximately 616 million litres) of biofuel was imported. A recent report by Pike Research estimated that the global biodiesel and ethanol markets are likely to reach US$ 247 billion in sales by 2020, up from US$ 76 billion in sales predicted for 2010.

In order to meet the necessary targets, the quantity of biofuels shipped both into the UK and worldwide is likely to increase, and it is therefore important for those involved in the carriage of biofuels to understand the issues that need to be considered if these products are to be carried safely, without risking damage to either the ship or the cargo.

Current biofuels

There are presently two main classes of biofuels in widespread use; biodiesel (or more correctly, FAME) and bioethanol. The two are very different in their properties and therefore have different issues to consider if they are to be safely shipped, handled, stored and used. Each will be considered in turn.

FAME/Biodiesel

Biodiesel is a fuel derived from vegetable oils or animal fats, although the term 'biodiesel' is too vague a description and we therefore use the more correct terminology, Fatty Acid Methyl Esters (FAME), when discussing these fuels. FAME is the product of reacting a vegetable oil or animal fat with an alcohol (methanol, a petrochemical which is generally derived from natural gas or coal) in a process known as transesterification. When compared to conventional diesel derived from crude oil, vegetable oils and animal fats generally have higher viscosities (which means they are more difficult to pump and store without heating) and are more unstable (which means they are more likely to degrade during storage, handling and end-use). The transesterification process brings the properties of the raw materials closer to those of a conventional diesel, making the product more suitable for use as a road transport fuel. However, whilst the FAME produced can be used neat as a fuel, it is more commonly blended with conventional petroleum diesel for use in diesel engines.

The ASTM has described a system of nomenclature for naming FAME/diesel blends (see ASTM D6751). Pure

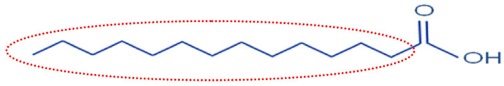
FAME is denoted B100, standing for 100% 'biodiesel'. Other common blends include B5 (5% 'biodiesel' and 95% conventional diesel), B7 (the EN590 European diesel standard allows up to 7% by volume FAME in diesel) and B20 (20% 'biodiesel' and 80% conventional diesel). In the UK, a major supermarket chain has introduced B30 (30% 'biodiesel' and 70% conventional diesel) pumps onto a number of their forecourts (*Motor Consult Update* November 2008). However, this fuel is not currently governed by any standards and is not approved for use by many of the major automobile manufacturers.

Raw materials for FAME production

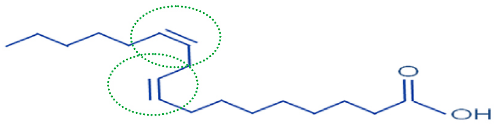
A wide number of raw materials can be used for the production of FAME, including palm oil, coconut oil, rapeseed oil, soybean oil, tallow and used cooking oils. A general FAME cargo might be the product of processing any one of these raw materials, or may indeed be a mixture of FAMEs produced from different raw materials. Each raw material would give FAME of a different chemical composition, with correspondingly different characteristics. For example, if we compare a FAME derived from palm oil (PME) with a FAME derived from rapeseed oil (RME), it is possible to notice an immediate visible difference between the two – namely

that at normal UK winter temperatures the PME is likely to be solidified whereas the RME will be a liquid. It is the chemical composition of the raw materials and the FAMEs produced from them that explains many of the different characteristics displayed.

One of the most important chemical characteristics of FAME is the structure and composition of the fatty acid methyl ester groups, which will be determined by the fatty acid components of the raw material used in the production process. Pictorially, we can see a difference if we look at the structures of two different fatty acids below – one a *saturated* fatty acid and one an *unsaturated* fatty acid – the saturated fatty acid has a 'straight chain' of carbon atoms (circled in red) whereas the unsaturated fatty acid has, in this case, two 'double bonds' present in the hydrocarbon chain. These are circled in green and result in 'kinks' in the hydrocarbon chain:



Myristic Acid – A saturated fatty acid



Linoleic Acid – An unsaturated fatty acid

FAME species which are composed of a relatively high proportion of saturated fatty acid methyl esters, for example, palm oil derived FAME (denoted PME) will in general be relatively stable to unwanted degradation reactions, but will have poorer cold temperature performance. FAME species which are composed of a relatively high proportion of unsaturated fatty acid methyl esters, for example, soybean oil derived FAME (denoted SME), will display markedly different behaviour, typically having improved cold temperature properties in comparison to PME, but being less stable to degradation reactions. The reason for the improved cold-temperature behaviour displayed by the FAME species high in unsaturated fatty acid methyl esters is that for every double bond in the hydrocarbon chain and associated kink in the molecule, the individual molecules cannot pack as closely together thereby reducing intermolecular forces and correspondingly decreasing the melting point. However, it is the presence of the double bonds in the unsaturated FAME species that infers the greater degree of instability upon the molecules – the double bond sites render the molecule prone to oxidative degradation.

The presence and composition of other chemical constituents are also important. For example, FAMEs with high levels of vitamin E are thought to be more stable to unwanted oxidative degradation reactions. Recent research reported in *Biodiesel* magazine has identified the formation of sediments in stored B5 and B20 blends. Analysis of the sediment components suggests that they originate from the oxidation of unsaturated fatty acid methyl ester components of FAME. However, the addition of antioxidants to the neat FAME prior to blending was found to prevent sediment formation. Vitamin E is a natural antioxidant which would appear to prevent the occurrence of such unwanted oxidation reactions.

FAME problems

Water contamination: A major problem with regard to the carriage of FAME by sea is the issue of water contamination. FAME is a hygroscopic material, which means that is will absorb water from its surrounding environment, including the atmosphere. This renders

FAME very sensitive to water contamination. The current maximum allowable water content in the European EN 14214 and American ASTM D6751 FAME standards is 500 mg/kg, although often selling specifications are lower (300 mg/kg being a typical maximum water content on a sales specification), reflecting the high potential for water pick-up in this material.

Unlike most conventional diesels, in which any un-dissolved water present will generally settle out over a period of time, FAME can hold water in suspension up to relatively high levels (above 1000 mg/kg). Apart from the fact this will render the cargo off-specification for water content, the presence of water can promote unwanted hydrolytic reactions, breaking down the FAME to form free fatty acids, which can again affect certain specification parameters for the material – such species are corrosive and may attack exposed metal surfaces. Additionally, once a certain threshold level of water content is reached, water can separate out from the FAME, forming a separate (and potentially corrosive) free water phase. The possibility of phase separation occurring is greater for blends of FAME and conventional diesel.

The presence of a FAME/water interface provides ideal conditions for the promotion of unwanted microbiological growth, which may in turn lead to filter blocking and corrosion problems. Certain publications have referenced the greater degree of biodegradability of FAME as a positive factor when dealing with environmental spillages. This is indeed correct, but by the same token this factor means that FAME is considerably more prone to microbiological attack than a conventional fossil fuel, with the associated problems mentioned above. A number of studies have been performed in this area which highlight the need for further detailed analysis and research into the potential for serious microbiological contamination occurring at various stages in the biofuel supply chain.

Possible sources of water contamination aboard a vessel range from the obvious – sea water ingress or residues of tank washing operations – to the less obvious – moisture in an inert gas blanket produced from a faulty flue gas generating system, or atmospheric humidity in tanks' ullage spaces that are not under a positive pressure of dry inert gas. Despite having relatively high flash points, FAME cargos are generally carried under a (dry) nitrogen blanket in order to avoid the potential increase in water due to absorption of moisture from tank ullage spaces.

Stability problems: FAMEs are generally more prone to issues with regard to their stability than conventional petroleum diesel. We have mentioned previously that certain FAME/diesel blends can be oxidised to form unwanted degradation products and that the addition of antioxidants may prevent the formation of these sediments. FAME can degrade under the influence of air, heat, light and water, and degradation may occur during transport, storage or even during end-use. FAME cargoes may display different levels of stability dependent upon their composition and the feedstock(s) used in their production. In general FAME with higher levels of unsaturated fatty acids, such as soybean and sunflower oil derived FAME, will be less stable than those composed of higher levels of saturated fatty acids, for example, palm oil or coconut oil derived FAMEs.

Potential shipping problems include the promotion of degradation reactions by trace metals (copper heating coils or zinc-containing tank coatings have the potential to cause deterioration in quality) and thermal stability issues if the FAME cargoes are stored next to heated tanks, for example, bunker settling tanks. Issues with the promotion of instability by the presence of trace metals are worse for B100 than for lower biodiesel blends (e.g. B5, B20). Degradation reactions can form insoluble sediments and gums, which may increase the viscosity of the FAME, lead to filter blocking or potentially further decompose to other more corrosive species. The carriage of FAME under dry nitrogen blankets can also help to prevent unwanted degradation reactions caused by the material coming into contact with air.

Low temperature behaviour: The poor low temperature properties of FAME when compared to conventional diesel may give rise to issues where FAME cargoes are shipped through extremes of cold temperature. It is possible for certain FAMEs to form waxy precipitates at low temperatures which will then not re-dissolve when the product is reheated, although this would not appear to be a common problem.

However, there is the potential for FAME cargoes shipped from a warm, humid climate to extremely cold conditions, if the correct measures for heating the cargo are not applied, to form unwanted waxy precipitates which may lead to specification failure or pumping problems.

As has been mentioned previously, it is generally recognised that FAMEs produced from vegetable oils with relatively high proportions of unsaturated fatty acids, for example, soybean oil, will have better cold-temperature properties than FAMEs produced from vegetable oils with high proportions of saturated fatty acids, such as palm oil. It is therefore vital that the correct heating instructions are issued and followed – an understanding of the nature of the FAME will impact upon the necessary heating instructions – this should be borne out by the appropriate research into the origin of the FAME and indicated by the results of any pre-shipment testing.

FOSFA International (The Federation of Oils, Seeds and Fats Associations Ltd) has now included FAME products in its published heating recommendations:

Oil Type	Temperature during voyage		Temperature at discharge	
	Min (°C)	Max (°C)	Min (°C)	Max (°C)
FAME from Maize/Rapeseed/Soya/Sunflower	Ambient		Ambient	
FAME from Coconut/Palm/Palm Kernel/Tallow	25	30	30	40

FAME contamination of jet fuel: FAME is a surface active material and can adsorb onto the walls of tanks or pipelines and de-adsorb into subsequently carried products. This can be an issue where multi-product pipelines or storage tanks are utilised, or where ships carry jet fuel cargoes after carrying FAME/diesel blends.

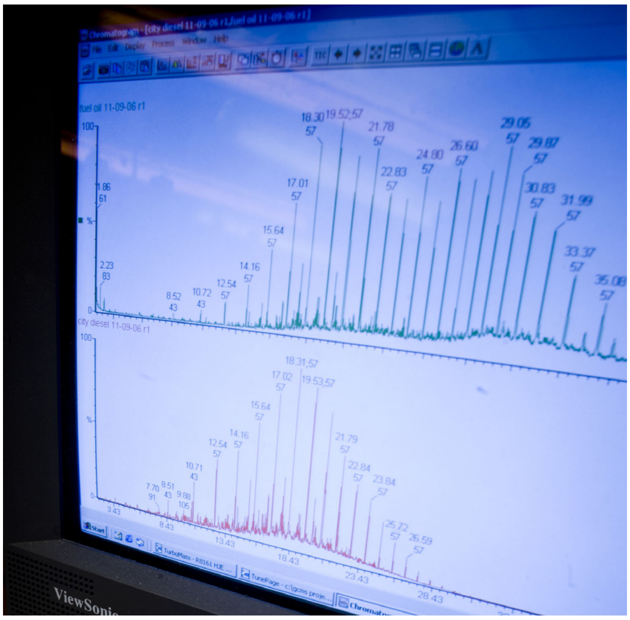
The latest DEFSTAN 91-91 jet fuel specification states that jet fuel containing less than 5 parts per million (ppm) FAME can be considered acceptable for use, that is, can be considered as being free from any FAME. Full inclusion of this specification limit into the DEFSTAN 91-91 standard is pending on the development of a suitable test method to accurately identify FAME in jet fuel at this level. A test program conducted by the Joint Inspection Group (JIG) tested jet fuel dosed with various FAMEs up to 400 ppm and found no significant affect on specification test results, and the inclusion of the 5 ppm maximum limit into the DEFSTAN 91-91 standard has been granted on the basis that the aviation industry is working towards a 100 ppm maximum FAME content (DEFSTAN 91-91 Issue 6).

In May 2008 a number of jet fuel storage tanks at Kingsbury supply terminal and Birmingham Airport were quarantined after it was discovered that samples of the jet fuel in question contained up to 20 ppm of FAME. The cause of the contamination is thought to have been as a result of mixing of jet fuel with B5 diesel in the distillate manifold at Kingsbury terminal. As an indication of the very small quantities needed to cause such a contamination, the 5 ppm specification limit would be equivalent to just 1 litre of B5 diesel in 10,000 litres of jet fuel.

When vessels may potentially carry jet fuel cargoes following on from FAME or FAME/diesel blends, the JIG recommends that care must be taken with tank cleaning and flushing and draining common lines including sea or jetty loading lines. From experience, they suggest that switching from a B5 to jet fuel requires at least a hot water tank wash (but preferably also an intermediate FAME-free cargo) to remove FAME residue. Switching from neat FAME to jet fuel requires particular care and some advocate at least three intermediate (FAME free) cargoes plus the hot water wash before loading jet fuel (source: *JIG Bulletin* No. 21).

As 5 ppm is such a low level of contamination, there is the potential for erroneous results to be produced from inaccuracies in the test methods or incorrect sample handling. The DEFSTAN 91-91 standard suggests that the currently specified method of flushing sample containers three times for jet fuel samples may not be sufficient to remove traces of FAME, which may even be transferred from contaminated gloves. This could potentially lead to false positive detection of FAME in actually on-specification material, resulting in erroneous claims being made. It is therefore recommended that new sample containers and new gloves are used when sampling jet fuel cargos.

For products tankers carrying multiple products, the danger of inadvertently contaminating a cargo of jet fuel with traces of FAME is a very real risk, even if it



does not initially appear that there is any potential for cross contamination to occur. For example, ultra-low sulphur diesel meeting the EN590 specification may appear in the shipping documents as ULSD, which would not immediately indicate that the product contained any FAME. However, the EN590 diesel specification allows up to 7% by volume FAME content. If the ship's tanks and lines are not completely stripped of all the ULSD prior to loading a cargo of jet fuel, the quantity of ULSD containing 7% FAME needed to render the jet fuel cargo off-specification would be very small.

Solvent behaviour: An interesting property of FAME is its ability to act as a solvent, taking up any organic residue, dirt or scale that may have accumulated on surfaces of tanks or pipelines. This can have the effect of cleaning out the dirty storage or pumping systems but contaminating the FAME itself, and may lead to subsequent fouling of filters or pump blockages.

As an indication of its solvent strength, researchers from Iowa State University are investigating how the solvent properties of FAME can benefit military applications, by looking into whether or not certain varieties of waste generated *in-situ* in battlefield locations will dissolve into biodiesel, and also if stationary engines can be run on the biodiesel containing certain levels of dissolved plastics. FAME is known to attack and quicken the ageing process of certain materials, including elastomers (which may be used as seals, valves, gaskets etc.) – materials should be checked for compatibility with FAME and FAME/diesel blends by consultation with the equipment manufacturer.

Biodiesel in bunkers: On 15 June 2010 the fourth edition of the marine fuels standard, ISO 8217:2010, was issued. The previous edition of the marine fuels standard, ISO 8217:2005, required under point 5.1 of Section 5 – General Requirements that the fuels to be classified in accordance with the standard should be "*homogeneous blends of hydrocarbons derived from petroleum refining.*" This was interpreted as precluding the fuel from containing any bio-derived components. During the preparation of the fourth edition of the standard, the working group committee responsible for the production of the standard considered the topic of biodiesel and the potential for the material to find its way into the marine fuel supply chain. It concluded that it was almost inevitable that as a result of blending FAME into automotive diesel that some marine distillates and possibly even marine residual fuels may contain a proportion of FAME as a result of cross contamination within the distribution system (Source: *Bunkerworld Forum* 03/09/2009).

As such, the ISO 8217:2010 International Standard now additionally requires under point 5.4 of Section 5 – General Requirements that "*The fuel shall be free from bio-derived materials other than* 'de minimis' *levels of FAME (FAME shall be in accordance with the requirements of EN 14214 or ASTM D6751). In the context of this International Standard,* 'de minimis' *means an amount that does not render the fuel unacceptable for use in marine applications. The blending of FAME shall not be allowed.*"

Annex A of the ISO 8217:2010 International Standard considers the issue of bio-derived products and FAMEs finding their way into marine fuels in more detail. Annex A states that notwithstanding the fact that FAME has "*good ignition, lubricity properties and perceived environmental benefits*", there are "*potentially specific complications with respect to storage and handling in a marine environment*", including:

- A tendency to oxidation and long term storage issues
- Affinity to water and risk of microbial growth
- Degraded low-temperature flow properties
- FAME material deposition on exposed surfaces, including filter elements.

It is recognised that there are a number of different sourced FAME products each with their own particular characteristics which may impact upon storage, handling, treatment, engine operations and emissions.

The standard states that in "*...those instances where the use of fuels containing FAME is being contemplated, it should be ensured that the ship's storage, handling, treatment, service and machinery systems, together with any other machinery components (such as oily-water separator systems) are compatible with such a product.*"

The meaning of a '*de minimis*' level is expanded upon in Annex A of the ISO 8217:2010 international Standard. It is noted that determining a '*de minimis*' level is not straightforward for a number of reasons, including the fact that there is no standardised analytical technique for detecting FAME materials in fuel oils and that, in most cases, sufficient data is not

yet available with respect to the effects of FAME products on marine fuel systems. For the purposes of the International Standard, for the four grades of distillate fuel (DMX, DMA, DMZ & DMB when clear and bright) it is recommended that '*de minimis*' be taken as "*not exceeding approximately 0.1 volume %*" when determined in accordance with test method EN 14078. For DMB when not clear and bright and for all categories of residual fuels, the standard notes that "... 'de minimis' *cannot be expressed in numerical terms since no test method with formal precision statement is currently available. Thus, it should be treated as contamination from the supply chain system.*"

Bioethanol

Bioethanol refers to ethanol produced by the fermentation of renewable sources of sugar or starch crops. Unlike FAME, bioethanol is a single chemical compound, the properties of which are well documented and understood. It is a volatile, colourless liquid which is miscible with water and also hygroscopic. Ethanol is the alcohol found in alcoholic beverages and is also commonly used as a solvent in perfumes, medicines and paints. However, the most common use for ethanol is as a fuel or fuel-additive. Ethanol for use as a fuel is generally dosed with a 'denaturant' to render it unsuitable for human consumption.

As we have mentioned previously, there has been significant experience worldwide in the use of ethanol as a fuel or fuel-additive. In the USA there has been over ten years successful use of gasoline containing up to 10% ethanol (E10), and in Brazil blends containing up to 85% to 100% ethanol (E85 and E100) are commonly used in flexible-fuel vehicles. The current European gasoline specification, EN228, allows up to 5% ethanol by volume (E5).

Whilst bioethanol can be produced from a number of raw materials, including sugar cane, corn and wheat, the raw materials do not impart the same variation in properties of the end product fuel as is the case with FAME. However, there are still a number of potential hazards for consideration.

Bioethanol problems

Water contamination: Issues with regard to the carriage of bioethanol and bioethanol-gasoline blends include the potential for damaging water contamination. We mentioned previously that ethanol is hygroscopic and highly soluble in water. Small quantities of water can be dissolved in gasoline/bioethanol blends, but, dependent upon temperature and the gasoline/bioethanol blend ratio, there is a critical threshold level of water that can be dissolved. Once this threshold level has been exceeded, irreversible phase separation will occur whereby the water causes the ethanol to separate from the gasoline, forming an alcohol rich water/ethanol aqueous phase and an alcohol poor gasoline phase. The alcohol rich aqueous phase will collect at the bottom of the ship's tank or storage tank. This phase is likely to be highly corrosive and will not be able to be used as fuel. In addition, if such phase separation does occur it is possible that the gasoline phase will be

classed as Pollution Category Z, which means that it is considered to present a "*minor hazard to either marine resources or human health*" if discharged into the sea from tank cleaning or deballasting operations and therefore "*justifies less stringent restrictions on the quality and quantity of the discharge into the marine environment*". Whilst the regulations do not require ethanol to be carried on a chemical tanker, ethanol is generally shipped on chemical tankers to maintain the integrity of the product.

It should be noted at this juncture that the terms biodiesel and bioethanol do not appear in the IBC Code. As it is a requirement that the proper shipping name be used in the shipping document for describing any product to be carried which appears in the IBC Code, these terms cannot be used to describe the products being carried.

The situation becomes somewhat more confusing when we consider how blends of conventional fossil fuels and biofuels are shipped, and which Annex of MARPOL they fall under. MARPOL Annex I covers the prevention of pollution by oil and MARPOL Annex II covers the control of pollution by noxious liquid substances carried in bulk. Blends of biofuels and conventional fuels are essentially mixtures of mineral oil based hydrocarbons and noxious liquid substances. At present, the International Maritime Organization (IMO) Bulk Liquids and Gases sub-committee are addressing the issue of how to classify the blends. In the interim, provisional measures are in place which state that blends of conventional fossil fuels and biofuels in which the proportion of biofuel component is less than 15% should be carried under the provisions of MARPOL Annex I. Blends with a proportion of biofuel component greater than 15% would have required the shipper in question to contact an administrator for a decision on how the product should be carried. These measures were to remain in place until July 2009 but have recently been extended until July 2011 and have been developed to take the form of a 3-band system as follows:

Band 1: 85% or more petroleum oil (15% or less FAME) – Product is carried as an Annex I cargo. Oil discharge monitoring equipment (ODME) should be approved/certified for the mixture carried *or* tank residues and all tank washings should be pumped ashore.

Band 2: More than 1% but less than 85% petroleum oil (15% to 99% FAME) – Product carried as an Annex II cargo. Blend is treated as tripartite mixture in line with MEPC.1/Circ.512 *but* ship type cannot be lower specification than any component in the blend;
or
Cargo treated as pollution category X, ship type 2 with worst case minimum carriage requirements assigned (based on analogous products in the IBC Code such as pyrolysis gasoline, butyl benzene or the generic entry for n.o.s. (4) products)

Band 3: 1% or less petroleum oil (Greater than 99% FAME) – Product carried as Annex II cargo and cargo treated as the Annex II product contained in the blend. Issues of concern include the potential effect that FAME and ethanol cargoes might have on ODME equipment – it is understood that further testing is needed to clarify this issue. The varying blend levels also impact upon how the cargo is measured – work is currently being undertaken on samples of FAME from various origins and at different blend levels to establish suitable volume correction factors (VCFs) to be used in cargo measurement.

Future developments

Up to this point, discussion has been limited to FAME and bioethanol, the so called 'first-generation' biofuels. The Renewable Energy Directive was updated in December 2008 to include sustainability criteria for biofuels, amid worries that the biofuels currently in production were not being produced in a sustainable manner. In order to meet the various legislative targets, not only will the volumes of biofuels used need to increase, but technology will need to be developed and made commercially viable to bring new, sustainable biofuels onto the market. Examples of such biofuels include; biodiesel produced from algal oil, biodiesel produced from the crop jatropha (which does not compete with food crops for land), bio-butanol (which is a slightly longer chain alcohol than ethanol) produced from renewable sources of biomass, and 'renewable diesel', a synthetic diesel which would meet the EN590 diesel standard, produced by the catalytic hydrogenation of vegetable oils.

Conclusions

It is clear that the integration of biofuels and blends of biofuels with conventional fuels into our current fuel infrastructure has raised a number of issues, many of which were unforeseen and have only come to light after the introduction of the fuels. The majority of the problems concern FAME, both as a neat product and as a blend with petroleum diesel. The variety in the feedstock which can be used to produce FAME can impart very different properties on the FAME produced. In Europe there is currently only a single FAME standard, and the particular type of FAME, and therefore the properties the material may be expected to display, may not always be clear from the shipping documents.

The major issues for consideration for those involved in shipping FAME are the high potential for water contamination and associated problems with microbiological spoilage, and, whilst a 5 ppm limit remains in the DEFSTAN 91-91 jet fuel specification, the potential for contamination of jet fuel cargos by traces of FAME. Additionally, the relative instability and sensitivity of the material to low temperatures and trace metals require extra care in terms of how the product is handled. Bioethanol and gasoline blends are also sensitive to water contamination with the potential for irreversible phase separation to occur if the level of water passes a certain threshold level.

Of course, it is possible that as blend levels increase, new and unforeseen problems will arise that will require further research and new approaches to our way of dealing with these materials. It is likely that biofuels will continue to provide a very real challenge to all those involved in their production and distribution over the coming years, and a knowledge of the often quite unique properties that these products display will be very beneficial for those wanting to minimise the risk of facing unwanted claims.

Acknowledgements: Richard Minton, Minton Treharne & Davies Ltd

UK P&I CLUB
IS MANAGED
BY **THOMAS**
MILLER

For further information please contact:
Loss Prevention Department, Thomas Miller P&I Ltd
Tel: +44 20 7204 2307. Fax +44 20 7283 6517
Email: lossprevention.ukclub@thomasmiller.com