Diesel Bug, Water Contamination and Bio Diesel

River Canal Rescue is the only dedicated Marine Breakdown Company offering boats annual membership to provide breakdown and recovery on UK inland waterways. In the last 10years RCR has attended thousands of breakdowns of various types but the issue of fuel related problems is one of the largest causes of breakdowns. With the recent introduction of Bio Diesel the confusion surrounding what is best practise and how to deal with situations which are affecting more boaters has lead to RCR provide the following guidance.

The introduction of increased Bio Diesel content in fuel is resulting in many industries from the emergency services, to agricultural and commercial companies experiencing diesel contamination and blockages for the first time. Although the arguments are strong for changing the directive it is unlikely to occur with the drive for newer greener alternatives; and therefore management of fuel is the only way to ensure trouble free cruising for the near future.

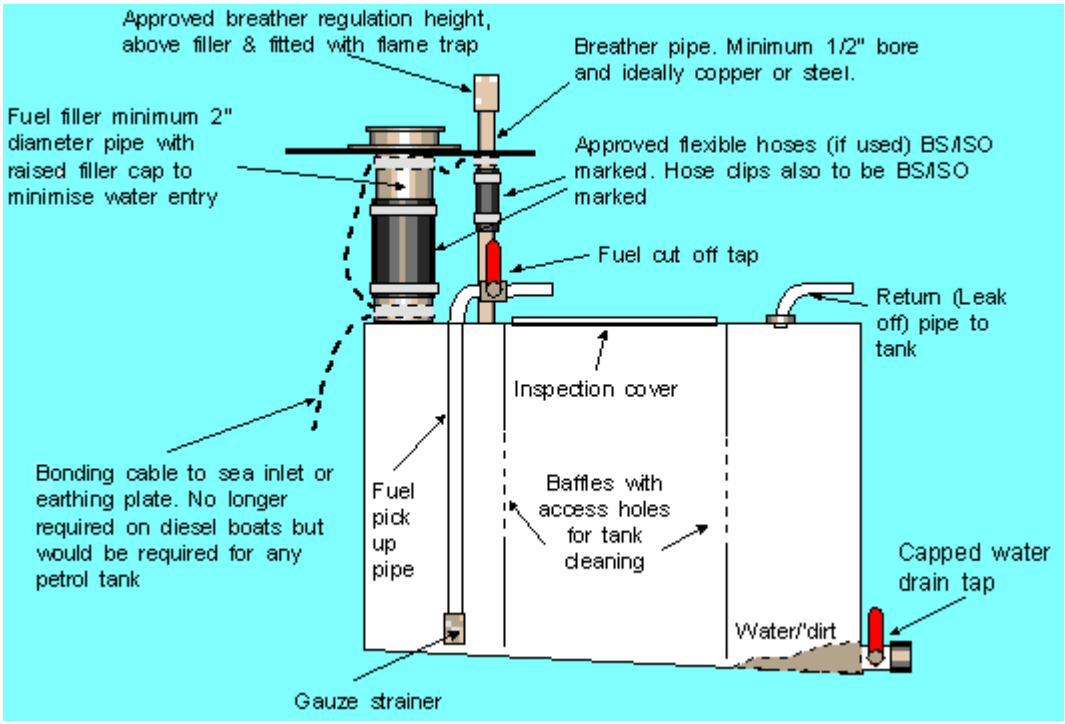
Fuel Tank construction in boats

Fuel tanks in boats are usually constructed so that the outlet pipe for the fuel system is located approximately 1-2 inches above the bottom of the tank, this can cause issues for boaters who dip their tank and believe they still have diesel but can't start their boat. The reason for this construction is two fold.

1) Most tanks are metal and therefore over time fuel /water/ air results in corrosion and rust build up, this debris drops to the bottom of the tank and remains there.

2) The water which is present due to condensation and water ingress in the fuel tank naturally separates out and drops to the bottom of the tank when left to stand.

In both these cases the outlet pipe position ensures that neither water nor debris is passed though the fuel system providing protection from these types of issues.



If there is excessive water in the tank, this can lead to water being fed through the fuel system, RCR regularly has to remove large quantities of water from fuel tanks who in some cases had just filled up! The easiest method to identify how much fuel/water is in your tank is to use a clear plastic hose, drop this in to the tank being careful not to disturb the fuel , and when you feel the bottom place your thumb over the end to seal it and withdraw the hose. This should provide you with a sample of the tank and will show the amount of water present, along with an indication of any diesel bug contamination.

We recommend that you :-

1) Dip your tank regularly and where water is present remove it, this can be done simply and cheaply using an oil extractor or electric pump, by pushing the pipe down to the layer of water and extracting water until the diesel comes though. Alternatively visit one of the Marina's who offer a fuel polishing service.
2) Regularly check your filler cap seal and replace if worn, cracked or damaged. Also if it has been raining the cap sits lower than the deck so wipe over to remove excess water before opening the cap.
3) If you have a water trap filter, check and empty regularly, so that it is effective.
4) Either leave the tank empty during winterisation and remove any water on your return, or leave the tank full and treated.

The advice above will combat both diesel bug and Bio diesel issues and water contamination removing almost all risks without the need to treat the fuel.

Water in Diesel

All diesels contains some element of water. On boats the diesel tanks are subject to condensation build up and also water ingress when the rubber seals on the filler caps begin to fail. Water content in diesel makes the diesel murky or cloudy and can be the first indication of an issue.

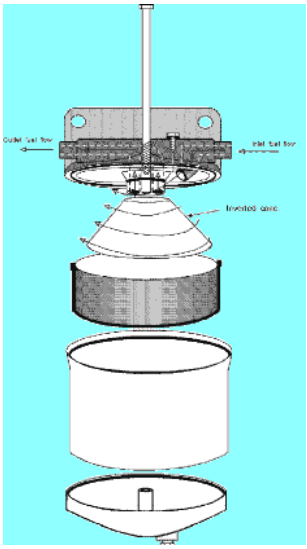
Water Contamination

No Water Contamination

Water is mixed with the diesel and although not healthy for any diesel engine small amounts (EU directive recommend max of 500ppm or 0.05%) can be burned harmlessly during the combustion cycle.

However when diesel is standing this water separates naturally (around 800ppm 0.08%) and as it is heavier than diesel it eventually drops to the bottom tank, the time this takes depends on a number

of conditions, weather, amount of water, temperature etc. This is why many commercial storage tanks have taps at the bottom to drain off the water.



Boats do not usually have a tank drain system in place instead they rely upon a water trap filter to capture any water that has separated but has been passed in to the fuel system. Many boats also have conglomerators /aglomerators; these spin the fuel as it passes and should remove excess water where this has been mixed with the diesel.

Water in diesel can be harmful to diesel engines, and if you own a diesel vehicle you will find that most manufacturers hand books carry a warning regarding diesel /water contamination and also include a water trap filter to remove any excess water. This warning indicates that water in the fuel system can result in damage to the internal of the engine and void warranties. Obviously the car industry has had many years experience and there recommendations are in line with our RCR advice in that where possible water should not be passed thought the fuel system.

Water in fuel is acceptable in small amounts and has been known to improve performance when in quantities of up to 1200ppm (0.12% volume), however there is a risk that too much water (greater than 1500ppm (0.15%) will result in the water lying un-burnt in the combustion chamber and affecting the operation of the pistons, valves, liners, ect by destroying the lubrication properties of fuel

In addition, too much water in the fuel can cause issues even before this point, as the injectors pressurise the diesel to turn it in to a fine spray, if there is too much water present in diesel then emulsification occurs and the white creamy solution that results will stop you in your tracks.

What is Diesel Bug

Diesel bug has been the centre of much debate, RCR has spent many years dealing with this issue and a number of these convincing people that this issue was present, however now most authorities bodies and people both in the boating and agricultural community agree that diesel bug exists and is responsible for numerous issues with fuel.

Diesel bug is the term given to the enzymes, bacteria etc that live of the water in diesel and affect the diesel properties, and there are over 148 different types identified so far. The first signs of fuel degradation are a fine black dust that is regularly described as soot, a very strong smell of varnish coming from the fuel tank and the fuel turning darker. This is typically a slow process over many months, even years but if it appears in a shorter time it is a early indicator that microbes are the catalyst and should be treated immediately.

Visible sludge and other lesser known variations of diesel bug that can show as yellow/orange or pale debris floating in the diesel is an indicator of severe or high risk contamination and should be treated as soon as possible. Extreme cases see this develop in to a thick black sludge that quickly clogs up the fuel system and stops the engine operating.

Bio Diesel & Low Sulphur Fuels NEW EU Directive

The introduction of the new rules relating to supply of diesel for recreational boats has stipulated that from 2011 it is an offence to sell diesel that contains more than 10mg of sulphur per kilogram of diesel, this effectively makes the fuel virtually 'sulphur free'.

Diesel which is low in sulphur can cause issues with rubber and plastic components in the fuel system because is contains less lubricants, and eventually this lack of lubrication can result in faster degradation of these components, resulting in fuel pump and seal failures.

To accomplish the low sulphur content many suppliers have opted to incorporate Bio Diesel, (when biodiesel is blended, fatty acid methyl esters (FAME) are added to the mineral diesel) the recommended maximum is 7% although this will rise to 12% in 2012. The previous level was 5% and the new increase has resulted agricultural users seeing a fast rise in both diesel bug contamination and fuel blockage issues.

Including bio diesel in the fuel mix can resolve the lubrication issue of low sulphur however it also promotes fuel oxidation and instability, and is incompatible with engine seals and sealants. Its biggest down side is its absorption /attraction of water and formation of emulsions, resulting in higher cases of diesel bug and emulsification.

There are a number of suppliers who offer of FAME free diesel however the traceability of the source is not as easy to confirm and recent tests across the country found all BS2869 diesel now used in the UK already has percentage of bio fuel and in some a bio diesel content of 9% was found.

An additional problem we face around the UK is that there are many different types of bio fuel and that these are usually mixed .(UK bio consist of a mix of animal fat including pork and turkey, fish oil, palm oil, rapeseed oil and whatever else they can find that goes to waste) Some has a higher energy content like palm oil that will raise engine temperature by 4 or 5 degrees (not good at all) and others have a very low energy content like fish oil that has 11% less energy (causing idling and cold start problems).

All these oils differ slightly in specific gravity and density. The reality is that they do not mix well (lab testing to show this is complex but put a fuel sample in the freezer and check it every 15 minutes and you will see layers forming because each type has a slightly different cloud point, very unscientific but practical method). These layers that form each have its own characteristics and on its own it will cause different engine problems.

Most importantly Bio diesel only has a shelf life of approx 6months, put it in a marine environment and this half's and if microbes like diesel bug are present it half's again, potentially you may only get a few months shelf life!

**100% true bio fuel ie biodiesel produced strictly according to EN14214 standards does not tend to suffer the issues identified above and is a true green alternative which has many other benefits not seen with bio diesel mixtures.*

Treatments

The treatments on the market at present have concentrated on two issues, removing water from the diesel and killing diesel bug. There are many different products on the market but these can be split into Biocides and Enzyme based products. Each tackles the issue in different ways.

With any treatment; it is important to ensure that the product is mixed with the fuel evenly, and therefore treat before filling up, or alternatively give the tank a stir to ensure that the product is effective. If using enzymes it is important not to overdose as this can result in excessive water retention in the diesel.

Biocides

These are chemically produced products designed to deal with specific issues. They can be used as a one off to treat diesel contamination (diesel bug killer), or dosed to prevent contamination occurring. These include products like M16 Diesel Bug, Grotamar, Yachtcon, Kathon, In general they contain biocide to kill micro bacterial contamination and inhibit further growth of micro bacteria. In some products they include demulsifies to separate out the water from the diesel , and lock in the dead bug 'bodies' in the fuel so that they are burnt in the combustions cycle, effectively removing the 'sludge'.

Biocides are toxic and therefore should be treated with care and applied strictly according to the supplied instructions. When treating for fuel contamination then it is always advisable to change your filter and remove any water form the tank and water separator. However please ensure that the water is disposed of in accordance to the EU Biocide Directive.

http://www.britishmarine.co.uk/other/environmental_code_of_practice/environmental_legislation/water_pollution.aspx).

There are many worries relating to bugs building an 'immunity' to these biocides, however in reality as all bugs are destroyed rather than treated, the analogy with antibiotics is not applicable.

Enzyme and Natural Emulsifier Products

These products are generally environmentally safe and are based on a combination of manmade enzymes and plant extracts, they tackle the issue by distributing and locking the water in to the fuel so that it can be burnt during the combustion cycle, by removing the water they remove the food for the diesel bug. If dosed correctly then the maximum water absorption should be in the region of 900ppm (0.09%) for the natural emulsifier products, which is safe; however if overdose this can raise to 2500ppm resulting in diesel turning milky. These include products like FuelSet, Fortron, Soltron and Starbrite. The other group of enzyme based products use Kerosene as a carrier and while this restrict the ability to absorb water kerosene has a much higher wax content. Overdosing with these types of products can lead to change in fuels ability to combust quick enough and cause injector damage.

Some enzyme based products are temperature and UV sensitive and this can cause them deteriorated or stop working effectively if subject to extreme temperature variations and if they are not stored properly. They are not suitable for treating **severe** diesel bug contamination and are only effective as a preventative maintenance solution. Overdosing is the biggest risk with these products.

Emulsification of Diesel

Too much water in the diesel can cause emulsification, this is seen at the filters or more commonly at the injectors as the fuel is put under pressure. Emulsification of diesel at the injectors due to water content has only recently become an issue and RCR in the past 2 months have attended nine boats where 20-40ltrs of bio diesel has been added to the fuel tank, in some cases these vessels have been using regular treatments of enzyme based products. Initially we were unable to resolve and the first three boats had to have the whole system cleaned and flushed, although in one case the diesel destroyed the seals in the fuel polisher, and resulted in over 200ltrs of fuel being lost!

To combat this issue we have had to develop a new strategy and after a number of test cases we now use biocide treatments to separate out the water from the diesel whilst in the tank, although because of the complex nature of the mixture this can take up to 48hrs to accomplish. Following this the fuel system is cleaned right though to the return pipes, and the water drained off from the fuel tank to remove the risk of the water being absorbed in the future.

So what treatment should you use:

The arguments will always remain between manufacturers as to which treatment is best, and in the hope of helping users to identify the best products on the market a number of independent tests have been completed, although the results could be concluded as being more confusing than helpful!

RCR attends hundreds of contamination issues each year and therefore we have had to ensure that the product we use provides instant results and stops these problems from reoccurring, and for this reason we favour the Biocide treatments. Enzyme based products are effective and useful when there is only a small amount of water content but too much and you run the risk of not removing it or overdosing and locking to much water in to the diesel.

Another reason for favouring the biocide treatment is with the new introduction of Bio diesel and rise in cases of emulsification at the injectors, we believe enzyme products can compound the problem of water absorption.

RCR use Marine 16 products and recommend the use of Diesel Fuel complete as a regular treatment. However the most important message to get across is to regularly check your tank for water and if found remove it, doing this will reduce the risk of water contamination and diesel bug irrelevant of which product you choose to use.

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Acknowledgment:- David White of M16, Ian Roos of FuelQC, and background support from David Fletcher NABO chairman, EU Directive, Tony Brooks training notes