PBO TESTED

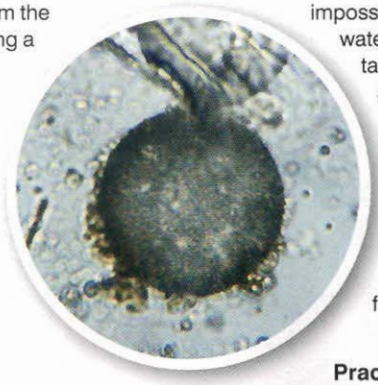
# 12 diesel bug treatments


Diesel bug can clog filters and starve your boat engine of fuel just when you need it most. Can diesel bug treatments kill it off? We test 12 to find out

**Tales of diesel bug can seem overstated to some of us. Many boaters have evaded the problem for years, often more by luck than judgement, but with the introduction of biodiesel (often referred to as FAME – Fatty Acid Methyl Ester fuels) and biodiesel mixtures the slice of luck required to avoid diesel bug is going to need to be a lot bigger.**

Diesel bug is a general term for a host of fungi, bacteria and yeasts ready and willing to inhabit your tank, whether by transfer from infected fuel or by colonisation from airborne spores. Around 147 species have been identified living in infected non-bio diesel fuel, but the new fuels bring a whole host of new organisms to join the party – over 1,400 at the last count. It makes sense when you think about it: the biofuel additive might have elements of fish oil, rapeseed oil, vegetable oil, animal fat – almost anything. Adding all these extra oils makes the fuel attractive to many more kinds of microbial life by offering a more varied diet.

Diesel bug thrives at the interface between fuel and water – ie just off the bottom of the tank, where the micro-organisms form colonies. In this cosy environment they break down the alkanes in the fuel using oxygen from the water, precipitating a black sludge to the bottom of the tank as they do so. This sludge is formed from the microbes' excretions and from badly emulsified fuel, and consists in part of thread-like compounds a few microns (micrometers) in size that quickly agglomerate to block fuel filters and stop your engine.



## HOW CAN YOU FIGHT DIESEL BUG?

The best weapon we have against all these organisms is their common factor: habitat. If there is no water in the tank, diesel bug cannot survive. In reality, it's impossible to prevent water entering your tank – tanks will suffer from condensation at the very least, even if you manage to avoid any water entering through the filler. However, you can limit the condensation by keeping your tanks topped up to minimise the volume of damp air in the top of the tank, and by regularly draining off the water and debris from the bottom of the tank. If your tank doesn't have a drain cock at the bottom, fit one at the lowest point, with a valve to allow you to run off fuel into a glass jar. When it runs pure, your tank is clean again.

Maintenance such as this can help keep your tank clean, but if you pick up diesel bug you will need to eradicate it. Additives are available, which split into two types: biocides and dispersants. Both rely on the bug's reliance on water: biocides by dehydrating the cells or blocking their ability to feed, and dispersants by lifting the water into suspension, destroying the micro-organisms' environment. They will then either starve or be burned in the engine, together with

the water. In fact, slight moisture can increase engine power.

In company with our sister magazine *Motor Boat and Yachting*, we set out to test 12 of these treatments, assessing how effective they are at killing diesel bug and, more importantly, in producing a fuel that can be easily burned without blocking filters.

## THE TEST

It's impossible to fairly test these additives outside a laboratory. At PBO we receive several letters each year claiming how effective an individual product has proved to be. While encouraging, these letters offer no scientific proof because they have not been compared with a control sample that did not receive the treatment.

With that in mind, we contacted Fuel QC, an Essex-based firm part of whose business is fuel testing, mostly for clients in the aviation and oil industries. Most of their work is done at their clients' premises, but for our test they set up in a barn adjacent to their offices.

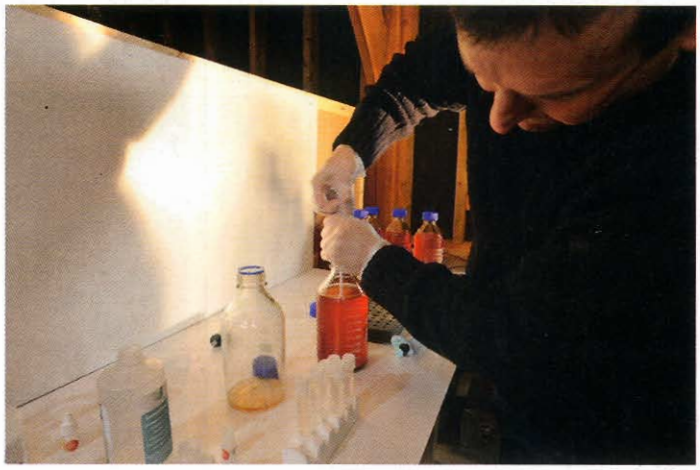
We collected together 12 leading products to take part in the test, of which seven are biocides and the others dispersants. On our behalf, Fuel QC sourced 200lt of fuel with mild contamination which was left to fester for three weeks, after which time it was judged to have a mid-range case of diesel bug consistent with a contaminated boat tank. We then siphoned the fuel into 13 one-litre sterilised glass jars: one for each sample and one for a control sample, which would be left untreated. Each sample was treated with the manufacturer's recommended dose for an initial 'curative' treatment – maintenance doses will be lower.

## TESTING FOR BUGS

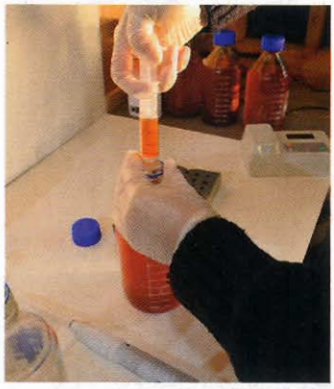
Several methods exist for calculating microbial activity, and one commonly used is to assess the presence of ATP (Adenosine Triphosphate). This is split into two types: free ATP (fATP) and cellular ATP (cATP). cATP is found inside the cells while fATP is free to move around in the host liquid.

Until recently tests simply verified the quantity of ATP present, but newer methods such as those employed by Fuel QC specifically assess the presence of cATP. They do this by using an enzyme which causes the cATP in the sample to break down and release light. This light can be measured very accurately with a device called a luminometer, and the result used to calculate the amount of cATP present.

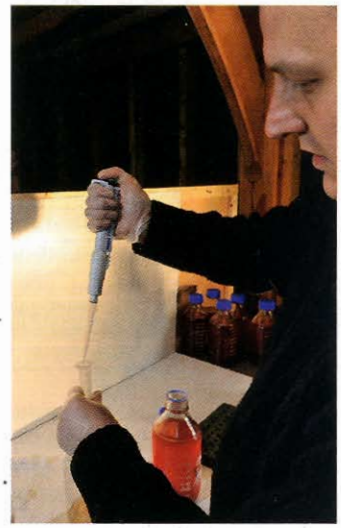
## FUEL QC'S cATP TEST, STEP-BY-STEP



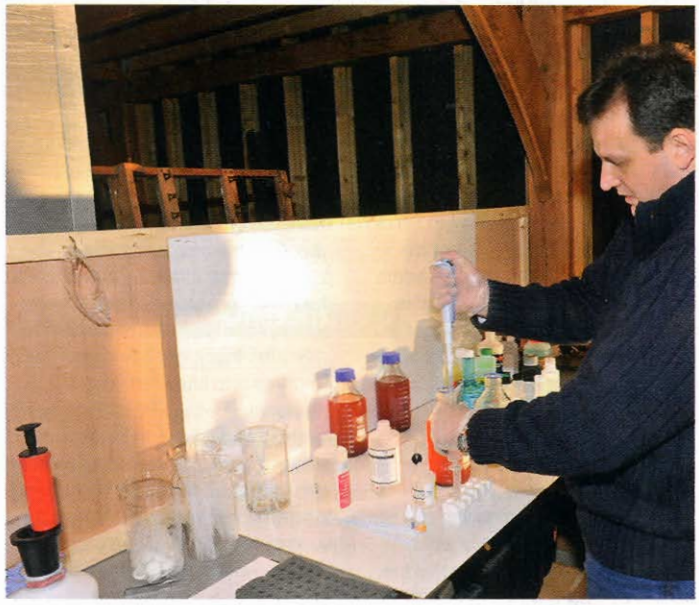
1 Draw a sample of contaminated fuel into a syringe from the interface between the fuel and water – this is where the diesel bug will be found.



2 Filter a sample of the fuel through a 0.75 micron filter attached to a syringe. This removes the fuel, leaving the micro-organisms and debris in the filter.



3 Wash the filter through with an acetone blend. This removes free ATP, leaving debris and cellular ATP. The filter is then dried with air passed through it from the syringe.

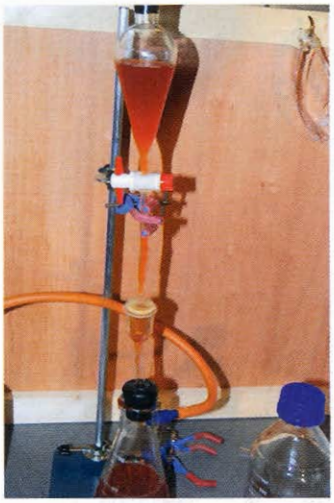


4 Pass a lysis agent through the filter to break down the cells, and collect the fluid in an extraction tube.

5 Dilute the contents of the extraction tube by adding a measured quantity of distilled water from a pipette.

6 Transfer a measured amount of fluid from the extraction tube to a culture tube and add two drops of the enzyme luciferase.

7 Use a luminometer to measure the RLU (Relative Light Unit) count of the sample, from which the level of cATP can be calculated to within +/- 5%.



**We filtered 500ml of treated fuel through a 10 micron filter**

This makes the test a more accurate assessment of whether life still exists, as cATP can only exist in living cells while the free ATP will survive after the cells have been destroyed.

We carried out the cATP test twice on each sample – once after 24 hours and again after 10 days. Each day of the test the bottles were agitated briefly, as even on a moored boat the fuel will not be completely static, then left to settle again. During the test the bottles were stored in the dark, as light is excluded from most boat fuel tanks and its presence can accelerate microbial growth.

## TESTING FOR FILTRATION

After we had completed the cATP testing, we used 500ml of each sample to check how effective the treatment had been at reducing the build-up of sludge that can block your filter. Boat fuel filters typically range in size from 5 microns to 30 microns, so we chose an intermediate value of 10 microns.

To see how easily the fuel would pass through the filter we agitated the sample and filtered it twice at 10 microns. The first pass removed inorganic and particulate matter, leaving the treated fuel. We timed the second pass through a clean filter to show how easily the treated fuel will pass through it. This gives an insight into the type of contamination left in the fuel – if it is the colonies, emulsions and thready compounds typically found in cases of diesel bug they will quickly accumulate, blocking the filter and slowing the passage of fuel, while other less tenacious contamination will pass through. Hence samples which passed slowly through the second filter would be likely to block the filter entirely over time.

## UNDERSTANDING THE RESULTS

The lower results graph on page 63 compares the initial cATP values with those after 10 days to give a measure of the effectiveness of the treatment over time, expressed as a percentage decline in cATP from the original figure. This should give a fair representation of how effective each treatment is in dealing with microbial activity, and removes any inconsistencies owing to variations of activity in each sample. The 24-hour figures, seen in the data panel for each product, vary in meaning according to whether the product is a biocide or an dispersant, so are not plotted as they can be misleading. However, low activity after 24 hours for a biocide suggests that it rapidly starts to kill the micro-organisms, while high activity for a dispersant product indicates that it quickly disperses colonies and lifts them into suspension – the key to this method of destroying diesel bug.

The filtration data is compared with the result obtained by running the same test with the untreated control sample to give a measure of how much faster treated fuel will pass through a fuel filter.

### Checking your tank

**If you don't have a tank drain, try dipping a length of clear hose to the bottom of the tank. Then seal the top end with your thumb and transfer the contents to a jar for a good look. If the fuel is dark or shows sticky deposits, it needs treatment. Severely infected fuel smells of rotten eggs or varnish.**

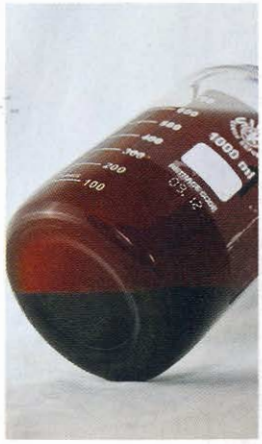
DIESEL BUG TREATMENTS TESTED

BIOCIDAL TREATMENTS – dehydrat

## Star Brite Bio Diesel

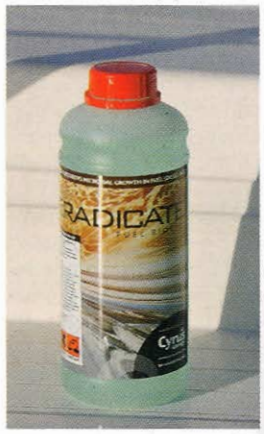

| | |
|---|---|
| Shock dose per litre: | **0.3ml** |
| Shock dose cost per litre: | **1.5p** |
| Maintenance dose p/lt: | **0.3ml** |
| Maintenance cost per litre: | **1.5p** |
| Bottle size: | **473ml** |
| Bottle cost: | **£24.12** |
| www.starbrite.com | |
| **CONTAMINATION** | |
| pg cATP/ml before: | **42.57** |
| pg cATP/ml after 1 day: | **10.80** |
| pg cATP/ml after 10 days: | **5.69** |
| cATP reduction: | **-87%** |
| **FILTRATION RESULTS** | |
| Faster than control by: | **44%** |

This product made a great start by doing 86% of its total work in the first 24 hours. In the test flask there was no evidence of gummy deposits that block filters and for this reason our expert observed that the product would be beneficial in cleaning your engine. However, the remaining microbial life and water in the fuel suggest that further treatment would be advisable.



**No gummy deposits, but water will need treating**

## Eradicate



| | |
|---|---|
| Shock dose per litre: | **1ml** |
| Shock dose cost per litre: | **5p** |
| Maintenance dose p/lt: | **0.5ml** |
| Maintenance cost per litre: | **2.5p** |
| Bottle size: | **1lt** |
| Bottle cost: | **£49.95** |
| www.bonnymans.co.uk | |
| **CONTAMINATION** | |
| pg cATP/ml before: | **14.51** |
| pg cATP/ml after 1 day: | **4.83** |
| pg cATP/ml after 10 days: | **0.45** |
| cATP reduction: | **-97%** |
| **FILTRATION RESULTS** | |
| Faster than control by: | **44%** |

We used the lower dose for this test as Eradicate recommend the standard dose for all but the heaviest contamination. It proved highly effective, removing all but a few percent of microbial life and giving above average performance in the filter test. There were a lot of sticky deposits left in the bottom of the jar for which further treatment would be required to avoid filter blockage problems.

**Sticky deposits are an issue, but a good kill rate**

**TEST KEY**

**Bottle size:** *indicates larger or smaller bottles available
**pg cATP/ml before/after:** the amount of cellular ATP (in picograms) present in the fuel sample before the test, after 24 hours and after 10 days
**cATP reduction:** Shows the percentage decline in the amount of microbial life over the 10 days, measured in cellular ATP
**Filtration results:** improvement on control in filter test

cells to rapidly kill diesel bug

## Grotamar 82

Shock dose per litre: **2.5ml**
Shock dose cost per litre: **8.7p**
Maintenance dose p/lt: **0.15ml**
Maintenance cost per litre: **0.5p**
Bottle size: **1lt**
Bottle cost: **£34.99**
**www.echamicrobiology.co.uk**

**CONTAMINATION**

pg cATP/ml before: **12.10**
pg cATP/ml after 1 day: **3.88**
pg cATP/ml after 10 days: **0.95**
cATP reduction: **-92%**

**FILTRATION RESULTS**

Faster than control by: **47%**

Grotamar 82 was developed to combat problems from low-sulphur biodiesel blends, and achieves its aim well. The 92% kill rate is good, and the sample proved the swiftest of the biocide-treated fuels through the filter. The product did a good job of dispersing the water into the fuel, although this is not its primary purpose. There were some minor deposits left in the bottom of the flask.

**Excellent filterability and kill rate, and only minor debris**

## Marine 16 treatment

Shock dose per litre: **1ml**
Shock dose cost per litre: **8.7p**
Maintenance dose p/lt: **0.05ml**
Maintenance cost per litre: **0.4p**
Bottle size: **100ml**
Bottle cost: **£8.71**
**www.marine16.co.uk**

**CONTAMINATION**

pg cATP/ml before: **42.57**
pg cATP/ml after 1 day: **1.33**
pg cATP/ml after 10 days: **1.45**
cATP reduction: **-97%**

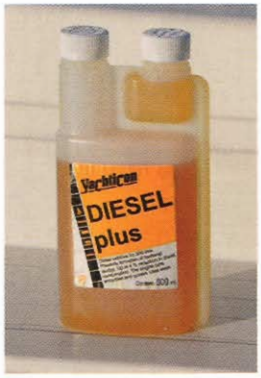
**FILTRATION RESULTS**

Faster than control by: **36%**

Our results suggest that this was the fastest biocide to act, doing all its work in the first 24 hours with no change over the next nine days (within the 5% error of the test). The bottom of the flask showed some gummy deposits and debris, but water was well dispersed. Marine 16 say that further doses will break down the debris. They offer another product for ongoing treatment, Diesel Fuel Complete (see page 100).

**Good dispersal and speed, but further treatment needed**

## Yachticon Diesel Plus




Shock dose per litre: **1ml**
Shock dose cost per litre: **3.4p**
Maintenance dose per litre: **1ml**
Maintenance cost per litre: **3.4p**
Bottle size: **500ml**
Bottle cost: **£16.95**
**www.meridianzero.co.uk**

**CONTAMINATION**

pg cATP/ml before: **3.71**
pg cATP/ml after 1 day: **1.46**
pg cATP/ml after 10 days: **1.06**
cATP reduction: **-71%**

**FILTRATION RESULTS**

Faster than control by: **28%**

Diesel Plus is claimed to be more than just a biocide, improving fuel efficiency and making your engine run more smoothly. Unfortunately, on our test it yielded below-average performance with gummy deposits and poor water dispersion at a high price.

However, the 24-hour result shows that it did set to work swiftly, suggesting that a higher initial dose may be needed in severe contamination cases.

**Gummy deposits suggest a bigger dose is needed**

## Wasp Biokem


Shock dose per litre: **0.3ml**
Shock dose cost per litre: **2.7p**
Maintenance dose p/lt: **0.1ml**
Maintenance cost per litre: **0.9p**
Bottle size: **250ml**
Bottle cost: **£22.60**
**www.separ.co.uk**

**CONTAMINATION**

pg cATP/ml before: **62.65**
pg cATP/ml after 1 day: **18.17**
pg cATP/ml after 10 days: **1.45**
cATP reduction: **-98%**

**FILTRATION RESULTS**

Faster than control by: **38%**

Wasp recommend three dosage levels, so we chose the 0.2ml/lt rate suggested for a moderate case such as ours. Results were good, with the 98% kill rate among the best on test and an average 38% result on the filtration. The treatment cleaned the fuel effectively and left no sticky deposits, but did not do as well dispersing water, which would need separate attention to ensure its removal.

**A good kill rate and no sticky deposits**

## Kathon FP 1.5


Shock dose per litre: **0.3ml**
Shock dose cost per litre: **0.6p**
Maintenance dose p/lt: **0.3ml**
Maintenance cost per litre: **0.6p**
Bottle size: **5kg**
Bottle cost: **£99.50**
**www.separ.co.uk**

**CONTAMINATION**

pg cATP/ml before: **20.84**
pg cATP/ml after 1 day: **10.93**
pg cATP/ml after 10 days: **4.35**
cATP reduction: **-79%**

**FILTRATION RESULTS**

Faster than control by: **32%**

Our results show Kathon with middle-of-the-road performance on both the kill rate and filter tests, but at just 0.6p per litre you could easily double the dose to increase its effectiveness. If you're a major fuel user this is worth considering. Of concern however were the sticky deposits left at the bottom of our sample, which would need attention, although it did disperse the water.

**Cheap, but sticky deposits are of concern**

## DISPERSANT TREATMENTS – disperse water to deprive diesel bug of its habitat

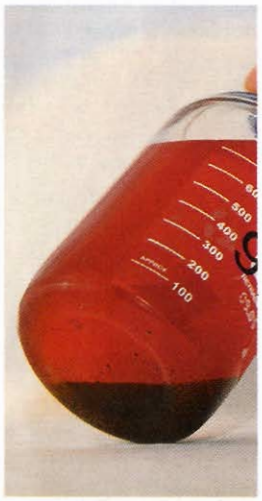
### Soltron

Shock dose per litre: **0.2ml**
Shock dose cost per litre: **2p**
Maintenance dose p/lt: **0.2ml**
Maintenance cost per litre: **2p**
Bottle size: **125ml**
Bottle cost: **£12.50**
**soltronjersey.com**

**CONTAMINATION**
pg cATP/ml before: **62.65**
pg cATP/ml after 1 day: **74.15**
pg cATP/ml after 10 days: **12.39**
cATP reduction: **-80%**

**FILTRATION RESULTS**
Faster than control by: **49%**

The flask revealed minimal gummy deposits and a low debris level. The 24-hour data shows that Soltron set swiftly to work scattering microbe colonies, and the filter result was the best on test, showing that this is a good choice for breaking up contamination to be burned in the engine. Water dispersal was incomplete, but more time or a bigger dose are likely to solve this.



**Fine debris passed quickly through our filter**

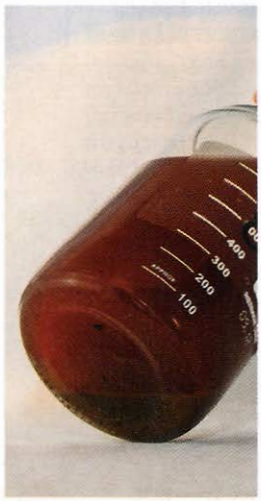
### Fuel Set


Shock dose per litre: **0.5ml**
Shock dose cost per litre: **2.1p**
Maintenance dose p/lt: **0.25ml**
Maintenance cost per litre: **1p**
Bottle size: **250ml***
Bottle cost: **£10.38**
**www.liquideng.eu**

**CONTAMINATION**
pg cATP/ml before: **17.81**
pg cATP/ml after 1 day: **91.37**
pg cATP/ml after 10 days: **3.68**
cATP reduction: **-79%**

**FILTRATION RESULTS**
Faster than control by: **40%**

This product gave a very good performance, with no gunge, only fine debris and all the water dispersed. A huge peak on our 24-hour test showed that it quickly broke down colonies and lifted them into suspension. Fuel Set claims to be made from natural compounds and also to clean your fuel system as it transits – the rapid action we observed will be of help here.



**Excellent dispersal and no sticky deposits**

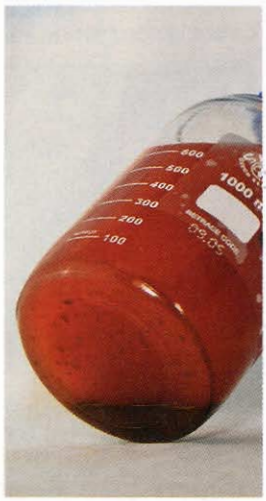
### Fuel Doctor

Shock dose per litre: **5ml**
Shock dose cost per litre: **16.1p**
Maintenance dose per litre: **1ml**
Maintenance cost per litre: **3.2p**
Bottle size: **500ml**
Bottle cost: **£16.13**
**expresslube.co.uk**

**CONTAMINATION**
pg cATP/ml before: **49.72**
pg cATP/ml after 1 day: **13.98**
pg cATP/ml after 10 days: **1.91**
cATP reduction: **-96%**

**FILTRATION RESULTS**
Faster than control by: **42%**

Fuel Doctor gave good test results, and inspection showed excellent dispersal and no gummy deposits. Some large crystals were seen at the bottom of the sample, which Fuel Doctor explain are formed from dried dead biomass which will disperse with continued use of the product. A filter change after 10-20 hours running is recommended.



**A good kill rate, filter result and water dispersal**

### Fortron


Shock dose per litre: **2ml**
Shock dose cost per litre: **8.5p**
Maintenance dose per litre: **1ml**
Maintenance cost per litre: **4.2p**
Bottle size: **1lt**
Bottle cost: **£42.43**
**www.fortron.co.uk**

**CONTAMINATION**
pg cATP/ml before: **8.39**
pg cATP/ml after 1 day: **28.40**
pg cATP/ml after 10 days: **6.75**
cATP reduction: **-20%**

**FILTRATION RESULTS**
Faster than control by: **43%**

Claimed to not only kill diesel bug but also clean injectors, Fortron struggled in our kill rate test, although the filter result was good and the 24-hour figure suggests rapid action. Of most concern was the jar inspection, which revealed significant gummy deposits and poor water dispersal. A heavier shock dose might well improve these results significantly.

**Deposits and poor dispersal suggest inadequate dosing**

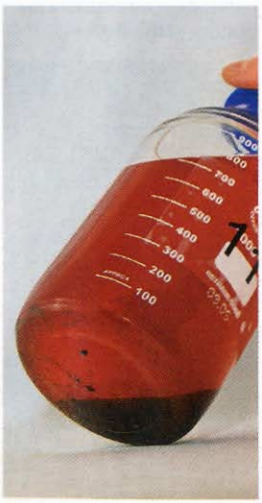
### Starbrite Star Tron


Shock dose per litre: **0.5ml**
Shock dose cost per litre: **2.9p**
Maintenance dose p/lt: **0.25ml**
Maintenance cost per litre: **1.4p**
Bottle size: **473ml**
Bottle cost: **£27.24**
**www.starbrite.com**

**CONTAMINATION**
pg cATP/ml before: **12.38**
pg cATP/ml after 1 day: **29.61**
pg cATP/ml after 10 days: **0.45**
cATP reduction: **-96%**

**FILTRATION RESULTS**
Faster than control by: **47%**

Among the best on test with a 96% kill rate, Star Tron also excelled with a 47% improvement in filter speed. However, it did leave some sticky deposits in the jar and had not completely dispersed the water. Starbrite say that their product is most effective when the boat is used, as the engine will then process the treated fuel and destroy the bug.



**Some deposits and water will require treatment**

## FAME and sulphur

**This test is about diesel bug, but other problems from the new FAME (biodiesel) mixtures and low-sulphur fuels are often referred to in the same context.**

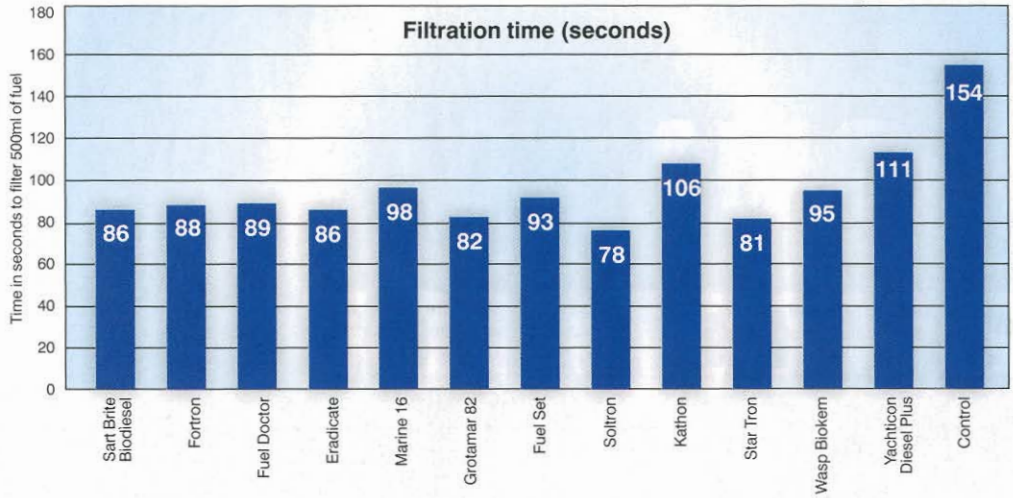
■ **Up to 7% FAME can be mixed with road diesel, but even this is enough that some adverse effects are being seen. One of the worst is the cold filter plugging point (CFPP), the lowest temperature at which fuel will pass through a specific filter. For non-bio diesel this is between -7°C and -14°C, but for FAME mixtures it can be as high as 1°C – bad news for winter sailing. At present none of the additives in EN590 DERV – the fuel supplied to garage forecourts – address this. A kerosene-based treatment such as Soltron or Star Tron will help, so if you sail in the winter is a point worth considering.**

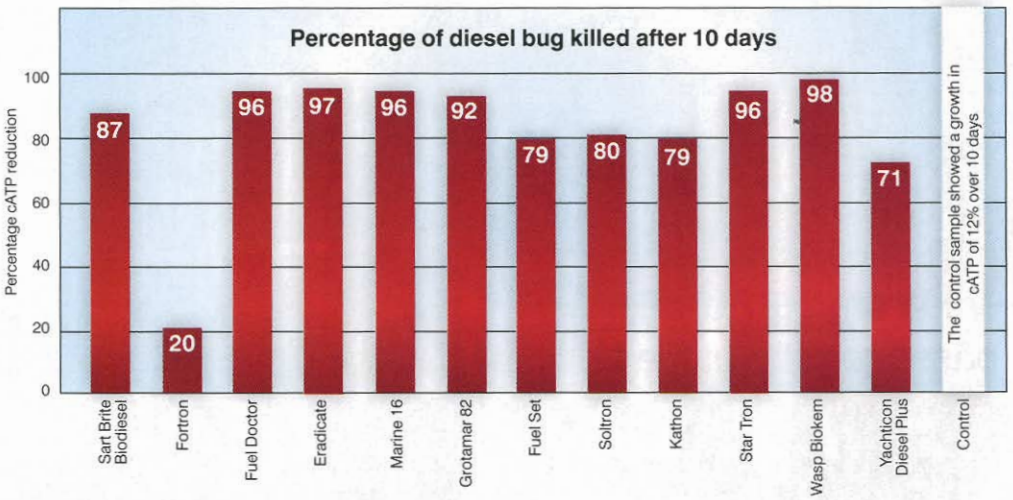
■ **Adding FAME has been shown to loosen debris and cause it to be washed through your fuel system. The filters should cope with this, but keep an eye on them and be prepared to change them more frequently until the system settles down again.**

■ **FAME will attack rubber and cause it to degrade over time, but a more immediate issue is that seals which have swollen in traditional hydrocarbon fuel can start to shrink and cause leaks. This is likely to affect seals older than about eight or 10 years, so if your engine falls into this category keep a careful eye out and keep plenty of spares.**

■ **Modern fuels also have a reduced sulphur content, which reduces their lubricity. The good news is that the additives in EN590 DERV meet a set standard which should bring the fuel's lubricity back to a level that will avoid harm to your engine. Even better, EN590 should give slightly more power for slightly lower fuel consumption.**

## RESULTS GRAPHS




## PBO VERDICT

The good news for boat owners is that, whichever of these products you use, it will have a positive effect. But some are better than others, and some are more suitable for continued use.

Firstly, there's a big difference between biocides and dispersants. Biocides are excellent at giving contaminated tanks a shock treatment and killing diesel bug, but often struggle to shift by-products and get rid of water. Dispersant treatments are slower at getting rid of the bug but have the benefit that they lift the water and much of the debris into suspension, so with perhaps a couple of filter replacements you stand a better chance of cleaning your tank.

So which should you use? A biocide will quickly and effectively kill the problem, and from our results and observations it's hard to choose between Grotamar 82, Wasp Biokem, Marine 16 and Eradicate. All of them had excellent kill rates, although Grotamar has the edge for filterability and Wasp for kill rate and price (for a shock dose).

For ongoing maintenance. Fuel Doctor would work well but is expensive, even in the smaller dose. Soltron and Star Tron have similar enzyme formulations which are both particularly good at improving filterability and would be good choices, especially if you use your boat regularly. Fuel Set didn't have the best kill rate or filtration results but had excellent water and debris dispersal. It's also quick.

There seems little doubt that with the introduction of biofuel mixtures, more boat owners are going to struggle with diesel bug. But it's something we're going to have to deal with and get used to, because it's here to stay.


**Choose a dispersant treatment for ongoing maintenance**

While FAME-free fuel is still permitted for coastal shipping, supply may well become scarce for small boats so the likelihood is that we will all have to put FAME into our tanks at some point. Perhaps it's time to give your engine and fuel system a thorough service, clean it well, change the seals and keep a careful eye out for the dreaded bug, confident in the knowledge that there are some effective products ready for combat if and when it comes to call.