

Fuel additives

Executive summary

As part of an integrated research programme looking at improving fuel efficiency for fishing vessels Seafish has tested eight diesel fuel additives for red diesel to assess manufacturer's claims that their use leads to a reduction in fuel consumption. The trials showed there were no discernable improvements in fuel economy when using diesel fuel additives under test cell conditions. Because of the difficulties of conducting standard tests at sea the tests were conducted at the Camborne School of Mines engine dynamometer test facility installed in the Holman's Test Mine in Cornwall. This facility was established as part of the biofuels for fishing vessels project, commissioned by Seafish. Eight different diesel fuel additives were subjected to the trials.

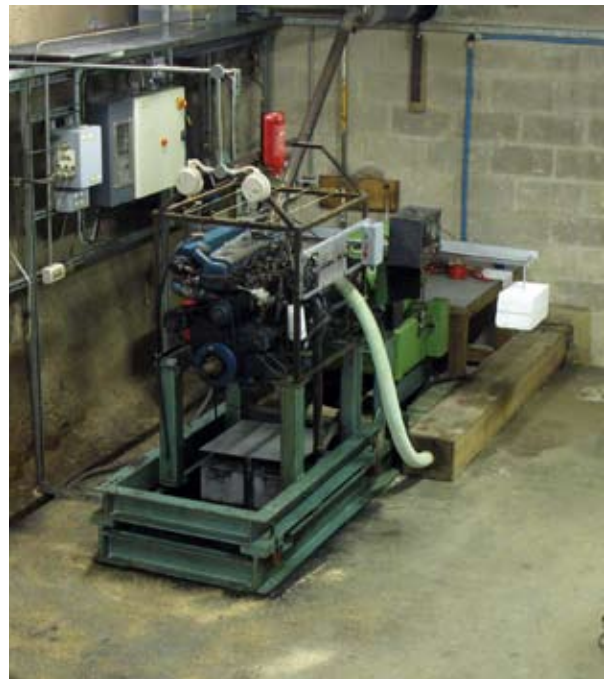
The test cycle used simulated a typical day trawl cycle – a trawler operating a 20 hour, 40 minute excursion from Newlyn and carrying out three tows of four hours each.

Results with the same simulated test cycle using biofuels revealed significant and appreciable increases in fuel consumption (which corresponded to the biofuel's lower calorific value) compared with the use of red diesel alone. However, sea trials in a ~10m potting boat conducted using the same two fuels revealed no identifiable differences in fuel economy.

This highlights a need to determine real engine performance data from fishing vessels through direct observation. The engine dynamometer test cell could then be programmed with the observed duty cycles, rather than simulated duty cycles, to establish (with known levels of repeatability and confidence) whether the central finding of this report holds in the context of practical fishing operations.

Key points

- The results of the work indicate that there was only one additive showing a saving of around 1%.
- The other seven additives showed no significant effect on the fuel consumption of the test engine through the test cycle used.
- If the results from the tests are considered typical of real duty cycles, then the use of additives would increase operating costs for fisherman as they would have to pay for the additive as well as for the fuel.



The biofuel engine test cell facility underground at the CSM Holman Test Mine

What is a fuel additive?

Fuel additives come in a number of forms and can be supplied as liquid, powder or in pill form. Whilst many maintain they will reduce fuel consumption they work in a number of different ways and claim to do different things to the fuel including removing sludge, controlling soot, improving combustion and acting as a biocide.

Fuel treatments

Some of the products tested are marketed as fuel treatments or fuel conditioners. These products inhibit and remove microbiological contamination or 'the diesel bug'.

Diesel bug is a microbe, but it is not a single species of microbe. It can comprise a collection of bacteria, yeasts and moulds. It can exist even in fuel that is quite clean, but at low levels. If it does not enjoy suitable conditions to enable it to flourish, there is little to worry about, as minor contamination will be filtered out as the fuel is drawn through to the engine.

'Suitable conditions' essentially means the presence of water, because the microbes live and multiply on a fuel/water interface. They live and reproduce in the water, but feed on the nutrients in the fuel. Given the presence of water, warm or humid conditions will also help them to propagate. The number of bugs required to pose a problem is many millions. Evidence of bug contamination starts with brown sludge settling at the bottom of the tank, this comprises of dead organisms and can cause problems by clogging the fuel filters. An effective way to prevent problems is to keep water out of the fuel tank, which is best by keeping the tanks full to minimise the air in the tanks and avoid condensation/water in the diesel.

There are a number of products on the market that break down the slime into particles small enough to pass through fuel filters though the most effective method of avoiding bug problems is through good onboard husbandry. Only the effect on fuel consumption was tested during the trials. The effectiveness of these products as fuel conditioners was not analysed.

Testing procedure

It is extremely difficult to conduct standardised fuel consumption tests at sea since there are many variable factors other than the performance of the fuel. Seafish therefore commissioned the University of Exeter to conduct a series of standardised tests on a range of eight fuel additives provided by Seafish, using the University's underground test cell.

In the test cell it was possible to conduct standardised tests to compare the performance of red diesel treated with the additives against untreated red diesel. The nature of the testing eliminated many of the possible variables that would be encountered at sea, whilst power correction factors (to ISO standard) were used to compensate for unavoidable variables such as humidity, temperature and atmospheric pressure. It should be noted that being underground, these environmental variables are more stable than would be the case above ground.

Under the guidance of Seafish, a standard test cycle of 20 hours and 40 minutes was devised. The test cycle was designed to give a simple representation of an inshore trawler leaving port, steaming to a fishing ground and carrying out three tows of four hours each, before returning to port. This was named the day trawl cycle.

Fuel additive testing

The additives were mixed into the red diesel at the concentrations recommended on the packaging. Each fuel was put through a baseline test cycle that plotted curves of maximum torque and fuel consumption over the full range of engine speeds. These curves provided a 'fingerprint' to define maximum engine performance, and also allow fuel treated with the additives to be compared against untreated fuel under maximum conditions.

After each fuel test containing an additive, a baseline test using untreated red diesel was repeated and compared with a known engine performance envelope. This allowed determination of whether or not the engine condition had returned to its state prior to any testing with additives, and also whether or not any engine failure or malfunction may have occurred during the prior day trawl test. It was found that the engine consistently returned to its original performance and that during the additives testing campaign the engine suffered no malfunction or deterioration of performance.

Products tested

Company	Product	Ratio	Product	*Percentage savings Litres/Kw hour
Cyrus Marine	Cyrus	2,000:1	Fuel treatment	0.08% (0.44% on 2nd test)
Prolong	MPG +	3,000:1	Fuel catalyst	0.27%
PD-5	PD-5	4,000:1	Fuel conditioner	0.18%
Liquid Engineering	Fuel set	4,000:1	Fuel Conditioner	0.23%
Soltron	Soltron	5,000:1	Enzyme Additive	0.15%
Energy 21	21 FG	2,500:1	Fuel Enhancer	0.20%
Oxonica	Envirox	2-4000:1	Fuel Combustion Catalyst	0.27%
Cashgrow	MPG Mega Caps	1 tablet per 40 litres	Engine conditioner	1.08%

*percentage savings from Standard red diesel BS590

Associated product costs

Company	Product	Cost to treat 1,000 litres of fuel	Quantity needed to be purchased	Website
Cyrus Marine	Cyrus	£5.87	25l treats 50,000l of fuel	www.fuel-treatment.co.uk/
Prolong	MPG Plus	£5.00	Various	www.prolong-uk.com/mpg/
PD-5	PD-5	£16.50	250ml treats 1,000l of fuel	www.fuel-additive.co.uk/
Liquid Engineering	Fuel set	£5.70	25 Litres treats 100,000l of fuel	http://liquideng.co.uk/
Soltron	Soltron	£10.99	1l treats 5,000l of fuel	http://soltron.co.uk/
Energy 21	(No name at present)	Unavailable	Unavailable	www.energy21.co.uk/
Oxonica	Envirox	Contact distributor	Contact distributor	www.oxonica.com/
Cashgrow	MPG Mega Caps	£12.50	10 x 5g tubes treats 5,000l of fuel	www.cashgrow.myffi.biz/

Results and next steps

Products tested

The results of the testing provided multiple sets of data that were remarkably consistent. The equipment proved to be capable of a very high degree of repeatability, giving confidence that any significant variation in fuel performance would be detected. The high repeatability is a result of the precision (computer) control of the test schedule and the relatively stable environment in which the engine test cell operates. When the tests were repeated using a fuel known to be different (biodiesel) significant differences in the results of both the baseline test and the day trawl cycle were observed.

Product costs

The additives vary in price. The cost to treat 1,000 litres of fuel is shown in the table. As an example we can look at MPG Mega Caps to weigh up the economics of treating diesel versus the cost of the treatment. The cost to treat 1,000 litres of fuel with the MPG Mega Caps would be £12.50. Assuming the cost of diesel was 50 pence per litre, 1,000 litres would cost £500. A 1.08% fuel saving, as seen during the tests, would relate to a saving of £5.40 ($£500 \times 1.08\%$), but taking into account the cost of the MPG Mega Caps there would actually be an additional cost per 100 litres of £7.10 ($£5.40 - 12.50$). This costing does not factor in reductions that could be made for bulk purchases or benefits that may be derived from the use of the additive.

Additive costs were taken from associated websites in July 08.

Conclusions

- The test equipment proved to be capable of a very high degree of repeatability, giving confidence that any significant variation in fuel performance would be detected (as was the case with the biodiesel).

- The results indicate that there is no significant effect of any of the additives tested on the fuel consumption of the engine through the day trawl test cycle.
- It would cost fishermen more to run their vessels on BS590 diesel with additives because as well as paying for the base fuel, they would also have to pay for the additive.
- The research highlights a need for direct observation on fishing vessels to determine real engine performance data to establish (with known levels of repeatability and confidence) whether the central findings of this report hold in the context of practical fishing operations.

For further information

Diesel - fishermen fuel additives testing summary for fishermen. March 2008.

<http://www.seafish.org/pdf.pl?file=seafish/Documents/Fuel%20additives%20summary%20for%20fishermen.pdf>

Further Seafish reports on fuel efficiency Search under fuel.

<http://www.seafish.org/resources/publications.asp>

References

This fact sheet has been produced in conjunction with:



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