

Reaping benefits of nanoparticles

Steve Rooney looks at the technology behind the Envirox fuel additive which is being used across the Stagecoach fleet.

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MODERN diesel engines are complex beasts; the product of extensive R&D from world-leading manufacturers that are put to the test every day in operational use by bus and coach businesses. So when someone asks you to drop a little magic additive into your diesel fuel with the promise that it will save you fuel, you would want to ask a few questions first. Does the supplier have a strong scientific reputation? Have there been extensive field trials to prove the product's efficacy? And who else is already a customer?

Well, Energenics Europe can confidently tick all three boxes. The business originated as Oxonica, an enterprise spun out of Oxford University's scientific community to develop commercial applications for nanotechnology-based products. Its Envirox fuel additive has been extensively tested to demonstrate improvements in fuel economy and reduced emissions, and Stagecoach has been using the product across its UK fleet for the past six years.

Being based at Oxford University's Begbroke Science Park, has given Energenics the credibility

to convince bus engineers, whose long-held scepticism on the subject of fuel additives is well known, to embrace the relatively new science of nanotechnology.

Envirox is specially developed as a diesel fuel additive which can be used in engines without any modification at concentrations of 1 litre for every 4,000 litres of diesel. Its active ingredient is cerium oxide which has a strong pedigree in the automotive sector from its use in catalytic converters where it provides additional oxygen to help reduce hydrocarbon emissions that result from unburnt fuel.

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Although it may be argued that nanoparticles have been used, perhaps unknowingly throughout much of human history, the modern scientific application of nanotechnology is relatively young, having been developed from the early 1990s. It resulted from chemists and engineers discovering ways of deliberately creating materials with smaller particle sizes in a controlled manner. Energenics' chief executive officer Mike Attfield explains that the process of producing smaller particles often leads to a change in the way the materials behave, for example, in the case of cerium oxide, it becomes more active and thus its effectiveness as an oxidation catalyst is enhanced.

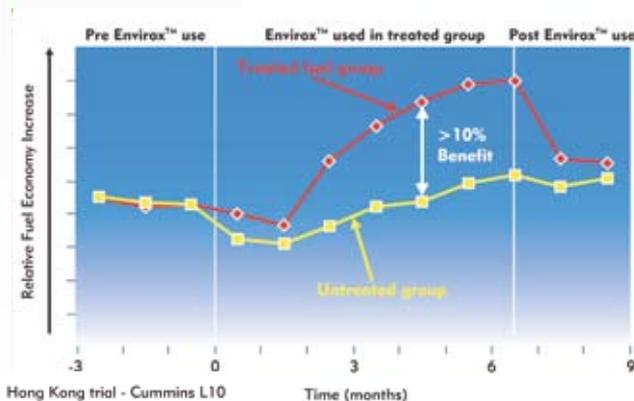
In recent years British universities have improved their track record of commercialising technological innovations. The Oxonica business was established

to develop commercial applications of nanotechnology. Alongside its work in the fuel additives field, the company also developed a product based on titanium oxide which has been extensively used in sunscreen. Titanium dioxide acts as a kind of mirror which can reflect UV rays and the use of smaller particles through nanotechnology increases the mirror-effect and thus the product's effectiveness.

The benefits of Envirox as a fuel additive also results from the 'amplifying' effect of nanoparticles. In this case it is the ability to provide additional oxygen at the end of the combustion process which prolongs burning and therefore produces more useful energy for the same amount of fuel. And as well as improving fuel efficiency directly, Envirox also has a longer term effect in reducing soot deposits that normally build up inside the engine and exhaust particulate filters. The catalysed oxidation process reduces the temperature at which the deposits are burnt off to around 450 degrees C rather than the usual 600 degrees C. This is something that is particularly important in urban bus operation, according to Attfield, since the evidence shows that stop-start and low-speed running means that bus engine temperatures may only get above 600 degrees C for a low percentage of operational time.

But of course it's not just about the theory. "To succeed in this field you have to be able to establish that the product works in end-user tests, not just in laboratory studies," says Attfield. So Envirox was put to the test in a major field trial in 2003 with Citybus

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in Hong Kong, then owned by Stagecoach. The trial involved 40 vehicles, half with Cummins engines and half with Volvos, with the same number and profile of vehicles left untreated as a control group.

Atfield is insistent that field trials need to be conducted properly in a scientifically-rigorous fashion including a large enough sample and control group, reliable data on fuel consumption and operational use before and afterwards, and adjustment for known seasonal variations in fuel consumption.

The Hong Kong trials delivered fuel economy improvements of around 10 per cent, based on an independent statistical report and although the sale of Citybus meant the initiative did not proceed at that time, Stagecoach had become convinced that there was something in it and agreed to a much larger field trial in the UK. In

2004 the group introduced Envirox into 12 depots in north west England and London with 15 different bus and engine combinations and involving a total of around 1,300 buses. The trial ran for 12 months and showed fuel savings of more than 5 per cent as a result of the additive, and at the beginning of 2005 Stagecoach agreed to implement Envirox across its fleet in a nationwide contract.

A further trial was conducted by Stagecoach in 2007, this time by removing Envirox from four depots and comparing with five depots in the same region which retained the additive. The results in the first three months demonstrated that Envirox accounted for fuel savings of 4.3 per cent, at which point the trial was concluded and the additive was re-introduced to all depots and Stagecoach renewed its commitment to the product.

Stagecoach now promotes

its use of Envirox as one of the activities it undertakes in making bus travel more sustainable, and it published data in 2008 identifying a £3.8million annual saving in the group's fuel costs and a reduction in carbon dioxide emissions of 24,500tonnes.

At the depot level the introduction of Envirox is made as easy as possible. A dosing unit ensures that the additive is introduced in the right proportions when bulk fuel is delivered. Around half of the dosing units are automatic with a flow meter to measure the required amount of Envirox to inject, and the other half have a simple keypad for staff to verify the quantity of bulk fuel being delivered at the time.

Envirox is supplied in 205litre drums and the dosing units have a warning system to alert depot staff to re-order when it falls to 15litres.

"We have deliberately played a long game by proving that the product works effectively in a large scale implementation across a whole group," says Atfield, pointing out that the benefits of Envirox are tangible and measurable, particularly for bus operations with bulk fuel storage at central depots. "Operators can spend £1 to save £5," he adds, "and with the higher net cost of fuel from the forthcoming reduction in BSOG payments, the savings will be even more."

Other UK operators using the product include Henderson Travel in west Scotland which

says that Envirox is reducing its CO2 emissions by up to 11 per cent, and some smaller coach operators have taken advantage of the Envirox Driver Pack which comes in handy 0.5litre packs that can treat up to 1,000litres of diesel. The driver packs are also supplied to the truck sector in the UK and overseas.

Bath and North East Somerset council uses Envirox in its municipal fleet, which includes some Optare Solos. In this instance, Envirox is supplied to the council's fuel supplier, Bath-based Ford Fuel Oils which has a dosing unit at its site and which, following a successful trial amongst its own tanker fleet, is now offering its other regional customers a premium fuel containing the Envirox additive.

Following the re-acquisition of the London operation, Energenics is now supplying Envirox to Stagecoach depots in the capital again bringing the total to over 120 depots nationwide. It has also just started implementation in seven depots in Quebec and Ontario for Stagecoach subsidiary Coach Canada. A local distributor Cerica is aiming to develop further markets for Envirox amongst other Canadian operators. The product is also used in the mining sector overseas with customers including Tata's raw materials division in India following a successful field trial there last year.

www.energenics.co.uk
www.enviroxdriverpack.com



Dosing units add the correct quantity of Envirox to bulk fuel deliveries.