STABILITY STUDIES

Tests have been carried out using the additive combined with water and diesel type fuels with a view to establishing the risks, or otherwise, of corrosion problems developing and of the fuel/water/additive mix breaking down.

Materials tested included steel, aluminium, copper, brass, bundy tubing, rubber and reinforced nylon tubing.

Laboratory Conditions

Introduction

Numerous past attempts to combine small amounts of water with diesel, either mechanically or chemically, have shown limited success. The emulsions created have been unstable, separating out within minutes. There have also been significant corrosion problems associated with the use of such emulsions in diesel systems, often leading to research programmes being abandoned.

The development of Coval's Aquasolve however, has overcome the major hurdle of stability. Its use has enabled over 10% of water to be completely absorbed in diesel. The additive, which is a combination of various organic compounds, has been successfully employed to create not only a diesel/water emulsion but also a clear stable solution.

A large amount of testing was required to support its performance and a comprehensive test program has been done at The City University, London.

Initial tests used:-

i) the additive,
ii) a clear solution of diesel, water and additive in the ratio of 30:3:4 (labelled S1),
iii) an emulsion of diesel, water and additive in the ratio of 30:3:2 (labelled E2).

Bench Testing

Static Corrosion Test

The basic diesel fuel system was divided into its components:-

Tank - Fuel Line - Filters - Pump - Injectors.

Component materials used were ascertained to be:-

Metallic	Non-Metallic
Structural Steel	Reinforced Nylon Tubing
Cold-drawn Steel Tube	Bundy Tube
Aluminium Alloy	Rubber
Brass	
Copper	

These materials were corrosion tested at room temperature (20°c). Two control tests were set up for each sample:-

i) Air - in order to compare test samples with an original sample.
ii) Diesel - in order to recognise any ‘normal’ effects due to contact with untreated diesel.

Later further corrosion tests were conducted using solution S1 mixed with various proprietory diesel fuel improvers.

Each material sample was carefully cleaned (using emery cloth on the metallic and tissue on the non-metallic samples) and then fully immersed in the test fluids.

Using tongs, each sample was then individually removed from its jar of fluid, dried using tissue and weighed on electronic scales (range 0 - 160mg, readability 0.1mg). The weight was recorded and the sample returned to its jar of fluid.

The samples were left undisturbed for two months during which time any visible changes in samples or fluids were recorded. After two months, the samples were re-weighed using the same technique as before to establish whether any weight gain/loss has occurred.

Steel

Rubber

The only metallic elements to show significant visible reactions were copper and brass. This amounted to discolouration of samples which included the additive. Rubber increased in weight in both S1 and E2 but also in diesel only. This indicated that the rubber used would not be a reliable element in diesel systems (although it had been sourced from diesel plant manufacturers).

Tank Corrosion Test

Since tank corrosion is usually initiated at the interface between the liquid and the air above, a test was set up to simulate conditions in a fuel tank.

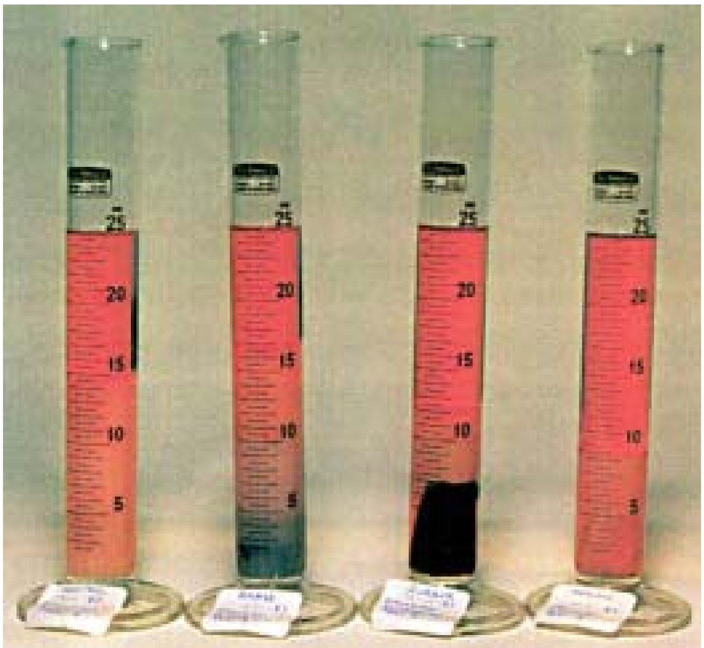
Narrow strips of mild steel were placed in bottles half filled with test fluids S1 and E2 and control fluids diesel and water. One set of these four bottles was left undisturbed, another was inverted once and then left undisturbed and a third set was inverted daily. The tops of the bottles were loosened to allow air into the bottles and the effects of corrosion were observed.

The only liquid sample to show any sign of corroding the steel in any of the sets of bottles was water. Both the emulsion and solution left the steel perfectly clean, as did the diesel. This illustrates that the use of the additive in the diesel/water mixtures enables the water to be completely absorbed as there is no visible reaction with the steel.

Emulsion Separation Test

In order to establish whether it would be feasible to use the additive with diesel and water in an emulsion form, a test was conducted to observe the stability of such an emulsion and the effects that certain materials had on it.

Samples of the reinforced nylon tube, rubber and brass were placed at the bottom of three measuring cylinders. Emulsion E2 was then poured onto the samples and into a fourth cylinder to act as the control. The separation of the emulsion was recorded periodically.



It was decided that the emulsion would be too unstable in the majority of situations to be encountered within a diesel system.

Conclusions

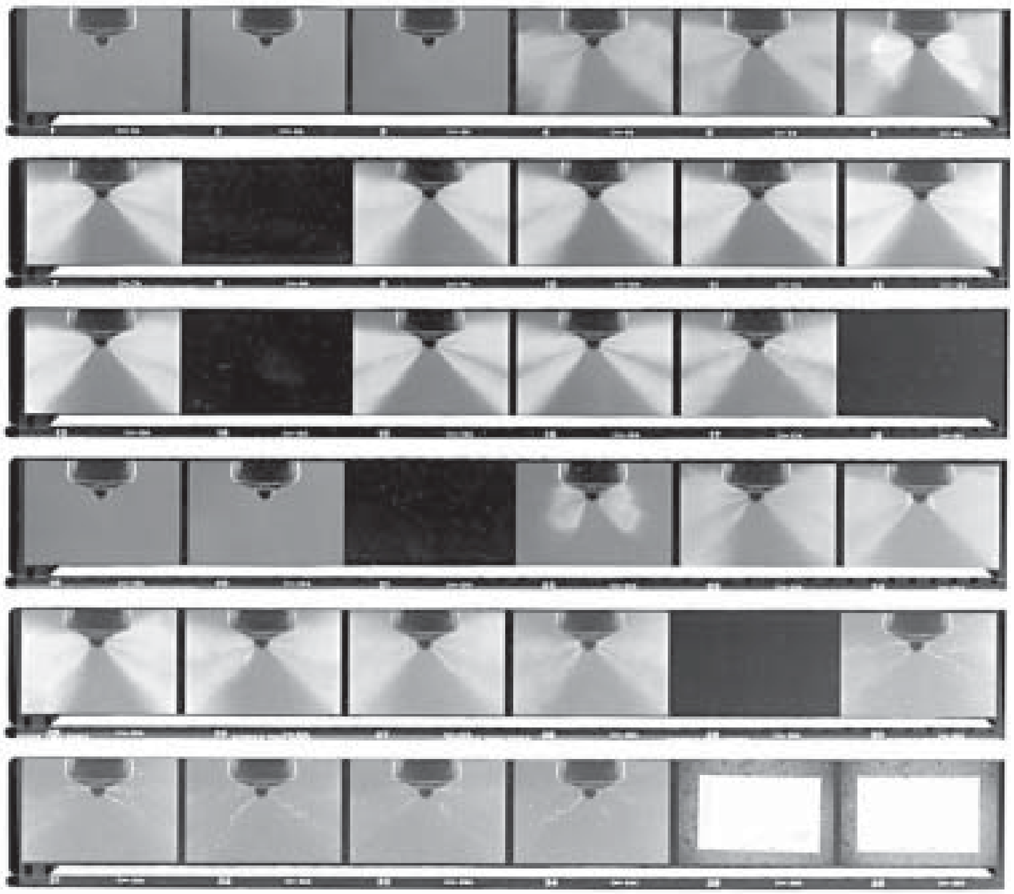
The static corrosion tests produced encouraging results for the steels and aluminium alloy samples. Although some problems were encountered with the copper and brass samples, further tests with fresh samples have begun to examine whether the reactions experienced by these samples are progressive.

SPRAY PATTERN TESTING

Spray Pattern testing is essential to ascertain whether the injectors e.g., droplet size and spray angle, are affected by the presence of water and does this affect performance and require new nozzles.

Tests proved this not to be the case.

SPRAY PATTERN TESTING USING HIGH-SPEED PHOTOGRAPHY



THE EQUIPMENT