CITY

University

Northampton Square
London EC1V OHB
Telephone 071- 253 4399

THERMO- FLUIDS ENGINEERING RESEARCH CENTRE
REPORT ON ENGINE TESTS WITH MODIFIED FUELS CONTAINING ADDITIVES 6.2, 3.24 AND 3.21

SEPT. 1991

EXTRACT

CO Emissions.

Diesel fuel was seen to produce the highest Carbon Monoxide at all loads where emissions were significant. CO was lower for each modified fuel and seemingly inversely proportional to the water content. The 10% solution gave the greatest reduction, approximately 1% of TGV at rack position 80; or a decrease of 25% in relation to diesel emissions.

As the variable injection timing test was conducted at a constant low load part load condition, the CO emissions were negligible in all cases.

CO2 Emissions

Diesel fuel results stand apart from the test fuels by approximately one percent of the total gas volume at mid and high loads. CO2 emissions generally appear to reduce depending on the amount of water contained in the test fuel. Although results for the modified fuels are tightly banded, it is possible to detect consistently lower CO2 output for the higher percentage water fuels. This trend is prevalent at mid and high load. There Is little difference in performance between any of the sample at low load.

There was shown to be no influence of injection timing on CO2 emissions in test SI1860. Predictably, the fuels with the highest water and additive contents produced the least CO2..
Start of rapid pressure rise

When plotted against static injection timing, the fuel with the least water content displayed the earliest point of combustion initialisation at all conditions of injection timing. The relationship between water/additive content, if any, is not clear from this data. A general description would suggest that the highest water content fuels tended to show the later start of rapid pressure rise i.e., nearer to top dead centre. The results for diesel fluctuate within the bandwidth of the modified fuels and therefore no firmer conclusions can be drawn at this stage. The diesel figures were plotted from a single test rather than mean values from a large sample as before; so the data set may not be representative of typical diesel performance.

When compared to load, slightly clearer relationships emerge. The SRPR is retarded furthest with diesel fuel and increases in proportion to the water content. At low load, results for all of the fuels are closely grouped and the widest differentials occur at mid to high range load. The peak ignition advance also appears at these points.

TEST ON MODIFIED FUEL CONTAINING ADDITIVE 3.21

The same tests as used with additive 3.24 were carried out using additive 3.21 i.e., S18 and SI1860. Four hydrated fuels were studied containing 1, 2, 3 and 5% of water.
A full set of results are available in appendix 4..

OBSERVATIONS

Power Output
The 3 and 5% fuels gave the best overall performance with behaviour closely akin to that of diesel. Once again, at low load, the pure diesel fuel produced the least torque of the sample. The 1% solution performed poorly with the 2% not faring much better. There was a general tendency for higher power output with increased water/additive content.

Fuel Consumption
The same general characteristic of linearity is evident with this sample as has been seen in previous trials. The scatter between the fuel with the lowest flow rate for a given rack position (diesel) and that with the highest (5% modified fuel) is slightly less than 0.1 l/hr. This value remains constant at all conditions.

Exhaust Temperature
Despite all of the fuels in this sample having similar water/additive contents compared to previous batches, the relationship between concentration and exhaust temperature is once again clear. Allowing for a pair of anomalous results from tests with the 3 and 5% fuels, the tendency is for these fuels to provide the lowest exhaust temperatures at all conditions. A mean scatter of 20 to 25 degrees C is noted.

CO
These results verify data recorded from previous tests. The CO content becomes significant at mid to high load. Emissions expressed as a percentage of total gas volume are reduced in the order of 0.8% maximum. CO reduces with increased water and additive concentration.

CO2
The distinctive grouping of the hydrated fuels at a level below that of emissions from diesel fuel is repeated here. There is a general reduction in CO2 of 8 to 9% at low and mid range loadings. The results for all fuels becomes progressively more tightly banded until at the low equivalence ratio point, the CO2 content of the 3 arid 5% modified fuels surpasses that from diesel.

Start of Rapid Pressure Rise.
The tendency of combustion to occur earlier with the modified fuels is clearly illustrated here. A general advance of the point of rapid pressure rise of 1.5 degrees of crank angle is common amongst all fuels compared to diesel. From this data it is unclear which fuels cause the greatest advancement to occur. Results for the higher percentage fuels are erratic, but they do include the maximum reading of SRPR, whereas those for the low concentration fuels gave the highest values of SRPR in the most cases. Indeed, data from the tests with the 1 and 2% modified fuels was very consistent and predictable.

The Variable injection timing test showed the modified fuels to be closely banded at all conditions, with the 3% fuel producing the earliest combustion point; an advance of around 1.5% compared with the diesel control. This figure is constant at all conditions of static injection advance. The 5% fuel performs closest to the diesel figures with a mean advance of approximately 0.5 degrees. No other consistent trends are evident.