

Report 2: An Assessment of the use of DME Within a Touring Car Internal Combustion Engine

Introduction

Dimethyl Ether (DME) is a clear, colourless, non-toxic environmentally benign compound that is currently used commercially as a propellant for aerosol cans. The potential of DME is as a replacement fuel for diesel in compression ignition engines. It has the attractive properties of a slightly higher cetane number than diesel, which burns very cleanly when compared to diesel.

Manufacture

DME is currently manufactured at the rate of about 400 MTPD by the catalytic dehydration of methanol. A new modified methanol process, by which DME can be manufactured in much greater quantities, has been developed and demonstrated by Haldor-Topsøe. The process produces DME directly from synthesis gases with capacities exceeding 7000MTPD.

DME Potential

- Sulphur free and metal free emissions – DME contains no heavy metals and only a trace of sulphur.
- Zero soot and particulate emissions – the only particulate matter produced by engines with DME can be attributed to lubricating oils.
- Low NO_x emissions – DME displays lower temperatures of combustion, which result in a substantial reduction in NO_x when compared to a diesel fuel. Reduced air mass flow rate per cycle (e.g. less nitrogen inducted into engine). Can employ high rates of EGR and a catalytic converter.
- Faster burn rates – possibility to run an equivalent DME engine faster.
- Can employ existing LPG technology

DME Problems

- DME has poor lubricity properties and it has been shown that this leads to high wear rates in fuel delivery system components e.g. fuel injectors.
- DME has a low calorific value – to achieve the same power output from a DME engine a higher rate of fuelling will be required which results in almost an identical amount of CO₂ emission.
- Doubling in size of existing fuel tank required to give range – This leads to:
 - o 5% increase in the mass
 - o 10% increase in polar moment of the car
 - o 1.8% shift to the rear in weight distribution.

This translates into a reduction in acceleration and cornering performance for front wheel drive cars.

- Forced induction required to get anywhere near the same power output of the equivalent gasoline engine volume – fundamental change in rules required.

Conclusions

This report concludes that using DME as a fuel will bring big benefits in terms of emissions from a DME powered Touring Car, but this will be detrimental to the track performance in the present Touring Car configuration.

The DME car would not be competitive against current gasoline powered Touring Cars and therefore it would be necessary to either:

- A) Set up a new category for DME powered Touring Cars.
- B) Or change current Touring Car regulations. The chief rules changes would need to,
 - Allow forced induction and intercooling.
 - Give more flexibility in location of components.
 - Increase the minimum weight of a Touring Car

The report also concludes that the introduction of such a technology would not require the development of technology that does not currently exist, and that this technology can easily be packaged into a Touring Car.

The main benefits from an emissions point of view are a reduction in nitrous oxide, HC, CO and particulate emissions, but there is no reduction in the CO₂ produced.

In the medium term, this is a technology that can be introduced into a competition Touring Car, but the potential emission benefits do not include any CO₂ reduction.

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