

Technology Systems Programme

7.) Combustion, Material Compatibility, and Engine Tribology Investigations in a Biodiesel Fuelled Turbo-charged Transportation Engine

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Project

Summary

The movement for use of biodiesel as a fuel in India is gaining momentum. A biodiesel life cycle study carried out in 1998, which was jointly sponsored by the USDOE (US Department of Energy) and the USDA (US Department of Agriculture) concluded that biodiesel reduces net CO₂ emissions by 78% compared to mineral diesel. India is an agro-climatically diverse country and it has more than 300 different varieties of oil seeds available, which can be put to use to produce biodiesel to power our transport sector. However engine technology has undergone tremendous improvements in past decade therefore there is a need to assess the suitability of biodiesel with the modern diesel engines. This project therefore looks at the possibility of using biodiesel in a modern transportation diesel engine based on common rail direct injection (CRDI) technology, where the fuel injection pressures are as high as 1400-1600 bars. This study also explores the effect of using variable injection timings and exhaust gas recirculation on the performance and emissions of such modern transportation engines. The material compatibility of different materials used in the engine with biodiesel will also be investigated and the effect on these materials upon long-term biodiesel usage will be explored, specially iron and copper corrosion aspects.

This study is conducting in collaboration with Tata Motors Pune on a modern automotive CRDI diesel engine (Tata Safari DICOR 2.2 L) typically used in sports utility vehicles (SUV) made by Tata Motors (Fig. 1). Approximately 1000 liters of biodiesel has been produced in-house in Engine Research laboratory of IIT Kanpur for these engine tests in pilot plant (Fig. 2). The physical, chemical and thermal properties of Karanja oil based biodiesel are evaluated. There is very limited technical data available on combustion related research on production grade CRDI diesel engines fuelled with biodiesel. The combustion process, heat release rates and pollutant species formation in the engine are investigated in detail. This project also evaluates engine engine performance, emissions, power and torque characteristics, fuel consumption, lubricating oil degradation etc. for biodiesel and compares it with the baseline data from mineral diesel.

There are numerous other issues with biodiesel, which are investigated in detail under this project. This includes relative effects of biodiesel on lubricating oil tribology, engine component wear, exhaust gas after-treatment technology, toxicity of particulate emitted by biodiesel fuelled engine, and compatibility of biodiesel with modern engines etc. These are extremely important aspects however there are extremely limited experimental investigations done on these aspects. This project therefore investigates these vital and important aspects, before our country goes full-steam on biodiesel program implementation.



Figure 1: CRDI Diesel Engine coupled with Eddy Current Dynamometer and Controller



Figure 2: Biodiesel Pilot Plant