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**Coconut Oil And Its Derivatives
As A Renewable Alternative Diesel Fuel
For Use In The Maldives**

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ABSTRACT

Maldives is a small country without any conventional energy resources and desperately needs alternative means to power their industry.

The work assesses the suitability of coconut oil as an alternative diesel fuel for the use on the individual islands of the Maldives.

A study was carried out to identify the availability of resources relative to the energy requirements of the country and coconuts became the most suitable candidate to produce an alternative fuel for the existing diesel engines.

For the study on the long term effects of coconut oil and its derivatives (Methyl and Ethyl Esters) a single cylinder direct injection Lister-Petter engine model AD 1 was used. The engine was equipped for continuous condition monitoring using a data acquisition system. The system measures the in-cylinder and fuel injection pressures relative to the crank angle. Also the cylinder and exhaust temperatures were measured for all the fuels. Since the viscosity of the crude coconut oil is relatively high compared to diesel a transesterification process was developed to reduce the viscosity and this gave very good results. The physical and chemical properties of the fuels were measured.

The engine was initially tested using a 20h test cycle with each fuel and this was followed by a 200h test cycle on COIL. The engine performance was mapped in terms of speed, load, volumetric fuel and air flow. In addition, exhaust gas analysis was carried out to measure the regulated emissions. Tenax glass fibre, coconut charcoal filters and dinitrophenylhydrazine tubes were used to sample the unregulated emissions. The pressures and temperatures were continuously observed and recorded at intervals. The ignition delay measurements showed that COIL and COME had shorter ignition delay periods compared to diesel fuel.

During the tests engine lubricating oil was checked for possible fuel dilution. After every 100 engine running hours, the engine was opened and physically inspected for wear and damage, as well as for carbon and lacquer deposits. Pictures were taken of the cylinder liner, piston top and cylinder head. The fuel injector was removed and tested on the fuel injector test rig. The results were favourable and also the scanning electron microscope measurements of the injector nozzle show that the deposits were low when compared to diesel. A novel non-intrusive combustion chamber deposit thickness measuring system was developed to measure the deposit thickness.

A separate rig was built using a similar type of fuel injection system as that on the engine for fuel spray studies. Initially fuel spray photography was done using a high speed camera to determine the pattern of the spray, spray penetration rate and the cone angle for the three fuels. Once this was established a Malvern particle sizing system was used to measure the droplet sizes for all fuels.

The results of the spray experiments helped to explain differences observed in the engine performance for the different fuels. All the work carried out to date supports the use of coconut oil as an alternative fuel for diesel engines in the Maldives./