Name of Scholar: Ashish Karnwal

Name of Supervisor: Dr. Mohd. Muzaffarual Hasan, Professor, Department of Mechnaical Engineering, Faculty of Engineering and Technology, Jamia Millia Islamia.

Name of Co-Supervisor: Dr. Naveen Kumar, Professor, Mechanical Engineering Department, Delhi Technological University, Bawana Road, Delhi

Department: Mechanical Engineering Department, Faculty of Engineering and Technology, Jamia Millia Islamia.

Title of Thesis: EXPERIMENTAL STUDIES ON THE POTENTIAL UTILIZATION OF BIODIESEL IN A VARIABLE COMPRESSION RATIO DIESEL ENGINE

Findings

In the present study of utilization of biodiesel derived from Thumba oil in a variable compression ratio diesel engine was investigated and exhaustive experiments were carried out on various aspects such as production of biodiesel, optimization of production process parameters, evaluation of physico-chemical properties of biodiesel and its blends and storage stability of Thumba Methyl Ester (Both rapid as well as long term) with different antioxidants. Utilization of biodiesel diesel blends in different proportions in diesel engine and effect of low percentage biodiesel blends, compression ratio, fuel injection pressure, and fuel injection timing were also studied for best engine performance and minimum emissions and their optimum combination were investigated. Taguchi method has provided a systematic and efficient methodology for the optimization of transesterification process. It was found that 6:1 molar ratio, 0.75% catalyst concentration, 1 hour reaction time and 60°C reaction temperature are the optimum process parameters that give maximum biodiesel conversion and molar ratio

was found to be the most significant parameter. Physico-chemical characterization of Thumba Methyl ester (TME) also suggestes that it has comparable fuel properties to diesel, and this makes it a potential substitute for diesel fuel in compression ignition engines. Studies related to one year storage stability have revealed that its physico-chemical properties changes with time and use of additives is necessary to store biodiesel. Two antioxidant namely tert-butyl hydroquinone (TBHQ) and Stearer Ecotive were added in proportion of 0.1 % and 0.5 % by weight in Thumba biodiesel and both samples passed the minimum limit of RIP of 6 hrs. From exhaustive engine trial, it was found that low percentage blend of Thumba biodiesel with diesel (B10) yielded highest BTE, least BSEC and low EGT for all loading conditions and 100 % Thumba biodiesel is found to exhibit lowest smoke emissions in comparison to other test fuels. Taguchi method coupled with grey relational analysis was used for multiple response optimization of diesel engine design parameters. The results of the study revealed that combination of 30% Thumba biodiesel (B30), compression ratio of 14, nozzle opening pressure of 250 bar and an injection timing of 20º produced maximum multiple-performance of a diesel engine with minimum multiple-emissions which is defined by maximum thermal efficiency, minimum brake specific energy consumption, least exhaust gas temperature and lowest emissions. It was because of higher oxygen content in B30, better atomization of the fuel due to lower maximum in-cylinder pressure (at CR 14) and higher nozzle opening pressure (250 bars). The analytical results of Taguchi and Grey relational analysis were well supported by the findings of confirmatory experiment.