CHAPTER 8

RESULTS AND ANALYSIS

8.1 SIGNIFICANCE OF TRANSESTERIFICATION PROCESS

Among the available methods say pyrolysis, micro emulsification, dilution and transesterification to produce biodiesel from natural oils and fats, transesterification process is made use of since the end product namely biodiesel’s combustion properties such as calorific value, viscosity and volatility are identical with that of diesel. This research study investigates the use of jatropha oil as substitute in place of diesel, the optimum process requirement seems to be 1.5 hrs of reaction time, 0.25w% amount of catalyst and 65°C reaction temperature for transesterification with methanol and NaOH as catalyst.

Also the mixing intensity should be increased using an automatic stirrer instead if manual stirring. The vegetable oil quality plays crucial role to give away better biodiesel recovery. The jatropha oil and the alcohol used must be free from sediments and water content. The viscosity of vegetable oil that was initially 40 cSt at 30 ⁰C had been reduced to 6 cSt at 30 ⁰C and hence the biodiesel becomes alternate fuel for C.I. Engines.

8.2 OUTCOME OF THE PERFORMANCE TEST

It is observed from the performance tests that (i) the maximum Mechanical Efficiency is 56.23 % for 20% blend of biodiesel with diesel and the minimum Mechanical Efficiency is 48.80% for 5% blend of biodiesel with
diesel; (ii) the maximum Indicated Thermal Efficiency is (56.33%) for 5% blend of biodiesel with diesel and minimum Indicated Thermal Efficiency is 46.32% for 20% blend of biodiesel with diesel; (iii) the maximum Brake Thermal Efficiency is 27.13 % for 5% blend of biodiesel with diesel and the minimum Brake Thermal Efficiency is 26.04% for 20% blend of biodiesel with diesel. These results are presented Figures 5.3, 5.4 and 5.5.

8.2.1 Outcome of Exhaust Gas Analysis

In the exhaust gas analysis, the difference in the emissions of the exhaust gases when using diesel and its blends with biodiesel is observed. The engine exhaust constituents like NO, NOx, CO₂ emissions etc are analyzed using portable flue gas analyzer and also Orsat’s apparatus. Flue gas was tested at maximum load and it was compared with Diesel and its blends with Biodiesel. From the investigations it is found that CO₂ was only 0.5% as maximum for 20% blend, and 0.4% as minimum for 10% blend. The NOx was 77 ppm as maximum for 10% blend 63 ppm as minimum for 5% blend (Chapter 5 / Table 5.12). The reduction in emission level was due to the increased Oxygen content (up to 10%).

8.2.2 Outcome of Simulation Study of Combustion Parameters

A simulation study of combustion parameters of biodiesel is formed to find the temperature, pressure, and velocity distribution in the simulation study of combustion parameters using CFD Fluent software. The values are compared for both diesel and biodiesel blended with diesel fuel. The flow model analysis reveals that the maximum velocity is around 5880 m/sec for diesel whereas it is around 5750 m/sec for biodiesel blended with diesel as fuel, however the pressure of diesel and biodiesel blended with diesel are same (maximum 1.12×10⁷ Pa and minimum -6.98×10⁵ Pa). The combustion temperature for diesel is 2980K (maximum) / 300K (minimum) and for
biodiesel blended with diesel is around 1200K (maximum) / 300K (minimum).

8.2.3 Concluding Remarks

This action research addresses the transesterification of natural oils and fats. It is the topic of recent research in the field of alternate fuels for C.I. engines. The main factors affecting the transesterification are reaction temperature, reaction time, and catalyst. The research methodology presented in this thesis report put forward the optimum process condition for transesterification with methanol and NaOH as catalyst. The reaction time is found to be 1.5 hrs, amount of catalyst 0.25w% with reaction temperature of 65°C. Also the mixing intensity has to be increased using an automatic stirrer instead of manual stirring. The quality of vegetable oil play crucial role and the jatropha oil should be free from sediments and water content to get better biodiesel recovery. The chosen alcohol has to be free from water content. The viscosity of vegetable oil that was 40 cSt at 30°C had been reduced to 6 cSt at 30°C and hence biodiesel becomes alternate fuel for C.I. Engines.

8.3 SCOPE FOR FUTURE WORK

This research work was done on a laboratory batch scale of one liter of raw jatropha oil for esterification process, in future it can be done on a pilot plant model of 20 liter capacity and later to commercial production range.

The present work was done up to 20% blending of biodiesel with diesel based on the literature available for biodiesel from other vegetable oils and waste oils. In future, research can be done with special chemical processes to use more proportions, up to 100% biodiesel that will replace the use of diesel completely.
The present work was done with different batches of the raw jatropha oil obtained from only one source (Erode, Tamilnadu). Future research can be done with the jatropha oil from different sources (allover India) so that sourcing of raw material for biodiesel production on large scale will be easy.

8.4 CONCLUSIONS

The conclusions are as follows:

1) For better Mechanical Efficiency and also due to lower combustion temperature 20% blend of Biodiesel is preferable.

2) Based on better Indicated Thermal Efficiency 5% blend is preferable.

3) For low NO\textsubscript{x} emission 5% blend is preferable.

However, in the point of view of alternative fuel for diesel, 20% blend of Biodiesel is preferable.