CHAPTER 7
CONCLUSIONS

Some of the important conclusions are arrived based on the present work listed in the following section.

7.1 PRODUCTION OF BIOETHANOL AND METHYL AND ETHYL ESTERS

The optimum condition for maximum concentration of bioethanol from sugar molasses was studied and identified using response surface methodology. The maximum concentration of bioethanol was found to be 53% at the temperature of 35°C, pH of 4, sugar molasses concentration of 300g/l and yeast concentration of 2 grams. The obtained bioethanol was further distilled four times to get 98% of bioethanol.

The response surface methodology was used to optimize the maximum yield of methyl ester of cottonseed oil and ethyl ester of pongamia oil were found to be 92% and 93% respectively. It is determined that the catalyst KOH is superior to that of the NaOH, because NaOH is not suitable for ethanolation due to immediate soap formation.

7.2 STABILITY TEST AND FUEL PROPERTIES

The phase separation can be avoided by using suitable additives such as ethyl ester of pongamia oil, n-butanol and methyl ester of cottonseed oil. The 10% of ethyl ester of pongamia oil is used as an additive upto E25P10D65 and 15% of ethyl ester of pongamia oil is suitable for
E30P15D55. The above blends have stability for more than 120 days. The stability test proved that by the addition of 3% of n-butanol additive is suitable for upto E20Z3D77 blends and 5% of additive is suitable for E25Z5D70 and E30Z5D65. All the blends are stable for more than 85 days. The 10% of methyl ester of cottonseed oil is used as an additive upto E15B10D75 blends and the remaining blends required 15% of MECSO. These blends are stable for more than 80 days.

The relative density of bioethanol-diesel-MECSO blend was higher than that of the bioethanol-diesel-EEPO blend due to the higher density of MECSO. The relative density of bioethanol-diesel- n-butanol blend is lower than that of the bioethanol-diesel-EEPO blend due to lower density of n-butanol as compared to EEPO. All the blends have the flash point, which is lower than that of the base diesel. The flash point value of the blends mainly depends upon the percentage of bioethanol in the blends and does not depend on the additives used in the blends. The addition of all the additives to diesel increases the fuel viscosity but the addition of bioethanol reduces the viscosity of blends. The calorific values of blends were reduced with the increase in bioethanol percentage in blends.

7.3 PERFORMANCE, EXHAUST EMISSIONS AND COMBUSTION ANALYSIS

The brake thermal efficiency of all the blends was almost equal to that of the base diesel at full load conditions. The exhaust gas temperatures of all the blends were lower than that of the base diesel because it mainly depended on the percentage of bioethanol in the blends. Hydrocarbon emission was increased significantly for all the blends at all load conditions as compared to that of the base diesel. The CO emission was higher at lower
loads and decreases for the increase in load, finally at full load the values were almost very close to the base diesel.

Carbondioxide emission of all the blends was lower than that of the base diesel at all load conditions. The NOx emission of all the blends was lower than that of the base diesel and it mainly depended on bioethanol content in the blends. The observed NOx reduction emission for E30P15D55, E30Z5D65 and E30B15D55 blends is 15%, 16% and 15% respectively compared to that of the base diesel at full load. The smoke emission of all the blends was lower than that of the base diesel. In comparison to base diesel fuel, E30P15D55, E30Z5D65 and E30B15D55, the blends emit 12%, 15% and 7% lower smoke emission at the full load. The combustion characteristic of bioethanol-diesel blends with additives results in high cylinder pressure and improved heat release rate as compared to that of diesel fuel. Based on the above results it can be concluded that E20P10D70, E20Z3D77 and E15B10D75 could be used as alternative fuels in the existing compression ignition engine without any further hardware modification.

7.4 ARTIFICIAL NEURAL NETWORK

The suitable ANN models were developed to predict the performance and exhaust emissions of the diesel engine by using different blended fuels. It was observed that the ANN model for bioethanol-EEPO-diesel blends can predict the engine performance and exhaust emissions with a correlation coefficient in the range of 0.975 to 0.999, mean relative error values in the range of 1.52% to 7.97% and root mean square error is found to be very low. For bioethanol-n-butanol-diesel blends, the ANN model can predict engine performance and exhaust emissions with a correlation coefficient in the range of 0.981 to 0.999, mean relative error values of 1% to 6.75% and very low root mean square error. It was also found that the ANN model for bioethanol-MECSO-diesel blends can predict the engine
performance and exhaust emissions with a correlation coefficient in the range of 0.975 to 0.999, mean relative error values of 1.308% to 6.46% and root mean square error is to be very low.

This developed ANN models were proved to be a useful tool for the evaluation of the diesel engine performance and emissions analysis by performing only a limited number of tests instead of detailed experimental study, thus reducing both engineering effort and cost.

7.5 SUGGESTIONS FOR FURTHER WORK

Further investigations can be made on the following aspects.

- To study the performance, emissions and combustion analysis of the blends at different injection timings.
- To study the maximum percentage of bioethanol in the blends with modification in the diesel engine.
- The component compatibility and corrosion effect of bioethanol and biodiesel may be studied.