CHAPTER 5

CONCLUSION AND FUTURE WORK

5.1 SUMMARY

This work aimed to prove the effects of adding different proportions of ethanol and water mixture with diesel in a single cylinder 4 stroke diesel engine. The blends were stabilized by adding Tetra Methyl Ammonium Bromide (TMAB) additive. The study was conducted at two operating conditions initially on normal diesel engine and in the second case the engine piston and cylinder walls coated with Zirconia Alumina coating. All the performance parameters were measured under all the conditions of operations of the engine. The sequence of steps carried out in the study is reiterated here.

At the beginning, experiments were conducted using diesel, at the rated speed of 1500 rev/min under variable load conditions. Load, speed, fuel flow rate, exhausts gas temperature, exhaust emissions of hydrocarbon, carbon monoxide, nitric oxide and smoke were observed. Cylinder pressure and top dead centre (TDC) position signals were recorded for processing to obtain combustion parameters.

In the next phase of the study, experiments were carried out under 2-phase operation without coating conditions, to obtain performance, emission and combustion parameters using ethanol-diesel blends stabilized by adding 2% of Tetra Methyl Ammonium Bromide (TMAB) by volume with the fuel mixture. The ratio of the ethanol in the fuel mixture was varied as 10%, 15%, 20%, and 25%. The percentage of TMAB surfactant was kept constant at 2%.

In the following phase of the study, under 3-phase operation without coating conditions, experiments were carried out to obtain performance, emission and combustion parameters using different proportions of diesel-
ethanol-water blends stabilized by adding 2% of Tetra Methyl Ammonium Bromide (TMAB) by volume with the fuel mixture. The ratio of the ethanol in the fuel mixture was varied as 10%, 15%, 20%, and 25%. The percentage of water in the fuel mixture was also kept constant at 5%. The percentage of TMAB surfactant was kept constant at 2%.

The above three stages of operation were repeated for the test engine under different operating conditions with the piston head and the cylinder wall was coated with ceramic coating. The tests were conducted to study the impact of coating on the performance of the single cylinder 4 stroke diesel engine.

Detailed discussions of the results of the performance tests along with relevant graphs were discussed in the chapter 4. The major conclusions and overall summary of the study is presented in the following statements.

5.2 MAJOR CONCLUSIONS

The results of the present study are summarized as follows:

• The brake specific fuel consumption of the test engine increases with the increase in ethanol blend in diesel fuel but the overall increase is less than when the engine is operated with a sole fuel. 10% of Ethanol by volume in the fuel mixture shows lower brake specific fuel consumption, and is further decreased for thermal barrier coated engines.

• The brake thermal efficiency of the test engine at 10% ethanol in the blend is almost the same when compared to a sole fuel, whereas the increase is 2% for without coated engines.

• Smoke reduction is found to be 8 HSU for 20% Ethanol in the fuel mixture at peak load for the normal engine operation. In the case of thermal barrier coated engines, HSU value has been decreased to 8 HSU.
• It was noted that engine operation with all the blends, D83:E10:W5:T2 shows the decrease in NOx emission at coated engine to 18%. When compared to sole fuel. The cylinder pressure is higher for D68:E25:W5:T2 Ethanol blends than other blends with thermal barrier coating operation of the engine increased up to 0.4%.

• There were deductions in the CO emissions with the use of the ethanol-diesel fuel blends with respect to that of the neat diesel fuel, with this reduction being higher, there will be higher the percentage of ethanol in the blend. However further reduction was observed for TBC engine.

• The unburnt HC emissions increased with the use of the ethanol-diesel fuel blends when compared with that of the neat diesel fuel operation of the test engine. The higher the percentage of ethanol in the blends, the higher the HC emissions. TBC increased the HC emissions for sole fuel; on the other hand HC emissions were decreased for the oxygenated fuel operation of the engine.

• The peak pressure and heat release rate for D68:E25:W5:T2 blends are higher than the sole fuel and is maximum for coated engines.

5.3 CLOSURE

On the whole, it is concluded that 10% of Ethanol in the fuel blend with 2% TMAB as surfactant has been found to provide better performance in the single cylinder 4 stroke compression ignition diesel engine. The blend with 10% Ethanol shows significant reduction in exhaust emissions of all gases including NOx as compared to neat diesel. However the increased NOx levels in the engine can be controlled by other techniques like turbo charging, exhaust gas recirculation, etc. The ethanol ratio in the fuel mixture can further be improved in thermally insulated conditions.
5.4 SCOPE FOR FUTURE STUDIES

The scope for further work in the current study is discussed here.

• The performance of the engine can be analyzed using different additives and the results could be compared with that of TMAB.
• The experimental investigations may be extended to analyze the vibration patterns of the test engine under various modes of operation using different fuel blends.
• Finite Element Analysis may be employed to assess the distribution of heat and stress developed in the engine for corresponding fuel concentration/compositions.
• A suitable tool/ technique may be identified to optimize the fuel compositions in order to yield the most efficient performance.