CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSION

The world is presently confronted with twin crises of fossil fuels; depletion and environmental degradation. Indiscriminate extraction and lavish consumption of fossil fuels have led to reduction in underground-based carbon resources that has alarmed the researchers to concentrate on alternative fuels. Among identified different alternative fuels, Jatropa based straight vegetable oil was used in pre- heated mode at 90^{o} C for the present investigation. But selected fuel showed deteriorated performance and increased emissions when compared to conventional diesel. Hence, a small dose of gaseous hydrogen was supplemented through the inlet manifold by using timed manifold induction technique in order to precisely meter the gaseous hydrogen as per injection timing and duration to eliminate the abnormal combustion anomalies like pre-ignition and backfire. Further, engine variables like injection timing and injection pressure also got varied in addition to hydrogen supplementation, showing enhanced combustion by which improved performance and reduction in emissions were observed. At optimized injection advancement of 22^{o} bTDC, injection pressure of 235 bar and 0.5 gm/min hydrogen supplementation (5% of total input energy) at 80% load, brake thermal efficiency was increased to 31.76%, which is 3.3% more than the pure PHSVO 90 and 1.34% more than the conventional diesel. Smoke was reduced to 27.4 HSU, which is 39.6 HSU lower than pure PHSVO 90 and 28.6 HSU lower than conventional diesel. CO was reduced to 0.05% by volume which is 0.15% lower than pure PHSVO 90 and 0.04% lower than conventional diesel. HC was reduced to 8 ppm, which is 7 ppm lower than the pure PHSVO 90 and 2 ppm lower than the conventional diesel. NO_x of 492 ppm, which is 142 ppm higher than the conventional diesel, 201 ppm higher than the pure PHSVO 90, Pmax was increased to 56.71 bar at 7^{o} aTDC which is 15.73 bar more than the pure PHSVO 90 and 13.1 bar more than the conventional diesel with CA advancement of 4^{o} and 2.5^{o} with pure PHSVO and conventional diesel respectively. Further, in heat release rate; both pre-mixed as well as diffusion combustion peaks were improved when compared to pure PHSVO 90 and the conventional diesel. Ignition delay appreciably reduced to 13.1^{o} CA, which is 3.6^{o} CA lower than PHSVO 90 and 2.91^{o} lower than the conventional diesel.

Hence, from the present investigation it was understood that, a small dose of hydrogen supplementation with Jatropa based straight vegetable oil in pre-heated mode at 90^o C in stationary agricultural diesel engines, enhanced the combustion thereby improving the performance and reducing the emissions.

5.2 FUTURE SCOPE OF THE WORK

Supplementation of gaseous hydrogen in a Straight Vegetable oil based in-direct Injection engine showed that, improved performance and reduction in emissions. However, during experimentation, certain aspects were identified on which one could always concentrate and think of further improvement. Some such aspects are discussed below.

1. As gaseous hydrogen was inducted through the inlet manifold, which can be modified to direct injection or induction into the main combustion chamber, thereby, wastage of gaseous hydrogen can be minimized and backfire can be totally avoided. However, with reference to direct induction or injection further can be investigated into time of induction or injection i.e., either at starting or ending of the suction stroke or compression stroke of the cycle by which inducted or injected gaseous hydrogen can better interact with air without any combustion anomalies.

2. In Manifold inducted or injected gaseous hydrogen operated mode, Electron Pulse Ionization Mass Spectrometer (EPIMS) can be used, by which active participation of GH_2 can be analyzed through measuring the gaseous hydrogen emissions.

3. As peak of the diffusion combustion sharply increased with the supplementation of GH_2 can be further looked into by changing the injection rate of the fuel and extending the duration of the fuel injection in the diffusion phase, in order to smoothly control the diffusion combustion phase

4. Theoretical study can be done to understand the chemical reactions of this optimized results for PHSVO 90 with gaseous hydrogen.

5. As NO_x increased with the supplementing the hydrogen; either by diluents like: Water / Helium or exhaust gas recirculation can be used to reduce the same.