An Investigation on the Effect of HHO Gas and Injection Pressure on Constant Speed Diesel Engine: A Review

Nitin V. Morichauhan[1] Piyush Patel[2] Gaurav Rathod[3]
[1]M.E. Student [2,3]Assistant Professor
[1,2,3]Department of Mechanical Engineering
[1,2,3]L.D.R.P.I.T.R., Gandhinagar, Gujarat, India

Abstract— The increasing demand for the petroleum based fuels and their less availability has lead to extensive research on diesel fuel engines. The combustion quality was improved significantly when use the better design of CI engine and also, improves the thermal efficiency and indirectly saving in fuel. So, as a supplementary fuel uses the HHO gas and the HHO gas was produced by the process of water electrolysis. Hydroxy gas (HHO) was produced by the electrolysis process of different electrolytes (KOH, NaOH, and NaCl) with various electrode designs in a hydrogen generator. This review paper presents the concern with the effectiveness of oxygen enriched hydrogen-HHO gas addition on performance and combustion characteristics of a CI engine with variable injection pressure. The effect will be shown on the CI engine of the brake thermal efficiency, carbon monoxide, un-burnt hydrocarbon, and carbon dioxide and NOx emission with the use of HHO and variable injection pressure.

Key words: CI engine, electrolysis, HHO gas, Hydrogen generator, performance characteristics, Electrolyte, injection pressure

I. INTRODUCTION

In the world the researchers were focused on reduced the environmental pollution with maintaining the performance of diesel engines. The review paper is the procedure of understanding, analyzing, evaluating and summarizing scholarly resources about a definite topic. This includes a various work is does on supplementary fuel as an HHO gas and various biodiesel with different ratio. Different techniques are used for production of HHO gas. Such like that electrolysis, catalysts and electrodes are used. The energy of the hydrogen bond is 436 KJ/Mol. [3]

The resulting parameters which are thermal efficiency, mechanical efficiency, indicated efficiency, brake power, engine torque and specific fuel consumption (SFC) measure for improving the diesel engine performance. Also the engine emission parameter like that carbon monoxide (CO), carbon dioxide (CO_2), hydrocarbon (HC), nitrogen oxide and (NO_X) was measured for the better performance of the diesel engine. To reduce the greenhouse gases effect on the environment and reduced the environmental pollution.

II. REVIEW OF LITERATURE

In this paper briefly discusses about the previous work carried out by the researchers in the various fields which are related to the topic and helped one gain to build platform for my work.

Sankar. T [1] (2014) et al in their study, they had been using the HHO gas and karanj oil as an alternative fuel. The performance and emission levels were calculated for the different blended ratio. The blended ratios were D100%, D+HHO, K100%,K+HHO, K25%+D75%+HHO, K50%+D50%+HHO, K75%+D25%+HHO. The brake thermal efficiency, indicated thermal efficiency, fuel power, mechanical efficiency were calculated for each blended ratio and mechanical loading was used in this. The loading can be increased from 0 to 16kg.

In ratio D75%+K25%+HHO we can get the emission of CO=0.04%, CO2=4.8%, HC=29ppm, SFC=1.81kg/Sec, mechanical efficiency =63.92%, brake thermal efficiency= 34.61%, indicated efficiency = 37.61%.

A. Vamshi Krishna Reddy [2] (2014) et al was taken secondary for IC engine and improving the efficiency of CI engine. The HHO gas was injected into the manifold of the through the air filter of the engine. From this design the fuel utility was reduced from 10% to 30%,which minimize the carbon deposition in the cylinder,thereby increasing the changing period of engine oil, it also improves the efficiency of the engine and the life span. Engine torque also increased and pollution gets reduced to maintaining the greenhouse effect. Also, HHO gas technology was considered experimental, but it is a supplemental fuel additive that could help in increasing horsepower, reduce emissions and cleaner the engine. Various bond energies are shown in below table,

Bond Type	Bond Energy (kJ/mole)
C single	347
C double	611
C triple	837
C – H	413
H – H	436
O – O	146
O = O	498
C – O	358
CO_2	803
C = O	745
H – O	464

Fig. 1: Bond Energies [2]

C.Naresh [3] (2014) et al was measured the performance and exhaust gas analysis of a single cylinder diesel engine using HHO gas.

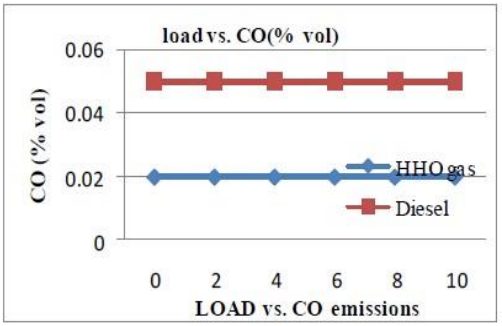

Fig. 2: Load vs. CO (%vol) emissions [3]

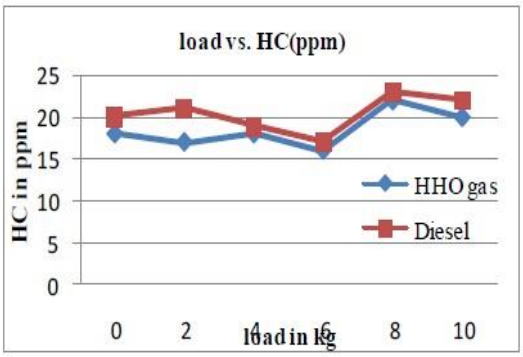

Fig. 3: Load vs. HC (ppm) [3]

As the load increases brake power increases. The brake power developed by the engine operated on HHO gas was more as compared with pure diesel. The Mechanical efficiency of the engine increase, for engine operated with HHO gas was more as compared whit pure diesel. Brake thermal efficiency, indicated thermal efficiency of engine increase, for engine operated with HHO gas was more as compared with pure diesel. Total fuel consumption of the engine increase, for engine operated with HHO gas were more as compared with pure diesel. Emissions like that carbon monoxide, hydrocarbon, carbon dioxide, The NO_x were greatly reduced for the engine operated with HHO gas compared to pure diesel engine.

Dipen V. shah [4] (2014) et al in their study, HHO was helped in the complete combustion and reduced the emission of the harmful gas. The Hydrogen was mixes with air and improves the combustion efficiency by complete combustion. The HHO gas was in the proportion of 0.45%, 1.6% and 3.45% with the air. Also reduce the fuel consumption and increase the brake power.

The effect of HHO gas on specific fuel consumption and on brake power are shown below,

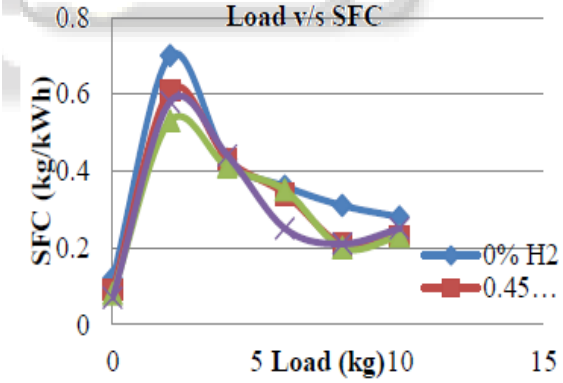

Fig. 4: Load Vs SFC [4]

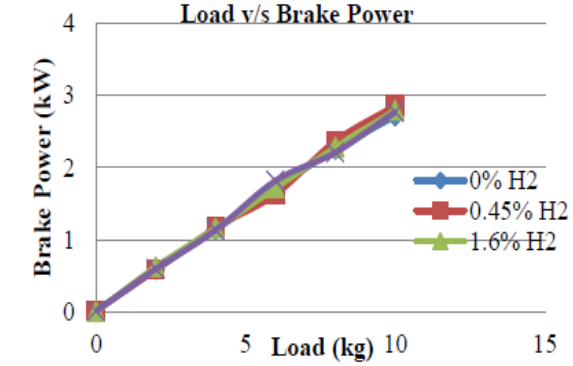

Fig. 5: Load Vs brake power [4]

The fuel consumption was decreased by use of HHO gas with air, which is shown in figure 4. The brake power is increased by the use of HHO gas with air, which is shown in figure 5. The effect of HHO gas on CO emission which is shown below,

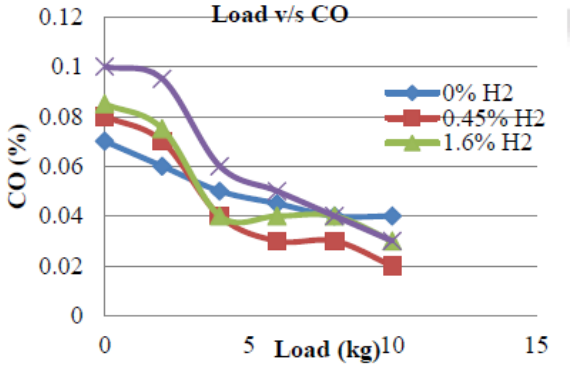

Fig. 6: Load Vs CO emission [4]

The CO emission decreased due to the complete combustion of fuel by use of HHO gas with air.

K. Keerthi [5] (2013) et al in their study, diesel engine with 10% Iso Butanol at different injection pressure. Biodiesel was derived from fish oil was mixed with diesel. Biodiesel was varying 20%, 30% and 40% by volume and isobutanol as an additive added as 10% by volume to the all blends. As higher the fuel injection pressure, improve the performance and reduce emissions. The performance, combustion and emissions characteristics were evaluated at 200, 225, 250 and 275 bar.

The injection pressure was increased up to 250 bar when the engine operates with biodiesel-diesel blends with isobutanol as an additive. Brake thermal efficiency and fuel economy were improved with increasing injection pressure and blend percentage while carbon monoxide and smoke reduced and NOx increased.

Ganesan. S [6] (2014) et al in their study effect of the injection pressure on the emission characteristics of DI Diesel engine with blends of biodiesel was measured. In this paper was to investigate the environmental aspects of lemon grass oil biofuel at 200, 220 and 240 bar injection pressure to study its effect on emission. At higher injection pressure 240 bar less emission of HC, CO and NOx at 75% load condition.

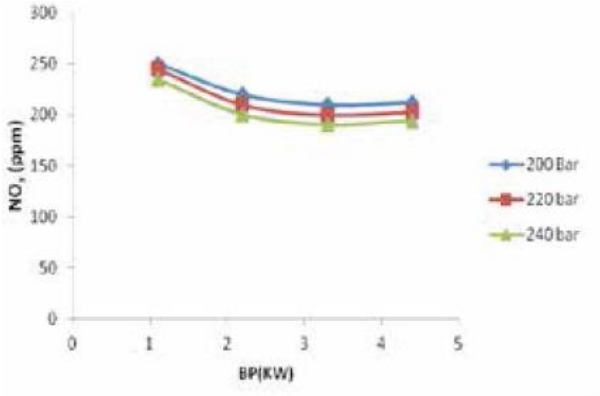

Fig. 7: Effect on NOx emissions [6]

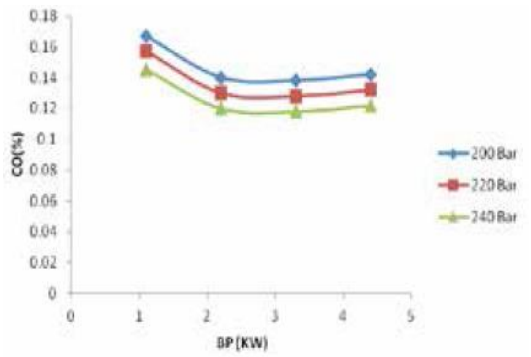

Fig. 8: Effect on CO emissions [6]

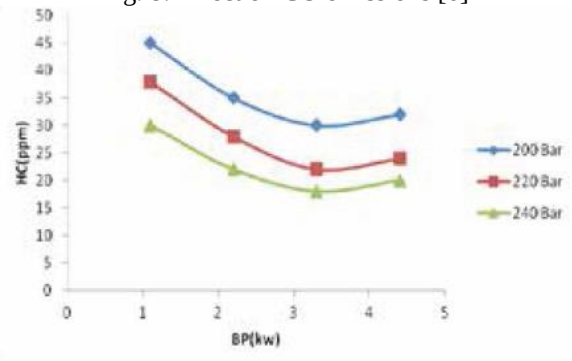

Fig. 9: Effect on UBHC emissions [6]

G VenkataSubbaiah[7](2015) et al in their study the effect of injection pressure on the emission characteristics of a diesel engine using diesel-rice bran biodiesel blends were measured. Rice bran oil is extracted from the germ and inner husk of the rice and was not a common source of edible oil. In this paper was to study the effect of injection pressure on the emission characteristics of diesel engine using and the blends of diesel and rice bran biodiesel, B10, B20 and B30. The injection pressure was varied from 180 bar to 240 bar.

The exhaust gas emissions such as carbon monoxide (CO), hydrocarbon (HC), oxides of nitrogen (NOx), carbon dioxide (CO2) and smoke opacity were measured at the different injection pressures. It was observed that the minimum CO, HC and smoke emissions were recorded at 220 bar. The NOx, emissions were increased and CO2 emissions decreased with the injection pressure. The optimum injection pressure was 220 bar and the blend was B20 with respect to emissions. The CO2 emissions were increasing with both the injection pressure and the percentage of ricebra biodiesel in the blends.

III. Conclusion

From this study, shown that the effect of operating parameter injection pressure on the compression ignition engine.

For the complete combustion of diesel fuel, the HHO gas was helped. And generated the various graphs and charts and measured the performance and emission characteristics of a compression ignition engine. Various methods of hydrogen production are studied in these papers. NaOH was the most appropriate catalyst for hydrogen production.

When increased injection pressure the brake thermal efficiency and brake specific fuel consumption was increased compared to the original injection pressure. Also, HC and CO emission were decreased and NOx emissions increased with increasing the injection pressure.

References

[1] Sankar.T , ”The Effect Of Oxy-hydrogen (Hho) On The Performance And Emission Characteristics Of Diesel And Karanj In Single Cylinder Four Stroke Diesel Engine” Journal of Multidisciplinary Scientific Research, pp. 12-18, February 2014

[2] A.Vamshi Krishna Reddy,T.Sharath Kumar, D.K. Tharun Kumar, B. Dinesh, Y.V.S. Saisantosh,”Improving The Efficiency Of I.C. Engine Using Secondary Fuel” International Journal Of Technology Enhancements And Emerging Engineering Research, vol. 2, 2014

[3] C.Naresh,Y.Sureshbabu 2 &S.Bhargavi Devi, “Performance and Exhaust Gas Analysis of a Single Cylinder Diesel Engine Using HHO Gas (Brown’s Gas)” International Journal of Engineering Research, vol. 3, pp. 40-47, March 2014

[4] Dipen V. Shah , Vivek B. Patel, Tushar Patel, Gaurav Rathod, “Performance and Emission Analysis of Diesel Engine by Using HHO at Inlet Manifold “ International Journal for Scientific Research & Development, vol. 2, 2014

[5] K.keerthi, Kiran. C. Kariankal, S. Sravya, ”Performance Characteristics of Four Stroke Single Cylinder Diesel Engine With 10% Iso Butanol at Different Injection Pressures ” International Journal of Modern Engineering Research, vol. 3, pp. 311-316, jan.- feb.-2013

[6] Ganesan.S, A. Elango, ”Influence of Injection Pressure on Emission Characteristics of Di Diesel Engine with Blends of Biodiesel” Indian Journal of Applied Research, vol. 4, October 2014.

[7] Dr G VenkataSubbaiah, ” Effect of injection pressure on the emission Characteristics of a diesel engine using Diesel-rice bran biodiesel blends” International Journal of Advanced Research in Engineering and Technology, vol. 6, pp. 27-34, January 2015

