

Investigation on Performance of CI engine Fuelled with Hydrogen Peroxide as an additive.

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Abstract— Due to market demand aimed at increasing the efficiency and engine performance the existing ignition systems are rapidly approaching their limits. To avoid this , engineers are in search of new technologies. In the present study , an experiment was conducted on four stroke multicylinder engine , water cooled CI engine . In the first case , the engine was operated with pure diesel and in second case the engine was operated with diesel and some amount of (4- 12 %) H_2O_2 as an additive.In the experiment injection timing was changed which is the most important parameter in the study. Result showed that , efficiency of the engine increased by adding the hydrogen peroxide in the diesel and exhaust gas temperature is found to decreased reasonably.

Index Terms— Compression Ignition engine, Hydrogen Peroxide, Injection timing, Exhaust gas temperature, Brake thermal efficiency.

1 INTRODUCTION

Nowadays , diesel engine become an important power source in farming activities in the rural areas where electrical energy is unavailable . Also the market demand of the diesel car has increased in many countries including India due to higher thermal efficiency.However , the problem with diesel engine is its higher emissions and exhaust gas temperature. Here an attempt is made to overcome this problem by injecting the hydrogen peroxide in to the diesel.

2 LITERATURE REVIEW

Sajit V [1] conducted experimental investigation on the effects of cerium oxide and he shows the flash point and viscosity of biodiesel were found to increase with inclusion of cerium oxide nanoparticles.

Dawa A.W. [2] carried the study on control of diesel engine emission by dilute oxidizer injection and he shows the effect of low concentration hydrogen peroxide injection in to the inlet air stream of diesel engine on exhaust emission.

Bedford F. [3] done a study on effects of direct water injection on diesel engine combustion by modeling of water injection for diesel engine and concluded that for 44% load , specific fule consumption , particulate matter , NOx emission decreases while for 86% load only NOx emission decreases.

3 EXPERIMENTAL SET UP

The major fuel used for running the engine is diesel. Table 1 shows the properties of diesel used in the experiment. Hydrogen peroxide solution is used as blends with diesel at various proportions. Hydrogen peroxide is a strong oxidizing agent and weak acid in water solution. The formula is same as that of the water with an extra atom of oxygen attached.

Experiment was conducted on a four stroke multicylinder, water cooled compression ignition engine.

Table 1. Properties of Diesel.

Density @ 16°C	700Kg/m ³
Boiling temperature	210°C
Cetane number	40
Calorific value	44800 kJ/kg
Viscosity	2.6 cP

Table 2. Properties of Hydrogen Peroxide.

Appearance	Colourless liquid
Density	1111 Kg/m ³
Boiling point	225°C
Viscosity	1.80 cP
Specific gravity	1.1

Specifications of the engine are shown in below table:

Table 3. Specification of Engine.

Engine Description	1.8L 4 cylinder OHV
Engine Displacement	1800 CC
No. Of cylinder	4
Maximum power	68bhp @ 4800 rpm
Maximum Torque	13.7 Kgm @2250 rpm
Bore X stroke	84 X82 mm
Compression ratio	23:1

Fuel Consumption for both diesel and diesel + H_2O_2 is calculated. Also the parameters like air and exhaust gas temperature has been recorded manually. All the test are conducted at different loads as no load, 10%load, 20%load and 50%load. The engine speed is maintained constant at 1500 rpm.The injection pressure is also kept constant at 150 bar with injection timing of 10⁰ BTDC and 15⁰ BTDC.

4 RESULT AND DISCUSSION

Fig 1 shows the engine performance for different blends of hydrogen peroxide with diesel. The injection timing is 10° BTDC and injection pressure is 150 bar. Comparing the results of pure diesel and with blending 4% and 8% of hydrogen peroxide with diesel. It is found that as the concentration of hydrogen peroxide is increased, the brake thermal efficiency of the engine has increased. This happens due to the presence of hydrogen peroxide in the diesel. The hydrogen peroxide which is present in the diesel fuel starts decomposing and releases very large amount of oxygen. This oxygen is helpful to reduce the ignition lag as well as assist the complete combustion of the fuel. The highest efficiency of 29.64% was observed at 50% of full load when 4% of hydrogen peroxide is added with diesel.

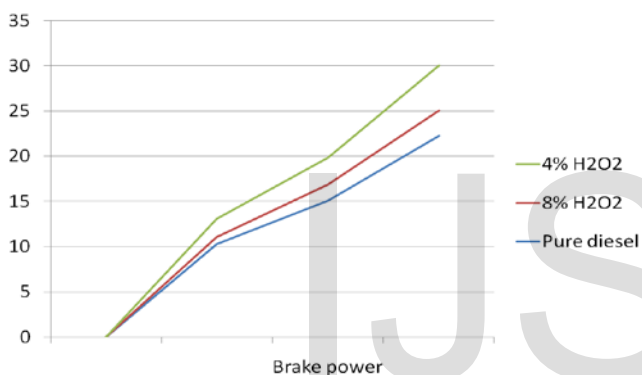


Fig 1. Brake thermal efficiency vs Brake power for different blends of H₂O₂.

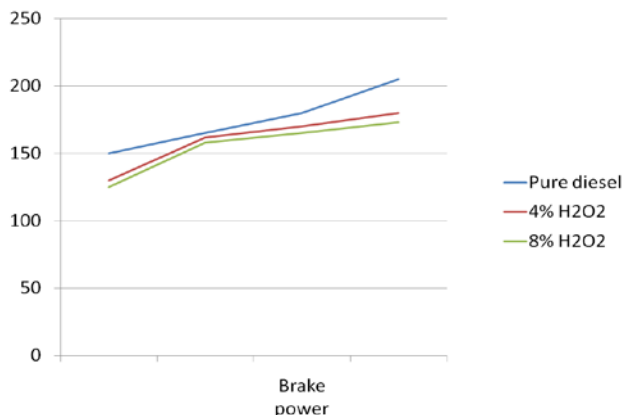


Fig.2 Exhaust gas Temp. vs Brake power for different blends of H₂O₂.

Figure 2 shows exhaust gas temperature for different blends of hydrogen peroxide with diesel at injection timing of 10° BTDC and injection pressure of 150 bars.

As the concentration of hydrogen peroxide is increased, the exhaust gas temperature of the engine decreased. This happens due to additional oxygen molecule released by hydrogen peroxide that leads to better combustion. The lowest value of exhaust gas temperature has found to be 178° with 8% of hydrogen peroxide with diesel.

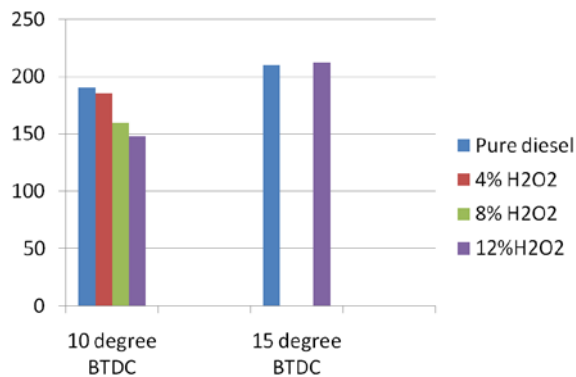


Fig 3. Effect of injection timing on EGT for different blend of H₂O₂.

Figure 3 shows the exhaust gas temperature for the different blends of hydrogen peroxide with diesel at injection timing of 10° BTDC and 15° BTDC for 45 % full load. The exhaust gas temperature is decreased with increase in blends at 10° BTDC but it remained same at 15° BTDC. The minimum exhaust gas temperature of 150° C was found for 12% of hydrogen peroxide.

Figure 4 shows the brake thermal efficiency for different blends of hydrogen peroxide with diesel at injection timing of 10° BTDC and 15° BTDC for 45% of full load. The engine was unable to start when 4% and 8% of hydrogen peroxide with diesel is injected at injection timing of 15° BTDC. The encouraging factor is that efficiency of engine increases with the increase in the concentration of H₂O₂.

The efficiency of the engine has increased by advancing the injection timing by 5° for both diesel and its blends with hydrogen peroxide. The efficiency has found to be highest of 29.64% both for pure diesel and 12% H₂O₂ with diesel when injected at 15° BTDC.

5 CONCLUSION

So, with the increase in concentration of hydrogen peroxide the brake thermal efficiency of the engine increased while exhaust gas temperature decreased. This happens due to additional oxygen molecule released by hydrogen peroxide. The maximum Efficiency of 29.64% was observed at 45% of full

load when the engine used 8% of hydrogen peroxide with diesel for injection pressure of 150 bar and injection timing of 10 degree before BTDC. The minimum value of EGT has been found to be 180 degree at same condition. The engine didn't start when 4% and 8% of hydrogen peroxide of diesel is injected at injection time of 15 degree before BTDC.

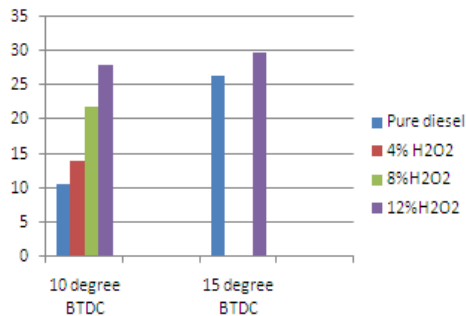


Figure 4. Effect of injection timing on brake thermal efficiency for different blends of H₂O₂.

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