Effect of Variable C.R. on Performance, Emission and Combustion Characteristics of C.I Engine Fuelled with Bio-diesel: A Review

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***Abstract*— Due to rapid depletion of petroleum on the earth and its bad side-effects on environment, it is necessary to find some alternate sources of fuel, which is available in plenty and has no harmful effects on environment. This paper reviews one of the most important alternative i.e bio-diesel on which lots of research is going on. The paper gives the comprehensive review of the effects of engine parameters operated by various bio-diesel and its blends. Focus has been given to effect of varying compression ratio. Since lots of research has been done on effect of compression ratio on engine performance by different researchers, therefore a comparison has been done for operation at different conditions like 100% diesel, blend of diesel and bio-diesel and 100% bio-diesel.**

***IndexTerms*— Compression ratio, specific fuel consumption, brake thermal efficiency**

I. INTRODUCTION

Petroleum resources are finite and almost 90% of energy needs of the world are provided by fossil fuels which are depleting at an alarming rate. In recent years, the consumption of petroleum products in India has been increased significantly. There is a large increase in number of automobiles result in great demand of petroleum products in recent years. Also Combustion of fuel results in the emission of carbon dioxide (CO2) and other harmful pollutants. This results in increasing the global CO_2 level and global warming. So there is urgent requirement of some alternative resources. Among other alternative, Bio-diesel is the best alternative fuel as it is renewable and eco-friendly. Biodiesel has higher viscosity, density, pour point, flashpoint and cetane number than diesel fuel. Also the sulphur content is negligible while it contains 10-15% oxygen by weight. These quality makes it good alternative for diesel. Performance of biodiesel is nearly similar to diesel engine with fewer emissions. Engine parameters such as compression ratio, injection timing and injection pressure are also found to be significant factors contributing on performance and exhaust emissions of diesel engine, fueled with bio-diesel. This paper focuses on finding the effect of varying compression ratio on diesel engine. It gives the comparison of effect of varying compression ratio on performance of engine fuelled by (a) 100% diesel (b) Mixture of diesel and bio-diesel and (c) 100% bio-diesel. In this paper, effect of varying compression ratio on brake specific fuel consumption (BSFC), brake thermal efficiency (BTE), smoke capacity and various harmful emissions are discussed after studying various research papers.

II. LITERATURE REVIEW

YB Mathur [1] has done experiment for finding the optimum compression ratio for variable compression ratio diesel engine fuelled with diesel. He suggested that compression ratio 17 at 203 bars injector opening pressure,23°CA BTDC injection timing and at 1500 rev/min rated speed exhibited better performance and lower emissions and hence was considered as optimum compression ratio.

Mohammed EL. kassaby [2] has investigated the effect of blending ratio and compression ratio on a diesel engine performance fuelled with waste oil produced biodiesel. He uses different blends and normal diesel fuel as well as different compression ratio for their study. His study shows that the engine torque for all blends increases as the compression ratio increases. The B.S.F.C for all blends decreases as the compression ratio increases and at all compression ratio B.S.F.C remains higher for the higher blends as the biodiesel percent increases. He found that the increase in compression ratio improved the performance and cylinder pressure of the engine and had more benefits with biodiesel than with pure diesel.

S Nagaraja [3] has investigated the effect of change in compression ratio on combustion and performance of single cylinder four stroke engine, when fuelled with preheated palm oil and its 5,10,15 and 20% blends with diesel. He analyzed that the brake thermal efficiency at full load was maximum when operated at highest compression ratio fuelled with 20% blend. Also he found that the specific fuel consumption (SFC) of O20 blend was lower than that of petroleum based diesel fuel (PBDF) at higher compression ratio. Exhaust gas temp was low for all the blends as compared to PBDF. The engine performance was found to be optimum using O20 as fuel at 20:1 compression ratio during full load condition.

Rahul Krishnaji bawane [4] has conducted experiment to evaluate the suitability of using biodiesel as an alternative fuel in VCR engine. He concluded that the BSFC for biodiesel and its blends are higher than that of diesel because of lower heating value of biodiesel, lowers the power generation for the same fuel consumption rate as compared to diesel. Exhaust Gas Temperature, EGT, for the biodiesel and its blends found lower at all conditions as compared to diesel. The CO emissions are higher at lower compression ratio, and decreased at higher compression ratio. The HC emission decreases with increase in compression ratio for the entire range of fuels, and for biodiesel and its blend it is higher than diesel.

P.Navaneetha Krishnan [5] has done a detailed experimental study to evaluate and analyze the performance, exhaust emission level and combustion of tamanu oil biodiesel and diesel blends in a fully instrumented single cylinder, variable compression ratio multi fuel engine. His analysis revealed that as load applied to the engine increases brake thermal efficiency of the fuel blends also increases. The maximum brake thermal efficiency was 41.72% for B40 at full load, which is 5.2% higher than standard diesel. As the load increases specific fuel consumption of the engine decreases gradually. At full load conditions the specific fuel consumption for the blends B20 and B40 is 0.2234 kg/ kWh, 0.2268 kg/ kWh respectively whereas for standard diesel it is 0.2201 kg/ kWh. As load increases mechanical efficiency of the blended fuel shows steady increase. At full load condition the maximum mechanical efficiency obtained from blend B20 and B40 is 93.77% and 87.62 % respectively. From the analysis of exhaust emission of the blends, he found that at higher load condition except B20 all other blends having higher hydrocarbon emission. At lower loads except B40 all other blended fuel having higher NOx emission than standard diesel. The carbon monoxide emission is closer to standard diesel at full load and it is higher for light and medium loads.

Senthil Ramalingam [6] has investigated the influence of injection timing and compression ratio on performance, emission and combustion characteristics of Annona methyl ester operated diesel engine and concluded that A20 blends can be effectively used in a diesel engine without any modification. Compression ratio of 19.5 along with injection timing of 30˚ BTDC (before top dead centre) will give better performance and lower emission which is very close to diesel. It was found that the combined increase of compression ratio and injection timing increases the BTE and reduces SFC while having lower emissions. Diesel (20%) saved, will greatly meet the demand of fuel in railways.

V. Hariram [7] has found the Influence of compression ratio on combustion and performance characteristics of direct injection compression ignition engine. In his study, single cylinder direct injection CI engine was tested on varying the compression ratios of 18, 17 and 16 at varying loads. Reduction in brake thermal efficiency and increase in exhaust gas temperatures were observed when compression ratio was reduced from 18 to 16. The brake specific fuel consumption was increased on reducing the compression ratio. Reduction of peak cylinder pressure was observed on reduction of compression ratio and the ignition delay period increased on reducing the compression ratio. The peak heat release rate was closer to TDC on increasing compression ratios from 16 to 18. The rate of pressure rise was also investigated and showed maximum of 5.38 bar/˚CA and minimum of 0.78 bar/˚CA on above compression ratios. Cumulative heat release was also evaluated in this study showing higher heat energy for higher loads and compression ratios. The performance and combustion parameters on the useful compression ratio of 18 were also justified.

III.CONCLUSION

Biodiesel can be used as a fuel in the diesel engine without modification. Variation in compression ratio gives nearly the same result on engine running with diesel, blend of diesel and bio-diesel and bio-diesel. Increasing compression ratio within a certain range gives us positive result like increase in brake thermal efficiency, decrease in brake specific fuel consumption, reduces smoke-CO emissions etc. However, the results may vary with change in parameters like injection timings and injection pressures.

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