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EXPERIMENTAL INVESTIGATION AND PERFORMANCE AND EMISSION ANALYSIS OF DIESEL ENGINE WITH MODIFIED INLET MANIFOLD USING B20 BIODIESEL BLENDS OF MAHUA AND KARANJA OILS

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Abstract - *An Investigation project done with the objective to analyse the emission and performance of single cylinder four stroke diesel engine at different load conditions fueled with Mahua biodiesel blended with diesel (B20 Biodiesel). The project consists of two phases .First one is to modify the the inlet manifold using swirl booster to generate the swirl of air so that efficient combustion is achieved . Next one is to blend the Mahua biodiesel with diesel in B20 form(20% biodiesel and 80% diesel) in the same engine setup so that emission levels are reduced and performance is enhanced.*

***Key Words*: Diesel engine, Swirl enhancer, Performance, Emissions, Combustion process, Biodiesel, B20 form.**

1. INTRODUCTION

In todays world pollution is the major problem caused by emissions of harmful gases from different sources like automobiles and industries which pollutes the environment. The harmful gases may be CO,HC,CO_2 and NOx etc. NOx emissions are greatly reduced by generating swirling air. Swirling air causes rapid mixing of fuel and air. Swirl is the ordered rotation of air entering the engine cylinder. Swirl can be generated in different ways, in our experent it is generated using swirl enhancer installed in inlet air manifold. Our project consists of two phases first one is to generate the swirl and the next one is to replacing the diesel with biodiesel

1.1 Swirl enhancing device

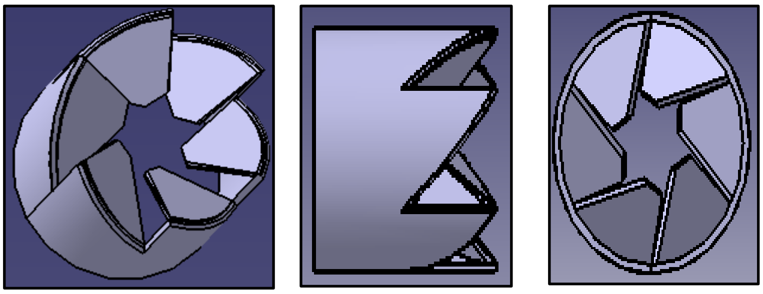

Fig-1: Modelling of swirl enhancer

Swirl Enhancer of 28mm diameter is inserted inside the Inlet air port of the engine head. The modification is done to create swirling. Its effect on performance and emission are discussed in the results section. It is made with sheet metal by cutting the blade on the front part which faces the combustion chamber.

1.2 Engine specification

1. Engine type: Computerized single cylinder four stroke diesel engine
2. Model: Make kirloskar, TV1
3. Cooling type: Water cooled
4. Speed:1500rpm

5. Stroke: 110mm
6. Bore:87.5mm
7. Compression ratio: 17.5
8. Fuel tank: 15lit capacity with metering column
9. Load sensor: Load cell type strain gauge, range 0-50
10. Load indicator: Digital, Range 0-50 kg
11. Rotameter: Calorie meter cooling 25-250 LPH; Engine 40-400 LPH.

1.3 Physical model preparation

1. Sheet metal is used for making swirl booster as it is deformable in nature.
2. It can easily take the shape of t he inlet air port.
3. Sheeet metal operations require less equipments and are easier than machining.

Swirl enhancer(Physical model)

Fig-2: Side view of the swirl enhancer

Fig-3: Top view of the swirl enhancer

2. METHODOLOGY

2.1 Phase 1

1. A 15x15 mm steel sheet metal is selected for making tapered swirl enhancer.
2. A sheet metal is selected because it is easy to perform operations while making a swirl enhancer.
3. Sheet metal working tools are used for making swirl enhancer.
4. A swirl enhancer made up of sheet metal can easily take the shape of the Inlet air port.
5. Initially a development of cone method is used to draw the development of tapered swirl enhancer.
6. The development is pasted on sheet metal and cutted accordingly.
7. The cutted sheet metal is rolled to form a tapered swirl booster.
8. The swirl enhancer is inserted inside the inlet air port of the cylinder head.

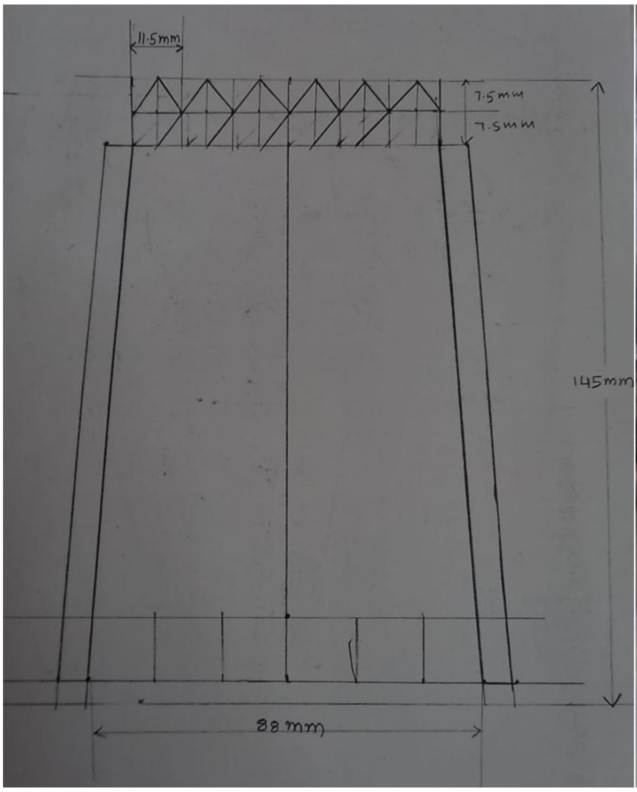

Fig-4: Devlopment sketch of swirl enhancer **Fig-5:** Swirl enhancer inserted in a cylinder head

2.2 Phase 2

1. Mahua Biodiesel is selected for the experiment.
2. 20% of Mahua biodiesel is mixed with 80% of diesel.
3. The blend of Mahua biodiesel and diesel is stirred for 4 minutes.

Fig-6: Karanja B20 Bioiesel **Fig-7:** Mahua B20 Biodiesel

3. EXPERIMENTAL SETUP

Fig-8: Computerised diesel engine test rig

3.1 Construction

Test rig consists of

1. Computerised diesel engine(1cylinder 4 stroke)
2. Fuel tank filled with fuel with a measuring unit attached.
3. Cooling measurement is done through rotameters.
4. Transmitters for fuel flow and air flow measurementnts.
5. dynamo meter for loading the engine
6. AVL 5 emission test unit.

3.2 Procedure

1. Engine is filled with diesel and biodiesel as required.
2. Ensuring the cooling water flow.
3. Ensuring the engine is at 0kg load.
4. Check for mains supply .
5. Ensure all the required connections of the engine are right with the computer and emission test kit.
6. Start the engine with 0kg load and run for 25minutes and slowly rise the load.
7. Load is increased by 2 kg ,4kg.6kg,8kg and 12 kg and readings are tabulated.
8. Same experiment is conducted for different biodieses.

4. EXPERIMENTAL ANALYSIS

4.1 Performance

1. **Load vs Brake thermal efficiency**

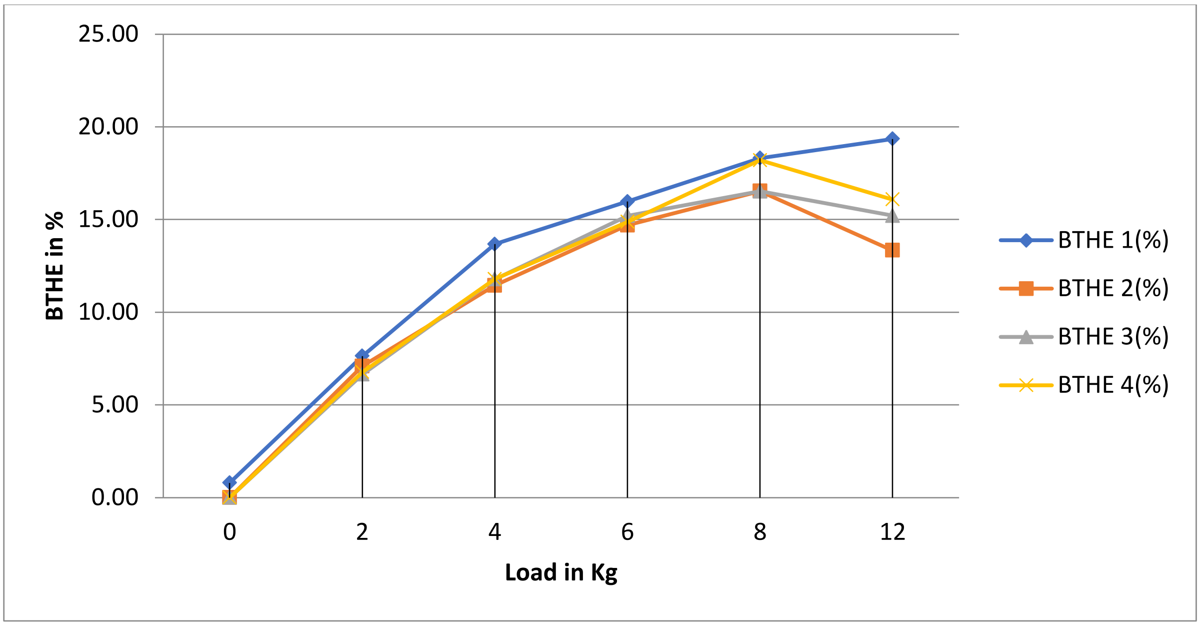

Chart-1: Load vs Brake thermal efficiency

Brake thermal efficiency depends on Brake power and specific fuel consumption. Here Specific fuel consumption is increasing in an engine with modified inlet manifold as the flow of fuel is more than air. Hence brake thermal efficiency is increasing with increasing load Brake thermal efficiency of karanja B20 Biodiesel will be same as that of diesel at 8kg load.

2. **Load vs Indicated thermal efficiency**

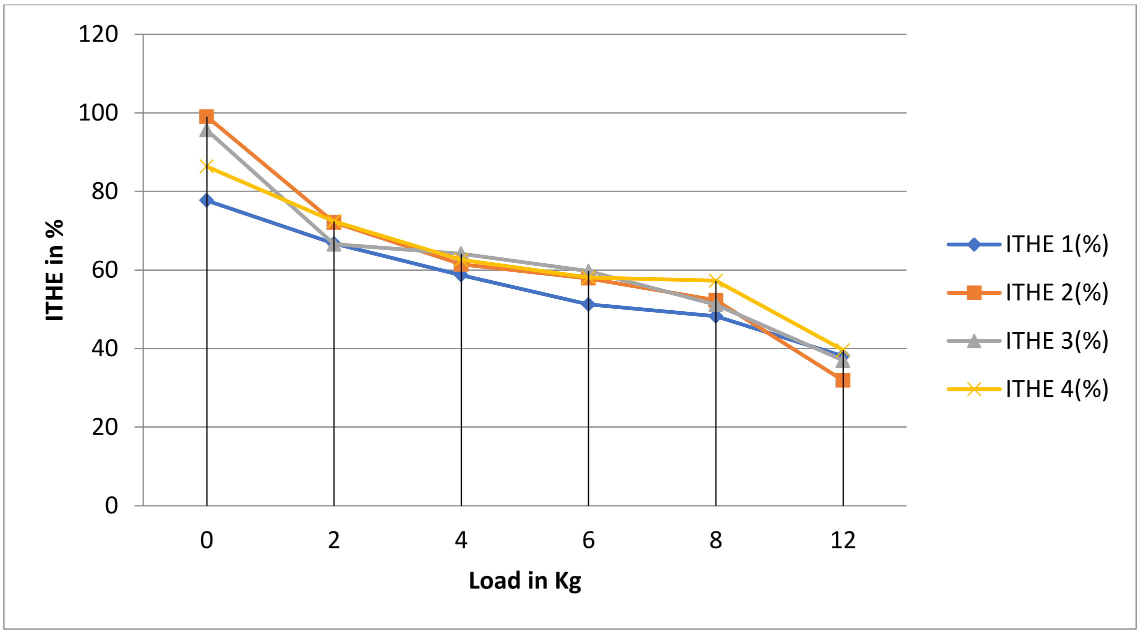

Chart-2: Load vs ITHE

Indicated thermal efficiency depends on the indicated power which inturn depends on the indicated mean effective pressure.Indicated mean effective pressure is the average pressure in the cylinder for a complete engine cycle. As indicated mean effective pressure is increasing for diesel engine with modified inlet manifold indicated thermal efficiency is also increasing by utilizing biodiesels.

3. Load vs Mechanical efficiency

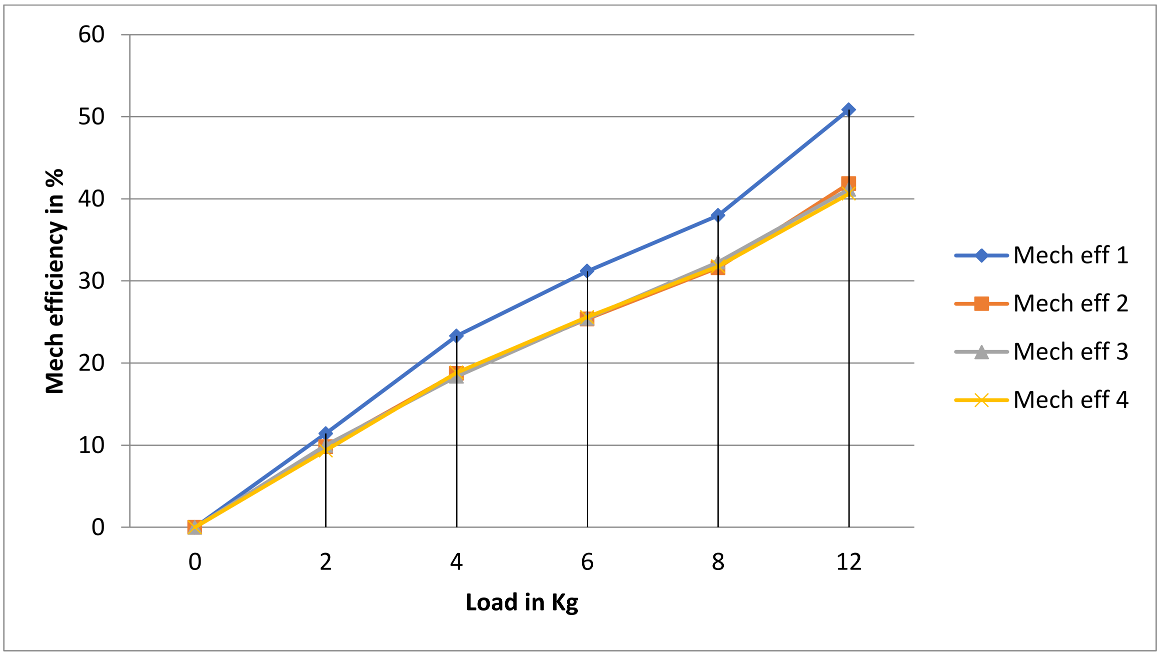

Chart-3: Load vs Mechanical efficiency

Mechanical efficiency is obtained by the ratio of brake power to the indicated power. As the indicated power is increasing in an engine with modified inlet manifold hence mechanical efficieny is decreasing.

4. Load vs Specific fuel consumption

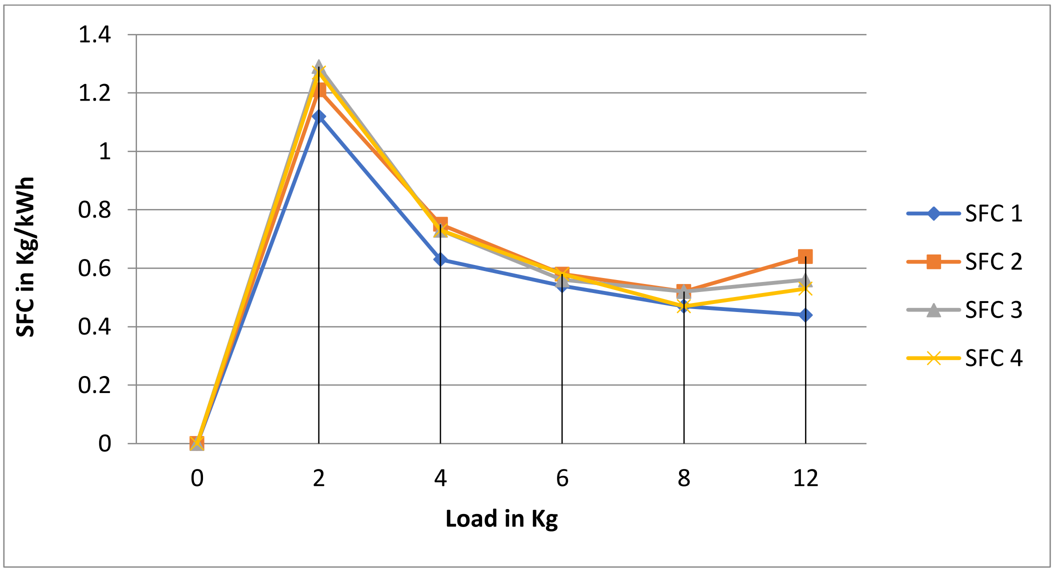

Chart-4: Load vs SFC

The specific fuel consumption of conventional diesel engine is lower than that of engine with modified inlet manifold. This is because of the disturbed air passage in the air inlet port and also due to the higher viscosity and poor mixture formation of biodiesel.

5. Load vs A/F Ratio

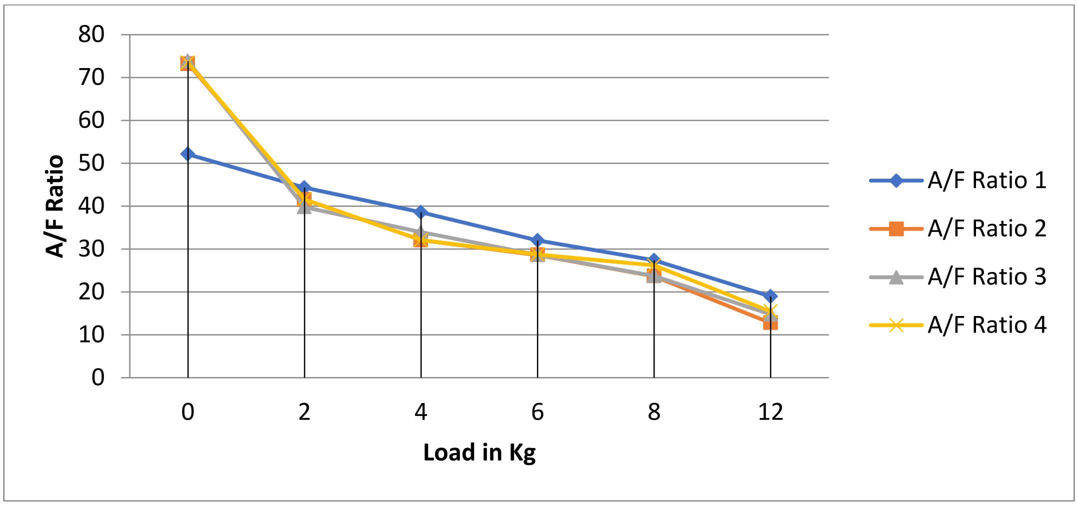

Chart-5: Load vs A/F Ratio

The air fuel ratio is more in conventional diesel engine and it is reducing in an engine with modified inlet manifold because of less air flow resulting in rich mixture.

4.2 Emissions

1. Load vs CO emission

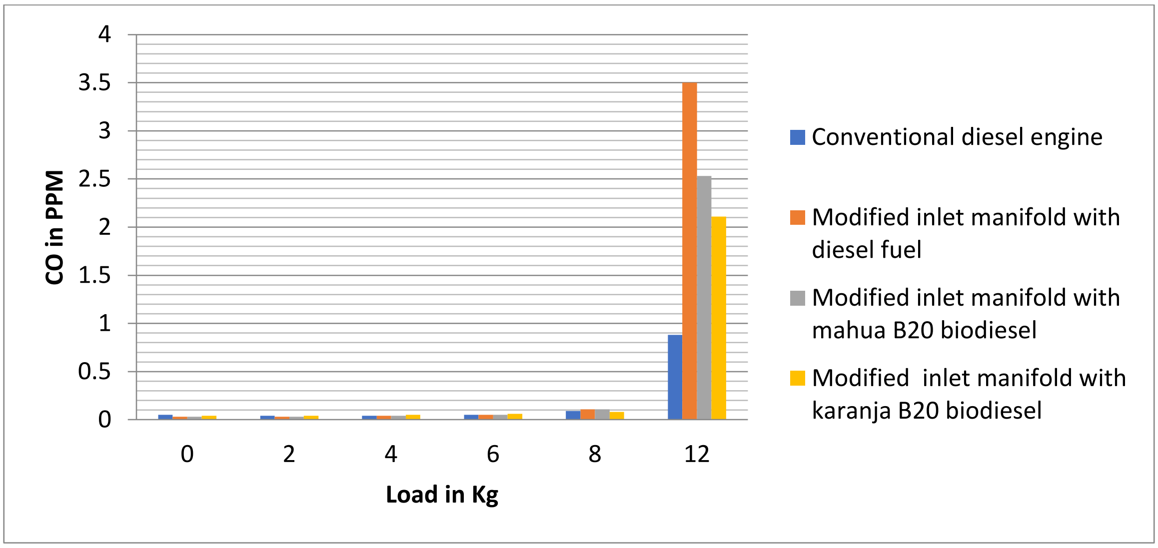

Chart-6: Load vs CO emission

2. Load vs HC emission

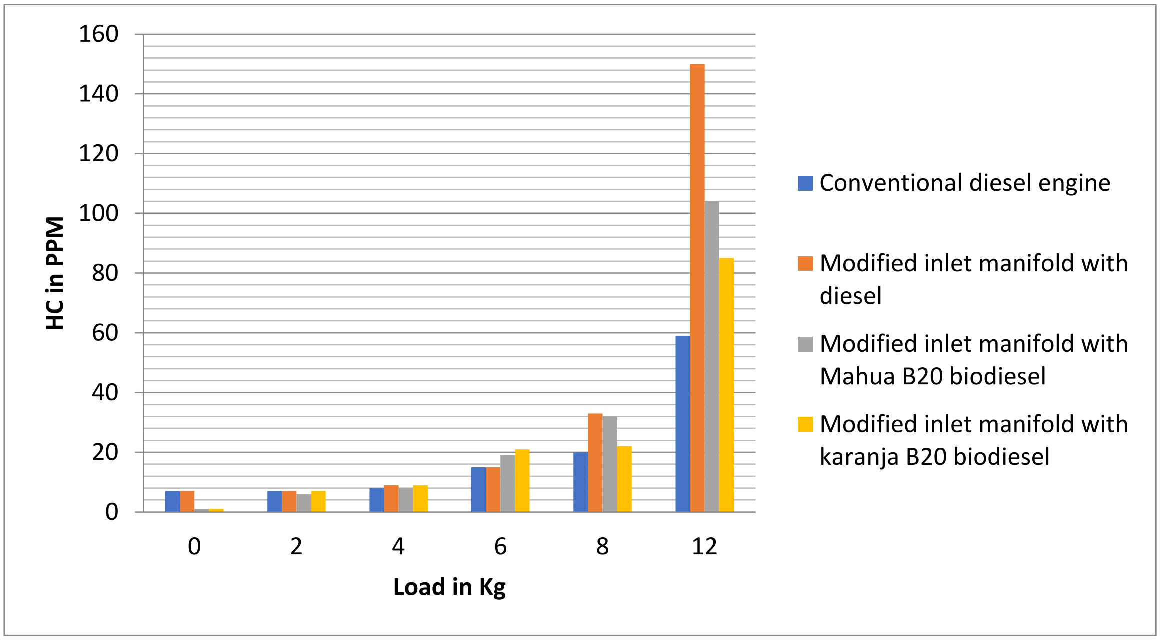

Chart-7: Load vs HC emission

Higher fuel/air ratio causes the emission of HC and CO. During the initial loads the CO and HC emissions are comparatively small and there is slight difference between difference setups. But at higher loads it is increasing because with increase in the load the fuel/air ration increases and also there is disturbance for air flow due to modification if an inlet manifold. This causes rich fuel/air mixture hence resulting in Carbon monoxide and hydrocarbon emissions. Even the emissions at higher loads are decreasing at higher loads by using Mahua B20 and karanja B20 Biodiesels.

3. Load vs CO_2 emission

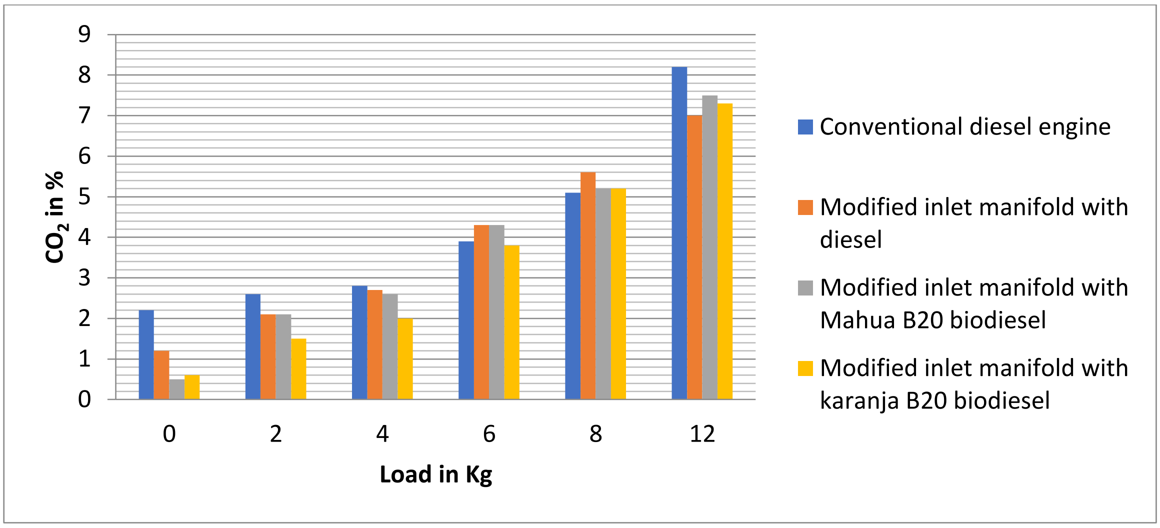

Chart-8: Load vs CO_2 emissions

The combustion process causes a mixing of carbon with oxygen in air resulting in the formation of carbon dioxide. The change of CO2 emission is almost same in all the setups.

4. Load vs O_2 emission

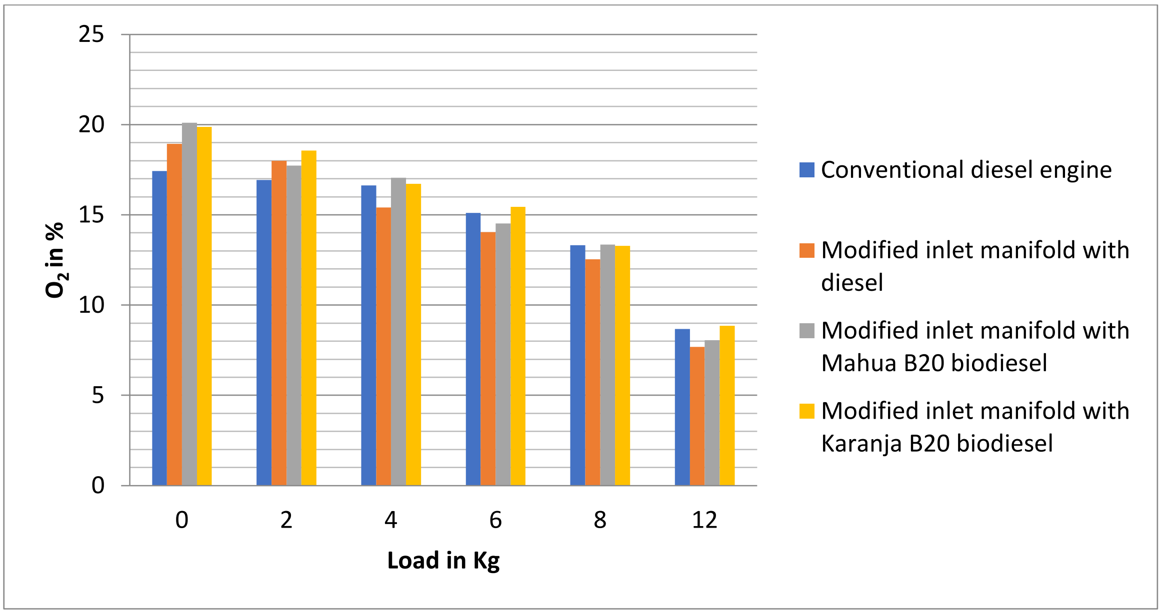

Chart-9: Load vs O_2 emission

With increasing load oxygen emission is reducing in different setups which results in good combustion of fuel.O2 emission is also nearly same for different setups and fuels. Biodiesels contains oxygen with it, consequently O_2 emissions are somewhat increasing by using biodiesels.

5. Load vs NOx emission

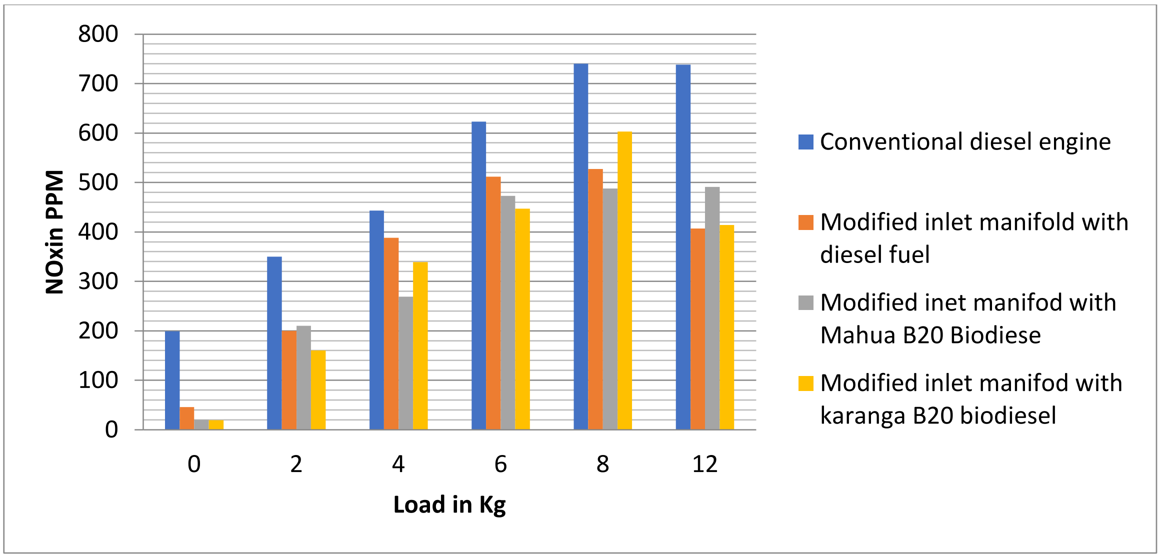

Chart-10: Load vs NOx emission

NOx emissions increases with increase in load because it causes increased fuel supply resulting in longer combustion duration causing increase in temperature hence it causes NOx formation. The NOx emissions are decreasing in an engine with modified inlet manifold because of rich mixture burning and in an engine with B20 biodiesel NOx is decreasing because of lower combustion temperature inside the cylinder because of modified inlet manifold and lower Calorific value of the biodiesel.

6. Load vs smoke emission

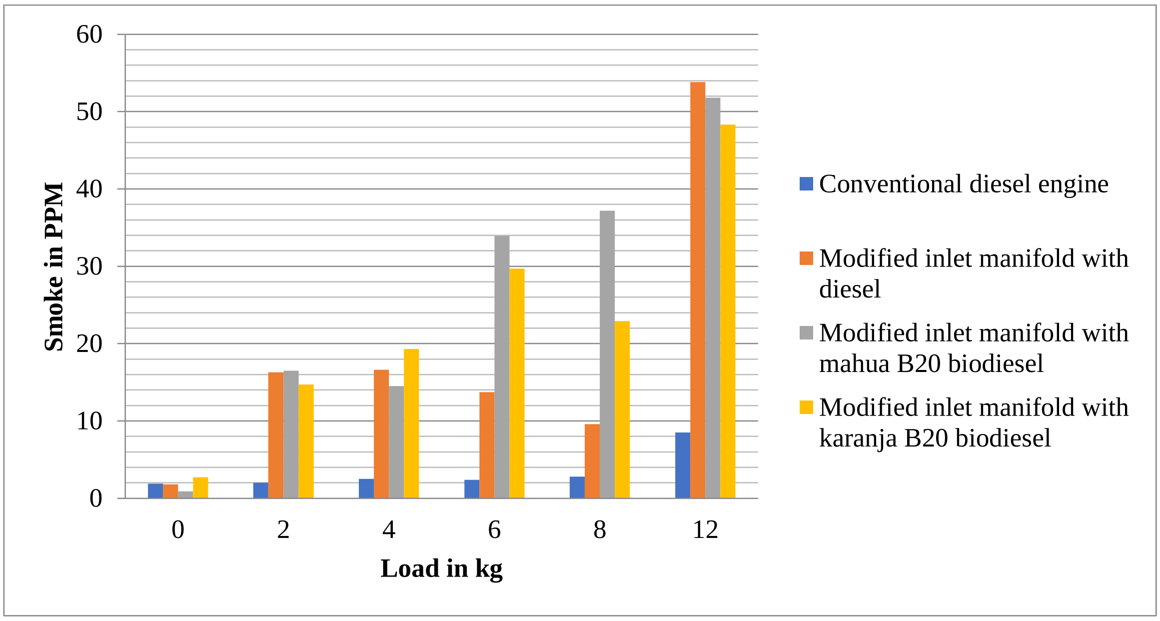

Chart-11: Load vs Smoke emission

Smoke emission is the part of combustion process.Smoke is increasing with increasing load because of rich air/fuel mixture and also due to the biodiesel blend.

5. CONCLUSIONS

1. The experimental results shows the improvement in the Performance and emission parameters of single cylinder four stroke diesel engine with modified intake manifold by using Mahua B20 and Karanja B20 Biodiesel

2. The swirl generated by modified Inlet manifold has good impact on CO, HC, NOx, CO2 and O2 Emissions at the lower loads but increasing at higher loads because of higher fuel/air ratio caused due to disturbance of air passage in the inlet manifold.

3. Brake thermal efficiency, Indicated thermal efficiency and Specific fuel consumption of engine with modified inlet manifold is improved With Mahua B20 and Karanja B20 Biodiesel compared to Diesel

4. Mechanical efficiency of an engine with modified inlet manifod by using Mahua B20 Biodiesel is nearly same by using diesel fuel and reduces negligibly with karanja B20 Bio diesel.

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