Study of Effect of Soya Bean and Jatropha Blended Biodiesel on Performance Parameters of Diesel Engine

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ABSTRACT

Nowadays, due to rapid growth in the population, it is very hard to maintain adequate supply of natural resources. Fossil fuels and its by-products are one of them. Hence, nowadays biodiesel is used as an alternative for pure diesel which includes less amounts of diesel and different oils, which results in reduction of diesel consumption. In this study, biodiesel was produced from the combination of soya bean and jatropha oil with petroleum diesel fuel. In this study the performance of the diesel engine was checked by using different combinations of diesel, jatropha oil and soya bean oil. Then mechanical efficiency of diesel and different blends of biodiesel is to be calculated and also the emission of CO, CO_2, HC, and O_2 was calculated and the mechanical efficiency is here compared with the emission of CO, CO2, HC and O2 gives the result. In the study four different blends were tested, first blend is pure form of diesel and other blends are the combination of diesel, soya bean and jatropha oil, that blends are B2 (S10J12D75), B3 (S10J15D70), B4 (S10J18D65), where as B2, B3, B4 are the blends and S is percentage of soya bean oil, J is percentage of jatropha oil and D is the percentage of diesel and here the catalyst is to be used is ethanol for transesterification process. Here, the comparison between the four different blends with the emission of CO, CO_2, HC, O_2 is to be done on the basis of two input parameters that is, change in variable compression ratio and change in loads. This all to calculate by using software internal combustion engine which is directly attached with diesel engine and gives the results.

Keywords: *Pure diesel, Jatropha and soya bean blended biodiesel, Mechanical efficiency, Performance parameters of biodiesel, Emission.*

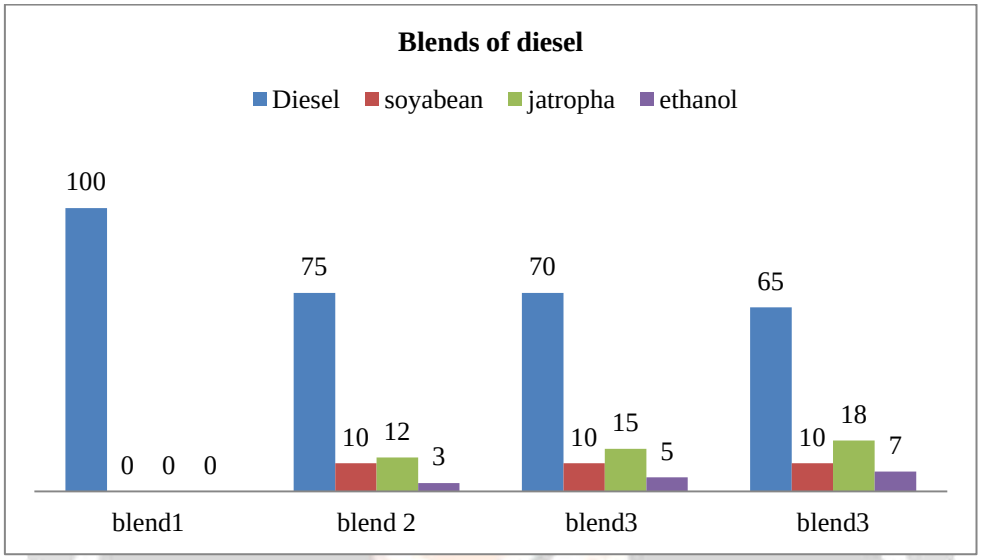
1. Introduction:

Nowadays we all face shortage of natural resources; one of them is crude oil. It also affects world economy. One of the solutions is to use biodiesel instead of pure diesel, which will reduce overall usage of diesel and consequently crude oil. In this study the research of different blends of biodiesel is too carried out which is compared with the pure form of diesel on the basis of different performance parameters. Here the study of mechanical efficiency, specific fuel consumption, brake thermal efficiency is to be tested by varying load and compression ratio of the engine and also emission of CO, CO_2, HC, O_2 is to be tested. The loads are 6kg, 9kg and 12 with the compression ratio 16, 17 and 18 with each load. In this paper the overall mechanical efficiency different blends is compared with emissions and gives the result is, which blend gives maximum efficiency and reduce emission of CO, HC and CO_2 by changing the input parameters load with variable compression ratio 16, 17 and 18. Here four different blends are tested in which, the first blend is pure form of diesel and other three blends are combination of diesel with blends of jatropha and soya bean oil. This all tests are to be carried on research engine that is four stroke constant speed diesel engine. For this purpose the software is used that is "IC engine" software. This is the CNC research engine which gives result that is performance of engine and combustion performance of engine.

2. Methodology:

2.1 Blends:

Here four different blends are used. First blend is pure form of diesel and other three are the combination of jatropha and soya bean with diesel. In this blends the catalyst is to be added is ethanol. Below graph represent the different blends of diesel.



Graph-1: Blends of biodiesel

First blend is pure form of diesel and other blends are as shown in figure that are S10J12D75, S10J15D70, S10J18D65, where as S is percentage of soya bean oil, J is the percentage of jatropha oil and D is percentage diesel. Here in this experimentation the percentage of soya bean oil kept constant that is 10% because in the winter season the soya bean oil is changing to solid state which cause the problem in the engine of vehicle that is starting trouble of engine due to that it is not work smoothly and causes the emission of NO, CO, HC is more, hence the proportion of soya bean oil kept constant. Soybean oil has good Tran's etherification properties and less emission of as compared to diesel engine. Percentage of jatropha oil as shown in above table is to change in the combination with soya bean oil and diesel. Engine works smoothly on the methyl esters of jatropha oil as compared with diesel. Thermal efficiency of jatropha is more as compared to diesel. In this study catalyst is to be used is ethanol because it causes good transesterification process, it helps for complete burning of fuel.

2.2 Testing Parameters:

- Mechanical efficiency
- Brake thermal efficiency
- Specific fuel consumption
- Emission of CO, CO_2, HC

These testing parameters are to be tested by varying load on the engine and change variable compression ratio as shown in below table:

1. Load: Following table gives idea about how much load is to taken for different blends

Sr no	% Soya bean	% Jatropha	% Diesel	% Ethanol	Load	load	load
1	10%	12%	75%	3%	6kg	9kg	12kg
2	10%	15%	70%	5%	6kg	9kg	12kg
3	10%	18%	65%	7%	6kg	9kg	12kg

Table 1: Load variation with different percentage of blends

2. VCR: Following table gives idea about how much VCR is to taken for different blends:

Sr no	%Soya bean	% Jatropha	% Diesel	% Ethanol	VCR	VCR	VCR
1	10%	12%	75%	3%	16	17	18
2	10%	15%	70%	5%	16	17	18
3	10%	16%	65%	7%	16	17	18

Table 2: Change in variable compression ratio

2.3 Test apparatus specifications: In this study four stroke water cooled diesel engine is used for experimentation. The specification of apparatus is given below:

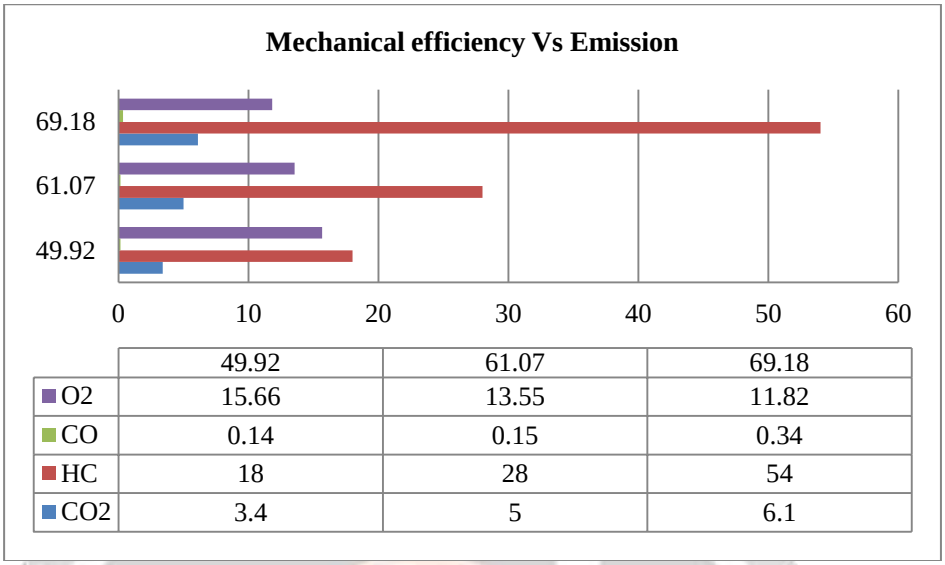
Sr No	**Specifications**	**Dimensions**
1	RPM	1500
2	Cylinder boar	87.180mm
3	Stroke length	110mm
4	Compression ratio	16
5	Orifice diameter	20mm
6	Swept volume	661.65cc
7	Orifice co-effient of discharge	0.60
8	Dynamometer arm length	185
9	Fuel density	830

Table 3: Four stroke water cooled engine specifications

3. Observations and calculations:

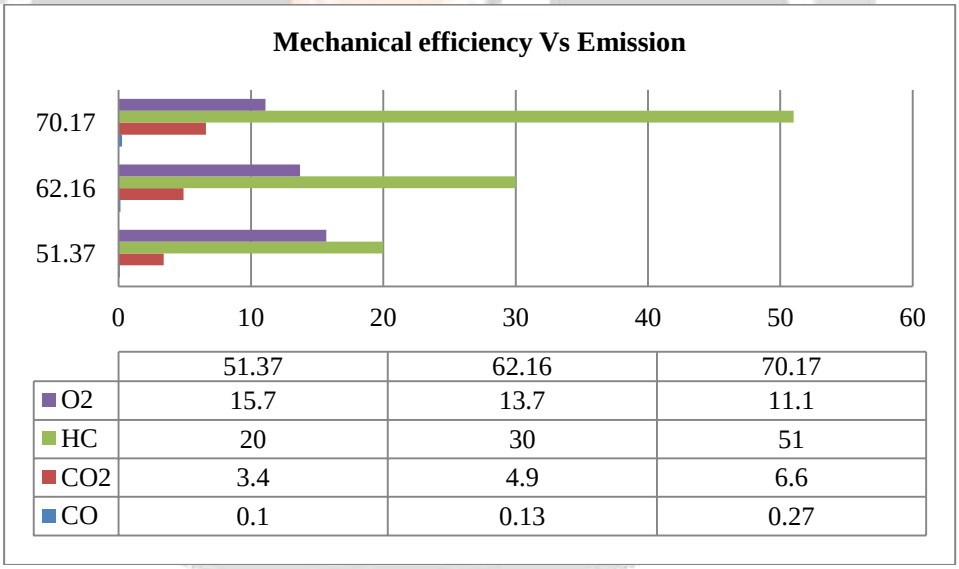
In this experimentation, four different blends of biodiesel are to be tested. From these four blends first blend is pure form of diesel, and others are the combination of jatropha oil, soybean oil and diesel. These blends are B1: pure form of diesel, B2: S10J12D75, B3: S10J15D70, B4: S10J18D65 where as S: percentage of soybean oil, J: percentage of jatropha oil, D: percentage of pure diesel. This experimentation is carried out by varying variable compression ration that is CR16, CR17, and CR18 at variable loads 6kg, 9kg, 12kg on this engine and measuring brake thermal efficiency, specific fuel consumption rate, mechanical efficiency of the engine and exhaust gas temperature and emission of CO, HC, CO_2, and O_2 is too measured. Following graphs gives the performance and combustion of different blends with VCM 16, 17, 18 and loads 6kg, 9kg, 12kg give the results showing below.

3.1 Blend 1 (Pure form of diesel):



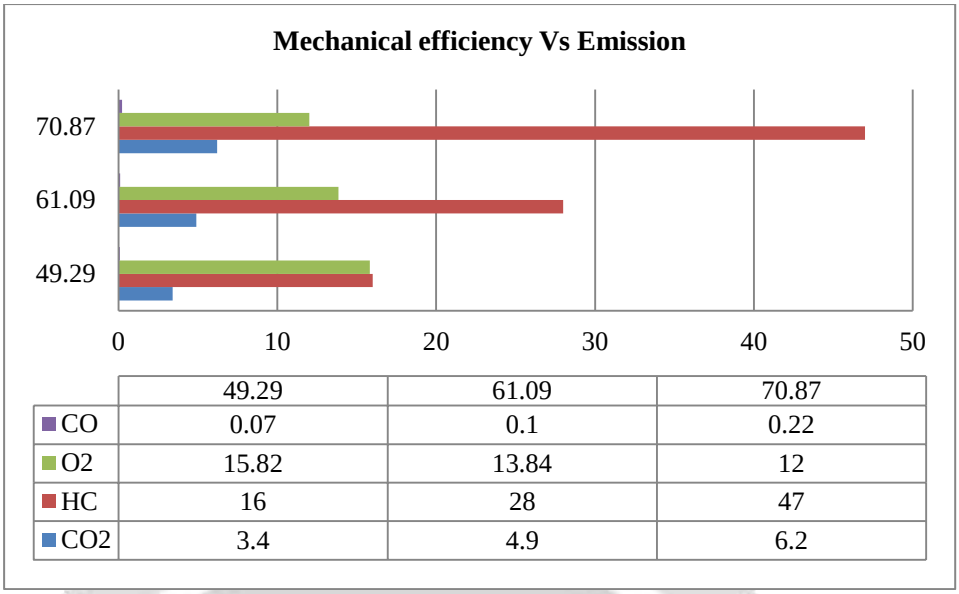
	49.92	61.07	69.18
O2	15.66	13.55	11.82
CO	0.14	0.15	0.34
HC	18	28	54
CO2	3.4	5	6.1

Graph-2: variable compression ratio 16



	51.37	62.16	70.17
O2	15.7	13.7	11.1
HC	20	30	51
CO2	3.4	4.9	6.6
CO	0.1	0.13	0.27

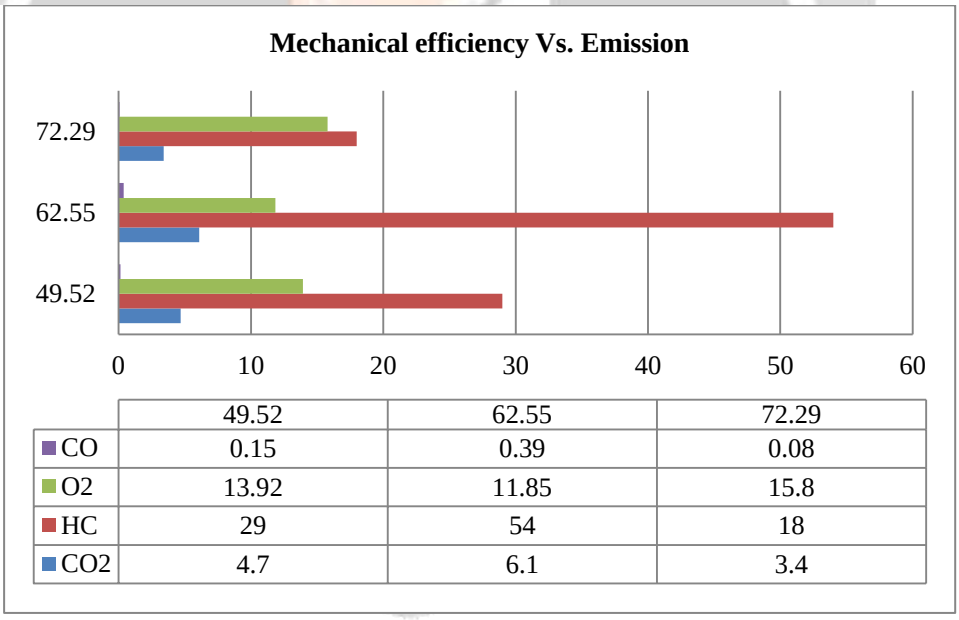
Graph-3: variable compression ratio 17



	49.29	61.09	70.87
CO	0.07	0.1	0.22
O2	15.82	13.84	12
HC	16	28	47
CO2	3.4	4.9	6.2

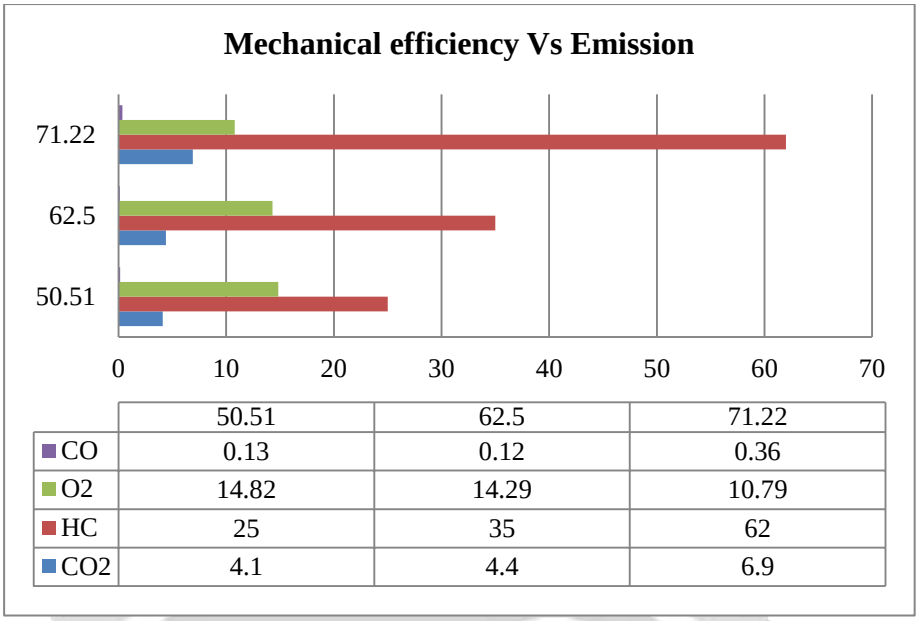
Graph-4: variable compression ratio 18

3.2 Blend 2 (S10J12D75) :



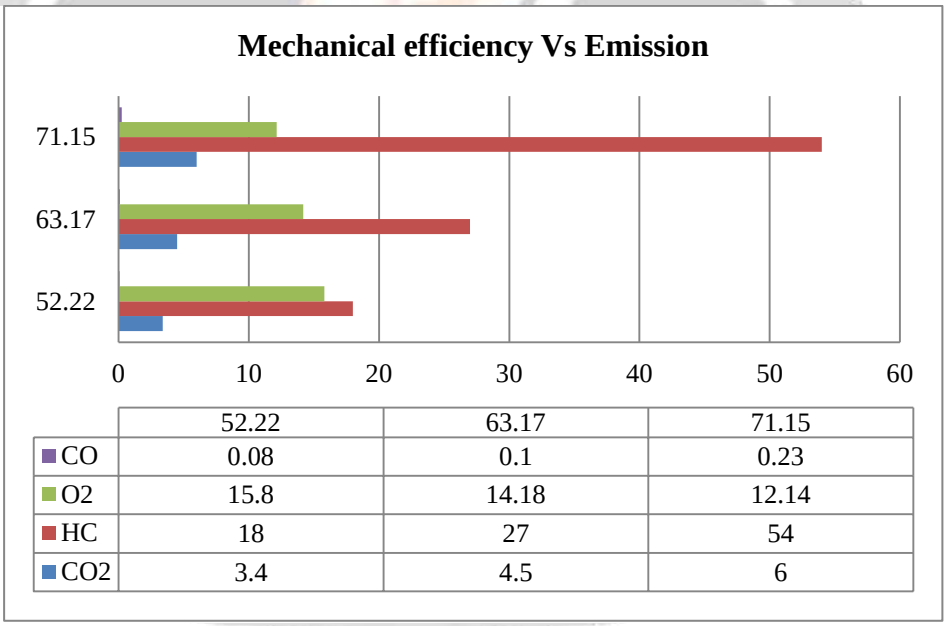
	49.52	62.55	72.29
CO	0.15	0.39	0.08
O2	13.92	11.85	15.8
HC	29	54	18
CO2	4.7	6.1	3.4

Graph-5: variable compression ratio 16 for blend



	50.51	62.5	71.22
CO	0.13	0.12	0.36
O2	14.82	14.29	10.79
HC	25	35	62
CO2	4.1	4.4	6.9

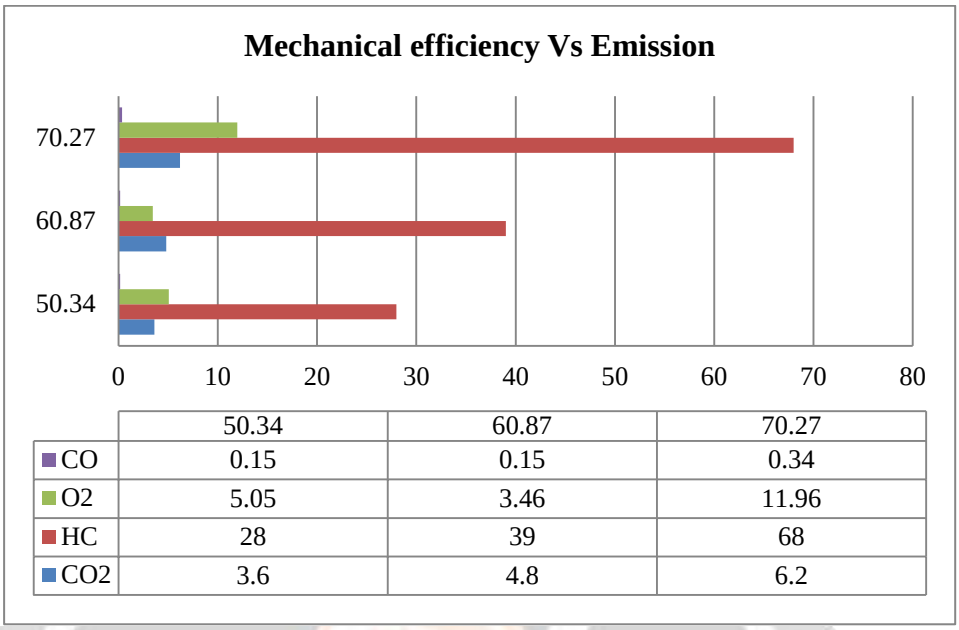
Graph-6: variable compression ratio 17



	52.22	63.17	71.15
CO	0.08	0.1	0.23
O2	15.8	14.18	12.14
HC	18	27	54
CO2	3.4	4.5	6

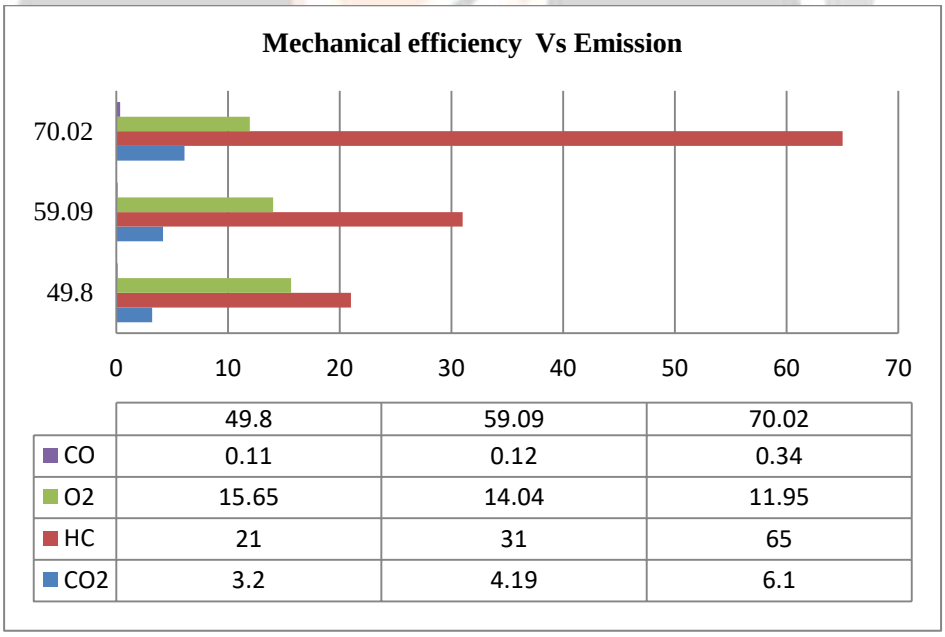
Graph-7: variable compression ratio 18

3.3Blend 3 (S10J15D70):



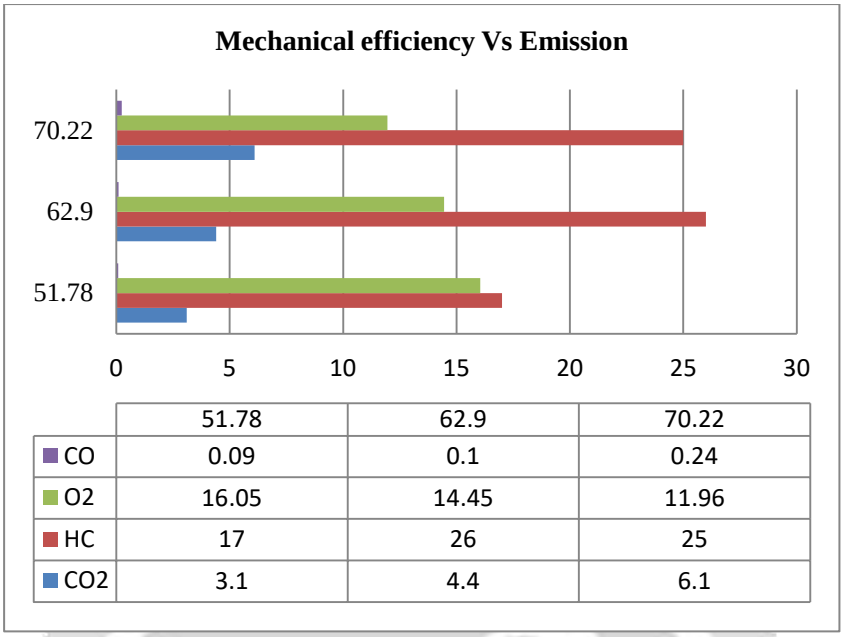
	50.34	60.87	70.27
CO	0.15	0.15	0.34
O2	5.05	3.46	11.96
HC	28	39	68
CO2	3.6	4.8	6.2

Graph-8: variable compression ratio 16



	49.8	59.09	70.02
CO	0.11	0.12	0.34
O2	15.65	14.04	11.95
HC	21	31	65
CO2	3.2	4.19	6.1

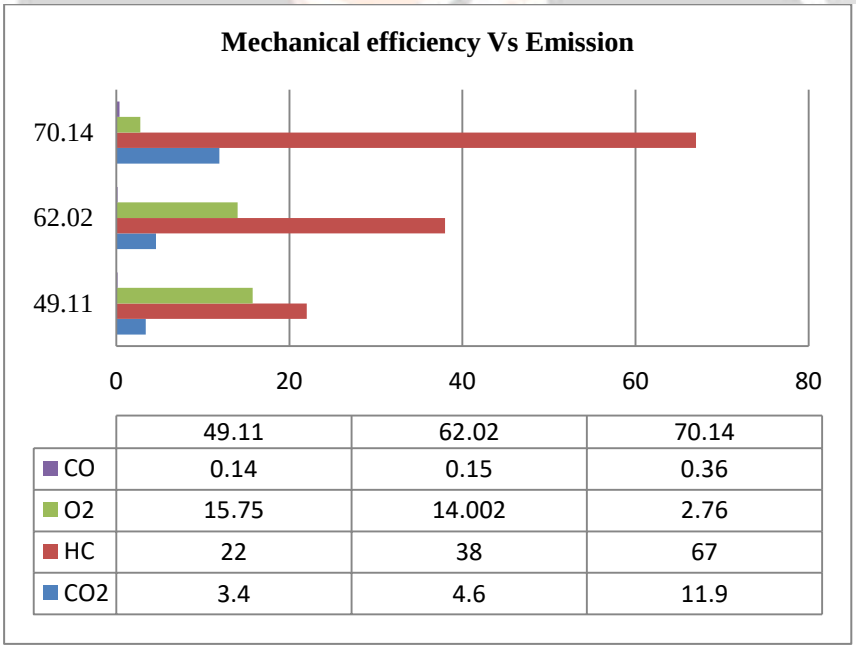
Graph-9: variable compression ratio 17



	51.78	62.9	70.22
CO	0.09	0.1	0.24
O2	16.05	14.45	11.96
HC	17	26	25
CO2	3.1	4.4	6.1

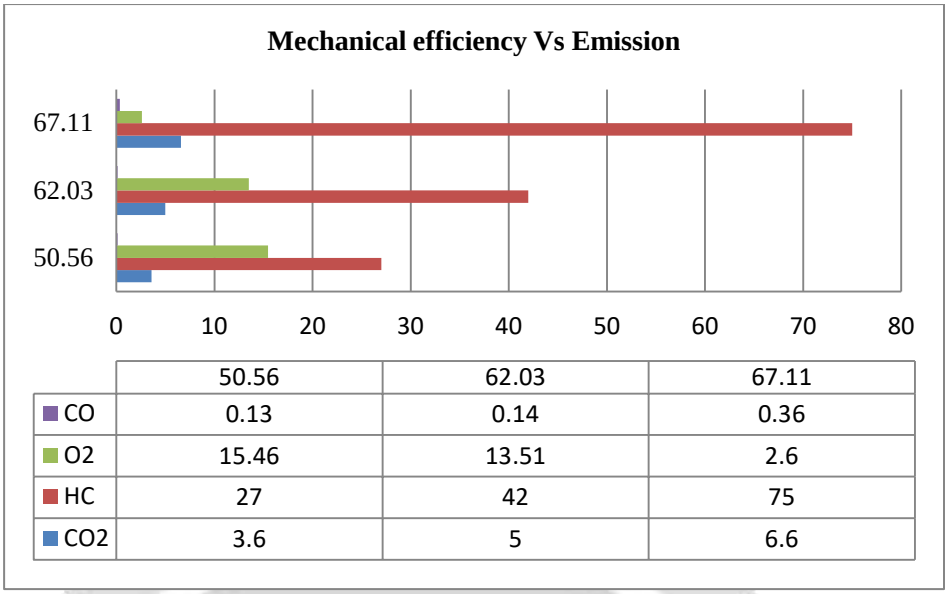
Graph-10: variable compression ratio 18

3.4. Blend 4 (S10J18D65):



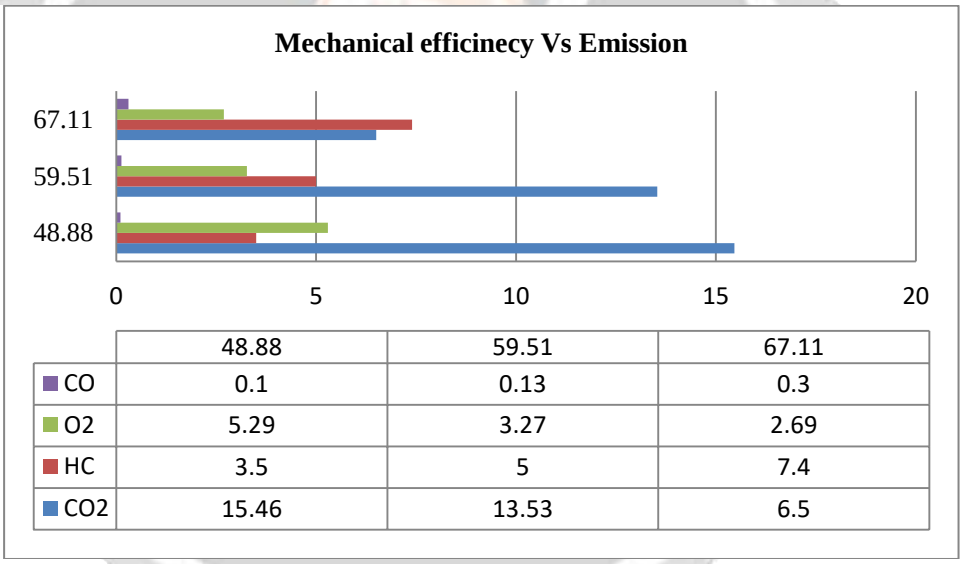
	49.11	62.02	70.14
CO	0.14	0.15	0.36
O2	15.75	14.002	2.76
HC	22	38	67
CO2	3.4	4.6	11.9

Graph-11: variable compression 16



	50.56	62.03	67.11
CO	0.13	0.14	0.36
O2	15.46	13.51	2.6
HC	27	42	75
CO2	3.6	5	6.6

Graph-11: variable compression ratio16



	48.88	59.51	67.11
CO	0.1	0.13	0.3
O2	5.29	3.27	2.69
HC	3.5	5	7.4
CO2	15.46	13.53	6.5

Graph-12: variable compression ratio 18

4. Conclusion:

1. In this Experimentation the performance of pure form of diesel and blends of diesel with soya bean and jatropha with different configuration was tested and result expressed in the form of graphs of mechanical efficiency verses emission of CO, CO_2, HC and O_2.

2. The maximum efficiency of pure form of diesel is 70.87 with its compression ratio 18 and after carried out above experimentation the efficiency of blend B1 (S10J12D75) is 72.29 at compression ratio 16, which is more than pure diesel.

3. After comparison of three different blends B1(S10J12D75), B2(S10J15D70), B3(S10J18D65) with pure form of diesel conclusion comes the efficiency of blend B1 is more than diesel and Emission of CO, HC, CO_2 is less as compared to diesel and Emission of O_2 is near about same and cost of this biodiesel is little bit more as compared to diesel engine but it gives less amount of CO, CO_2, HC is less and O_2 is near about same, which is less harmful for environment. So, we could conclude that blend B1 can be used as alternative fuel for diesel engine.

5. Future scope:

- Changes in proportions soybean oil and jatropha oil can be studied to improve the efficiency of engine.
- Experimental work on the combustion properties is to be further done.
- Biodiesel is a viscous fluid as compared to diesel, hence cleaning of engine component is necessary. Use of heater in biodiesel blends of the engines can be studied.
- Biodiesel used in diesel engine continuously causes corrosion so wear and tear properties of engine must be studied further.

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