Experimental Analysis of Performance and Emission Characteristic between Diesel and Varying Blends of diesel-Isopropanol-Biogas with different CR

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Abstract

Increasing demand of fossil fuels due to diminishing fuel reserves and the environmental consequences of exhaust gases from diesel fuelled engine has become a major concern for researchers to focus on fuel related techniques and to find the substitution fuel for diesel engine.Among all alternative fuel, vegetable oil has the ability to substitute the conventional diesel fuel with few modifications and shows a sign of favorable renewable fuel resource due to its environmental advantage and accessible production in any area. Since the pure biodiesel is not widely used in diesel engines due to its high viscosity leading to higher pumping load, poor atomization and carbon deposition on the piston in the cylinder which is very vital in terms of engine performance and emissions. Therefore it is important to balance the viscosity and other parameters of biodiesel with alcohol additives and contribute positively to combustion efficiency. A comparative experimental investigation was performed to through light upon the optimum results of physical-chemical characteristics and performance characteristics of various blends of diesel, bio-gas bio-diesel & isopropanolin a diesel engine. Experimentation will be carried out using various blends of bio-gas biodiesel & isopropanol with conventional diesel designated as BGIP5D95, BGIP10D90, BGIP20D80, BGIP30D70, BGIP50D50 (0-50% Bio-gas , 0-50% isopropanol, 50-100% Diesel) respectively and compared to other blends such as BGCIP5D95, BGCIP10D90, BGCIP20D80, BGCIP30D70, BGCIP50D50(0-50% Bio-gas , 0-50% Caster, 0-50% isopropanol, 50-90% Diesel). After experimentation the blend BGIP30D70(code-BGIPD-4) and BGCIP30D70(code-BGCIPD-4) has shown better results than Diesel in all parameters such as performance, emission, physical and chemical parameters. But the blend BGCIP30D70 (code-BGCIPD-4) has shown morebetter results than BGIP30D70(code-BGIPD-4) and Diesel.

Keywords. castor oil biodiesel, esterification, isopropanol, chemical-physical characteristics, performance characteristics.

DOI Number: 10.14704/nq.2022.20.9.NQ44268 **Neuro Quantology 2022; 20(9):2286-2307**

1. Introduction

This research involves the extraction of palm oil from the palm bunch in the oil palm mill of kerela, India. In this, about 4.4 litres of palm oil was obtained using 15kgs of palm kernels and it helped in formation of various blend with diesel , they are like:- PO20(20%palm oil+80%diesel oil), PO30(30%palm oil+70%diesel oil) and PO40(40%palm oil+60%diesel oil)[1]. First, the seeds that are collected should be dried in oven for about 50 to 24 hrs and then after drying them, they are crushed mechanically and the oil is obtained in hexane using Sochiet apparatus. The oil produced using papaya and watermelon seeds has low volatility and high viscosity and in order to deal with these problem, these oils are

converted into biodiesel. The several methods used to change over the seed oil into biodiesel are as Pyrolysis-involves crushing, Dilution-involves blending, Micro emulsification & Transesterification.

In all of the above methods, the most reliable method is transesterification as it is cost friendly, with high yield and has short reaction time [3]. It is obtained from mahua kernels present in the mahua trees. These trees are deciduous in nature with medium heights of 60 to 70 feets and are basically present in rural areas of India. These trees produces 20 to 40kgs of seeds per year and has yellow colour of the raw oil, it has average oil per year of 1,35,000 million tons in India. The raw oil contains 36mg/gms acid value and has 18% of FFA which is more than 1% . So, the process of catalysed transesterification is considered to reduce the acid value below 1-2 mg/gms in the oil.The Castor oil has been used as a fuel due to its ease of bendability and availability. As it possess resistant to drought, it makes the cultivation possible at the desert areas as well. The Castor oil is been made by pressurizing the Castor seeds. It has been mentioned about the choice of Castor oil as a fuel in the previous content, so we purchased it from the local area shop at Rs.585 (1000 ml) [2]. For the food chain algae is necessary to entire world, algae are largely comprises fats, proteins,nucleic acids and carbohydrates in diverse proportion. Algae cultivation doesn't need fertile land. preferably, it could be cultivate anywhere, including saltwater, fresh water or sewage. It is detailed that almost 50%wt of algae is oil and this faty oil is transformed into biodiesel[24].It is a shrub with a quality of drought resistance which belongs to family Euphorbacae grown in the areas of south region of world, Africa and India. It has 800 species. Some toxic components are also present in these species which makes this oil unfit for the purposes like cooking and that's the reason it is used for fuel production. After conducting an experiment in single cylinder ,4 stroke water cooled with constant speed direct injected CI motor where preheated Jatropha oil and other blends of Jatropha oil with diesel was used. The main conclusion was that, the increase in the compression ratio was observed accompanied by increase in injection pressure which ultimately maximize the performance of the CI motor[24]. It's grows in the humid and subtropical regions and can also grow in the areas with annual rainfall of 500mm to 2500mm. An experiment was conducted by Mahanta, where he utilised the Karanja oil and its blends with the biodiesel of Karanja. He tested it in a 5-HP cooled, 4 stroke directly injected diesel motor where there were clear results which showed methyl esters produces relatively high power than that of ethyl esters. After all the experiment, it showed methyl esters have better performance and emission factors than the other blends. Its also showed that full load diesel emitts the more amount of NOx than esters[24]. This oil is obtained from pine tree, firstly separating them from wood chips after the wood chips are cooked by the process of kraft-paper making. This oil is obtained from the mixture of water and turpentine vapour which is kept separated in a tank and later extracted from the upper layer of the water as this oil is lighter in density. It has yellowish colour , opaque and has a property of water unmissablitiy. It has no odour. These are flammable, combustible and volatile and has α-pinene 40% by weight in turpentine. So, due to its these properties it can be mixed with diesel at any proportion and can be used as a supplement of diesel[24]. The seeds of the sunflower produces the oil. Sunflower grows in the areas of US, Italy, Afghanistan, China, India, Egypt, Russia and Europe. The seeds of sunflower has black colour with thin hull covered with kernels. The oil content in them is about 38 to 50%. The PCSO(Preheated crude sunflower oil) has been tested for the combustion and emission against the diesel in a natural aspirated engine with indirect injection. The experiment showed that there was no change in the power production and the fuel consumption[24]. Isobutanol has especially gotten solid consideration due to its qualities as a potential fuel, such as moderately tall vitality substance, decreased combustibility and hygroscopicity, tall octane esteem, and compatibility with gasoline. Though isobutanol is created mechanically through carbonylation (consolidation of carbon monoxide into natural compounds) of propylene or hydrogenation of isobutyraldehyde utilizing an encased nonstop reactor, isobutanol is actually created in irrelevant sums by Saccharomyces cerevisiae as a corruption item of valine. The key issues

related with the bioproduction of isobutanol are accessibility of cheap substrates, meager accessibility of local makers, and isobutanol toxicity/inhibition of the creating microorganisms, coming about in a low isobutanol titer within the maturation broth [47].

2. Availability Analysis

The main point of this examination was to diminish the thickness of jatrophacurcas oil near to that of customary fuel to form it reasonable for utilize in a diesel motor and to assess the execution of the motor with the altered oils. Significant decrease in thickness was accomplished by weakening of vegetable oil with diesel in varying extent[4].This paper presents the exploratory outcomes about the jatropha methyl ester of botswana's semiarid climatic conditions. Physicochemical properties, execution and emanations properties of jatropha methyl ester and its mixes with petroleum diesel were examined tentatively. The comes about appeared that consistency values for all power fall inside the determinations of American standards test strategies(ASTM) with a most extreme variety of 21% watched between B0 and B100[5].In this work expolatory and hypothetical examinations were compass on a single barrel, coordinate injection diesel engine working on the diverse mixes of a soyabean methyl ester (SME) with diesel fuel. The impact of mixing on the barrel weight , warm discharge rate, carbon monoxide(CO), unburned hydrocarbon(UHC), nitrogen oxides(Nos), smoke murkiness were measured. the outcomes shows that the utilize of biodiesel make less smoke darkness upto 48.23% with 14.65% higher brake particular fuel consumption(BSFC) compared to diesel fuel[6]. The utilization of biodiesel will lead to loss in engine control fundamentally due to the reducing in warming regards of biodiesel contrast to diesel and it result inside the increase in biodiesel fuel utilization. The encourage advancement in generation of biodiesel ought to be performed within the future to advance biodiesel properties and quality. And the advance improvement in added substances which progress utilization of biodiesel ought to be required to support control recuperation, economy and emissions especially for NOx emanations[7].Seven zygomycetestempesegregrates were separator for ethanol generation at various at certain temperature like 40˚C, 45˚C, 50˚C. all the confines were able to construct ethanol at 40˚c with the yield of 0.39-0.47g/g on $C_6H_{12}O_6$& 3 separates were able to deliver ethanol at 45˚C with the yield of 0.22-0.26g/g on $C_6H_{12}O_6$ [8].An test plan is implemented to look at the relationships among the factors that influence the popularity abdicate from the microalgalbiomass.And it was seem that the alkali-acid-catalyzed transesterification driven to a better acclaim surrender than that acquire without catalyzed and as it were corrosive catalyzed transesterification[9].The investigation pointed to discover the ideal conditions within the copretreatment of OPF by utilizing the sulphuric corrosive and microwave, hydrogen peroxide and microwave pretreatment to progress enzymatic hydrolysis and to study aging of ethanol combination with the hydrolysis by concurrent saccharification and fermentation (SSF) in a clump[10].This study is aimed to assess the ideal extents of two shapes of feedstocks such as cassava roots and chips to minimize add upto fetched of 340,000 litre/day ethanol generation capacity by fathoming a direct programming issue[11].considering the require for interchange powers, the experimental examinations were carried out in the present work in arrange to run the existing diesel engines with biofuels (alcohols). From the outcomes that are obtained from this compared investigation, the diesel using the alcohol mixes decrease the contamination within the environment and it moreover moves forward engine's productivity[12].To progress the concentration of ethanol and hydrogen , the immobilized cell technique was connected. The result demonstrated that biofuel generation was expanded essentially by immobilized cell procedure. In this consider, pineapple peel was demonstrated as one of the novel and potential raw material for biofuel generation. In any case the optimization of substrate concentration and other environmental conditions will need for an mechanical appeal[13].The main objective of this survey The aim to this survey is to highlight the diminishment of toxins such as (CO), (UHC), particulate matter(PM) and impact of greasy corrosive configuration on performance and outflows characteristics. The different outcomes appears shows that the diverse chemical of

biodiesel lead to the variety in performance and emission characteristics based on their source of production[14].This experiment highlight the impact of mixing isopropyl liquor (IPA) and diesel fuel with customary diesel. It can be come to an end that the tried isopropyl alcohol-diesel fuel mixes displayed comparative characteristics value contrast to those of standard fuel [15]. Biodiesel mix determined from jatropha oil is suited for utilize in diesel motors given that its kinematic consistency, streak point, cloud point, and cetane number accommodate to the recommended international benchmarks. mixing of diesel with proportion up to 50% jatropha can be applicably utilized [16]. The objective of this research is the definition and approval of a union prepare for change of glycerol in an oxygenated fuel added substance (glycerol alkyl-ether)fitting for mixing with diesel and biodiesel[17].The study focus on the optimal analysis of supercritical transesterification response with squander canola oil to look at the impacts of prepare factor like as reaction time, response temperature, and weight proportion of methanol to oil on the biodiesel abdicate[18]. On the basis of the outcomes of the diesel engine with cottonseed biodiesel mixes as contrast to base diesel. Cottonseed biodiesel can be utilized in mixed frame as an elective fuel in any diesel engine without any alteration[19].Appropriately, a unused worldview is required for the plan of maintainable biofuel forms supply chains, and is unexpected on collaboration over investigate spaces and evaluation of potential impacts over diverse spatial and transient scales . This work examined a novel measured multiscale and multiobjective system for analyzing developing biofuel supply chain[20].Biodiesel mixes with such parameter with RBME, NME, and CSME were contrast with ND in terms of combustion, emanation, and execution properties in fuelling a four stroke single-cylinder actually aspirated direct-injection CI motor at 1500rpm[21].The point of this consideration is to assess the execution emanations of tall extent of methanol and propanol(20% by volume)in a B30 mix routine diesel when working on a direct infusion diesel engine. It was concluded that NOx emanations diminished up to 32.4% and 27.9% for B30M10P10 and B30M15P5, separately at 2000rpm in comparison with biodiesel[22].The reason of this enquire about was to explore the impacts of water concentration in a biodiesel nanoemulsion fuel on motor execution and debilitate emanations of a fourcylinder CI motor. The outcomes about the given solid confirmations on the impact of expanding water concentration in biodiesel emulsions on lessening NOx and sediments from a Four-cylinder CI engine[23].Investigation the different blend of diesel oil such as ethanol, methanol, biodiesel and diesel at different percentage in compression ignited engine. BMD and BED shows same baseline result and on increasing alcohol quantities, new parameter obtain in performance and emission .CH_4 has much effective than C_2H_6 [90].Analyzing the blend of Karanja with diesel in four stroke multi fuel single cylinder CI engines and compare their output result with standard fuel. The investigation takes in diverse compression ratio for their brake thermal efficiency, HC and pressure combustion and at last B25 give better outcome than other mixtures[28].Comparing the properties of various blend of biodiesel high ethanol and diesel in multi cylinder compression ignited engine to evaluate the brake thermal efficiency, toxic gases and combustion characteristic and outcome show that timing of injection fuel is to be doubled for different mixture as measure with standard one.at high stress advanced effective result is seen form this blends in unique point[31].Analyzing the properties of various blend biodiesel mix with nanomaterial in diesel engine. The outcome show maximize the percentage of BTE and decreasing the harmful gases at different aspects. changes of various bmep in this mixture show diverse parameter in their graphs[27].Checking the impact of the blend in diesel engine using palm and jatropha as major source. As testing the properties of fluid , both mixture have reduce the emission of HC and CO but hike in NOx emission due to high viscosity in jatropha as contrast to the palm mixture[26]. Investigation the property of biodiesel in various aspect like exhaust and efficiency. Now world is more focusing on easy available energy and biofuel with different integrant are the good option for economically and availability. various types of fuel is use such as edible and nonedible oil with pure diesel. The outcome are different as per mixing percentage[24]. the property of biodiesel that effect the efficiency and exhaust activity of engine. the testing is done on single cylinder CI setup and the outcome shows

characteristic of bio diesel is differ in certain parameter of petrol and diesel and it slow down the effect of toxic gases and enhance the efficiency at diverse stage of percentage mixture[25].Analysis the impact of blend at different compression ratio in engine .compression proportion grow as increasing the torque in engine and reduce in all bsfc. As ratio enlarge form 14to 18 there is impact on emission i.e carbon dioxide , NOx is high , hydrocarbon, carbon monoxide is low at certain level. A little tall viscosity and short volatility of biodiesel see detain in ignition. At conclude, up to mixture of 20% fuel there is no effect in efficiency and exhaust. Property of engine like bth increase as change the ratio of mixture[45] . The methyl ester of diverse oil like palm, rice bran and pongamiaas main resource of relative evaluation of bio gas worked on dual based fuel system engine. At investigation bth of RBME gas introduce high in various ratio and as contrast between the exhaust with RBME other two have little high emission characteristics like CO and low NOx [36]. Analysis the property of pine oil like efficiency and exhaust in diesel engine. As consider for investigation various property is contrast between with oil like viscosity, calorific value etc and mix with diverse solution at particular % at result exhaust capability is low such as carbon monoxide and HC and high the nitro oxide with difference between normal diesel fuel. All the parameter consider for the analysis such as bhp, boiling point and flash point [35].

Study the property of compression ignition engine exhaust at different parameter of blend are consider such as diesel, ethanol and biodiesel at the main role for concentration of ethanol. Experiment work is performed with mixing ethanol at blend of biodiesel diesel and output of mixing maximum and minimum different % of concentration ethanol. output shows that exhaust depend on fuel blend as well as engine operating system [33]. Study the property of combustion and exhaust at various blend of fuel like diesel ethanol and biodiesel in the four cylinder CI engine. Analysis of diverse blend of fuel at various % and variety of effect is show in engine and fuel property. As the outcome of this experiment is max heat remove and in cylinder pressure is maximum in DBE with contrasting ULSD at the blend of fuel. Emission property like NOx is minimize with DBE blend [32]. Analysis the property of efficiency exhaust and combustion at diverse blend of diesel ethanol biodiesel in multi cylinder direct ignition diesel engine at high level ethanol. The preparation of blend is consider on high oxygen level, viscosity density etc. the outcome of this experiment is injection timing is twice NO exhaust and high in cylinder pressure. Minimized the smoke NO exhaust and carbon monoxide minimum at high load at various blend [34]. Analysis the property of combustion and exhaust of biodiesel biogas in twin nature fuel firing in compression ignition engine. To study the property various combustion is formed like diesel and biodiesel, biogas biodiesel and biogas diesel. for firing pressure and rate of heat release is consider to analysis the burning ability and emission. The outcome of this investigation is delay in ignition in twin fuel more useful than single one mechanism this is due to reduce of charge temperature for mixture of gas air. The firing ability of both the single or double is same in their property [30].

3. Problem Statement

Sooner or later diesel fuel will vanish. India is bringing in increasingly of the crude oil it needs. The reality also is that increasingly of the imported and costly fuel is being utilized to drive vehicles commercial and individual. India's vitality security must be caught on and pondered in these terms. By

2006, the nation was expending 120 million tons of crude oil, but delivered as it were 34 million tons locally. The issue is that household generation has more or less stagnated, but utilization is spiraling. In this manner, we moment more. Any increment within the worldwide cost of unrefined hits India severely. A amazing share of open cash goes into buying unrefined oil. On the other hand Biodiesel is progressively esteemed for its ecologically neighborly properties which can help meet the challenges coming about from discuss, water and soil contamination due to the proceeded utilize of the fossil fuels. As compared to the current state, we need improvement in diesel properties such as performance and emission characteristics so that it can sustain last long,

this will only achieve, when we will blend the diesel fuel with varying biodiesels.

The following points of biodiesel oils come up with their attraction as alternative fuels:

- It can elemenate the environmental effect up to some instinct.
- The blending of biodiesel with diesel altogether decreases the outflow of particulate matter since the mixed biofuel contains oxygen.
- Biodiesel raises the cetane number of the fuel and moves forward fuel lubricity. The next cetane number implies the motor is less demanding to begin and diminishes start delay.
- Due to the high consumption of diesel in automobile sector and as diesel is a non renewable resource of energy, sooner or later it will deplete one day, so through blending this diesel with bio fuels and alcohols will increases the quantity and consumption life of diesel.

4. Objective

- The Preparation of bio oil from castor seed.
- Preparation of varying blend of castor oil, isopropanol or diesel.
- Determine the physical characteristics.
- Determine the performance characteristics of proposed blends.
- Determine the emission characteristics of proposed blend.

5. Material And Methods

5.1.Synthesis of Material

The several methods used to transform the seed oil into biodiesel are as Pyrolysis-involves crushing, Dilution- involves blending,pre heating, thermal cracking, Micro emulsification & Transesterification. **Transesterification process**: [46-50] The widely common procedure for formation of biodiesel is transesterification. It is the first step use to interchange the oil into other form of fuel that can be use in CI engine, the organic reaction in which the conversion of alcohol group R into ester group of R'. the catalyst used in this process is NaOH and KOH[24].this mechanism also decrease the weight of the oil to its original value at ratio of 1/3.it grow the volatility and cetane number and decrease the viscosity at certain level compairing to ideal fuel[29]. **Double transesterification**:- A dual step process used to change the oil to its methyl ester.Due to high fatty acid amount of oil this process is used which cause the formation of saop i.e fatty acid salt at base catalysed .Glycerin fraction pocess is used to prevention of soap separating the methyl ester. The primary procedure for removal of free fatty acid by pretreatment and esterification. This procedure involves the basic catalyst for complete transformation[46]. **Alkyl Transesterification**:- The Carbonyl carbon of the starting ester (RCOOR1) undergoes nucleophilic attack by the incoming alkoxide (R^2O^-) to give a tetrahedral intermediate, which either reverts to the starting material, or proceeds to the trans-esterified product ($RCOOR^2$).The transesterification process is carried out by blending Castor oil with Methanol in a molar ratio of 6:1 (i.e. 30ml of Methanol is added to the 100ml of Castor oil). In transesterification process, molar ratio play a vital role in carried out reaction and most recommended ratio for ethanol and methanol is 9:1and 6:1.[43] Also 3% by volume, KOH is added to the Castor oil to catalyze the reaction. This reaction is to be carried out by maintaining the oil temperature at 60°C through a magnetic stirrer. Then the mixture is kept still for few hours to get the Biofuel and glycerin separated.

Alcohol+ Ester ⟶ Different alcohol + Different Ester

5.2.Material Properties

Table Number 6.1: Properties of oil as per past literature with past bio fuel extraction technique (i.e. extraction of bio fuel with seed crushing technique

s.no	Parameters/properties of solo biofuel	properties of solo biofuel						
		Diesel	Jatropha	Castor	Seasame	Pongamia	Mohua	palm
1	clarific value (MJ/KG)	44	40	37.2	39	34.38.5	39.4–	39.8
							39.9	
2	flash point (degree celcius)	69	180	228	280	205270	208	167.3
3	fire point (degree celcius)	69	270	265	205	150	~	~
4	cloud point (degree celcius)	−15 to 5	0~5	-18	-3	1~3	3–5	23
5	pour point (degree celcius)	-6	7	-30	-4	6	1–6	12
6	solidifying point (degree celcius)	-14	2	-13	-6	1	~	~
7	density (gm/m3)	0.83	0.8692	0.9621	0.9066	0.924	0.904	0.879
8	kinematic viscosity (40 degree celcius)	2.42	48.095	231.22	34.087	27.84-38.2	~	41.9
9	cetane number	51	53.5	58	52	51	51–52	52
10	sulphur(%)	0.85	0.13	0	0	0.12	~	1
11	oxygen%	1.19	11.06	~	~	41	~	185
12	carbon(%)	86.83	~	~	~	~	~	~
13	Reference	[44],[40]	[42],[41],[40]	[44],[37]	[41,[39]	[38],[43]	[40]	[40],[42]

7.Engine Testing Setup Specification

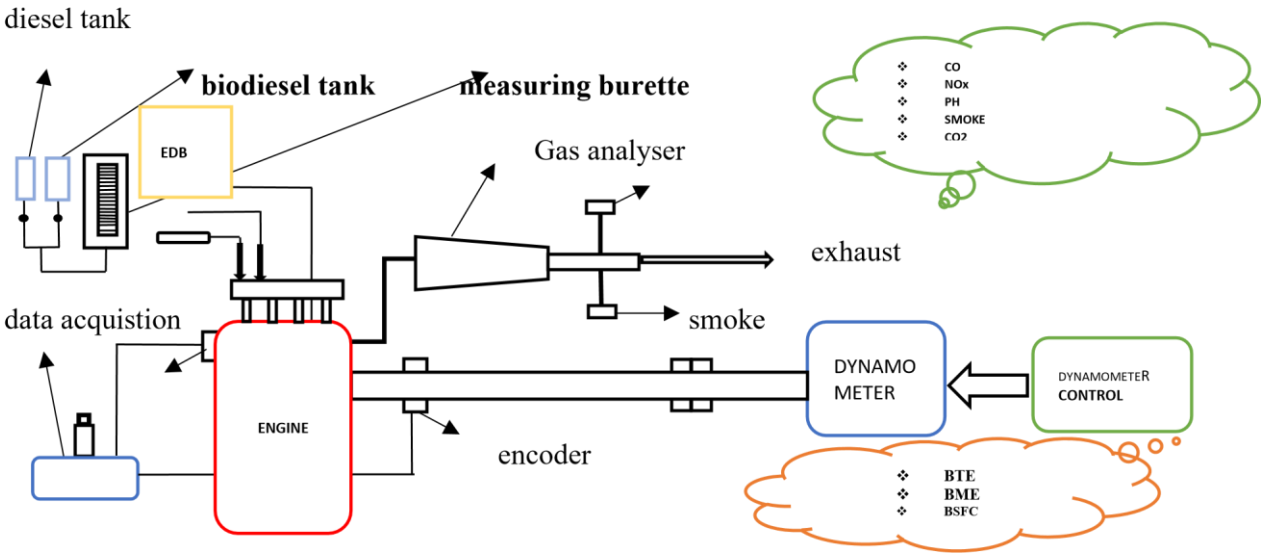

Figure Number 6.1: Experimental Setup

6. Proposed Fuel Properties:

Various physio and chemical characteristics of diesel and blends of (castor biodiesel-isopropanol diesel) were tested and the following data was recorded. Most of the fuel properties were similar to those of diesel. The outcome shows that Transesterificaton process improved the fuel characteristics of the castor oil with respect to density, calorific value, viscosity, flash point, fire point etc. The contrast of all these properties with diesel shows that the blend so prepared by mixing castor biodieselisopropanol-diesel have closer fuel property values to that of diesel.The blends CPD1 and CPD2 were found most appropriate as compared with diesel with respect to various properties, hence can directly be used without any hardware modification in existing diesel engines.

More complex tables. The following is a slightly more complex table with a caption that is narrower than the table. Centre the caption across the width of the table. If it is difficult to make a table fit the page, use a smaller font. Headings should normally be in Roman (i.e., not bold or italic) type, have an initial capital and normally align left (but centred sometimes looks better); it is up to the author to choose a layout that is most useful to the reader. Columns of numbers normally align on the decimal point.

Table Number 8.1: Chemical and physio charactersitics of variety blends of (castor biodiesel – isopropanol-diesel).

Property	Diesel	Iso-propanol	Castor oil	Castor Biodiesel	CPD 1	CPD2	CPD3	CPD4	CPD5
Density (Kg/L)	0.832	0.786	0.95	0.85	0.8126	0.8203	0.8190	0.8199	0.8158
Flash point (°C)	52	11.7	150	80	38	30	28	25	24

Fire point (°C)	60	14	165	88	48	38	35	32	30
Specific Gravity	0.823	0.778	0.945	0.865	0.8136	0.8223	0.810	0.811	0.8178
Kinematic viscosity (centistokes)	3.36	2.54	4.04	3.29	2.823	4.388	5.22	5.25	5.28
Dynamic Viscosity (Poise)	0.0288	0.0196	0.0388	0.0289	0.02294	0.03608	0.04276	0.1374	0.0428
Calorific value (KJ/Kg)	45000		38158.172		42138.653	39750.343	36964.008	34774.73	31988.353

7. Result and Discussion:

7.1 Performance characteristics:

The above graphs shows the performance between BTE (Break Thermal Efficiency) and engine load at CR (Compression Ratio) 16, 17 and 18. The performance of BTE against engine load is tested at blends BGCIPD-4 and BGIPD-4 for different compression ratio. It has been acknowledge that the blend BGCIPD-4 shows better performance at compression ratio 18 with 100% engine load. Biogas, castor, isopropanol and diesel mixture gives better result than others and diesel at 1.2kg/h. As the diesel % decreases and blend mixture increases, performance increases marginally.

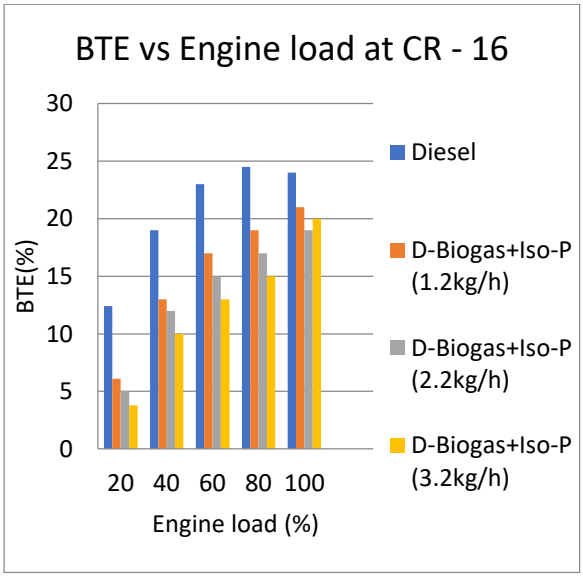

Figure Number 4.1.1(a): Graphical representation between brake thermal efficiency(BTE) and engine load with CR-16 for composition of blend BGIPD-4

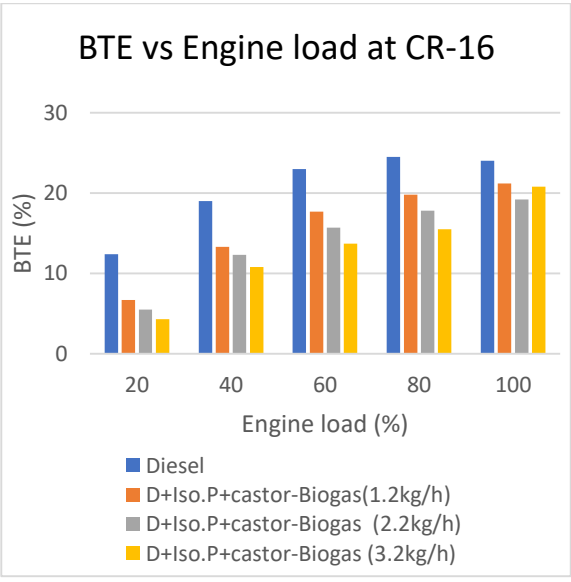

Figure Number 4.1.1(b): Graphical representation between brake thermal efficiency(BTE) and engine load with CR-16 for composition of blend BGCIPD-4

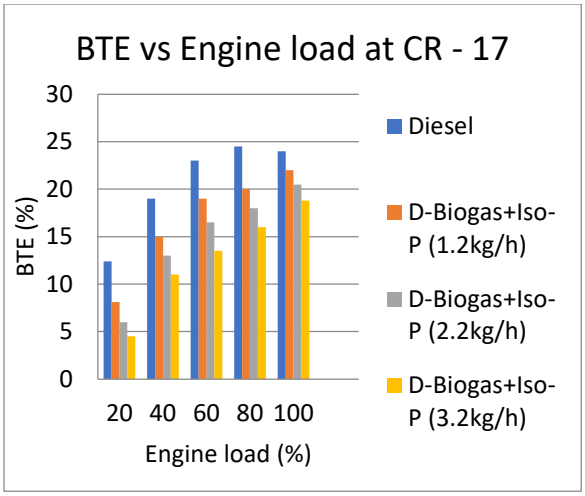

Figure Number 4.1.2(a): Graphical representation between brake thermal efficiency(BTE) and engine load with CR-17 for composition of blend BGIPD-4

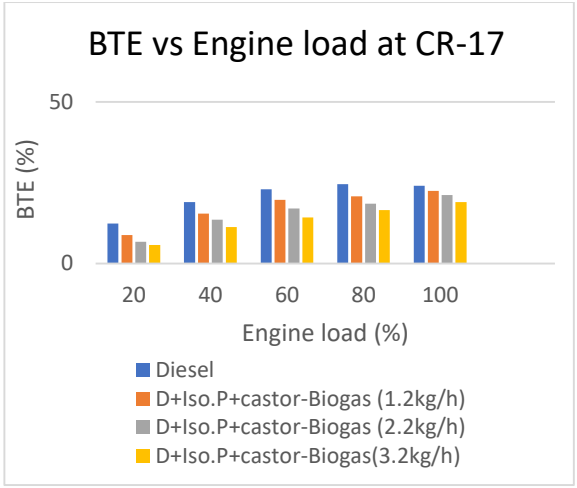

Figure Number 4.1.2(b): Graphical representation between brake thermal efficiency(BTE) and engine load with CR-17 for composition of blend BGCIPD-4

The above graphs shows the performance between BSFC (Break Specific Fuel Consumption) and engine load at CR (Compression Ratio) 16, 17 and 18. The performance of BSFC against engine load is tested at blends BGCIPD-4 and BGIPD-4 for different compression ratio. It has been acknowledge that the blend BGCIPD-4 shows better performance at compression ratio 18 with 40% engine load. Biogas, castor, isopropanol and diesel mixture gives better result than others and diesel at 3.2kg/h. As the diesel % decreases with and increment of bio-fuel mixture, performance increases marginally.

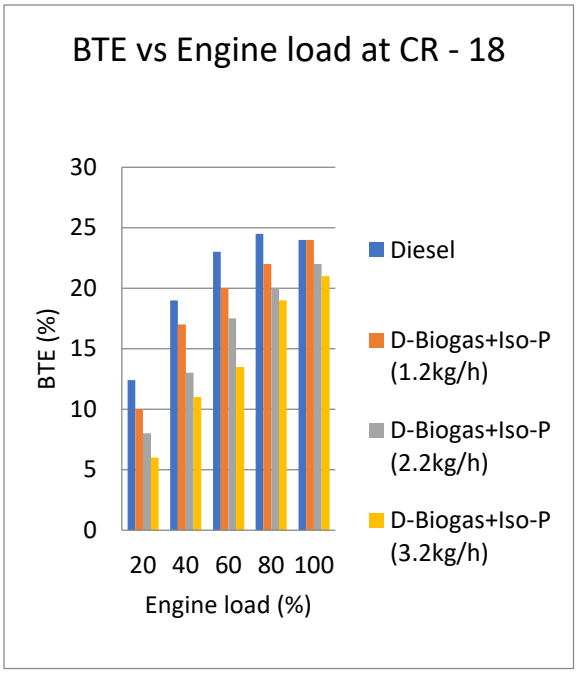

Figure Number 4.1.3(a): Graphical representation between brake thermal efficiency(BTE) and engine load with CR-18 for composition of blend BGIPD-4

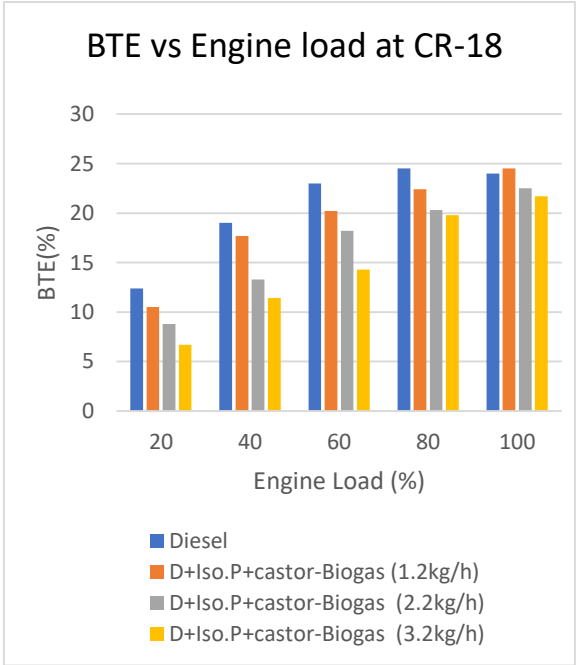

Figure Number 4.1.3(b): Graphical representation between brake thermal efficiency(BTE) and engine load with CR-18 for composition of blend BGCIPD-4

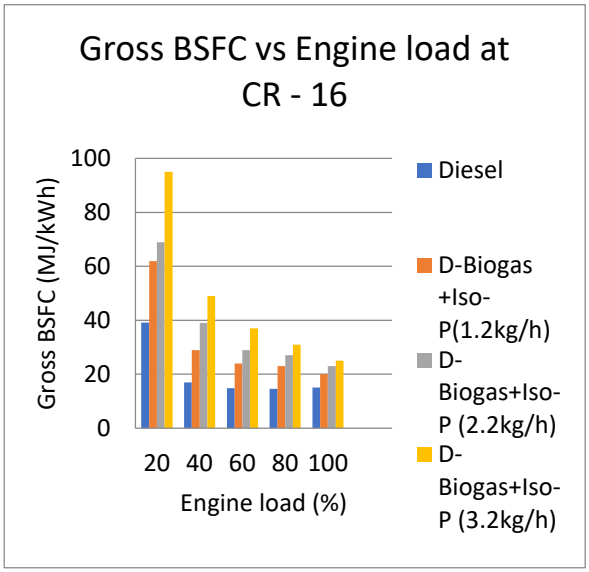

Figure Number 4.1.4(a): Graphical representation between brake specific fuel consumption(BSFC) and engine load with CR-16 for composition of blend BGIPD-4

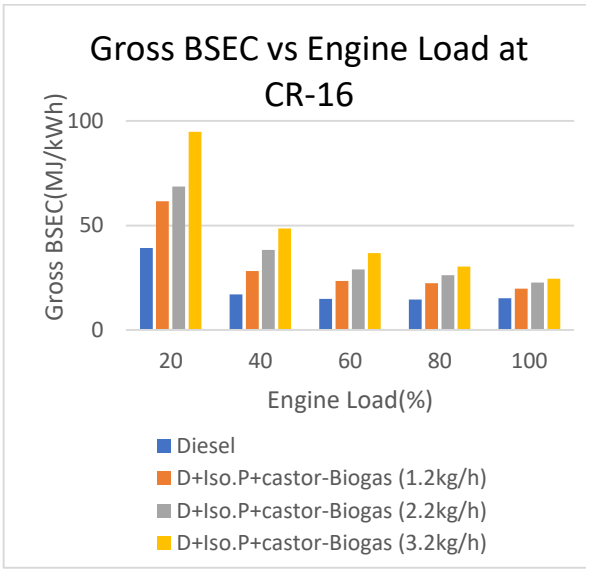

Figure Number 4.1.4(b): Graphical representation between brake specific fuel consumption(BSFC) and engine load with CR-16 for composition of blend BGCIPD-4

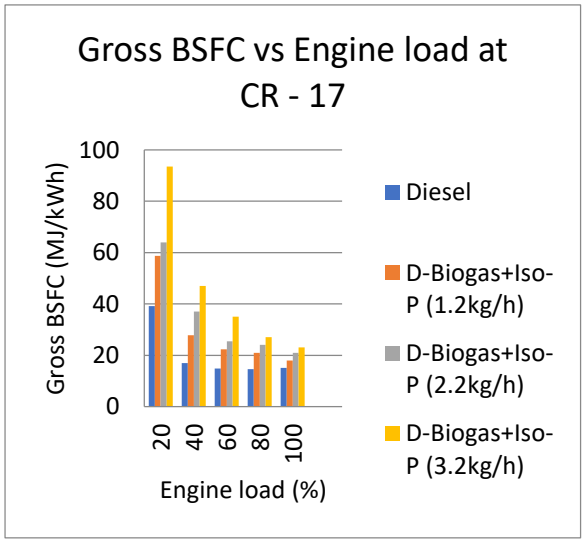

Figure Number 4.1.5(a): Graphical representation between brake specific fuel consumption(BSFC) and engine load with CR-16 for composition of blend BGIPD-4

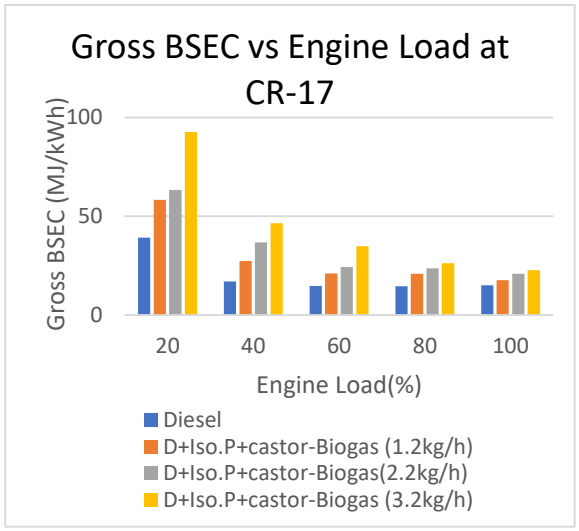

Figure Number 4.1.5(b): Graphical representation between brake specific fuel consumption(BSFC) and engine load with CR-17 for composition of blend BGCIPD-4

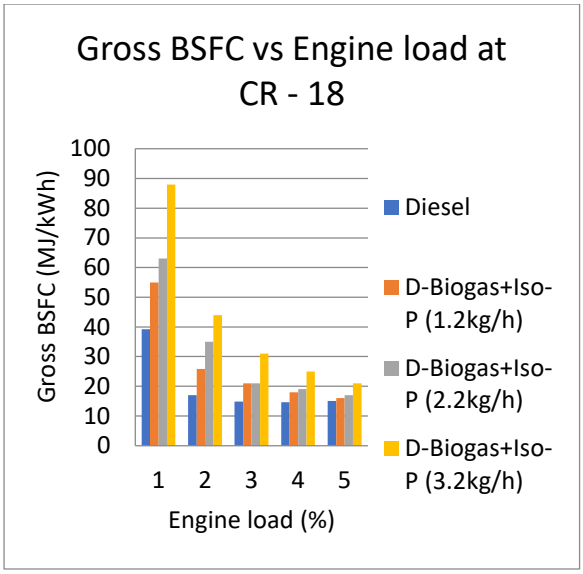

Figure Number 4.1.6(a): Graphical representation between brake specific fuel consumption(BSFC) and engine load with CR-18 for composition of blend BGIPD-4

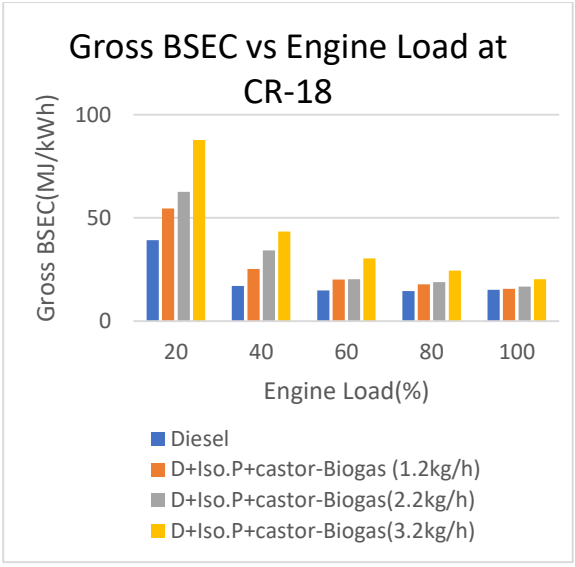

Figure Number 4.1.6(b): Graphical representation between brake specific fuel consumption(BSFC) and engine load with CR-18 for composition of blend BGCIPD-4

7.2 Emission characteristics:

The above graphs shows the emission properties between NOx (Nitrous Oxide) and engine load at CR (Compression Ratio) 16, 17 and 18. The emission of NOx against engine load is tested at blends BGCIPD-4 and BGIPD-4 for different compression ratio. It has been acknowledge that the blend BGCIPD-4 shows better emission at compression ratio 18 with 100% engine load. Biogas, castor, isopropanol and diesel mixture gives better result than others and diesel at 3.2kg/h. The above graphs shows the emission between HC (Hydro Carbon) and engine load at CR (Compression Ratio) 16, 17 and 18. The emission property of HC against engine load is tested at blends BGCIPD-4 and BGIPD-4 for different compression ratio. It has been acknowledge that the blend BGCIPD-4 shows better emission properties at compression ratio 18 with 100% engine load. Biogas, castor, isopropanol and diesel mixture gives better result than others and diesel at 2.2kg/h.

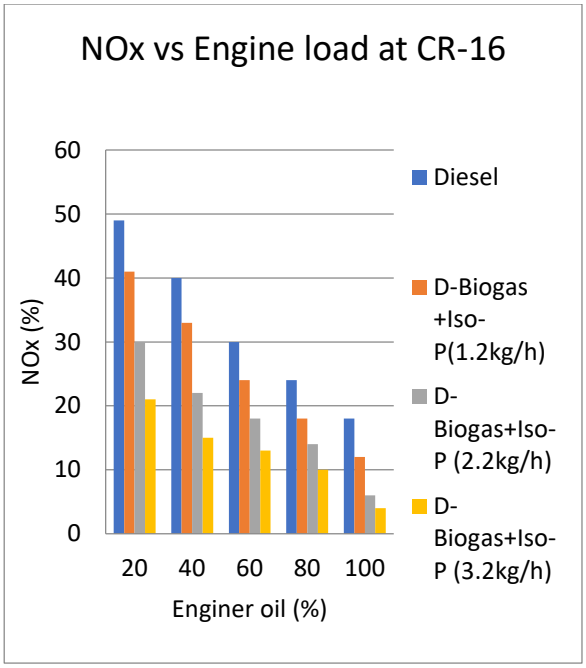

Figure Number 4.2.1(a):): Graphical representation between NOx and engine load with CR-16 for composition of blend BGIPD-4

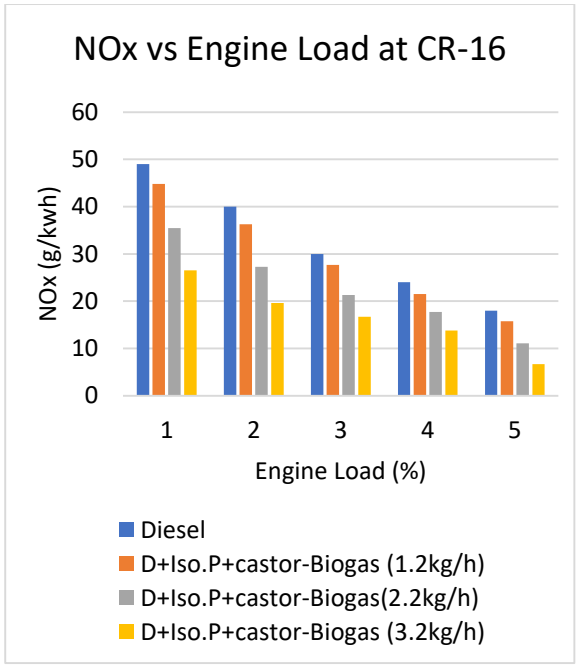

Figure Number 4.2.1(b):): Graphical representation between NOx and engine load with CR-16 for composition of blend BGCIPD-4

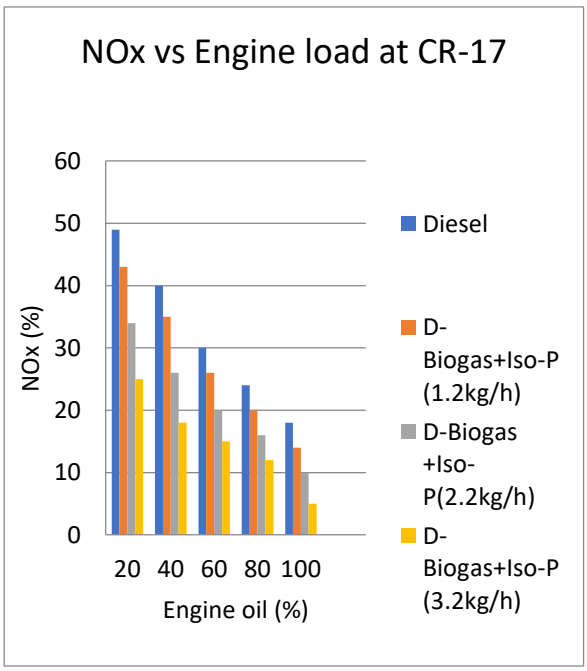

Figure Number 4.2.2(a): Graphical representation between NOx and engine load with CR-17 for composition of blend BGIPD-4

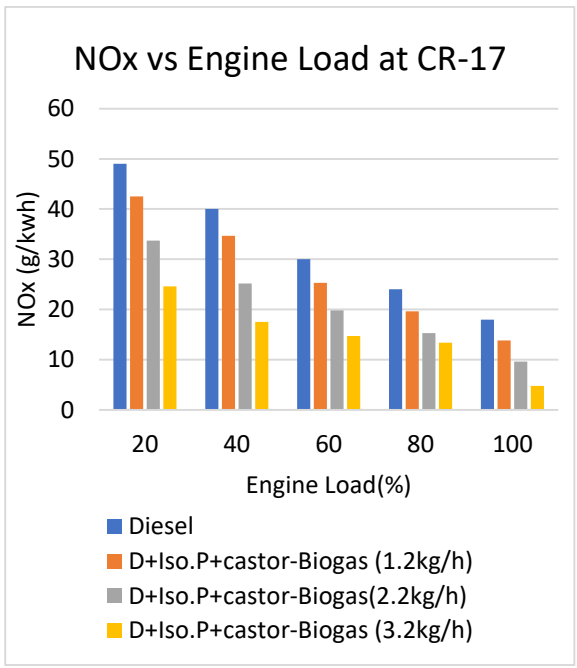

Figure Number 4.2.2(b): Graphical representation between NOx and engine load with CR-17 for composition of blend BGCIPD-4

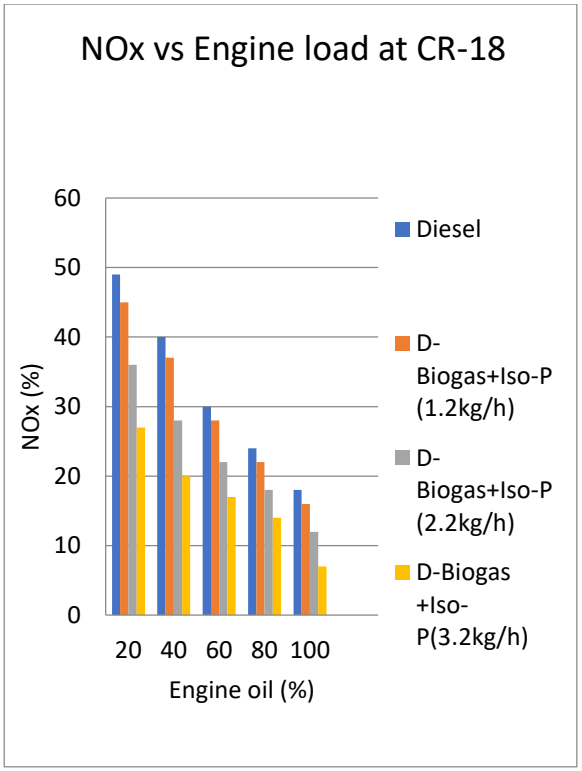

Figure Number 4.2.3(a): Graphical representation between NOx and engine load with CR-18 for composition of blend BGIPD-4

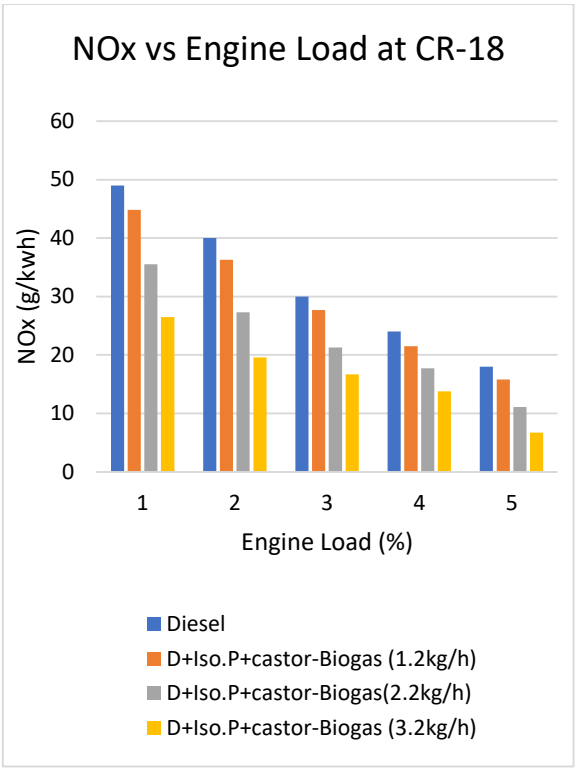

Figure Number 4.2.3(b): Graphical representation between NOx and engine load with CR-18 for composition of blend BGCIPD-4

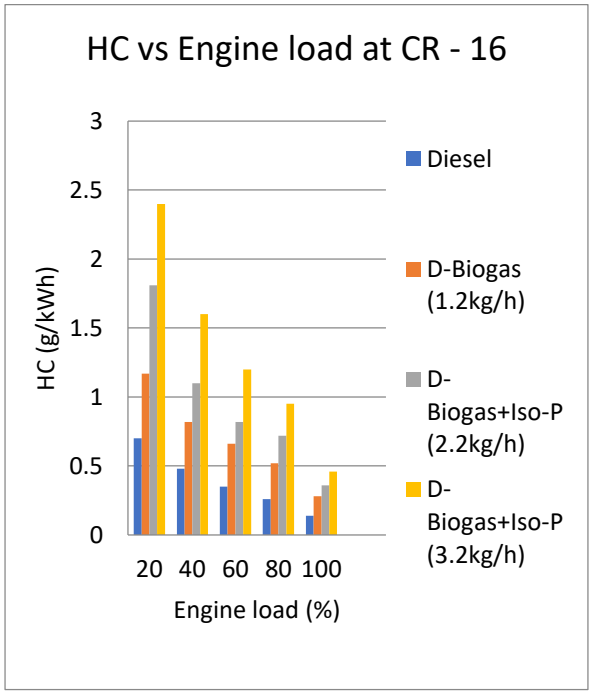

Figure Number 4.2.4(a): Graphical representation between HC and engine load with CR-16 for composition of blend BGIPD-4

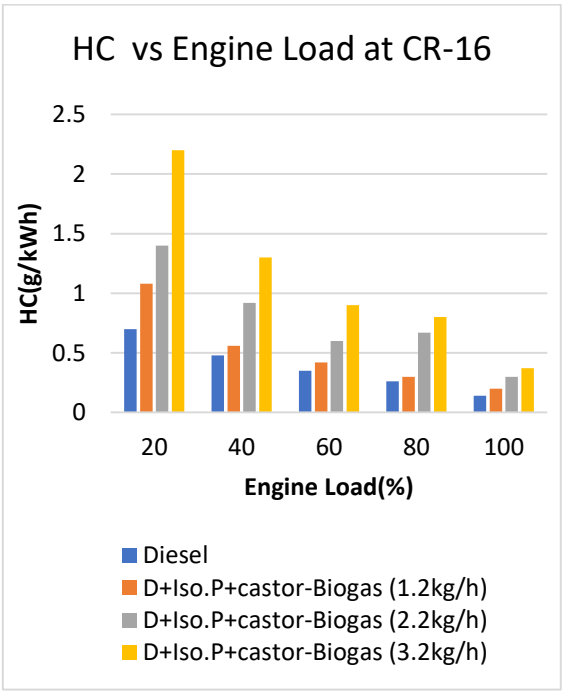

Figure Number 4.2.4(b): Graphical representation between HC and engine load with CR-16 for composition of blend BGCIPD-4

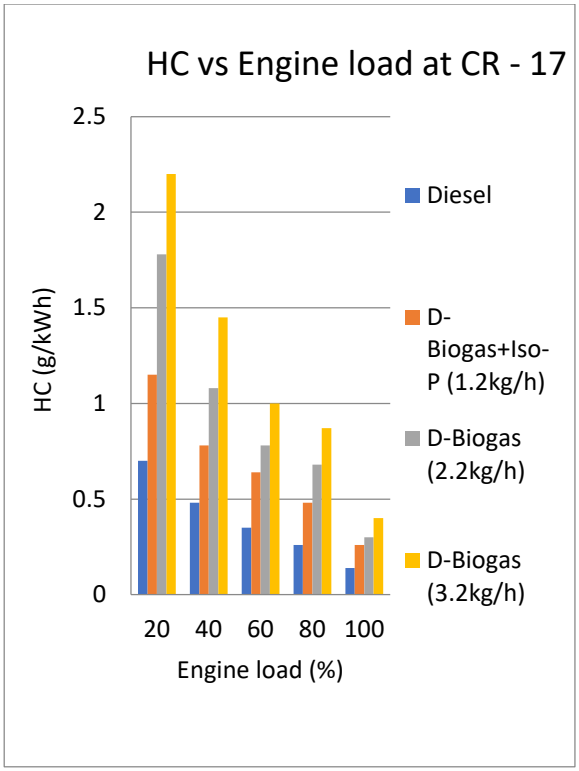

Figure Number 4.2.5(a): Graphical representation between HC and engine load with CR-17 for composition of blend BGIPD-4

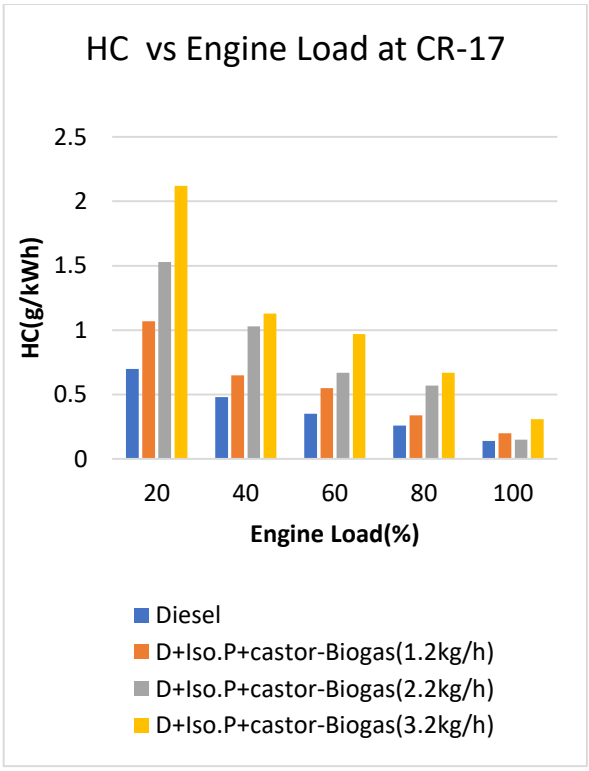

Figure Number 4.2.5(b): Graphical representation between HC and engine load with CR-17 for composition of blend BGCIPD-4

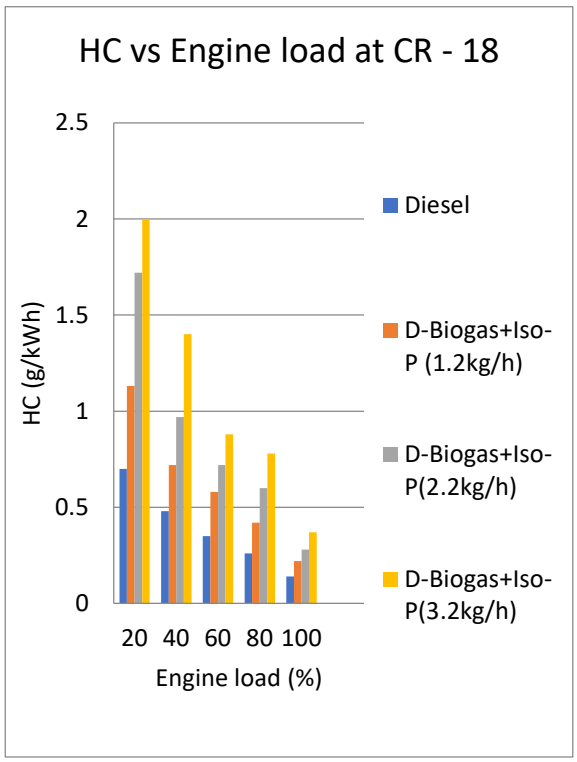

Figure Number 4.2.6(a): Graphical representation between HC and engine load with CR-18 for composition of blend BGIPD-4

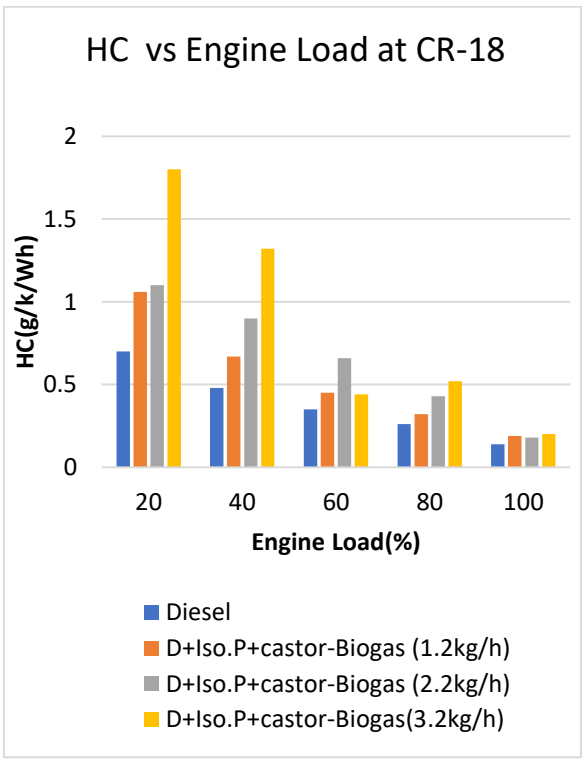

Figure Number 4.2.6(b): Graphical representation between HC and engine load with CR-18 for composition of blend BGCIPD-4

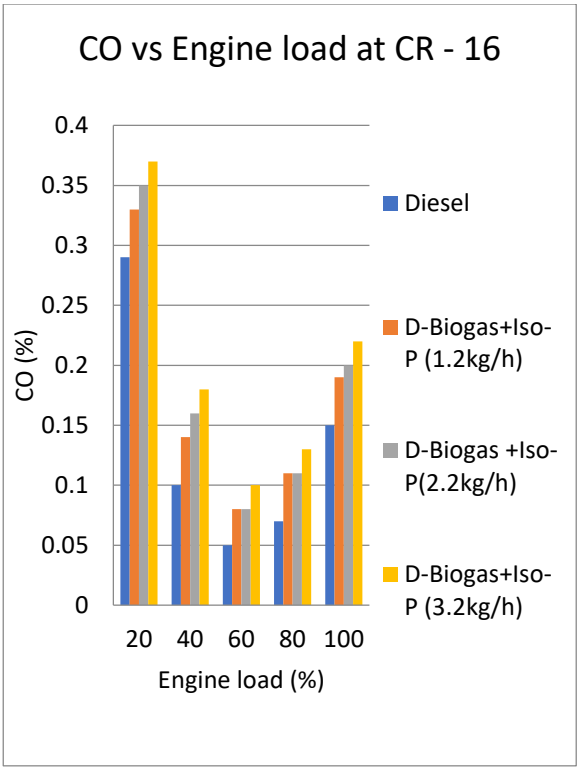

Figure Number 4.2.7(a): Graphical representation between CO and engine load with CR-16 for composition of blend BGIPD-4

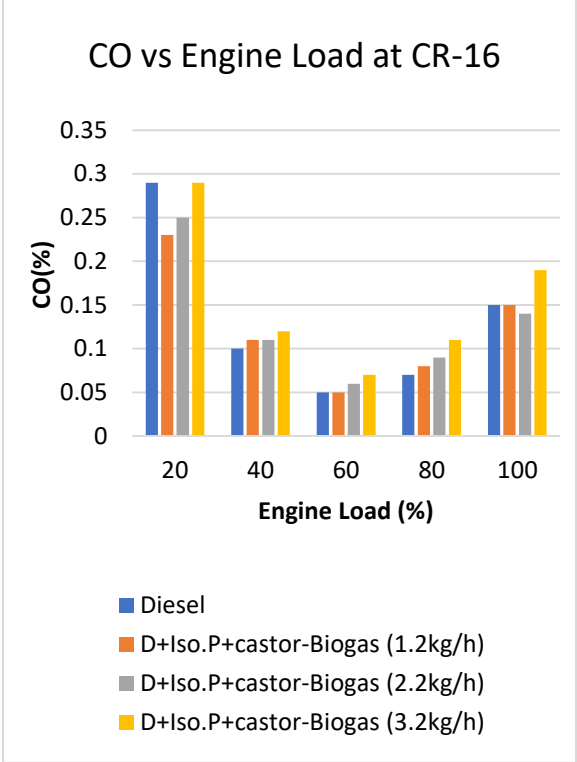

Figure Number 4.2.7(b): Graphical representation between CO and engine load with CR-16 for composition of blend BGCIPD-4

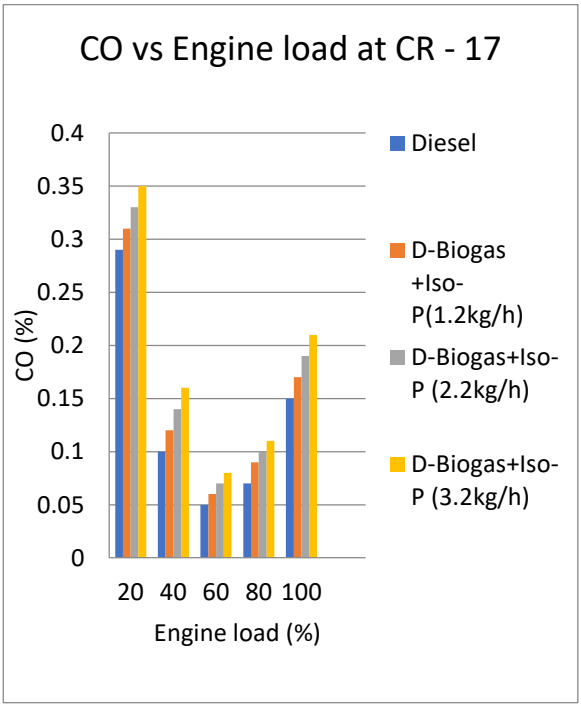

Figure Number 4.2.8(a): Graphical representation between CO and engine load with CR-17 for composition of blend BGIPD-4

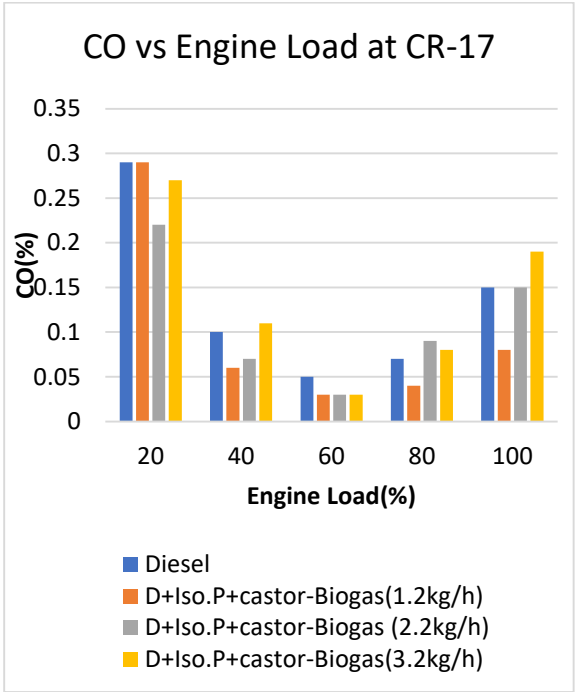

Figure Number 4.2.8(b): Graphical representation between CO and engine load with CR-17 for composition of blend BGCIPD-4

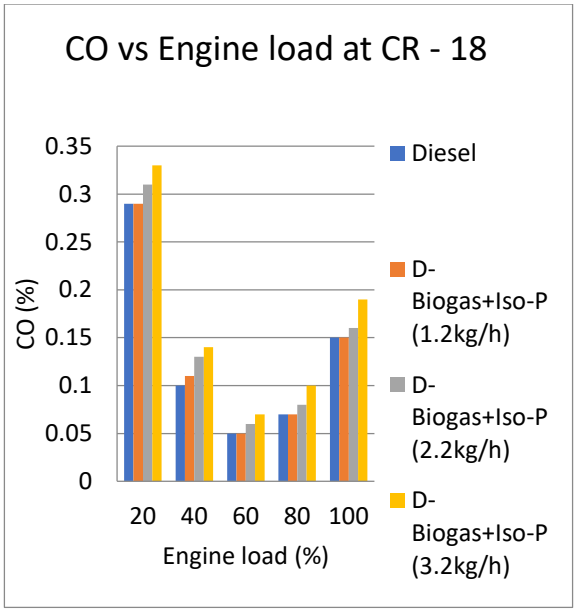

Figure Number 4.2.9(a): Graphical representation between CO and engine load with CR-18 for composition of blend BGIPD-4

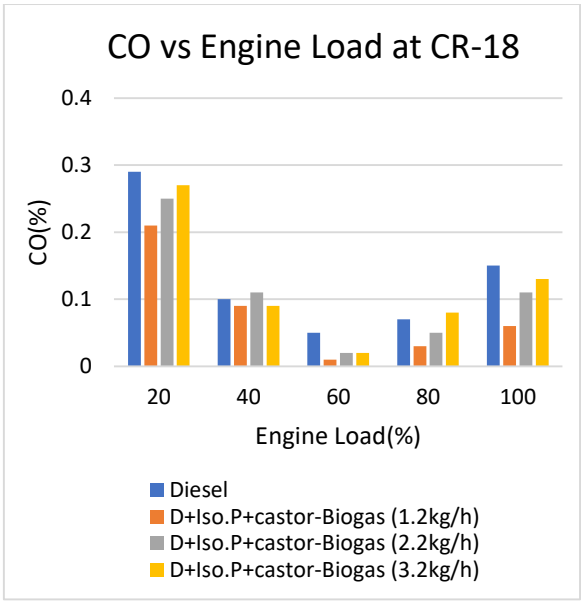

Figure Number 4.2.9(b): Graphical representation between CO and engine load with CR-18 for composition of blend BGCIPD-4

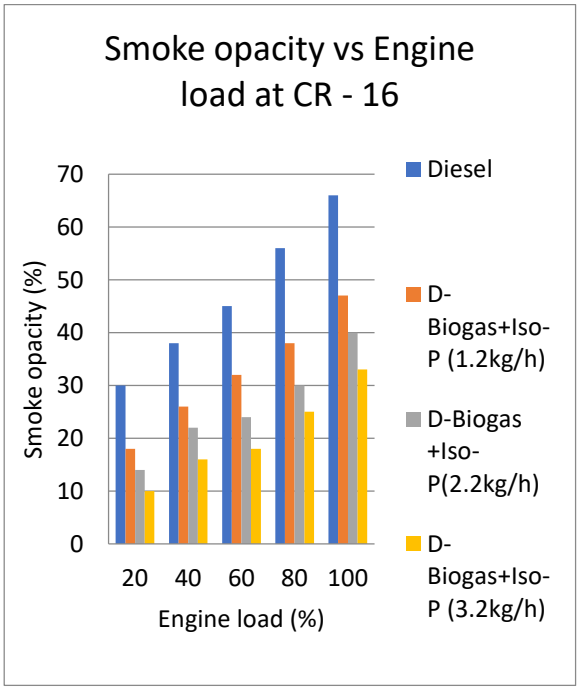

Figure Number 4.2.10(a): Graphical representation between Smoke Opacity and engine load with CR-16 for composition of blend BGIPD-4

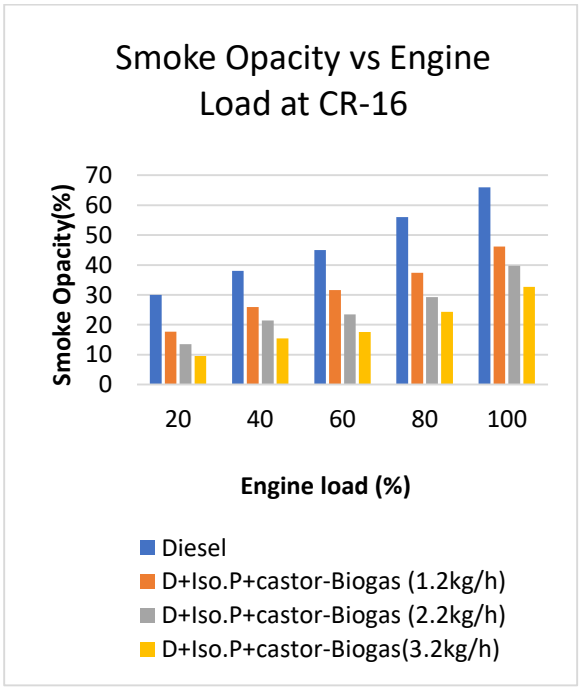

Figure Number 4.2.10(b): Graphical representation between Smoke Opacity and engine load with CR-16 for composition of blend BGCIPD-4

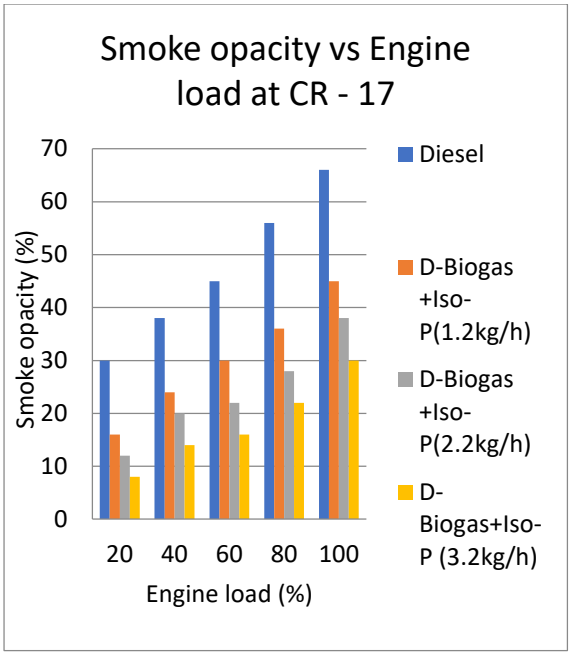

Figure Number 4.2.11(a): Graphical representation between Smoke Opacity and engine load with CR-17 for composition of blend BGIPD-4

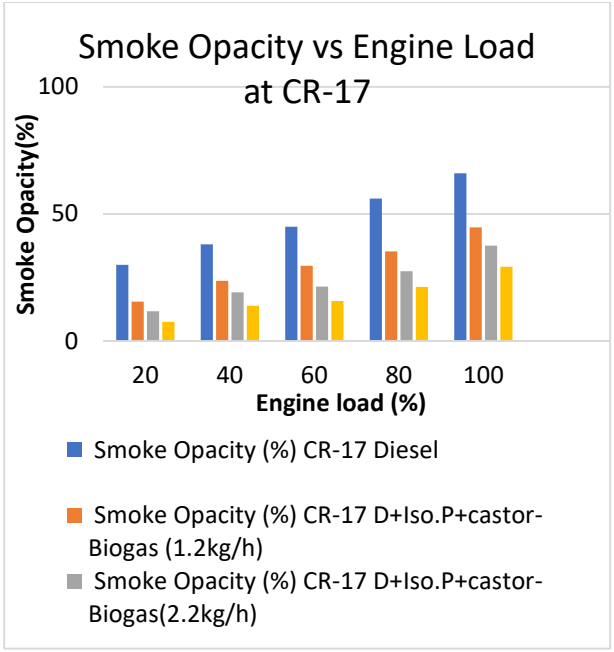

Figure Number 4.2.11(a): Graphical representation between Smoke Opacity and engine load with CR-17 for composition of blend BGCIPD-4

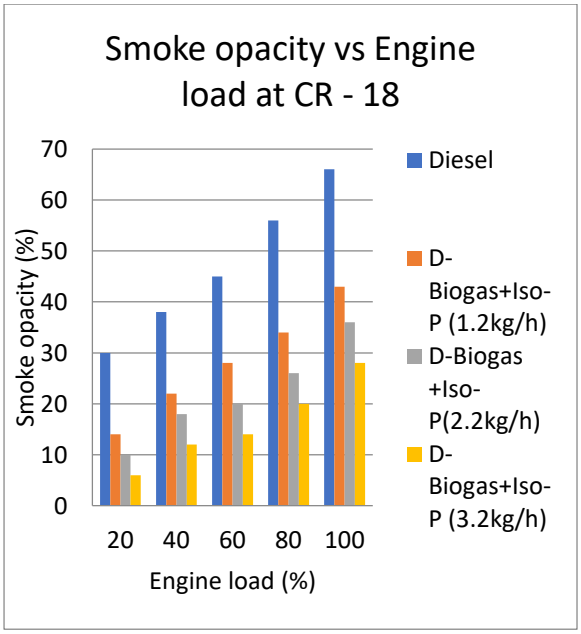

Figure Number 4.2.12(a): Graphical representation between Smoke Opacity and engine load with CR-18 for composition of blend BGIPD-4

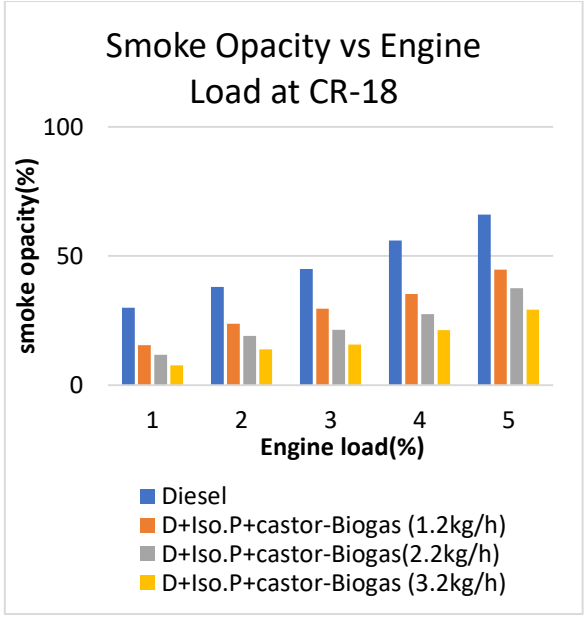

Figure Number 4.2.12(b): Graphical representation between Smoke Opacity and engine load with CR-18 for composition of blend BGCIPD-4

The above graph shows the emission property between CO (Carbon Monoxide) and engine load at CR (Compression Ratio) 16, 17 and 18. The emission property of CO against engine load is tested at blends BGCIPD-4 and BGIPD-4 for different compression ratio. It has been acknowledge that the blend BGCIPD-4 shows better emission property at compression ratio 18 with 60% engine load. Biogas, castor, isopropanol and diesel mixture gives better result than others and diesel at 3.2kg/h. As the emission property achieved better due to higher mixture % of bio-fuel in the proposed blends. The above graph shows the emission property between Smoke Opacity and engine load at CR (Compression Ratio) 16, 17 and 18. The emission property of smoke against engine load is tested at blends BGCIPD-4 and BGIPD-4 for different compression ratio. It has been acknowledge that the blend BGCIPD-4 shows better emission property at compression ratio 18 with 20% engine load. Biogas, castor, isopropanol and diesel blends give better result than other blends and diesel at 3.2kg/h.

8. Conclusion

It is analysed from the composition that blend BGIPD and BGCIPD showing better results in terms of performance, emission, physical parameter and chemical parameter than convectional Diesel. It is also observed that among both compositions BGCIPD shows better result than BGIPD composition where BGCIPD-4 has gain optimum value among other blends. It is also acknowledged that blends having CR-18 shows better result in terms of performance, emission result when compared with CR-16 and CR-17. The optimum result has acknowledged for BGCIPD-4 at CR-18 for 60% load for performance.

9. References

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Acknowledgments

I am extremely fortunate to be involved in an exciting and challenging research work like **Comparative Analysis Of Physio-Chemical, Performance -Emission Properties between diesel and varying blend of castor biodiesel with Iso-Propanol.** It has enriched my life, giving me an opportunity to work in a new environment of hydrodynamic and thermal analysis in pipe flow. I would like to express my most sincere heartfelt gratitude and respect to my supervisor Assistant Professor **Mr. Ashish Joshi** and Assistant Professor **Mr. Shivasheesh Kaushik**, for suggesting the topic for my thesis report and for his excellent guidance, valuable suggestions and endless support throughout the course of my preparing the report. I am greatly indebted to him for his constructive suggestions and criticism from time to time during the course of progress of my work.

I would like to express my sincere gratitude to Departmental Academic Committee of Mechanical Engineering Department and entire faculty who has imparted considerable knowledge to me during my study at this institution.

I am also thankful to all my friends and the staff members of the department of Mechanical Engineering and to all my well-wishers for their inspiration and help.

Finally, I express my deepest gratitude to my parents for their continuous encouragement, understanding and support.