

**PERFORMANCE AND EMISSION CHARACTERISTIC ON CI
ENGINE BY USING TRANSESTERIFIED CHICKEN SKIN OIL
WITH TITANIUM DIOXIDE AS ADDITIVES**

Submitted in partial fulfilment of the requirements for the award of

Bachelor of Engineering Degree in

Automobile Engineering

by

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DEPARTMENT OF AUTOMOBILE ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of V.NOBLE YUGESH (37860021), S.SARAVANAN (37860031) who carried out the project entitled **“PERFORMANCE AND EMISSION CHARACTERISTIC ON CI ENGINE BY USING TRANSESTERIFIED CHICKEN SKIN OIL WITH TITANIUM DIOXIDE AS ADDITIVES”** under our supervision from October 2020 to April 2021.

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DECLARATION

We V.NOBLE YUGESH (Reg. No.37860021) and S.SARAVANAN (Reg. No.37860031) hereby declare that the Project Report entitled "**PERFORMANCE AND EMISSION CHARACTERISTIC OF CI ENGINE BY USING TRANSESTERIFIED CHICKEN SKIN OIL WITH ADDED TITANIUM DIOXIDE** " done by us under the guidance of Mr. P. KARTHIKEYAN, M.E., is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Automobile Engineering.

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ABSTRACT

Biodiesel is an alternative to conventional diesel fuel made from renewable resources, such as non-edible vegetable oils. In this experiment we added Titanium dioxide for good performance and emission in the amount of 0.005mg. No engine modifications are required to use biodiesel in place of petroleum-based diesel. Biodiesel can be mixed with petroleum-based diesel in any proportion. This interest is based on a number of properties of biodiesel including the fact that it is produced from a renewable domestic source, its biodegradability, and its potential to reduce exhaust emissions. The climate change is presently an important element of energy use and development. Biodiesel is considered "climate neutral" because all of the carbon dioxide released during consumption had been sequestered out of the atmosphere during crop growth. The use of biodiesel resulted in lower emissions of unburned hydrocarbons, carbon monoxide, and particulate matter. Biodiesel also increased catalytic converter efficiency in reducing particulate emissions. Chemical characterization also revealed lower levels of some toxic and reactive hydrocarbon species when biodiesel fuels were used. The fuel consumption in the world particularly in developing countries has been growing at an alarming rate. Petroleum prices approaching record highs and they will deplete within few decades, it is clear that more can be done to utilize domestic non-edible oils while enhancing our energy security.

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CHAPTER 1

INTRODUCTION

1.1 ENGINES

An engine is a machine measured to convert chemical or electrical energy into useful mechanical motion. Heat engines, including internal combustion engines and external combustion engines (such as steam engines) scald a fuel to create heat, which then produces motion. Engines change chemical energy into mechanical energy

1.2 CLASSIFICATION OF ENGINES

Based on combustion of fuel the engines are classified into two types. They are,

- External combustion engine
- Internal combustion engine.

1.2.1 External Combustion Engine

Here, the working medium, the vapour, is generated in a boiler, engine placed outside and allowed in to the cylinder to operate the piston to do mechanical work.

1.2.2 Internal Combustion Engine

In internal combustion engine, the combustion of fuel takings place inside the engine cylinder and heat is generated within the cylinder. This heat is additional to the air undisclosed the cylinder and thus the pressure of the air is increased tremendously. This high pressure air moves the piston which rotates the crank shaft and thus mechanical work is ended

1.3 BASED ON ENGINE FUEL

Based on the engine fuel the engines are classified into Diesel engine, Petrol engine and Gas engine.

- Diesel engine – Diesel is used as fuel

- Petrol engine – Petrol is used as fuel
- Gas engines – propane, butane or methane gases are used

1.4. FOUR STROKE CI ENGINE

The basic workings of diesel engine are cylinder, piston, injector, valves, connecting rod and crankshaft. In diesel engines only air is strained into the cylinder. The air in the cylinder attains very high temperature and pressure at the end of the compression stroke so the engine has high compression ratio. At the conclusion of the compression stroke, the fuel is scattered into the cylinder in atomized form using injectors. Due to high temperature, the fuel becomes ignited, begins to burn and produce lot of heat. Due to the heat the gases expand, move the piston downward and rotate the crankshaft. The torque offered at the rotating crank shaft is second-hand to do any mechanical work. The compression ratio of CI engine it is from 16 to 20.

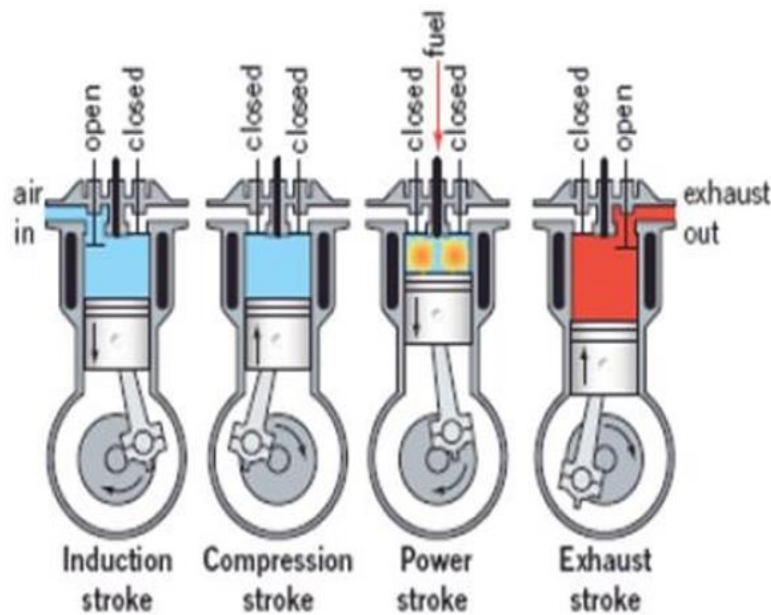


Fig1.1 four stroke diesel engine

1.4.1 SUCTION STROKE

Suction stroke starts when the piston is at the top dead centre and about to interchange downwards. The inlet valve is opened at this time and the exhaust valve is closed. Due to the suction created by the motion of the piston towards the bottom dead centre, the charge containing of fuel air mixture is drawn into the cylinder. When the piston reaches the bottom dead centre the suction stroke ends the inlet valve closes.

1.4.2 COMPRESSION STROKE

The charge taken into the cylinder through the suction stroke is compressed by the return stroke of the piston. During the stroke both inlet and exhaust valve are in closed position. The mix which fills the entire cylinder volume is now beaten into the clearance volume. The mixture is ignited at the end of the compression stroke. In ideal engines it is assumed that burning takes place rapidly when the piston is at the top dead centre and hence the process can be approached as heat calculation at constant volume. During the burning process the temperature rise of the fuel is renewed into heat energy making a temperature rise of about 2000 C. the pressure at the end of the compression process is considerably increased due to the heat release from the fuel.

1.4.3 POWER STROKE

Tremendous amount of heat is generated after ignition of fuel, causing very high pressure in the cylinder which energises the piston downward. Power stroke is called the downward movement of the piston at this instant. The connecting rod spreads the power from piston to the crank shaft and crank shaft rotates. Mechanical work can be elicited at the rotating crank shaft. Both valves remain closed during power stroke.

1.4.4 EXHAUST STROKE

During this stroke piston moves upward exhaust valve opens and exhaust gases go out over exhaust valves opening. All the burnt gases go out of the engine and the cylinder becomes ready to receive the fresh charge. Valve remains closed during this stroke inlet. Thus it is initiated that out of four strokes, there is only one

power stroke and three shiftless strokes in four stroke cycle engines. The power stroke materials necessary momentum for useful work.

1.5 TWO-STROKE CI ENGINE

The cycle of the four-stroke of the piston (the suction, compression, power and exhaust strokes) is confirmed only in two strokes in the case of a two-stroke engine. The air is strained into the crankcase due to the suction fashioned by the upward stroke of the piston. It is compressed in the crankcase on the down stroke of the piston. The compression pressure is habitually very low, being just enough to allow the air to flow into the cylinder over the transfer port when the piston reaches near the bottom of its down stroke. The air thus flows into the cylinder, where the piston icepacks it as it ascends, till the piston is practically at the top of its stroke. The compression pressure is enlarged sufficiently high to raise the temperature of the air overhead the self-ignition point of the fuel used. The fuel is injected into the cylinder head just before the completion of the compression stroke and only for a brief period. The burnt gases expand through the next downward stroke of the piston. These gases escape into the exhaust pipe to the atmosphere through the piston finding the exhaust port.

1.6 ALTERNATE FUEL

The major fuel used for marketable vehicles in India is the diesel and petrol fuels. This is non-renewable fuel is also reducing oil resource. Diesel and petrol is well suit for the commercial transportation resolve compare to the other fuel with gasoline. Thus the various blends are used as it is same as that of diesel properties. Due to lack of petroleum, diesel fuel and its increasing cost an alternative source of fuel for diesel is very much required. It has been found that vegetable oils hold special capacity in this regard, since they can be produced from the plants grown in rural areas.

Biodiesel can be used straight in compression ignition engines with no extensive modifications in the engine. Biodiesel contains no sulphur and therefore this is the important point in relations of future European regulations. A single cylinder 4 stroke direct injection diesel engine has been used to measure the general performance of traditional Diesel and biodiesel. The alternate fuels such as LPG, ethanol, methanol, biogas and rice bran oil are also used. With vegetable oils,

emissions of HC and NO_x could be higher too. However, these might be overcome by injectors considered specifically for the fuel or the use of anti-oxidant, detergent and other additives. To economies in the consumption of products derived from crude oil as a 30% blend of vegetable oil with diesel fuel could be practicable. blending in this way emissions and smoke levels, though the power output will still tend to be lower and separation of the blended constituents could occur in the cold.

The definition of alternative fuel varies to the context of its usage of petroleum substitutes, the term “alternative fuel” can imply any available fuel or any energy source, and does not necessarily refer to a source of renewable energy. In the context of environmental sustainability “alternative fuel” often implies an ecologically initiate renewable fuel. They produce less pollution than diesel or gasoline. Alternative fuels are any materials or substances that can be used as a fuel, other than conventional fuels. It includes: fossil fuels petroleum (oil), propane, and natural gas.

1.6.1 BIODIESEL AS FUEL

Recently, there are several concerns about the dependence on foreign controlled fuels sources of finite supply rising prices of petroleum and reserves of petroleum shortages based fuels. These problems have encouraged the advance of alternative fuels, obtained especially from renewable sources like fats and oils. In compression-ignition (diesel) engines directly or in a blend with other fuels oils can be used as liquid fuel for combustion. This use, however, has many problems (Rathore & Madras, 2007), that can be overwhelmed by way of pyrolysis, micro-emulsification or transesterification in direction to modify raw fats or oils. Transesterification is by distant the most used process for oil change, yielding fatty acid alkyl esters, the so-called biodiesel. This biofuel has a viscosity like to that of the petrodiesel, as the oil viscosity decreases as transesterification reaction takings, as verified for alkyl esters of refined soybean oil.

1.6.2 SOURCES OF FATS AND OILS

Along with vegetable oils, animal fats and oils also have a excessive potential to be used as substrate for biodiesel production. The choice of the source depends mostly on the country and its climate. A wide variety of feedstock is expected to be used in Brazil for biodiesel production. Currently, the main resource for biodiesel production in 6 this country is soybean oil, comprising about 80% of total feedstock, followed by tallow, cottonseed oil and other sources such as chicken fat, pork fat, waste cooking oil, oil seed radish.

The usage of biodiesel has not expanded in developing countries frequently due to the high production cost which is related with the expensive high-quality virgin oil feedstocks. The cost of the raw materials currently represents about 70% of the total production costs. Fats and oils of opposing origin have different fatty acid compositions. The properties of fats and oils, and hence their marketable value, depend on the fatty acid composition and of the triacylglycerol structure (Sheldon, 1996). For example, a high content of saturated fatty acids in the raw feedstock (i.e., myristic, palmitic, stearic acids) rises turbidity and the cetane number, decreases NO_x emissions, and shows better stability. Furthermore, a high ratio of polyunsaturated fatty acids (i.e., linoleic or linolenic acids) has the opposite effect. Knothe & Dunn (2005) discussed in detail the influence of fats and oils compositions on biodiesel properties. One of the main criteria for the quality of biodiesel is the storage stability which, in turn, depends on the fatty acid composition of the feedstock. Vegetable oil results especially tend to deteriorate owing to hydrolytic and oxidative reactions.

Their degree of unsaturation makes them susceptible to thermal and/or oxidative polymerization, which may lead to the formation of insoluble products that cause problems within the fuel system, especially in the injection pump. Santos et al. (2010) outlined the high amount of unsaturated fatty acids found in fish oil may outcome in higher oxidation problems. It is also a serious limit when dealing with phytoplankters and seaweeds rich in long-chain polyunsaturated fatty acids. Autooxidation of unsaturated oils can be limited by addition of suitable antioxidants.

1.6.3 VEGETABLE FATS AND OILS

Traditional oilseed feed stocks for biodiesel production predominantly include soybean, rapeseed/canola, palm, corn, sunflower, cottonseed, peanut, and coconut oils . According to Liu (2004), the range oil content in soybean is 12-30% (dry weight; typical oil content 20%), whose major components are triacylglycerols. There is a large genetic difference in fatty acid composition of soybean oil, mainly resulting from plant breeding. The range of fatty composition (% relative to total oil) among soybean germplasm is palmitic acid, 4-23%; stearic acid, 3-30%; oleic acid, 25-86%; linoleic 7 acid, 25-60%; linolenic acid, 1-15%. This oil covers minor components (phospholipids, unsaponifiable material, free fatty acids, and trace metals) that are reduced later oil refinement.

These substances affect lipase activity, as verified in the methanolysis of unrefined soybean oil, containing phospholipids, catalysed by the immobilized *Candida antarctica* lipase. Palm-base alkyl esters are possible substitutes for diesel fuel, as previously investigated by Dors (2011). Palm trees are an attractive alternative feedstock, especially because of their great productivity. These plants produce two types of oils, palm oil from the fibrous mesocarp and lauric oil from the palm kernel.

The former contains mainly palmitic (44.0%) and oleic acids (39.2%), while the latter is rich in lauric (48.3%), myristic (15.6%) and oleic acids (15.1%). The world's two largest producing nations are Indonesia and Malaysia. Batistella et al. (2002) proposed an approach to improve carotenoids, valuable pigments for the food industry, and biodiesel from palm oil by means of suitable techniques. *Jatropha curcas* oil, a nonedible vegetable oil, has been considered as a potential alternative feedstock for biodiesel production.

Jatropha curcas is a large shrub or tree native to the American tropics but normally found and utilized throughout most of the tropical and subtropical regions of the world. It is a hardness plant with rapid growth, easy propagation and wide ranging usefulness. The oil content of *jatropha* seed ranges from 30 to 50% by

weight and the kernel itself ranges from 45 to 60%. The major fatty acids found in jatropha oil are the oleic and linoleic acids. The seeds and oil are toxic due to the incidence of curcive and curcative. The properties of this oil make it appropriate for alkyl esters production, as they have lower viscosity than the starting material. Berchmans & Hirata (2008) produced biodiesel from crude *Jatropha curcas* L. seed by a high content of free fatty acids (15%) by means of a two-step chemical reaction.

Castor oil is a unique commercial resource containing ricinoleic acid with a major share of up to about 90%. Castor oil is obtained from the seeds of *Ricinus communis*, with a produce of about 50%. It is non-edible, virtually insoluble in water, chemically steady and fully biodegradable. It is widely used in oleochemical applications, mostly in special productions.

The countries of production are primarily India and Brazil, where the plant grows native through high hectare yields. Cvengros et al. (2006) suggested a dilution of castor oil-based methyl and ethyl esters with esters based on oils/fats without - OH group, or a blending with conservative diesel fuel and addition of a cetane enhancer, as alternatives for reaching EN 14214 standards. Oliveira et al. (2004a, 2004b) considered the lipase-catalyzed transesterification of castor oil to produce biodiesel. An alternative feedstock for biodiesel production is the non-edible oil extracted from babassu, a palm tree available in great amount in tropical forests.

Their coconuts hold in average 7 wt% of almonds with 62 wt% of oil rich in lauric acid. The possibility of the whole custom of the coconut for other purposes makes babassu a potential source for biodiesel production (Freitas et al., 2009). Rubber tree is another likely feedstock for biodiesel production .

Rubber seed kernels (50–60% of seed) contain 40–50% of brown colour oil, consisting of 18.9% saturated (palmitic and stearic acids) and 80.5% unsaturated fatty acids (oleic, linoleic and linolenic acids). It may contain up to 17% free fatty acids

1.6.4 ANIMAL FATS AND OILS

Although animal fat such as beef tallow is considered an industrial residue, and a not renewable source of energy, if related to oleaginous seeds, there is an increasing interest in its use as feedstock for biodiesel production. Additionally, the use of animal fat from residues as initial material for alkyl esters production plays an important role in the pollution reduction (Krause, 2008). Giving to Lee et al. (2002), lard is an inexpensive coproduct of the meat-packing industry that could be further converted to value-added products such as biodiesel. Though, the relatively high contents of saturated fatty acids in lard result in the poor cold temperature properties of its alkyl esters.

To expand cold temperature properties, the content of saturated fatty acid in lard could be reduced through a fractionation process before esterification. As a consequence of this process, biodiesel from fractionated lard resists forming crystals at low temperatures, thus improving cold temperature properties. Chicken fat obtained from processing results is a promising alternative feedstock for biodiesel production because of its great availability and low cost. Brazil is the third world's largest producer of chicken meat and the first largest exporter of chicken meat, whose total production was 10.98 million tonnes in 2010, the methanolysis of low free fatty acids chicken fat by using shells as catalysts. Krause (2008) described the economic feasibility of biodiesel production from animal fats (beef tallow and chicken fat), by using the alkaline methanolic route. The same research group described the alkali-catalyzed methanolysis of biodiesel from beef tallow in a pilot plant (Cunha et al., 2009). Hoque et al. demonstrated a high potential of making economically viable biodiesel from low cost feedstock (beef fat, chicken fat and used cooking oil) with proper optimization of the process parameters. Giving to Food and Agriculture Organization of the United Nations [FAO] (2010), capture fisheries and aquaculture supplied the world with about 142 million tonnes of fish in 2008, excluding aquatic plants.

Of this, 27.2 million tonnes were used for non-food purposes. The dominant species in marine fishery catches were Alaska and Atlantic herring China remained by far the largest fish-producing country, with production of 47.5 million loads in 2008. Brazil was one of the main producer countries of inland capture fisheries,

accounting for an estimated amount of 243,000 tonnes in 2008. Total fish oil production by the five main exporting countries (Peru, Chile, Iceland, Norway and Denmark) in 2009 was 530,000 tonnes, a decline of 100,000 tonnes compared with 2008. Fish-oil prices reached US\$950/tonne in March 2010, which was 50 percent higher than an year earlier. For fish oil, nearly 85 percent of production was castoff as an ingredient in fish and shrimp feeds . This oil could be applied as substrate for the production of biodiesel. In 2009, the total fisheries making in Brazil was extra than 1.24 million tonnes. The Northeast region was the major national producer (34%), but the state of Santa Catarina, at the South, was the largest producer (more than 199,000 tonnes). The sardine was the main fish resource caught in this country (more than 83,000 tonnes) in the aforementioned year. According to Feltes, the oil extracted from sardine viscera and heads by the Bligh & Dyer method, contains 5.43% of lipids (wet weight), with 12.1% of EPA and 16.5% of DHA. These residues are therefore an alternative substrate for the production of biodiesel in this region.

1.6.5 WASTE FATS AND OILS

Low-cost causes such as restaurant greases and soap stock can be used for biodiesel production. These sources, yet, are of lower quality than refined vegetable oils, especially because of the high content of free fatty acids, what is a major tricky when dealing with transesterification reactions catalyzed by alkali. Along with free fatty acids, restaurant grease contains other substances formed during cooking, 10 especially deep-frying, that must be removed prior to alcoholysis in order to a high yield in alkaline-catalyzed responses. The usage of vegetable oils as frying oils produces important amounts of used oils which may present a disposal problem. Their use for biodiesel production has the benefit of their low price. Free fatty acids present in this feedstock can be a drawback when dealing with alkaline catalyzed-processes, but acid or enzymatic reactions can be a applied solution to the creation of this biofuel.

Besides free fatty acids, this starting material contains other filth products as polymers, as revised by Kulkarni & Dalai (2006). These complexes can affect the catalyst activity, but they can be removed by means of simple filtration. Waste oils have advanced amounts of saturated fatty acids, leading to less favourable cold

flow properties . Charoenchaitrakool & Thienmethangkoon (2011) explored the optimum conditions in biodiesel production from waste frying oil using two-step catalyzed process (acid catalysis followed by alkali-catalysis). Though liquid mineral acids can be cast-off to catalyze the modification of an oil with a high free fatty acids content, Silva et al. (2011) pointed out serious problems, such as high corrosiveness, large effluent generation, the impossibility of catalyst reuse, compromise their application. Contrarily, solid acid catalysts seem to be an striking option; however, the water present or generated during free fatty acids esterification causes the leaching and deactivation of these catalysts.

Coconut and palm kernel distillates covering a high content of free fatty acids (71.3 and 61.2%, w/w as lauric acid), rich in saturated fatty acids, especially lauric acid, a low content of unsaponifiable matter and neutral acylglycerols could be used as starting material for biodiesel production.

1.7 NECESSITY FOR ALTERNATE FUEL

Availability of the energy at a genuine cost is a vital importance for the economic development of our nation. In recent times due to uncertain supplies fluctuation in prices for fossil fuel in international market, the necessity to search renewable, safe and non-polluting causes of energy assumes top priority.

One of the major factors that has declared India's rate of economic development is the need to import about 70% of petroleum demand. widely fluctuating world prices 11 oil have been establishing element for the country's balance of payments situation, the current yearly consumption of diesel oil India is approximately 40 million tone forming about 40% of the total petroleum product consumption.

1.7.1 CHICKEN FAT

Fossils drive energy resources such as petroleum, coal and natural gas have played a significant role in the economic development of human beings. However, these energy resources are non-renewable and are projected to be exhausted in the near future due to over extraction and utilization. Moreover, they

are raising several environmental problems such as rising greenhouse gases and carbon dioxide levels in the atmosphere. Therefore, due to escalating demands for energy and elevated petroleum cost coupled with scarcity of known petroleum reserves has prompted an urgency to develop or employing modern technologies and efficient bioenergy conversion processes, which are becoming inexpensive cost-wise with fossil fuels and also to meet energy challenges of the era. Biodiesel, a standby of petroleum diesel, derived from biological sources received increasing attention globally as it lessens the dependence on petroleum products, the energy crisis and environmental pollution.

ASTM defined biodiesel as “a fuel collected of mono alkyl esters of long-chain fatty acids derived from renewable vegetable oils or animal fats. The chicken skin is collected from the chicken stall and the waste like features are removed .the collected chicken skin is kept in the vessel and it is heated .through heating it the extraction of oil takes place at particular temperature and the oil is collected and it is filtered then it is used for further process.

There are four primary customs by which biodiesel is produced: thermal cracking (pyrolysis), direct use and blending, micro emulsions, and transesterification. However transesterification reaction is the most commonly used method which is basically a classic chemical process used to convert the vegetable oils and animal fats into biodiesel. It generally involves a three step or two steps reversible reaction in which initial triglycerides yields a mixture of fatty acid methyl ester.

There are four main ways to make biodiesel, direct use and blending, micro emulsions, thermal cracking (pyrolysis) and transesterification. The most commonly used method is transesterification of vegetable oils and animal fats.

1.8 .TRANSESTERIFICATION PROCESS

Transesterification or alcoholysis is the displacement of alcohol from an ester by another in a procedure alike to hydrolysis, except than alcohol is used instead of water. This process has been generally used to reduce the high viscosity of triglycerides. If methanol is used in this procedure it is called methanolysis. Transesterification is one of the reversible reactions and proceeds essentially by fraternisation the reactants. However, the occurrence of a catalyst (a strong acid or base) accelerates the conversion. Transesterification of triglycerides yield fatty acid alkyl esters and glycerol. The glycerol layer settles down at the bottom of the reaction vessel. Diglycerides and mono glycerides are the mediates in this process. The step wise responses are reversible and a little excess of alcohol is used to shift the equilibrium to the formation of esters. In occurrence of excess alcohol, the foreword reaction is pseudo-first order and the reverse reaction is found to be second order. It was also practical that transesterification is faster when catalyzed by alkali. The first step contains the occurrence of the alkoxide ion to the carbonyl carbon of the triglyceride molecule, which results in the formation of a tetrahedral intermediate. The reaction of this in-between with an alcohol produces the alkoxide ion in the second step. In the last step the rearrangement of the tetrahedral intermediate stretches rise to an ester and adiglyceride.

CHAPTER 2

LITERATURE SURVEY

[1].Karthick and Ganesh. Et.al, extraction of biodiesel from chicken waste.

The author has done the project in extraction of biodiesel from chicken waste. Chicken skins thus are sources of solid waste that are usually not utilized. It deals with the production of useful biodiesel from utilizing the waste chicken skins. Oil from the waste chicken skins (sourced from local poultry farms), was first extracted and then subjected to trans-esterification. The products of trans-esterification were FAME (Fatty acid methyl esters) and glycerol. The FAME produced was tested for density, viscosity, calorific value, fire point and flash point when compared to Indian standard values. Comparison of the obtained values of the parameters with the standard values for diesel was performed to determine the viability of the biodiesel produced. The results of this experiment showed that the calorific values of FAME produced from chicken skin fat were close to that of petroleum derived diesel. However, two test parameters namely kinematic viscosity and flash point differed when compared to diesel. The obtained biodiesel is blended with different percentage of diesel in single cylinder 4-stroke engine. Due to the relatively high yield charge of biodiesel, it is possible to utilize chicken skin fat at a rural level to produce FAME that can be an alternative to diesel in this time of fuel scarcity.

[2].John Abraham. Et.al, the analysis on biodiesel production from broiler chicken waste

The author has done the Broiler slaughter waste has become a major source of pollution throughout the creation. Use of broiler slaughter waste by dry rendering process produced Rendered Chicken Oil (RCO), a economy raw material for biodiesel production and Carcass Meal a feed ingredient for pets and fishes. Alteration of RCO into biodiesel may open new vistas for generating wealth from waste besides controlling the major havoc of environmental pollution. A two-step procedure to adapt RCO to good quality Biodiesel was invented. Acid catalyzed esterification of FFA followed by base catalyzed transesterification of triglycerides

was carried out after meticulously standardizing the methanol molar ratio, catalyst concentration, reaction temperature, and reaction time to obtain the maximum biodiesel yield of 97.62% and lowest glycerol yield of 6.96%. RCO biodiesel blend was tested in a CRDI diesel engine. The results revealed that the blending of commercial diesel with 20% RCO biodiesel (B20) led to less engine wear, a quieter engine and better fuel economy. The better lubricating abilities of RCO B20 prevented over heating of engine, which prolongs the engine life. RCO B20 can decrease the import of crude oil and substantially reduce the engine emissions as proved through significantly lower smoke levels, thus mitigating climatic changes.

[3]. Kambiz Tahvildari .A and Narges Davari .Et.al, The analysis on biodiesel production from waste chicken fat.

The author has done, based source Chicken fat was employed as a feedstock for producing of biodiesel by transesterification reaction with methanol and alkali catalyst (KOH). In this learning chicken fat biodiesel with 1.4% free fatty acid, methanol and various amount of potassium hydroxide for 2 hour were studied. The progression of reaction and conversion of triglycerides to methyl ester were checked by IR spectrum method.

[4]. Chia- Wei Lin. Et.al, production of biodiesel from chicken wastes by various alcohol-catalyst combinations.

The author has done that An environmentally friendly bio refinery process for producing biodiesel from chicken wastes was performed for this study. Low acid value (0.13 ± 0.01 mg KOH/g) chicken oil was obtained by making chicken wastes with moderate heating and filtration procedures that minimized damage to the lipids and thus facilitated subsequent reactions. Methanol lipids in a molar ratio of 6:1 and a methanol ethanol-lipids mixture in a molar ratio of 3:3:1 were both reacted with 1% KOH catalyst for transesterification. Furthermore, ethanol-lipids in a molar ratio of 6:1 were analogously transesterified with 1% sodium ethoxide. The quantities of biodiesel were $771.54 \text{ mg/mL} \pm 15.28$, $722.98 \text{ mg/mL} \pm 37.38$, and $714.86 \text{ mg/mL} \pm 29.99$ from methanol, ethanol, and a mixture of methanol/ethanol (3:3), respectively, after transesterification. The total amount of ethyl ester was similar with the total amount of methyl ester. In addition, ethanol is

a renewable resource and a bio refinery perception can be contributed for biodiesel production. Further more, transesterification of chicken oil with a blend of methanol/ethanol (3:3) only needed a relatively short reaction time of an hour. Densities, viscosities, sulphur contents, acid values, and flash points of entirely esters were within the specifications of CNS 15072 and EN 14214. The transesterification system for chicken oil in ethanol and mixed methanol/ethanol (3:3) demonstrated in this study is a potential candidate for biodiesel making.

- [5]. Murugan.S and Debabrata Barik. Et.al, combustion analysis of the diesel biogas dual fuel direct injection diesel engine

The author has done that biogas (BG) was used as an alternative fuel in a single-cylinder, four-stroke, air-cooled through injection (DI) diesel engine that was operated on a dual fuel mode. Biogas was produced from a nonedible seedde-oiled cake-pongamia pinnata (Karanja), which was collected from the biodiesel industries. The BG was inducted sideways with the air in suction of the engine at four different flow rates varying from 0.3 kg/h to 1.2 kg/h in steps of 0.3 kg/h. The investigation results revealed that BG inducted at a flow rate of 0.9 kg/h gives better combustion characteristics of engine behaviour than those of other flows throughout the engine operation. The ignition delay (ID) and combustion duration of the engine run by dual fuel operation at a BG flow rate of 0.9 kg/h were created to be longer by about 2 °CA and 2.9 °CA, separately, in comparison with diesel at full load. The cylinder peak pressure was found to be overall higher by about 11 bar than that of diesel at full load

- [6] D Yuvarajan, MD Babu, N BeemKumar , Pollution Research, 2018

The present study investigates the effect of the TiO₂ nanofluid on the formation of hydrocarbon, carbon-monoxide ... (2013) studied the effect of novel nano-organic ... The optimum conditions based on the literature for the alkali trans-esterification process is found for methanol oil

- [7] D Balasubramanian, KR Lawrence - ... Science and Pollution Research, 2019

best of the author's knowledge gained from a thorough review of the literature, only a In the current experimental research work, a novel biodegradable, renewable alternative fuel was produced from 20% with diesel 80% (on a volume

basis) was prepared for the present study.

[8] D Ramimoghadam, S Bagher- BioMed research , 2014 - hindawi.com

Vast choices of advanced technologies are available to employ the agricultural wastes into novel functional nanomaterials. Our knowledge, no such study on the synthesis of TiO₂-NPs using rice straw as biotemplate is found in the open literature.

[9] R Vigneswaran, D Balasubramanian, BDS Sastha – Fuel, 2021 – Elsevier
of bio-fuels, low heat rejection strategy, coating in-cylinder parts etc .

In the recent past, as per the available relevant literature, among many ...
Four loads were chosen for this study. Also, it can be used as a novel catalyst while blending with diesel/biodiesel fuels

[10] S Karthikeyan, SM Silaimani - 2017 - nopr.niscair.res.in

non-edible grade, waste vegetable oils as well as from animal fats which offer many novel advantages that ... Moreover, there are very few literatures available on the usage of TiO₂ blended biodiesel ... Smoke meter The smoke meter used in this study was AVL 437 C smoke meter

CHAPTER 3

AIM AND SCOPE OF PRESENT INVESTIGATION

3.1 AIM

To increase the performance of the engine and minimize the emission by introducing the biofuel.

3.2 SCOPE

Increasing energy demand, climate change and carbon dioxide (CO₂) emission from fossil fuels make it a high priority to search for low carbon energy resources. Biofuels have been increasingly discovered as a possible alternative source of fuel and represent a key mark for the future energy market that can play an important role in maintaining energy security. It is primarily considered as potentially cheap, low-carbon energy source. Bioenergy- 2016 is the event intended for the International professionals to facilitate the dissemination and application of research findings related to Bioenergy as extra fuels. It is a scientific platform to meet fellow key decisionmakers all-around the Biotech organizations, Academic Institutions, Industries, & Environment Related Institutes etc., and making the congress a perfect platform to share and gain the knowledge in the field of bioenergy and biofuels. Biofuels -2015 is a platform to gather visionaries through the research talks and presentations and put forward many thought provoking plans of production and scale up of renewable Energy and making the congress a perfect platform to share ability.

The project aims at abstraction of biodiesel from chicken waste. Chicken skins thus are sources of solid waste that are usually not utilized. It deals with the production of useful biodiesel from utilizing the waste chicken skins. Oil from the waste chicken skins (sourced from local poultry farms), was first extracted and then subjected to trans-esterification. The products of trans-esterification were FAME (Fatty acid methyl esters) and glycerol. The FAME produced was tested for density, viscosity, calorific value, fire point and flash point when compared to Indian standard values. Comparison of the obtained values of the parameters with the

standard values for diesel was performed to determine the viability of the biodiesel produced. The results of this experiment showed that the calorific values of FAME produced from chicken skin fat were close to that of petroleum derived diesel. However, two test parameters namely kinematic viscosity and flash point differed when compared to diesel. The obtained biodiesel is blended with dissimilar percentage of diesel in single cylinder 4-stroke I.C engine. Due to the relatively high yield value of biodiesel, it is feasible to utilize chicken skin fat at a rural level to produce FAME that can be an alternative to diesel in this time of fuel scarcity

3.3. PRESENT INVESTIGATION

3.3.1 *TRANSESTERIFICATION PROCESS*

Table 3.1 Transesterification of chicken skin oil

S.No	Parameters	Results
1	Free fatty acid	0.28 %
2	Catalyst (NaOH) quantity	5 grams
3	Oil to Methanol molar ratio	1:6
4	Temperature	60 °C
5	Reaction time	90 minutes
6	Yield	94.3 %

3.3.2 Properties of chicken skin oil

Table 3.2 Properties of chicken skin oil

S.No	Parameters	Results
1	Free fatty acid	0.28 %
2	Density	0.894 g/cc
3	Kinematic Viscosity @ 40°C	9.42 cSt
4	Flash point by PMCC method	193 °C
5	Fire point by PMCC method	204 °C
6	Cloud point	26 °C
7	Pour point	17 °C
8	Moisture content	0.812%
9	Calorific value	6718.66 Cal/g

3.3.3 Engine specification

No. of Cylinders	1
Bore	87.5 mm
Stroke	110 mm
Cubic Capacity	0.662 Ltr
Compression Ratio	18.00
Rated Speed	1500 rpm
Orifice Diameter	20.0 mm
Rated Output as per IS: 11170	4.41 kw 6 hp
Constant Injection Pressure	200 bar
Constant Injection Timing	23°

table 3.3 Engine specification

Chapter 4

Experiment and method

4.1 METHODOLOGY

For the experiment the following process taken place are explained below.

4.1.1 EXTRACTION OF OIL

The collected chicken skin is kept in a vessel and it is heated. From 1kg of chicken skin 420ml of oil is extracted. It is filtered and collected.

4.1.2 TRANSESTERIFICATION PROCESS

Sodium hydroxide and methanol are mixed with the extracted oil and it is kept at 60°C for 90 minutes.

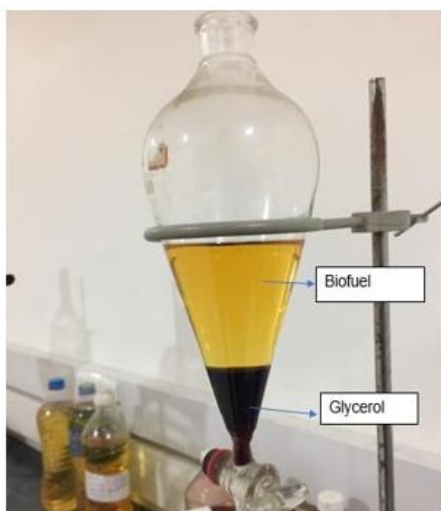


Fig 4.1 Separating funnel



Fig 4.2 biofuel

The Two layers will be formed on the separating funnel and the mixture was allowed to settle meant for 24 hours. The heavier glycerol layer was separated from the lighter methyl ester layer by separating funnel. The biofuel is cleaned with de ionized water

4.1.3 ADDITION OF TITANIUM DIOXIDE

Titanium oxide (TiO_2) was introduced as an alternative material for heterogeneous catalysis due to the effect of its high surface area stabilizing the catalysts in its mesoporous structure. 0.005 mg of Titanium dioxide was added in the fuel after the transesterification process.

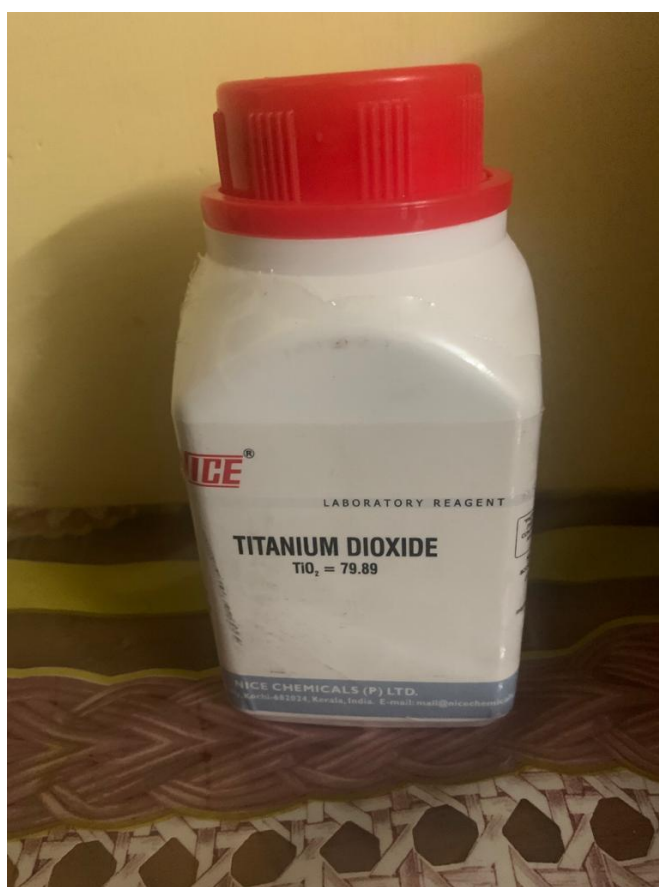


Fig 4.3 Titanium dioxide

4.1.4 BLENDS OF BIOFUEL

The transesterified chicken fat is blended in various ratio with diesel.

Table 4.1 Blends Ratio

Blend Ratio	S1	S2	S3
Diesel	90	80	70
Chicken Skin Oil	10	20	30

4.2 PERFORMANCE AND EMISSION TEST

The blended fuels are tested in Single cylinder CI engine with load as Eddycurrent Dynamometer. the speed rated is 1500 rpm and the compression ratio is 17.5:1. the bore is 87.5 mm and the stroke is 110 mm. through testing the performance and emission of the different blended fuels are calculated

4.2.1 PERFORMANCE OF S1

Table 4.1 Performance of S1

Torque (Nm)	BP (kW)	FP (kW)	IP (kW)	BMEP (bar)	IMEP (bar)	BTHE (%)	ITHE (%)	Mech Eff. (%)
0.40	00	4.34	4.41	0.08	5.00	1.44	94.83	1.52
6.13	0.87	5.26	6.26	1.17	7.30	15.64	98.01	15.95
11.78	1.74	5.73	7.63	2.24	8.97	23.42	93.85	24.96
16.96	2.76	6.12	8.83	3.22	10.50	29.16	95.01	30.69
22.56	3.5	6.03	9.59	4.29	11.56	33.97	91.66	37.07

Air Flow (kg/h)	Fuel Flow (kg/h)	SFC (kg/kW h)	Vol Eff. (%)	A/F Ratio	HBP (%)	HJW (%)	HGas (%)	HRad (%)
29.71	0.40	5.94	79.82	74.58	1.44	4.89	21.21	72.45
28.96	0.55	0.55	79.91	52.87	15.64	4.01	16.41	63.94
28.64	0.70	0.37	79.63	41.08	23.42	4.04	14.79	57.74
28.12	0.80	0.29	79.12	35.30	29.16	4.77	15.04	51.03
27.68	0.90	0.25	79.01	30.88	33.97	5.45	15.41	45.17

4.2.2 PERFORMANCE OF S2

Table 4.2 Performance of S2

Torque (Nm)	BP (kW)	FP (kW)	IP (kW)	BMEP (bar)	IMEP (bar)	BTHE (%)	ITHE (%)	Mech Eff. (%)
0.44	0.07	4.08	4.16	0.08	4.74	1.59	89.48	1.78
6.07	0.99	4.75	5.74	1.15	6.69	15.49	89.82	17.24
11.18	1.81	5.52	7.33	2.12	8.61	23.94	97.05	24.67
16.78	2.68	6.03	8.71	3.19	10.36	28.82	93.70	30.76
22.31	3.51	5.78	9.29	4.24	11.21	30.24	79.99	37.80

Air Flow (kg/h)	Fuel Flow (kg/h)	SFC (kg/kW h)	Vol Eff. (%)	A/F Ratio	HBP (%)	HJW (%)	HGas (%)	HRad (%)
29.56	0.40	5.37	79.71	74.20	1.59	7.22	25.52	65.66
28.97	0.55	0.55	79.92	52.88	15.49	3.95	18.44	62.11
28.68	0.65	0.36	79.68	44.29	23.94	3.77	17.11	55.18
28.16	0.80	0.30	79.27	35.34	28.82	3.91	15.41	51.86
27.63	1.00	0.28	78.86	27.74	30.24	4.20	14.31	51.26

4.2.3 PERFORMANCE OF S3

Table 4.3 Performance of S3

Torque (Nm)	BP (kW)	FP (kW)	IP (kW)	BMEP (bar)	IMEP (bar)	BTHE (%)	ITHE (%)	Mech Eff. (%)
0.45	0.08	4.11	4.19	0.09	4.74	1.85	102.98	1.80
6.36	1.03	5.03	6.06	1.21	7.09	16.19	94.88	17.06
11.35	1.83	5.13	6.96	2.16	8.19	26.28	99.87	26.32
16.46	2.63	6.01	8.64	3.13	10.27	30.16	99.09	30.44
22.15	3.49	6.23	9.72	4.21	11.73	33.33	92.90	35.88

Air Flow (kg/h)	Fuel Flow (kg/h)	SFC (kg/kW h)	Vol Eff. (%)	A/F Ratio	HBP (%)	HJW (%)	HGas (%)	HRad (%)
29.66	0.35	4.64	79.49	85.10	1.85	10.16	36.56	51.44
28.86	0.55	0.53	79.83	52.69	16.19	5.12	21.45	57.24
28.58	0.60	0.33	79.56	47.82	26.28	5.30	20.76	47.65
28.11	0.75	0.28	79.13	37.63	30.16	5.38	18.38	46.07
27.58	0.90	0.26	78.78	30.77	33.33	5.46	17.04	44.17

4.2.4 EMISSION OF HC

Table 4.4 Emission of HC

LOAD	S1	S2	S3
0	2	2	2
0.8	8	7	10
1.74	10	13	12
2.76	14	16	15
3.5	18	18	16

4.2.3 EMISSION OF CO

Table 4.5 Emission of CO

LOAD	S1	S2	S3
0	0.016	0.017	0.020
0.8	0.025	0.020	0.025
1.74	0.028	0.024	0.032
2.76	0.031	0.028	0.036
3.5	0.034	0.040	0.041

4.2.4 EMISSION OF CO₂

Table 4.6 Emission of CO₂

LOAD	S1	S2	S3
0	0.56	0.79	0.85
0.8	1.17	1.20	1.33
1.74	1.35	1.47	1.80
2.76	1.62	1.64	2.14
3.5	1.86	2.30	2.60

4.2.5 EMISSION OF O₂

Table 4.7 EMISSION OF O₂

LOAD	S1	S2	S3
0	19.43	19.25	17.72
0.8	19.06	19.16	180.32
1.74	18.40	18.60	17.80
2.76	17.85	17.71	17.13
3.5	17.76	16.80	16.44

4.2.6 EMISSION OF NO_x

Table 4.8 EMISSION OF NO_x

LOAD	S1	S2	S3
0	70	128	164
0.8	91	139	186
1.74	155	214	261
2.76	262	373	328
3.5	290	422	431

CHAPTER 5 PERFORMANCE ANALYSIS

5.1 PERFORMANCE OF ENGINE

5.1.1 BRAKE THERMAL EFFICIENCY

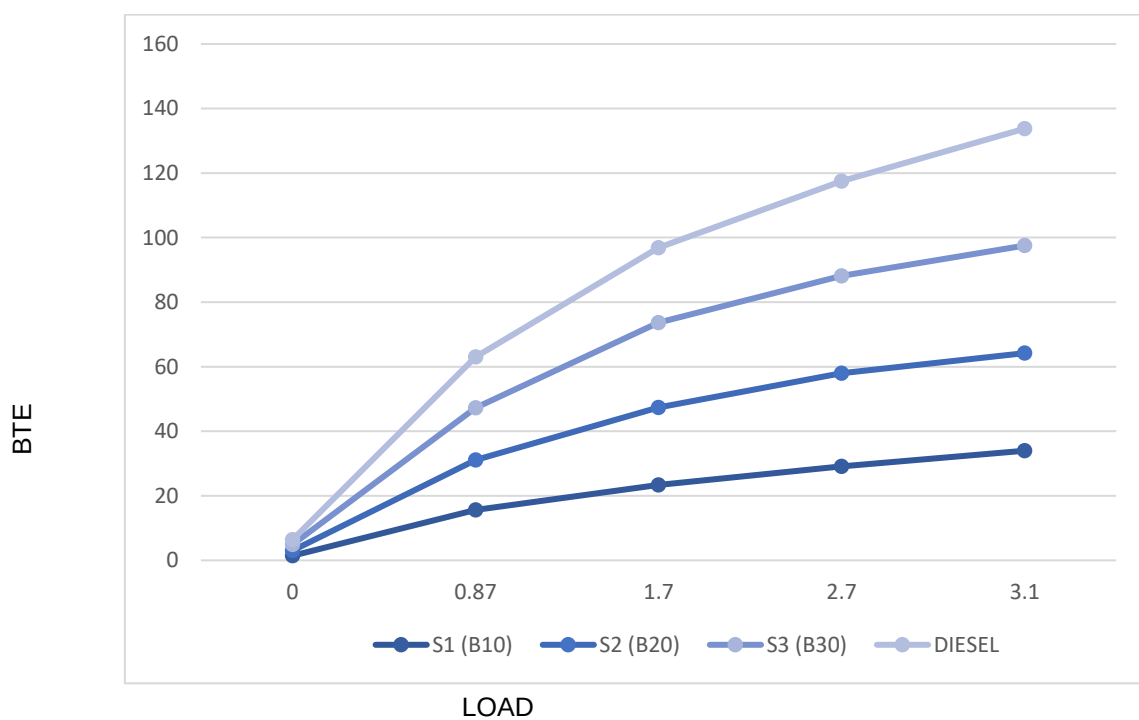


Fig 5.1 Brake thermal efficiency

The above mentioned graph is used to estimate how well an engine converts the heat from a fuel to mechanical energy. S3 has the high Brake Thermal Efficiency when compared to the Diesel, S1 and S2. It was identified that the best result was given by S3 of 30%, followed by S2 of 28.4%, S1 of 29.4 % against Diesel which is 26%.

5.1.2 SPECIFIC FUEL CONSUMPTION

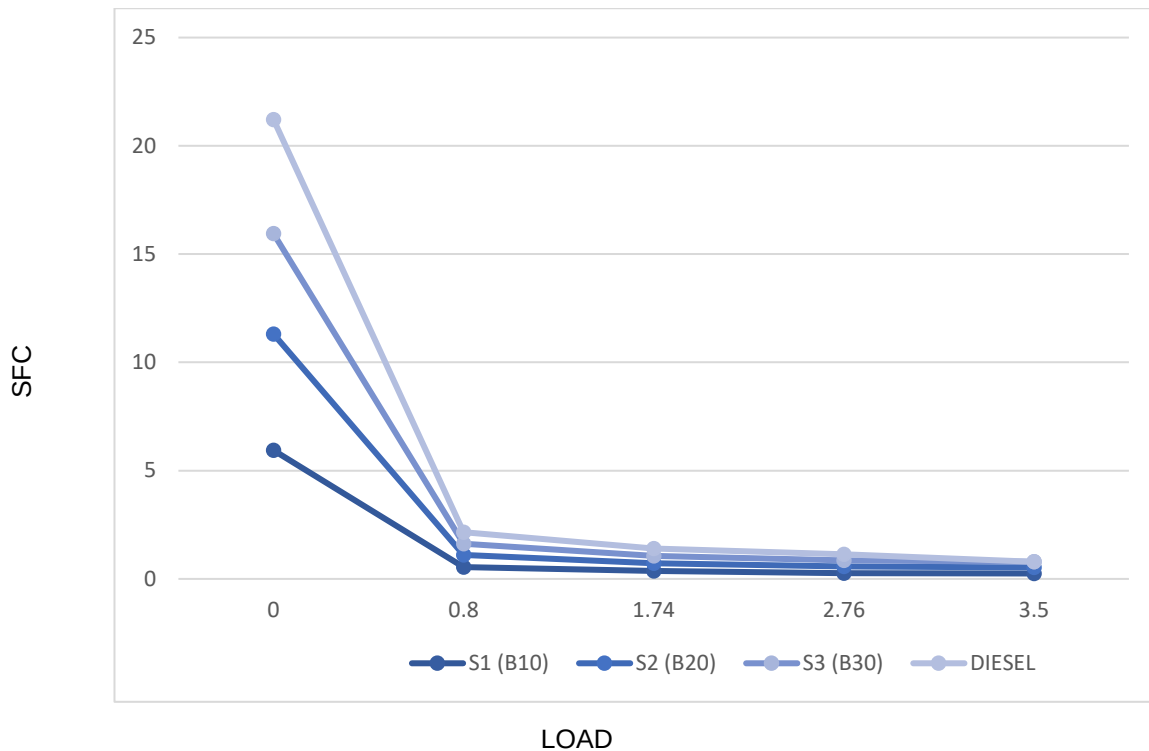


Fig 5.2 specific fuel consumption

The above mentioned graph is used to evaluate the rate of fuel consumption divided by the power produced. S2 has the high specific fuel consumption compared to the Diesel, S1 and S3. It was identified that the best result was given by S2 of 0.34 kg/kWh, followed by S3 of 0.34 kg/kWh, S1 of 0.32 kg/kWh against Diesel which is 0.30 kg/kWh.

5.2 MECHANICAL EFFICIENCY

5.2.1 CARBON MONOXIDE (CO) EMISSION

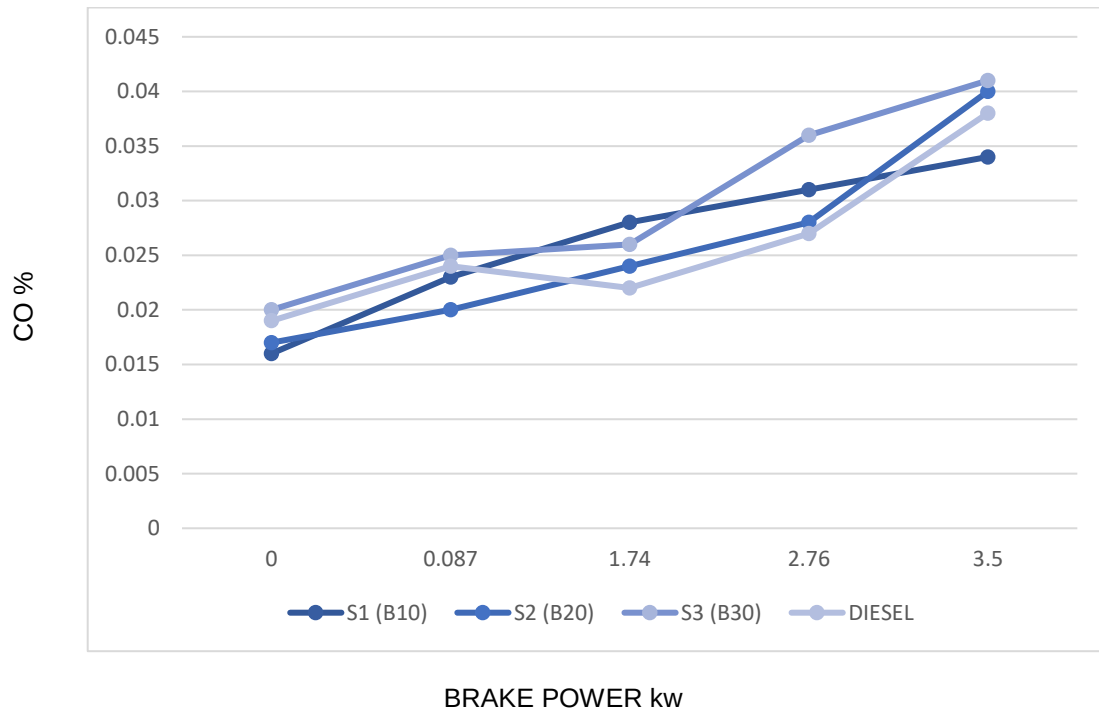


Fig 5.3 emission of carbon monoxide

In this CO and CO₂ are inter related when oxygen increases CO₂ occurs and when the oxygen decreases CO occurs. The S2 has the minimum CO emission when combustion takes place in the engine

5.2.2 HYDROCARBON (HC) EMISSION

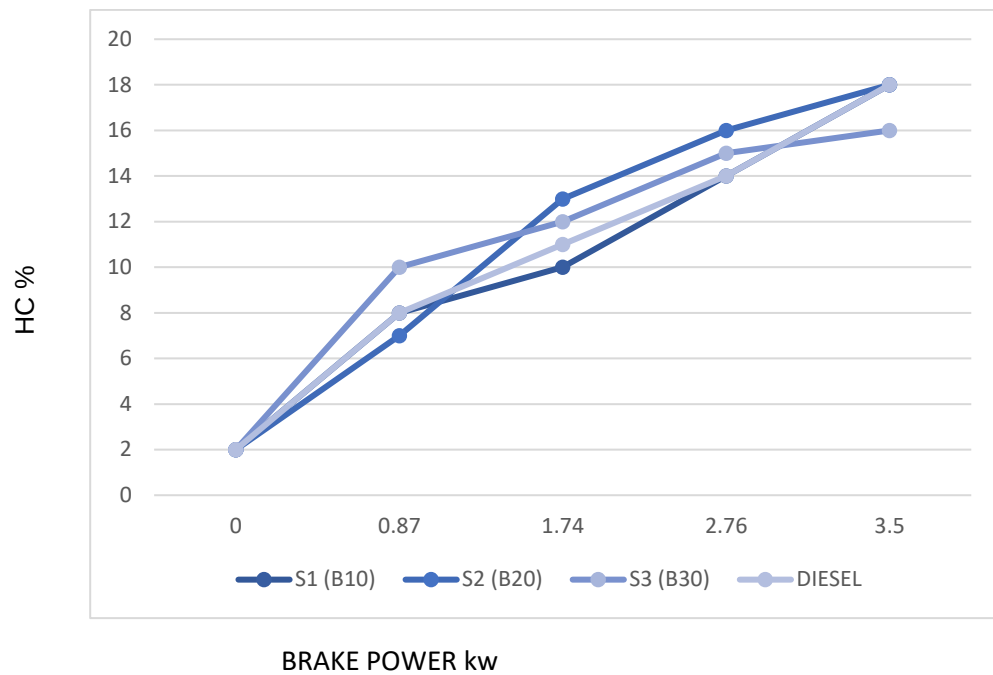


Fig 5.4 emission of hydrocaron

Hydrocarbon emissions are almost always a sign of poor fuel ignition. It is related with stroke timing, mixing of fuel, atomization and stoichiometric ratio. S1 has the lowest HC emission compared to the Diesel, S2 and S3.

5.2.3 CARBON DIOXIDE (CO₂) EMISSION

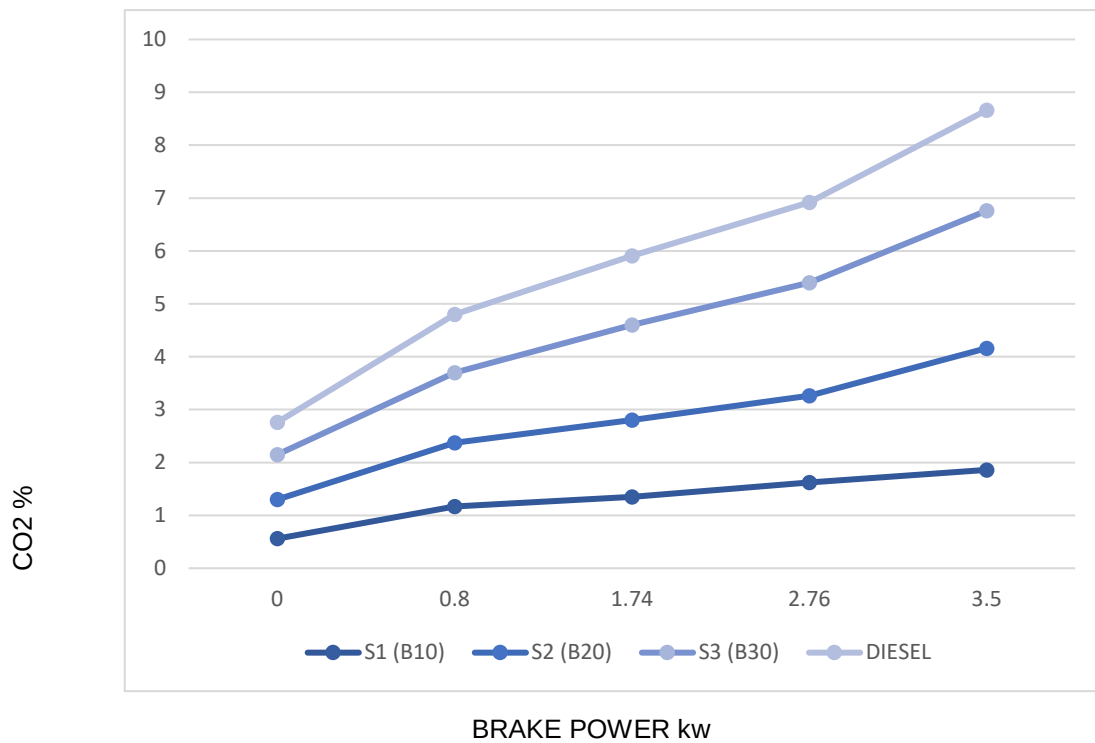


Fig 5.5 emission of carbon dioxide

Carbon dioxide are almost always a sign of poor fuel ignition. It is related with stroke timing, mixing of fuel, atomization and stoichiometric ratio. S2 has the lowest CO₂ emission compared to the Diesel, S1 and S3.

5.2.4 OXYGEN (O₂) EMISSION

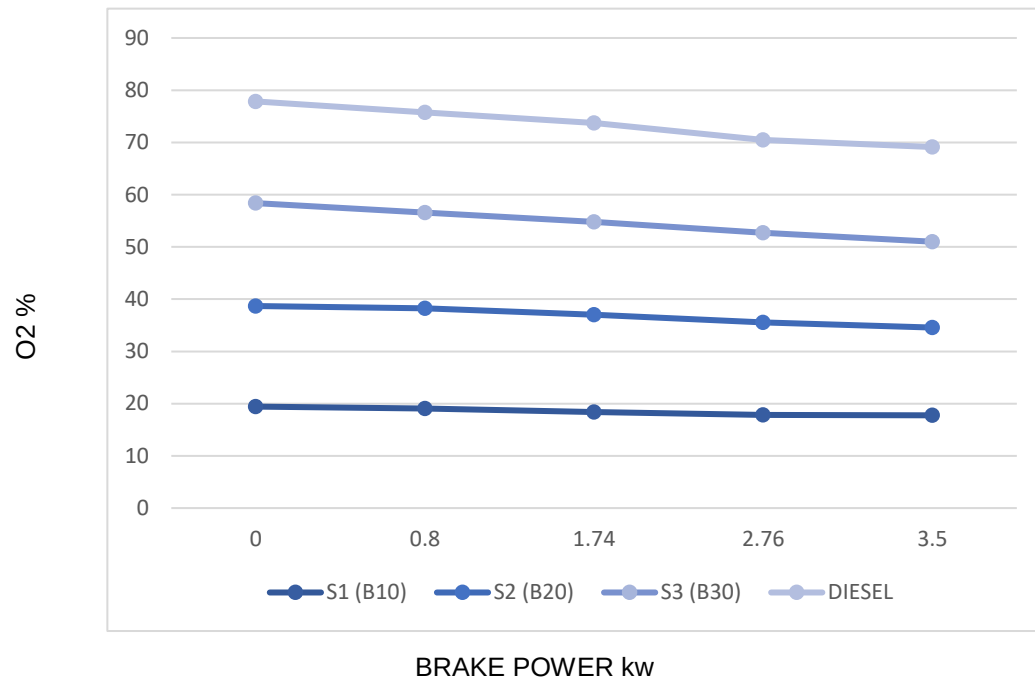


Fig 5.6 emission of oxygen

The O₂ is produced from the response of nitrogen and oxygen gases in the air during combustion, especially at high temperature. O₂ is related to knocking and it is inter related to with calorific value

5.2.5 OXIDE OF NITROGEN (NO_x)

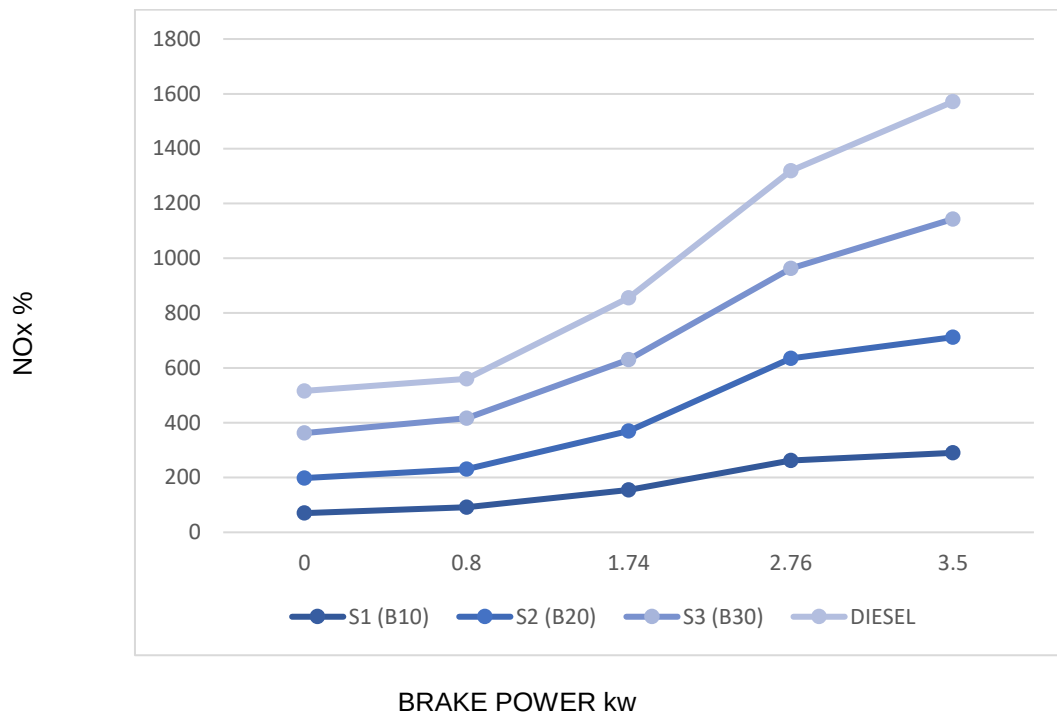


Fig 5.7 emission of oxide of nitrogen

The NO_x is produced from the reaction of nitrogen and oxygen gases in the air during combustion, especially at high temperature. NO_x is related to knocking and it is inter related to with calorific value.

CHAPTER 6

CONCLUSION

6.1 CONCLUSION

In this chapter, the purpose of the proposed research work is explained in detail. The bend S2 is the optimizing fuel when compared to diesel .through this the performance of engine is increased and the emission is controlled .the further result is given below.

From the graph.Mechanical Efficiency, the best result was given by S1 of 72%, followed by S2 of 70.17%, S3 of 60 % against Diesel which is 67.8%. The Mechanical Efficiency is the effectiveness of an engine in transforming its input energy to output energy.

From the graph.BTE, the best result was given by S3 of 30 % followed by S2 of 28.4%, S1 of 29.4 % against Diesel which is 26%. The Brake Thermal Efficiency is used to evaluate hoe well an engine converts the heat from a fuel to mechanical energy.

From the graph .SFC, the best result was given by S2 of 0.34 kg/kWh,followed by S3 of 0.34 kg/kWh, S1 of 0.32 kg/kWh against Diesel which is 0.30 kg/kWh.

The Specific Fuel Consumption is typically used for comparing the efficiency of internal combustion engines with a shaft output.From the graph.4.5. CO, the less reduction in CO was given by S2 of 0.07%

followed by S3 0.10 %, S1 0.12 % against Diesel which is 0.14%. In this CO and CO₂ are inter related when oxygen increases CO₂ occurs and when the oxygen decreases CO occurs

From the graph . HC, the best result was given by S2 of 53 % decreasing followed by S3 of 57 % decreased, S1 of 74 % increased when compared to Diesel, which is 58 %. Hydrocarbon emissions are almost always a sign of poor fuel ignition.

From the Graph. NO_x, when compared to conventional pressure crank angle graph at the full load condition for different blends it is observed that knocking is said to be happened at the angle of -6° to 90°. Which is observed numerically from the NO_x tabulation.

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