

PERFORMANCE AND EMISSION STUDY ON THE EFFECT OF DECANOL ADDITIVE WITH NEAT BIO-DIESEL FUELED CI ENGINE

Submitted in partial fulfillment of the requirements for the award of Bachelor of
Engineering degree in Mechanical Engineering

By
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**DEPARTMENT OF MECHANICAL ENGINEERING SCHOOL OF MECHANICAL
ENGINEERING**

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY (DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC

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APRIL 2023



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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of Maneesh.N(39150080) Rohith.I (39150111) who carried out the project entitled **performance and emission study on the effect of decanol additive with neem bio-diesel fueled CI engine** under **Dr. S.P. Venkatesan** from December 2022 to April 2023.

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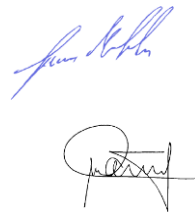
Submitted for Viva voce Examination held on 26-04-2023

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DECLARATION

I Maneesh.N(3915008) and Rohith.I (39150111) hereby declare that the Project Report entitled I and hereby declare that the Project Report entitled **PERFORMANCE AND EMISSION STUDY ON THE EFFECT OF DECANOL ADDITIVE WITH NEAT BIO-DIESEL FUELED CI ENGINE** done by me under the guidance of **Dr.S.P.VENKATESAN** is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering in Mechanical Engineering.

Two handwritten signatures are present. The top signature is in blue ink and appears to be 'Maneesh N'. The bottom signature is in black ink and appears to be 'Rohith I'.

DATE: 26.04.2023

PLACE: CHENNAI

SIGNATURE OF THE CANDIDATES

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

I convey my sincere thanks to **Dr. S. Prakash, M.E., Ph.D.**, Dean, School of Mechanical Engineering and **Dr. G. Arun Kumar M.E., Ph.D.**, Head of the Department, Department of Mechanical Engineering for providing me necessary support and details at the right time during the progressive reviews.

I would like to express my sincere and deep sense of gratitude to my guide **Dr.S.P.VENKATESAN** for their valuable guidance, suggestions and constant encouragement paved way for the successful completion of my project work.

I also express my thanks to all Teaching and Non-teaching staff members of the Department of Mechanical Engineering who were helpful in many ways for the completion of the project work.

ABSTRACT

In recent years, extensive study has been done to identify appropriate alternatives to replacing petroleum fuels. The objective of this research is to improve the performance characteristics, reduced emissions from neem biodiesel (BD100), and investigate the possibility of using clean BD100 directly in a diesel motor. The concentrations of biodiesel were kept at 80% and 90%, where the Decanol volumes were 10, 20. This work revealed an adopted increase in decanol concentration by both the decrease in fuel usage and the increase in the engine's thermal efficiency. Minor changes in the environment resulted in lower levels of smoke, HC, and CO and more NOX emissions compared to diesel. Moreover, the Combustion front, such as the rate of heat release rate (HRR) whereas for neem, the peak pressure rose as decanol content did. biodiesel. According to this study, 80% of neem biodiesel and 20% of decanol can be enhanced the diesel engine combustion performance and emission with no alternative.

Keywords: Neem Biodiesel, performance, diesel, emission, CI Engine, Decanol

LIST OF ABBREVIATIONS

VCR Variable Compression Ratio

BTE Brake Thermal Efficiency

SFC Specific Fuel Consumption

HC Hydro Carbon

CO Carbon Monoxide

CO₂ Carbon Dioxide

O₂ Oxygen

Nox Oxides of Nitrogen

CHAPTER 1

INTRODUCTION

Biofuels can meet the demand from the transportation sector. Compared to fossil fuels, biofuels are clean, renewable fuels that produce fewer greenhouse gases [1]. The food chain is negatively impacted by the larger-scale manufacturing of biodiesel from edible oil sources such as rapeseed, soybean, palm, and sunflower seeds. Numerous studies are being done on non-edible sources for industrial output as a means of solving these problems. Neem oil (NO), available in abundance, is non-edible, has a greater energy content, and is most crucially a source from a waste product, all of which make it a viable source of biodiesel (BD). In India, NO is widely available but is inedible. The use of Neem biodiesel (NOBD) as a fuel or as part of a fuel blend in CI engines has only been tested in a very small number of experiments [2-4]. Due to their broad spectrum of inflammability, high cetane number, high heat of vaporization, and low sulfur content, alcohols offer a viable alternative to fossil fuels [4]. Alcohols are not used as a neat substitute due to their corrosive nature and poor cold start qualities. Alcohols are used with diesel and BD to reduce viscosity and density, improving the fuel's ability to spray and atomize [5]. Alcohol also improves the O₂ in gasoline, lowering HC, CO₂, and CO emissions as a result. Alcohols also increase the effectiveness of combustion. Numerous investigations on various alcohols, including ethanol, pentanol, butanol, methanol, octanol, and hexanol, showed a substantial positive trend in terms of emissions. The suitability of ethanol in diesel at 5, 10, and 20% v/v for research engines were evaluated by Venu and Madhavan [4]. CO and NO_x emissions were found to be lower than those of neat diesel. Diesel, however, was superior to BTE. Madhavan and Venu [4] rice biodiesel/diesel mixes with methanol (5, 10, and 20% v/v) and tested in a single-cylinder CI engine. Methanol is added to biodiesel/diesel blends to improve their poor performance and emission characteristics. They saw an immediate decrease in smoke and NO_x emissions. Devarajan and others [5] tested whether papaya seed biodiesel at 5, 10 and 20% v/v was suitable for research engines. It was observed that crude biodiesel had lower CO and NO_x emissions.

Additionally, the BSFC was better than palm biodiesel. It is evident from the review of the literature that NOBD is widely distributed. Nevertheless, it cannot be used effectively in the engine as a straight fuel due to its low performance, poor atomization, and greater NO_x emissions. Additionally, alcohol's heat capacity and oxygen concentration show promise as a positive addition when combined with BD. Additionally, the atomization property The research report's findings also make clear that adding alcohols to BD or diesel at a certain volume has the potential to drastically cut tailpipe emissions without significantly altering combustion or performance characteristics. Alcohols are a perfect candidate for diesel & BD partial substitution because of their excellent solvency, low polarity, and moisture content [6]. Additionally, higher alcohols have a higher heating value than many biodiesels due to their higher carbon content. As a result, several studies have focused on using higher alcohols as an additive for BD applications, such as hexanol, pentanol, and butanol [4–7]. Additionally, the method used to create these alcohols from a variety of biological feedstocks has gradually improved. These alcohols are created using the feedstocks of lignocellulose biomass, glucose, rice strum, and microorganisms.[7] Numerous studies look at how alcohol with three to seven carbon chains affects diesel and BD. seeking an alternative for fuel applications. Decanol with BD & diesel applications hasn't, however, been the subject of any specific research studies. More oxygen and calories are contained in decanol than in any other alcohol. [7] Decanol actually has a higher cetane index than diesel. For easier ignition, a higher cetane index is preferred. The goal of this research is to determine how different concentrations of decanol affect NOBD. Neem biodiesel is preferred because it is non-renewable, more readily available, contains more oil, has enhanced physicochemical qualities, and supports the agriculture industry. Additionally, it has no effect on the security of food or fuel.

CHAPTER 2

LITERATURE SURVEY

SN. NO	YEAR	AUTHOR&JOURNAL NAME	INTFERENCE
1	29 February 2020	Mathalai Sundaram Chandra Sekar, Vennimalai Rajan Ananthan , Nagarajan Baskaran , Hari Kishore Suresh Kumar , and Rameshbabu Arumugam	Octanol and 80% of biodiesel can optimize diesel engine emissions, combustion, and performance with undergoing any modifications. This research work investigates on the impact of octanol with neem biodiesel (NBD) on diesel engine characteristics. Two different fuel blends are created by changing the n-octanol content in NBD from 10 to 20%.
2	8 December 2019	S. Madhankumar M. Jerome Stanley · S. Thiagarajan V. Edwin Geo V. Karthickeyan · Zheng Chen	Oxygen enrichment reduced smoke, HC and CO emissions by 36, 34 and 50%, respectively, at maximum load condition. Direct use of straight vegetable oil in CI engine can mitigate CO ₂ emission and be cost effective. BTE was reduced by about 5% with MO in comparison with diesel at maximum load condition.
3	06 February 2019	Suresh Vellaiyan	Carbon nanotube (CNT) was used as an additive to a diesel engine. CNT's physiochemical properties are in good agreement with standard limits. Tests were carried out on a single-cylinder, four-stroke, and natural aspirated research diesel engine.
4	25 October 2016	Harish Venu , Venkataramanan Madhavan	Diethyl ether (diethyl ether) can improve the performance of ternary blends (alcohol-biodiesel-diesel) by using it as an ignition enhancer. EBD, MBD and EBD5DEE blends have better engine performance, combustion and emission characteristics than EBD blend.
5	19 May 2020	Yuvarajan Devarajan Beemkumar Nagappan G. Mageshwaran M. Sunil Kumar R.B. Durairaj	A study examines the prospect of utilizing biodiesel from non-edible, waste seed derived from grapefruit. 30% volume of grape-seed biodiesel (BD) is blended with 70% volume of diesel and identified as base fuel. Two antioxidants namely BHA and BHT are partially blended to enhance theignition patterns of diesel/biodiesel blends.

6	November 11, 2019	Ravikumar Jayabal, Lakshmanan Thangavelu, and Chandran Velu	Two oxygenates, derived from non-food-based lignocellulosic biomass in a blended form with transesterified oil extracted from waste sapota seeds. Results were correlated with baseline diesel fuel. The brake thermal efficiency (BTE) of an engine fueled with a B40% + DMC10% blend was better.
7	30-may-2020	Devarajan, Y., Munuswamy, D., Nagappan, B., & Ganesan, S.	A study examines the impact of oxygenated additives namely DTBP (Di-Tetra-Butyl-Phenol) and 1-Pentadecanol on emissions, combustion and performance patterns of Karanja biodiesel/diesel blends. Addition of additives lowered harmful emissions significantly with a slight increase in NO emissions to the KBD/D blends. However, blending the additives enhanced its HRR and peak pressure.
8	15 February 2019	Thiyagarajan, S., Sonthalia, A., Edwin Geo, V., Ashok, B., Nanthagopal, K., Karthickeyan, V., & Dhinesh, B.	A fuel ionization filter placed in the fuel line, before the injection pump, ionizes the fuel molecules and increases the rate of disintegration of droplets due to a decrease in viscosity and surface tension. The magnetic field strength of electromagnet is higher than permanent magnet which tends to increase the ionization of the fuel.
9	2020	<i>Vellaiyan Suresh</i>	Emulsion fuels with 5% and 10% volume of water in soybean biodiesel along with mass fraction of cerium oxide nanoparticle were prepared using mechanical agitator and ultrasonicator. At low load conditions, the emulsion fuels increase the hydrocarbon and CO emissions, whereas these magnitudes are reduced at high load conditions.
10	1 September 2019	Devaraj Rangabashiam, Jayaprakash V, Ganesan S & Christopher D	Octanol-based biodiesel blends have slightly higher Brake efficiency (0.3–0.7%) and lower Brake specific fuel consumption (0.4% to 0.9%) than that of neat biodiesel (PBD) at all engine loads. Nitrogen Oxides (NO _x) emission and smoke emission are reduced by 2–2.9% and 2.1–3.2% for octanol and biodiesel blend respectively.
11	02 July 2018	S. Thiyagarajan, V. Edwin Geo, Leenus Jesu Martin, B. Nagalingam	Karanja oil methyl ester (KOME), orange oil (ORG), oxygenates blended fuel and zeolite-based post-combustion capture system (ZPCS) were tested on a single CI engine. ZPCS was placed in the exhaust line and tested with all oxygenate blends with KOME-ORG, methanol blend and n-butanol.
12	22 September 2019	Devaraj Rangabashiam, Jayaprakash V, Ganesan S, Nagaraj M & A Rameshbabu	Pongamia biodiesel fuel with the addition of titanium oxide (TiO ₂) nanoparticles has improved combustion when compared to diesel fuel. The TiO ₂ nanoparticle significantly increases the peak pressure and the net heat release rate values for Pongamia biodiesel engine.
13	29 January 2020	Devarajan, Y., Beemkumar, N., Ganesan, S., & Arunkumar, T.	The purpose of this work is to enhance the performance aspects and to limit emissions from Papaya seed biodiesel operation. This research paves a way of investigating the impact of decanol (n-D) and DTBP on biodiesel/diesel blends on the research engine.

14	30 July 2019	Suresh Vellaiyan	A study details the enhancement in combustion, performance, and emission characteristics of SB fueled diesel engine by using water emulsion (10% and 20%) and CNT nanoparticle. Studies in the engine revealed that the combustion starts later for water/biodiesel blends, and ICP, NHR, and RPR are higher compared to pure SB.
15	19 May 2018	D. Boopathi, S. Thiyagarajan, V. Edwin Geo, S. Madhankumar, R. Gheith	Gutter oil/waste cooking oil obtained from vegetarian and non-vegetarian restaurants used for frying chicken and fries (WCO2) is blended 20% by volume with WCO1 and WCO2 and tested in a CI engine. BTE improves with geraniol blending in par with diesel, according to experimental results.
16	14 October 2016	Bharathiraja, B., Jayamuthunagai, J., Sudharsanaa, T., Bharghavi, A., Praveenkumar, R., Chakravarthy, M., & Yuvaraj, D.	The global demand for energy and material products is steadily growing. To meet the increasing demand of energysources, biomass resources are extremely promising. Biobutanol is found to be efficient fuel compared to other known biofuels both by physical and chemical properties.
17	23 Dec 2019	Suresh Vellaiyan, Arunkumar Subbiah, and Prabha Chockalingam	Diesel-water emulsion fuel blends and TiO ₂ nanoadditive incorporated into diesel engines significantly improve the exhaust characteristics. 10% water in BD reduced the EGT by 8.8% at peak BMEP condition. The HC and CO emissions of water emulsified BD are seem to be higher at low-engine loads.
18	3 April 2019	Yuvarajan Devarajan · Dineshbabu Munusamy· Beemkumar Nagappan Ganesan Subbiah	Study examines the effect of butanol as an oxygenated additive to lower carbon monoxide, smoke, nitrogen oxide and hydrocarbon emissions from diesel engines. Transesterification technique yielded 88% biodiesel from raw Punnai oil. Engine tests resulted in lower CO, smoke, NO _x and HC emissions when fuelled with both butanol blends (B10 and B20) compared to P100.
19			
20	August 29, 2016	Harish Venu, Venkataramanan Madhavan	Experimental work focused on improving the performance and emission characteristics of biofuel blend (diesel, biodiesel, ethanol and diethylammonium nitrocellulose). Compared analysis was done for addition of Diethyl ether (DEE) and alumina nanoparticle (Al ₂ O ₃) at various concentrations.
21	21 January 2018	K. Nanthagopal, B. Ashok a, B. Saravanan, Shane Mathew Korah Snehith Chandra	Biodiesel can serve as potential alternate fuels in compression ignition engine as it leads to an effective reduction in consumption of fossil fuels. However, the lowercalorific value of biodiesel coupled with higher oxygen content leads to a poor performance and higher oxides of nitrogen emissions.
22	27 May 2019	Suresh Vellaiyan, Arunkumar Subbiah & Prabha Chockalingam	10% water-emulsified diesel fuel reduced NO _x and smoke emissions by 21.3% and 8.1% compared to pure SB and improved the BTE by 13.5%. An inclusion of TiO ₂ nanoparticle significantly improves the performance and emissions of a single-cylinder, four-stroke diesel engine.

23	25 July 2018	V. Mathan Raja, L.R. Ganapathy Subramanian, S. Thiyagarajan , V. Edwin Geo	Simarouba glauca and diesel blends (B20 and B40) were prepared and tested to study the CI engine performance, emission and combustion characteristics under different load conditions. The outcome of this research work is that poor combustion characteristics of the biofuel-diesel blend can be improved with the minor addition of aliphatic and aromatic alcohols.
24	19 November 2018	Lingesan Subramani & Harish Venu	Chlorella emersonii methyl ester (CEME) was blended with petroleum diesel fuel. CEME blends resulted in slightly higher levels of CO ₂ (carbon dioxide) and NO _x (oxides of nitrogen) emissions. It can be utilized in an unmodified diesel engine with minimal tailpipe emissions.
25	7 November 2018	K. Nandagopal, B. Ashoka B. Saravanan, M. Ramesh Pathy, G. Sahil, A. Ramesh Md Nurun Nabi, Mohammed Golam Rasul	40% blend of decanol, biodiesel and diesel can optimize engine performance and emission without performing any modifications in the CI engine. Peak pressure is found to be highest for 40% decanol blend and least for 10%, while CO, HC, and smoke opacity decrease with decanol content.
26	16 October 2018	Edwin Geo Varuvel & Ankit Sonthalia & Thiyagarajan Subramanian & Fethi Aloui	Study investigates effect of blending oxygenate with minor vegetable oil on NO _x -smoke trade-off and other engine characteristics. Addition of diethylene glycol dimethyl ether (DGM) increased brake thermal efficiency by 2–7%. DGM reduced smoke, HC, and CO emission drastically with a slight increase in NO _x emission.
27	21 August 2018	B. Ashok, K. Nanthagopal B. Saravanan, Kalam Azad, Deepam Patel B. Sudarshan, R. Aaditya Ramasamy	Iso butanol is the next generation biofuel which can be used as partial substitute to petroleum diesel or biodiesel due to its better solvency character. All binary and ternary blends of isobutane reduce CO emission by 13–59% than that of diesel fuel.
28	December 29, 2015	Harish Venu Venkataramanan Madhavan	Addition of nanoparticles increases the oxidation rate, reduces the light-off temperature and creates large contact surface area with the base fuel. Addition of Zirconium nanoparticles increased BSFC and HC emissions with lowered CO, CO ₂ and smoke emissions in comparison with BE blends.
30	23 May 2019	Devaraj Rangaatam, K. Logesh, U. Yashvanth, Ganesan Subbia , and Christopher Selvam D.	Silicon oxide as an additive in various particle-size of 10 nm and 20 nm is included to D100. SiO ₂ nanoparticle further reduces CO and HC emissions by 3.2% and 2.6% respectively for D100SiO ₂ 20. Tailpipe NO _x emission was found to be 0.7% lower when fueled with these particles.
31	25 July 2018	B. Ashok, K. Nanthagopal, Vivek Anand, K.M. Aravind,	Biodiesel can serve as possible alternate fuels in compression ignition engine as it leads to effective reduction in consumption of fossil fuels. It has been observed that the addition of n-octanol with biodiesel decreases the calorific value due to its inherent oxygen

		A.K. Jeevanantham, Saravanan Balusamy	content. Brake specific fuel consumption has been reduced by about 20% and brake thermal efficiency improved by 30%.
32	13 March 2019	A. Ramesh , B. Ashok , K. Nanthagopal , M. Ramesh Pathy, Abhijeet Tambare , Prajwal Mali , Pratik Phuke , Sumit Patil , Rayapati Subbarao	The brake thermal efficiency was observed to be significantly higher for the hexanol blends, especially for 40% hexanol is closer to that of pure diesel at elevated brake mean effective pressures. A significant improvement in the combustion characteristics such as the in-cylinder pressures and net HRR figures were observed when compared to biodiesel.
33	2013	Md. Hasan Ali Mohammad Mashud , Md. Rowsonozzaman Rubel , Rakibul Hossain Ahmad	Renewable energy sources such as biodiesel, bioethanol, biomethane, and biomass from wastes or hydrogen have become the subjects of great interest. Biodiesel can make a major contribution in the future if it meets the few percent of petroleum and it can provide improved fuel properties.
34	4, APRIL 2010	K. Anbumani and Ajit Pal Singh	Studies have shown that on blending vegetable oils with diesel a remarkable improvement in their physical and chemical properties was observed. Oils were esterified (butyl esters) before blending with pure diesel in the ratio of 10:90, 15:85, 20:80, and 25:75 by volume.
35	, Number 4 (2009)	Meda Chandra Sekhar , Venkata Ramesh Mamilla , M.V. Mallikarjun and K. Vijaya Kumar Reddy	This study supports the production of biodiesel from non edible neem oil as a viable alternative to the diesel fuel. The viscosity of this biodiesel oil is nearer to that of diesel and the calorific value is about 16% less than that for diesel.
36	20 October 2011	S. Kent Hoekmana,* Amber Brocha, Curtis Robbins a, Eric Ceniceros a, Mani Natarajanb	Biodiesel is a renewable transportation fuel consisting of fatty acid methyl esters (FAME), generally produced by transesterification of vegetable oils and animal fats. Coconut, palm and tallow contain high amounts of saturated FA; corn, rapeseed, safflower, soy, and sunflower are dominated by unsaturated FA. Algal species contain considerably higher levels of poly-unsaturated FA than is typically found in vegetable oils.
37	2010	Kazi Mostafijur Rahman, Mohammad Mashud, Md. Roknuzzaman and Asadullah Al Galib	Jatropha is a wildy growing hardy plant in arid and semi-arid regions of the country on degraded soils having low fertility and moisture. The seeds of Jatropha contain 50-60% oil, which can be converted to biodiesel by the well-known process.
38	24 December 2009	Gerhard Knothe	The search for alternatives to petroleum-based fuels has led to the development of fuels from various sources, including renewable feedstocks such as fats and oils. Biodiesel is defined as the mono-alkyl esters of vegetable oils or animal fats. "Renewable diesel" is produced from the fat or oil by a hydrodeoxygenation reaction at elevated temperature and pressure.

39	2007	Tom Kalnes* Terry Markert† David R. Shonnard‡	Paper describes a new process technology developed by UOP and Eni S.p.A to produce greendiesel from vegetable oil. The novel process utilizes catalytic saturation, hydrodeoxygenation, decarboxylation and hydroisomerization reactions to produce isoparaffin-rich diesel fuel.
40	29-November 1, 2007	Markku Kuronen and Seppo Mikkonen Neste Oil Päivi Aakko and Timo Murtonen	NExBTL is a 2nd generation renewable diesel fuel made by a refinery-based process converting vegetable oils to paraffins. Properties of this non-ester type biobased fuel are very similar to GTL. Emissions of two heavy duty engines and two city buses are presented with HVO and sulfur free EN 590 diesel fuel.
41	9 November 2016	Gerhard Knothe a, , Luis F. Razon b	Biodiesel is an alternative to conventional petrodiesel for use in compression-ignition engines. The fatty acid esters that comprise biodiesel largely determine many important fuel properties. Feedstocks with widely varying fatty acid composition can be used for biodiesel production. Optimizing biodiesel composition is also addressed.
42	01 October 2020	• Michaël Clairotte, • Ricardo Suarez-Bertoa, • Alessandro A. Zardini, • Barouch Giechaskiel, • Jelica Pavlovic,	The study aims at summarizing methane and nitrous oxide exhaust emissions from L-category, light-duty and heavy-duty vehicles in the European Union. The assessment is based on measurements carried out in the Vehicle Emission Laboratory of the Joint Research Centre between 2009 and 2019.

CHAPTER 3

AIM AND SCOPE

The United States produces biodiesel, a sustainable, clean-burning alternative to petroleum-based diesel. The use of biodiesel as an automobile fuel promotes safety while also enhancing the ecology and air quality. Biofuels contribute to by enhancing the carbon cycle on our planet, we can reduce the carbon footprint of transportation and other industries. Lower greenhouse gas emissions result from using biofuel in place of fossil fuel in every gallon of transportation.

CHAPTER 4

MATERIAL AND METHODOLOGY

MATERIAL

NEEM oil

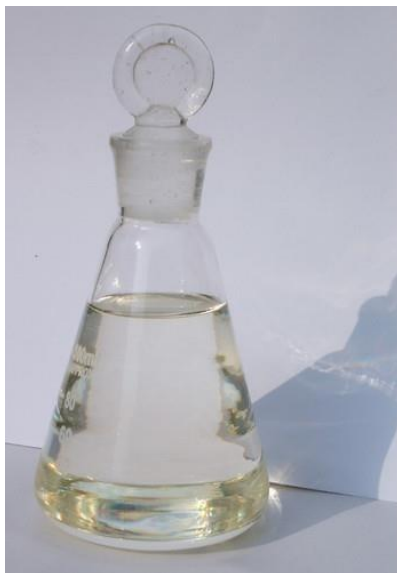
The seeds of Neem contain 30-40% oil. Vegetable oil cannot be directly used in diesel engines for its high viscosity, high density, high flash point, and lower calorific value. Biodiesel production is a valuable process that needs continued study and optimization process.



Properties	Neem oil
Density (gm/cc)	0.878
Kinematic viscosity (centistokes) at 35°C of oil	24.14
Calorific value [MJ/kg]	26.65

DECANOL ADDITIVE (C₁₀H₂₂O)

Decyl alcohol appears as a clear colourless liquid with a sweet fat-like Odor. Flashpoint 180°F. Less dense than water and insoluble in water. Vapores are heavier than air.



Properties	
Chemical formula	C ₁₀ H ₂₁ OH
Molar mass	158.28 g/mol
Appearance	Viscous liquid
Density	0.8297 g/cm ³
Melting point	6.4 °C (43.5 °F; 279.5 K)
Boiling point	232.9 °C (451.2 °F; 506.0 K)
Solubility in water	37 mg/L at 20°C
log <i>P</i>	4.57
Viscosity	12.048 mPa.s (@ 25 °C)

DIESEL

Diesel fuel is specifically designed to use in a diesel engine, a type of internal combustion engine in which fuel ignition takes place without a spark as a result of compression of the inlet air and then injection of a fuel. Therefore, diesel fuel needs good compression ignition characteristics



PROPERTIES	DIESEL
Density (kgm-3)	850
Viscosity(mm2s -1)	2.6
Flash point(oc)	68
Calorific value (kj/kg)	42
Cetane number	45-50

Table 2 Properties of diesel

CHAPTER 5

TRANSESTERIFICATION PROCESS

Alcohol undergo transesterification, also known as alcoholics, in the presence of a catalyst to create mono-esters. The triglyceride molecules with the long, branched chains are converted into mono-esters and glycerine. Three sequential reversible processes make up the transesterification process. Specifically, the transformation of triglycerides into diglycerides and then from diglycerides to monoglycerides. Each time the glycerides are transformed into glycerol, one ester molecule is produced. These esters' characteristics are similar to those of diesel. According to stoichiometry, three moles of alcohol must be present for every mole of triglyceride, but in reality, a higher molar ratio is used to shift the equilibrium and increase ester synthesis. Although esters are the targeted end products of the transesterification reactions, glycerine recovery is crucial because of its many industrial applications. The short-chain alcohols methanol, ethanol, propanol, and butanol are frequently utilized. The type of alcohol utilized has no effect on the esterification yield. Therefore, the final decision on which of these three alcohols to use will be determined by factors such as cost and performance. Due to its low cost, methanol is employed in the industry. Compared to acid catalysts, alkaline hydroxides are the most efficient transesterification catalysts. The two most widely used alkaline catalysts are potassium hydroxide and sodium hydroxide. Vegetable oils can only be transesterified using an alkaline catalyst if their acid value is higher FFA content in the oil lowers the esterification process' output

CHAPTER 6

ENGINE SET-UP

Variable compression ratio (VCR) is a technology to adjust the compression ratio of an internal combustion engine while the engine is in operation. This is done to increase fuel efficiency while under varying loads. Variable compression engines allow the volume above the piston at top dead centre to be changed. Higher loads require lower ratios to increase power, while lower loads need higher ratios to increase efficiency. The compression ratio is the ratio between the volume of the cylinder and combustion chamber in an internal combustion engine at their maximum and minimum values. A fundamental specification for such engines, it is measured two ways: the static compression ratio, calculated based on the relative volumes of the combustion chamber and the cylinder when the piston is at the bottom of its stroke, and the volume of the combustion chamber when the piston is at the top of its stroke. Compression ratio determines the type of fuel, how much boost, and has a significant influence on an engine's power and torque potential.

Advantages Of ci engine

Comparisons between CI and SI engines are frequently addressed in terms of the advantages one engine type has over the other. There must be compelling and significant benefits to employing a compression ignition diesel engine, as compression ignition engines are employed in a variety of applications serving a wide range of sectors.

Applications Of ci Engine

- High power two stroke diesel engines (CI Engines) are used in ship population.
- Small diesel engines are used in pump set, compression machinery, aircompressor, drilling rigs etc.
- These engines are widely used in automobiles like car, jeep, trucks etc.
- Earthmovers like loader, excavator, paver etc. uses supercharged dieselengines.
- It is used for high power electricity generators.

Chapter 7

BIODIESEL SAMPLE PREPARATION

Neem raw oil can be blend and transesterification process converted into neem biodiesel .we can take raw neem oil and blend it get biodiesel .In that we can take three sample for this experiment that shown in below

Sample	diesel	Biodiesel	decanol
1	65%(650ml)	20%(200ml)	15%(150ml)
2	60%(600ml)	25%(250ml)	15%(150ml)
3	55%(55ml)	30%(300ml)	15%(150ml)

CHAPTER 8

RESULT AND DISCUSSION

CHAPTER 9

CONCLUSION

The purpose of this study is to identify the biodiesel. compounds used in diesel engines to create the SFC, BTE, CO, NO_x, and smoke emissions at maximum power and consumption. Jatropha cruces as a viable substitute fuel source for biodieselA large desert area that receives municipal rubbish is better suited for a diesel engine.Widespread usage of jatropha aims to replace non-edible biodiesel oil sources with the pure oil extracted from its seeds for biodiesel production.

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