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To Study the effect of C.R. and additive on performance and emission characteristic of Hybrid Methyl Ester(W+U) on diesel engine using optimization technique.

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ABSTRACT: Consumption of fossil fuels to meet increasing demand of globalization is increased considerably resulting in depletion of fossil fuel reserves. Stringent environmental norms and increase in greenhouse gases emissions has forced researchers to search alternatives to fossil fuels. Biodiesel (Methyl Ester) is one of the alternatives that can be used as fuel in conventional diesel engine without any design modifications. This project deals with synthesizing good quality of Methyl Ester from Mexicana seeds which is available cheaply in rural areas and grown in marginal lands. Different blends of Undi and waste cooking/fired oil are prepared in order to investigate the properties of blends and if necessary eco-friendly additives are added with blends. Also, it deals with validation of properties of synthesized Undi and waste cooking/fired oil Methyl ester according to ASTM 6751-96 standards.

KEYWORDS: Biodiesel, crude oils, microalgae, diesel engine, emission, nano particles.

I. INTRODUCTION

Biodiesel, an alternate fuel has attracted considerable attention during the past decade as a renewable, biodegradable and non-toxic fuel. Increasing uncertainty about global energy production and supply, environmental concerns due to the use of fossil fuels like petroleum products especially of diesel fuel has grown up significantly. A reduced cost than fossil fuel and produce biodiesel from waste fats and oils and another option for cost reduction is to reduce the cost of processing through optimizing the process variables that affect the yield and purity of biodiesel. Undi, an annual herb, is common weed in both agricultural and waste lands. The seeds of a Undi are narcotic and emetic and they yield (35%) yellowish brown oil apparently looking like mustard oil with respect to color, odor and even specific gravity. It is non-edible oil and its toxicity attributes to the presence of two alkaloids. Undi has been found most suitable for this purpose. This plant found everywhere as weed. The plant prefers light (sandy) soils, requires well-drained soil and can grow in nutritionally poor soil.

II. LITERATURE REVIEW

[1]Pravin Ashok Madane, of Mechanical Department said that biodiesel is produced from hybrid oil (dairy waste milk scum and karanja). To achieve the essential requirement of the day and provision of forthcoming energy storage with lowest concession in performances and exhaust emissions, suitable source should use for energy supply. Hence, in this work the effect of varying compression ratio on performance-emissions profiles using Undi ethyl ester is investigated and presented. The experimental study was conducted on single cylinder, direct injection variable compression ratio Diesel engine to analyses the performance-emission using various blends (10%, 20%, 30%, 40% and 50% biodiesel

content on volume basis) of Undi ethyl ester by changing compression ratio (CR) from 16 to 20. The outcomes exhibit that brake thermal efficiency (BTE) and brake specific energy consumption (BSEC) increases with rise in compression ratio (CR) and amount of Undi ethyl ester in blend. Furthermore, for all Undi ethyl ester blends, rise in compression ratio (CR) reduces carbon monoxide (CO), unburned hydrocarbon emissions with the cost of higher NOX emissions. In perception of experimental results, artificial intelligence-based artificial neural network model has established for exact prediction and locating optimal diesel engine operating conditions using Undi ethyl ester blends.

[2]Aniket Edgaonkar, Prasad Gargade, Everyone is well aware of the fact that the fossil fuels are not going to last long, as they are non-renewable sources of energy and they are depleting very fast. Maximum amount of energy demand is fulfilled with fossil fuels and there are very less alternatives available to fulfill the needs. Due to this reason a better alternative to this danger was much needed. After studying various alternatives available, we came across biodiesel. Biodiesel is form of diesel fuel derived from plants or animals which contains long chain fatty esters. Biodiesel obtained from Undi Plant seed oil has given better results. But biodiesel independently is not able to replace the Crude diesel fuel and hence require some additives with proper extraction procedure to improve its performance. For this reason, a proper extraction methodology needs to be followed to get the best results possible. Biodiesel from Undi plant seed can be obtained by either In-Situ Transesterification or Transesterification process. Instead of using biodiesel directly, nanoparticles of Aluminium oxides were added in 50ppm as a stabilizer.

[3]Rahul Krishnaji Bawane, Nilima Baliram Gadge, Dinesh Krishnaji Bawane, An increasing demand of fossil fuels has being a critical problem for us. The natural resources of fossil fuel are dwindling day by day. Biodiesel that may called natural fuel may be a good source or substitute for fossil fuel in future. An experiment is conducted to obtain the operating and emission characteristics of Undi Oil Biodiesel on Diesel Engine run on various Blends of biodiesel, Load Conditions and Injection Pressure. From the comparison of results, it is inferred that the engine performance is improved with significant reduction in emissions for the chosen oils without any engine modification. The effective injection pressure can be fixed based on the experimental results obtained in the engine since the findings of the present research work infer that the biodiesel obtained from Undi oil is a promising alternative fuel for direct-injection four-stroke VCR diesel engine.

[4]Bhupendra Singh Chauhan, In order to meet the growing global energy requirement, exhaustive research is carried to develop and use variety of renewable fuels. Main objective of the present study is to compare the performance, emissions and combustion characteristics of biodiesel derived from non-edible Karanja oil in an unmodified diesel engine and to compare the results with baseline results of diesel fuel. Important physicochemical properties of Karanja oil after transesterification were experimentally evaluated and found within acceptable limits of relevant standards. The performance parameters evaluated in the present study includes brake thermal efficiency of Karanja biodiesel with different compositions at 5%, 10%, 20%, 30% and 100% with mineral Diesel. BTE was about 3e5% lower with Karanja biodiesel and its blends with respect to diesel. Also, emissions parameters such as carbon monoxide, carbon dioxide, UBHC (unburned hydrocarbon), oxides of nitrogen and smoke opacity for different test fuels were also measured. UBHC, CO, CO₂ and smoke were lower with Karanja biodiesel fuel. However, NO_x emissions of Karanja biodiesel and its blend were higher than Diesel. The combustion analysis was done using peak cylinder pressure and heat release rate with respect to crank angle. The peak cylinder pressure and heat release rate was lower for Karanja biodiesel.

[5]Atul Dhar, Avinash Kumar Agarwal, said that For large-scale and reliable implementation of biodiesel in transportation engines, its effects on engine wear and engine durability upon prolonged usage needs to be experimentally investigated. Therefore effects of 20% Karanja biodiesel blend (KOME20) on engine wear and durability was studied vis-à-vis mineral diesel in 250 h long endurance test on a direct injection compression ignition (DICI) engine. Visual inspection of engine components for deposits indicted higher carbon deposits on piston top, cylinder head and injector tip for biodiesel fuelled engine. Relatively lower wear of valves, pistons, piston rings, liners and small end bearings of the connecting rods was observed for biodiesel fuelled engine. Wear of big end bearing of the connecting rods, main bearings and crank pins was found to be higher for biodiesel fuelled engine. Surface texture of cylinder liners remained in acceptable condition after the endurance test for mineral diesel as well as Karanja biodiesel blend. Despite higher carbon deposits and higher wear of some vital engine components, no operational problems were observed during the long-term endurance test for the biodiesel fueled engine.

[6] Mr. Sushil.B.Dole, Prof. S.Y.Bhosale, they perform the Experiment were carried out by using callophyllum inophyllum oil blends B10,B20, B30, B40, B50, B70 on diesel engine. Parameter of engine performance like brake thermal efficiency, brake specific fuel consumption, brake power, heat supplied are studied. The graphical presentation of results was done to observe rate of decrease in pollution and increase in efficiency of callophyllum inophyllum with respective blends and diesel. B70 has higher efficiency at maximum load and have less BSFC i.e 0.2355 kg/kw-hr as compare to diesel fuel BSFC which was 0.2691 kg/kw-hr. It was found that B70 has 22% higher efficiency than diesel. B70 can be better replacement for diesel fuel in future. The comparision was done with previous results of pongamia oil biodiesel blend

and it was found that undi biodiesel B70 blends is having higher efficiency, less BSFC compare to pongamia oil blend. It was observed as undi oil performs better than pongamia oil. In future economically undi oil biodiesel can be better replacement to diesel fuel if we increase the plantation of seeds. [7]Yew Heng Teoh 1,* , Heoy Geok How 2 , Thanh Danh Le said that in this study, The test fuels comprised a conventional diesel fuel and four different fuel blends of ALB. The results showed relatively close physicochemical properties of ALB and its blends when compared with petroleum diesel. However, the use of ALB-blended fuel resulted in penalties engine brake power, brake specific fuel consumption (BSFC) despite slightly improved brake thermal efficiency (BTE). Brake specific nitrogen oxide (BSNO_x) was found worsened with higher ALB content in the blends. Nonetheless, consistent improvements in brake specific carbon monoxide (BSCO), brake specific carbon dioxide (BSCO₂), and smoke were noticed when ALB blends were used. Additionally, ALB blends contributed to reduction in peak combustion pressure, peak heat release rate (HRR) and combustion duration. In general, the findings suggest satisfactory operation with ALB biodiesel-diesel blends in an unmodified diesel engine.

[8]Charudatta M. Kshirsagar & Ramanathan Anand, In this study, a non-edible seed oil of Alexandrian Laurel (*Calophyllum inophyllum* L.) with higher free fatty acid content has been harnessed to produce biodiesel by transesterification process. The 20.2% free fatty acid (FFA) content was first reduced to 12.9% by using TOP degumming process. Ortho-phosphoric acid was used to esterify the refined kernel oil. Transesterification reaction was performed with NaOH as an alkaline catalyst and methanol as an analytical solvent. The effects of methanol to oil molar ratio (MR), catalyst concentration (CC), reaction temperature (TP), reaction time (TM), and stirrer speed (SS) on biodiesel conversion were studied to optimize the transesterification conditions using DOETaguchi OA approach. The experimental study revealed that 9:1 MR, 0.8 wt. % CC, 60°C TP, 75 min TM and 1000 rpm SS were the optimal process control variables. The study indicated that CC was the most important control parameter in optimal methyl ester production. The optimal treatment combination yielded 97.14% of biodiesel. [9]M. Rizwanul Fattah,* M.

A. Kalam, said that in the study of Biodiesel is a green fuel produced from renewable resources. It is a clean-burning alternative fuel, which has drawn the attention of energy researchers for the last two decades. This paper presents an experimental investigation on Alexandrian laurel oil as a potential feedstock for biodiesel development. Biodiesel was produced using a two-step esterification–transesterification process. Analysis of the physicochemical properties of diesel–biodiesel blends precedes the performance and emission study using 10% and 20% blends (ALB10 and ALB20). A 55 kW, 2.5 L, four-cylinder indirect injection diesel engine was used to carry out tests under conditions of constant load and varying speed. Brake power decreased 0.36–0.76%, and brake-specific fuel consumption (BSFC) increased 2.42–3.20% for these blends. In general, the exhaust emission profile was much better compared to diesel except for NO_x emission, which increased by 2.12–8.32% compared to diesel.

[10]P.Mohamed Nishatha, A. Krishnaveni, The chief criterion for non commercialization of biodiesel is the unbalanced fuel properties and poisonous NO_x emission level in elevated quantity. But in the case of marketable petrol and diesel fuels, the fuel properties are in much steady state leading to extended fuel stability without putrefying in fuel properties and lower NO_x emission level. The difference between the stability capacities is the reaction of fuels to the atmospheric oxygen. Obviously biodiesel contains oxygen content in superior quantity, as the feedstock is the naturally available resources when compared to fossil fuels. The present attempt has been focused to stable the fuel properties by evaluating the oxidation, storage and thermal stability of Alexandrian laurel and Poison nut biodiesel with the assist of Tert-butyl hydroquinone antioxidant at 1000 ppm, in the subsequent ratios as AP10T, AP15T, AP20T, AP25T and AP30T using high-tech equipments. [11]Md. Ruhul Amin, Md. Joynul Abedin, This

experimental investigation deals with the effects of fatty acid methyl ester (FAME) composition and the physicochemical properties of biodiesel on engine performance and emissions. FAME compositions have a considerable influence on the physical and chemical properties of biodiesel, such as density, viscosity, heating value, cetane number (CN), oxidation stability, and cold flow properties. The performance and emissions of a fourcylinder turbocharged diesel engine were studied under varying speeds and full load condition. For this investigation, 10% and 20% blends of *Jatropha* (*Jatropha curcas*), Alexandrian laurel (*Calophyllum inophyllum*), and palm biodiesels (JB, ALB, and PB, respectively) were used, and the results were compared with that of the B5 fuel (95% diesel and 5% palm biodiesel). The content of saturated fatty acid (methyl palmitate) for ALB and JB was found to be 23.3% and 20.4% higher respectively than that for PB. In total, PB showed 19.8% higher saturation than JB, while ALB showed 7.3% higher saturation than JB because of their higher content of longer chain. [12]H. Venkatesh Kamath, I. Regupathi *, M.B. Saidutta, The free fatty acid of crude karanja oil (*Pongamia pinnata*) was reduced and biodiesel was synthesized from pretreated oil under microwave irradiation. The process variables such as irradiation time, methanol–oil ratio and sulfuric acid concentration for pretreatment step; irradiation time, methanol–oil ratio and KOH concentration were optimized through the Box–Behnken experimental design. The free fatty acid of crude karanja oil was reduced to 1.11± 0.07% with an optimal combination of 190 s irradiation time (180 W), 33.83 (w/w)% methanol–oil ratio and 3.73 (w/w)% sulfuric acid concentration. An optimal combination of 150 s irradiation time, 33.4 (w/w)% methanol–oil ratio and 1.33 (w/w)% KOH

concentration yielded $89.9 \pm 0.3\%$ biodiesel. The model was validated by conducting experiments at optimal design conditions.

[13]Obed M. Ali, Rizalman Mamat, and Che Ku M. Faiza, As a renewable, sustainable and alternative fuel for compression ignition engines, biodiesel is widely accepted as comparable fuel to diesel in compression ignition engines. This is due to several factors like decreasing the dependence on imported petroleum; providing a market for the excess production of vegetable oils and animal fats; using renewable and biodegradable fuels; reducing global warming due to its closed carbon cycle by CO₂ recycling; increasing lubricity; and reducing substantially the exhaust emissions of carbon monoxide, unburned hydrocarbons, and particulate emissions from diesel engines.

[14]K. Varatharajana, D.S. Pushparanib, One of the major issues associated with the use of biodiesel is to maintain the fuel at specified standards for a longer period. Biodiesel is more prone to oxidization than a mineral diesel, and it starts turning rancid within a week or less, and complete degradation occurs after a period of 4 weeks. The final products of oxidation alter the physical and chemical properties of fuel which results in the formation of insoluble gums that can plug fuel filters. This instability of biodiesel is a long-standing issue, and it has not as yet been satisfactorily resolved. As the use of biodiesel has increased massively, this oxidation issue could become a significant barrier to market expansion. One very promising and cost-effective approach to improving the stability of biodiesel is that the addition of appropriate antioxidants to the biodiesel fuels. Antioxidants perform better or worse in different biodiesel fuels, and there is no unique inhibitor that suit for every kind of biodiesel fuels. To screen the antioxidants for a specific biodiesel, it is necessary to understand the chemistry of antioxidants and the key factors that influence their effectiveness against biodiesel oxidation

[15]V. Sajith, C. B. Sobhan, and G. P. Peterson, This paper reports the results of experimental investigations on the influence of the addition of cerium oxide in the nanoparticle form on the major physicochemical properties and the performance of biodiesel. The physicochemical properties of the base fuel and the modified fuel formed by dispersing the catalyst nanoparticles by ultrasonic agitation are measured using ASTM standard test methods. The effects of the additive nanoparticles on the individual fuel properties, the engine performance, and emissions are studied, and the dosing level of the additive is optimized. Comparisons of the performance of the fuel with and without the additive are also presented. The flash point and the viscosity of biodiesel were found to increase with the inclusion of the cerium oxide nanoparticles. The emission levels of hydrocarbon and NO_x are appreciably reduced with the addition of cerium oxide nanoparticles.

[16]Paulo H.R. Silva, Valter L.C. Gonçalves, Claudio J.A. Mota, Glycerol acetals from butanal, pentanal, hexanal, octanal and decanal were prepared with the use of Amberlyst-15 acid resin as catalyst. The glycerol conversion decreases with the size of the hydrocarbon chain. This fact has been associated with formation of micelles and aggregates of the aldehyde to minimize the interaction between the polar glycerol molecule with the hydrocarbon chain. The Z + E mixture of the acetals with five and six-member rings were produced in all cases. The distribution of the acetal isomers varied with the reaction time, especially for the long chain aldehydes. Addition of 5 vol.% of the butanal-glycerol acetal reduced the pour point of animal fat biodiesel (methyl ester) from 18 to 13 C.

[17]B. Ashok, K. Nanthagopal, Aravind Mohan, In the present experimental study, CI engine is made to run on 100% Calophyllum Inophyllum Methly Ester (CIME) biodiesel and the same dozed with fuel additives. The study mainly focuses on the influence of two types of fuel additives namely Zinc oxide (ZnO) which is a metal oxide nanoparticle and Ethanox which is an antioxidant. ZnO was added to CIME in the form of nanofluid at different constituent levels of 50ppm and 10ppm while Ethanox was added at concentration levels of 200ppm and 500ppm. Addition of 100ppm of ZnO improves the efficiency by 4.7% and 12.6% reduction of NO_x at full load. These improvements arise due to the catalytic effect of nanoparticle and micro explosion of water molecules present in the fuel. Antioxidants inhibit the formation of free radicals, Ethanox was found to be better fuel additives in terms of NO_x reduction and 500ppm of Ethanox results in maximum decrease of 17.8%. But this improvement was found to be achieved at the expense of HC and CO. A slight improvement achieved in efficiency for fuel samples containing antioxidant can be attributed to the volumetric effect which arises due to unmodified injection rate and increase in density of the fuel.

[18]S.S. Hoseini a , G. Najaf, In the present study, the effects of graphene oxide (GO) nano-particles on performance and emissions of a diesel engine fueled with Oenothera lamarckiana biodiesel was investigated. Biodiesel was used in the blend of B20. The GO nano-particles with concentrations of 30, 60, and 90 ppm were considered for each fuel blend. Experiments were performed at a constant speed of 2100 rpm at loads of 0%, 25%, 50%, 75%, and 100%. Various parameters, such as power, exhaust gas temperature (EGT), carbon monoxide (CO), carbon dioxide (CO₂), unburned hydrocarbons (UHCs), and nitrogen oxides (NO_x), were investigated. Results showed that by using GO, power and EGT significantly increase. Furthermore, by using GO nanoparticles, significant reductions in CO (~5%e22%) and UHCs (~17%e26%) were observed. However, under similar conditions, a slight increase in CO₂ (~7%e11%) and NO_x (~4%e9%) emissions observed. Finally, it can be concluded that nano-graphene oxide can be introduced as a suitable alternative fuel additive for Oenothera lamarckiana biodiesel blends.

[19] Syed Ameer Bashaa*, K. Raja Gopal, This article is a literature review of the effect of different catalysts and additives on biodiesel production, performance, combustion and emission characteristics. This study is based on the reports of about 60 scientists who published their findings between 1998 and 2010. It was reported that base catalyst produced more biodiesel compared to acid type catalysts. There was not much variation in engine performance with the use of catalyst. Combustion characteristics were improved with the use of additives. It was found that ignition delay was reduced and premixed combustion duration was increased with the addition of catalyst. HC emission and PM emission were reduced with the use of catalysts.

[20] A. Prabu, This experimental work investigates the performance, combustion and emission characteristics of a single cylinder direct injection (DI) diesel engine with three fuel series: biodiesel–diesel (B20), biodiesel–die sel–nanoparticles (B20A30C30) and biodiesel–nanoparticles (B100A30C30). The nanoparticles such as Alumina (Al₂O₃) and Cerium oxide (CeO₂) of each 30 ppm are mixed with the fuel blends by means of an ultrasonicator, to attain uniform suspension. Owing to the higher surface area/volume ratio characteristics of nanoparticles, the degree of mixing and chemical reactivity are enhanced during the combustion, attaining better performance, combustion and emission attributes of the diesel engine.

[21] A. Murugesana., A. Avinashb, E. James Gunasekaran, Nanofuels are new type of fuels that use nano additives (nanoparticles) to improve the engine performance, combustion and reduce exhaust emissions. In this perspective, this research investigates the performance of direct injection compression ignition engine fuelled with waste cooking oil biodiesel blend (B20) with and without nano additive dispersion. The waste cooking oil biodiesel was produced by alkaline transesterification. The aluminum oxide and cerium oxide nanoparticles were dispersed in biodiesel blend at different weight mixtures with the aid of ultrasonic cleaner bath. In this work, six test fuels were prepared by adding different concentration of nano particles (250 mg/l to 750 mg/l at the interval of 250). It was noted from the research work that the presence of highly reactive surface promoted the chemical reactivity which resulted in better combustion. The brake thermal efficiency and specific fuel consumption of nanoparticles dispersed biodiesel blend improved by 1.6% and 8%. In addition, the products of incomplete combustion such as carbon monoxide, unburnt hydrocarbon, and smoke density reduced appreciably up to 5%, 9%, and 16%, respectively.

[22] Vijayakumar Chandrasekaran, Initially the single cylinder diesel engine was operated with 20MEOM, 40MEOM, 60MEOM, 8MEOM and 100MEOM without additives with diesel at different loads at constant rated speed. From the experimental study proved that 20MEOM is the best fuel ratio compared to other blends. In second phase based upon first phase results the engine was operated 20MEOM blended fuel with adding 50 ppm copper oxide nano additives with diesel using solgel process. From the results, the brake thermal efficiency was 2.19% improved compared than 20MEOM blend without additive at full load condition. Emissions of HC, CO and smoke were considerably reduced.

[23] Obed Majeed Ali,a, Rizalman Mamat, Biodiesel fuel can be used as an alternative to mineral diesel, its blend up to 20% used as a commercial fuel for the existing diesel engine in many countries. However, at high blending ratio, the fuel properties are worsening. The feasibility of pure biodiesel and blended fuel at high blending ratio using different chemical additives has been reviewed in this study. The results obtained by different researchers were analysed to evaluate the fuel properties trend and engine performance and emissions with different chemical additives. It found that, variety of chemical additives can be utilised with biodiesel fuel to improve the fuel properties. Furthermore, the chemical additives usage in biodiesel is inseparable both for improving the cold flow properties and for better engine performance and emission control. Therefore, research is needed to develop biodiesel specific additives that can be adopted to improve.

[24] H.K. Rashedul , H.H. Masjuki, With growing concern over greenhouse gases there is increasing emphasis on reducing CO₂ emissions. Despite engine efficiency improvements plus increased dieselization of the fleet, increasing vehicle numbers results in increasing CO₂ emissions. To reserve this trend the fuel source must be changed to renewable fuels which are CO₂ neutral. As a renewable, sustainable and alternative fuel for compression ignition engines, biodiesel is widely accepted as comparable fuel to diesel in diesel engines

[25] S Madiwale1 , A Karthikeyan, -To presents the literature review on effect of biodiesel additives on properties, performance and on emission. Method:-In the current paper reviews are taken from previous years paper which necessitates the need of addition of additives in the blends of biodiesel and studied the its effect on properties , performance and emissions. Emissions from the diesel powered vehicles mostly damaged the earth's environment and also increased the overall earth's temperature. This attracts the need of alternative fuels in the field of transportation sector. Past inventions and research showed that Biodiesel can be used as an alternative fuel for the diesel engine. Biodiesel have good combustion characteristics because of their long chain hydrocarbon structure.

[26] N.B. Dole, Rahul Barjibhe Character traits of Hybrid Bio-Fuel as performance and exhaust emission in a Diesel Engine. It has been shown that when load and blend ratio increase, volumetric efficiency at CR either increase. CO emission from biodiesel and its mixture are greater than those from diesel the whole spectrum of fuel blends. CO, CO₂,



HC, NO_x and O₂ emission are also lower in B20 than in diesel. the fuel properties and achieve best engine performance at lower exhaust emission effects.

III. CRITICAL DISCUSSION ON LITERATURE REVIEW

- The Production of bio-diesel Undi ethyl ester is investigated and presented. The experimental study was conducted on single cylinder, direct injection variable compression ratio Diesel engine to analyses the performance-emission using various blends (10%, 20%, 30%, 40% and 50% biodiesel content on volume basis) of Undi ethyl ester by changing compression ratio (CR) from 16 to 20
- Biodiesel from Undi plant seed can be obtained by either In-Situ Transesterification or Transesterification process.
- Important physicochemical properties of Karanja oil after transesterification were experimentally evaluated and found within acceptable limits of relevant standards. The performance parameters evaluated in the present study includes brake thermal efficiency of Karanja biodiesel with different compositions at 5%, 10%, 20%, 30% and 100% with mineral Diesel.
- Analysis of the physicochemical properties of diesel–biodiesel blends precedes the performance and emission study using 10% and 20% blends (ALB10 and ALB20). A 55 kW, 2.5 L, four-cylinder indirect injection diesel engine was used to carry out tests under conditions of constant load and varying speed.
- Transesterification reaction was performed with NaOH as an alkaline catalyst and methanol as an analytical solvent.
- Bio-renewable feedstock for biodiesel production without compromising food and water supply. Additionally, the microalgae could gain desirable properties for production of an ideal biodiesel.

IV. CONCLUSION

1. Now these days, we perform on single cylinder four stroke engine using additives, karanja, undi for blends on biofuel on I.C. engine. The emission analysis and performance analysis is evaluated by running the engine at different compression ratios like 14, 16 and 18 by varying load. The emission parameters measured are CO, HC and NO and performance parameters measured are brake power, specific fuel consumption, exhaust gas temperature.
2. all blends except B20+8% but as a result of advance combustion due to oxygen content of biodiesel blends the efficiency of biodiesel is more than diesel fuel. B20+8% with CR18 has 26.44% of brake thermal efficiency than conventional diesel fuel which is good sign.
3. Volumetric efficiency it is observed that volumetric efficiency at CR 18 either increases or decreases with increase in load and blend ratio and for CR 18 at blends B20+8% volumetric efficiency is increased with increase in load.
4. The HC emission decreases with increase in compression ratio for the entire range of fuels, and for biodiesel and its blend it is higher than diesel. – This is due to the complete combustion of fuel at a higher compression ratio, hence less amount of HC will emits. Biodiesel and its blends, due to poor volatility and poor mixing retard the chemical reaction which results in higher HC emission as compared to diesel.
5. CO, CO₂ HC, NO_x and O₂ Emissions are also very low in case of B20 than diesel fuel.

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