Karanja Biodiesel as an Alternate Fuel in CI engine: A Review

Nikhil R Nayee[1] Dr. Tushar M Patel[2]
[1]M.E. Scholar [2]Professor
[1,2]Department of Mechanical Engineering
[1,2]LDRP-ITR, Gandhinagar, India

Abstract— In today's Technological revolution era, boost of usage of fuel has a requirement for identifying the substitute fuel for today's researcher engineers. Energy utilization becomes more vital because of an augmentation of global population and industrialization. Fossil fuels reverses drop down daily and its price becomes higher. So, alternative fuel named Biodiesel need arise to mitigate this shortage. The source used for the Biodiesel production is the eco-friendly and emit less emission. Several cooking and non-cooking oils and fats, agricultural waste, plastic waste, tire waste, etc. are feedstock of the Biodiesel and engine lubes. Biodiesel is decomposable, degradable and protect the globe. These Biodiesel used in most CI engines with minimum alteration in the engine manifold. This review paper contains the harvesting the Biodiesel from the source of Non cooking oil like Karanja oil, by altering the different Factors, demonstration and the exhaust features of Biodiesel blend in CI engine in different content like B10, B20, B30 etc. and discover the best suitable proportion of the blend for CI engine. Based on a descriptive piece of writing, this review paper shows that Karanja Biodiesel blend is successfully used in CI engines as substitute fuel without any alteration in the engine component and the circuit unit of the engine system.

Key words: Karanja biodiesel, Performance, Trans-esterification, Taguchi method

I. INTRODUCTION

Biodiesel is green energy made from the plant and the creature fats, cooking, non-cooking oil and Domestic waste and put up in CI engine with minimum or no Alteration in engine manifold. These Biodiesel used in the CI engine to blend in diesel fuel are also utilized in the saturated condition (B-100) contingent the finance and Exhausts. But in pure forms may require alteration in the engine manifold to avoid overhaul and Mechanism problems. Biodiesel will seem a solution for tomorrow in the place of Hydrocarbon oils because of the exhaustion of crude oil resources and cost increase of petroleum products. The several renewable oils are Available in place of HC fuels like alcohols (Ethanol, Methanol), cooking oils (Caster, Sesame, Groundnut, Palm, Soybean, Corn, etc.), non-cooking oils (Jatropha, Karanja, Neem, Mahuva, etc.) and vegetable fats. Due to hike usage of cooking oils as fuels become more costly compare to the conventional petroleum fuels and carbon deposit around nozzle mouth and piston are the critical issues. In other hand, non-cooking oils have higher viscosity but cheaper than convectional and petroleum fuels. Viscosity is not the major problem because it can be reduced by blending, trans-esterification and pyrolysis process. Hence, Biodiesel production from the non-cooking oils like Karanja becomes cheaper than other sources. Making Biodiesel from non–cooking oils is accept globally as unique broad scope of solution of Problems of bio-degradation, existing resources preservation and agricultural economy. Biofuels are fuels produced by a number of Biodiesel made from several bio-chemistry methods from eco-friendly resources like the number of trees, Domestic wastes, farming by-products, etc. Biodiesel made Karanja oil crank out using trans-esterification.

Biofuels most hopeful substitute fuel for diesel because of the following reasons:

- There is small or say no alteration needed in the engine manifold to use of Biodiesel.
- Biodiesel is made totally from eco-friendly sources so it does not carry harmful particulates for living organisms.
- Biofuels are an Oxy-rich fuel.
- Exhausts mainly oxides and oxides of nitrogen, carbon blacking are expelled less from the exhaust manifold.
- The usage of biofuel can stretch the life of CI engines and formal fuels because it has better coating and covering property than petroleum diesel fuel.
- It is made from green, natural and home products, thus preserves the exhaustible resources and financial dependence of the other foreign countries.

A. Karanja oil:

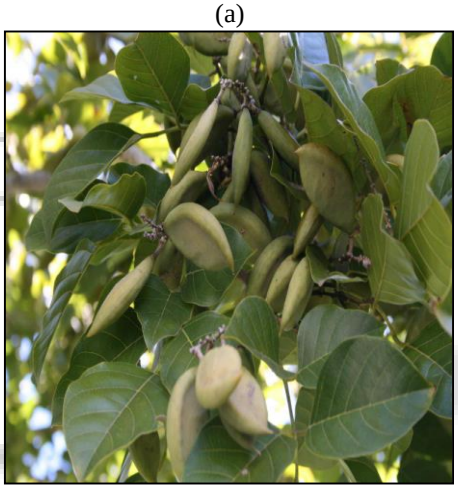
It's Woods, Oil, Leaves, Kernel, Roots & Bark, Fruit hull all are useful in many ways taking from alternate fuel to health. Karanja oil has better parametric and burning characterizes than Mahuva, sesame. Karanja oil is a good antiseptic feature so it is used as medicine by Homeopathic doctors in many regions of India in the care of rheumatism and curing skin infections. Its medicament advantage is that used for remedial, medicinal drug, and surgical, drug. Concerned with 5thved (Hindu art of healing), Karanja is parasitical and help with the illness of optic, vaginal dieses, bark. It is good for neoplasm, injury, lesion, scabbing, magnify of lien and stomach, urinal vent. It also heals illness, lashings, and headache. As per Union procedure of healing, fruits are pungent and carminative, seeds purify and enrich the blood, relieves inflammations, cure earache, chest problem, backache. Oil is styptic and anthelmintic, best in scabies, leprosy, piles, lumbago, chronic fever, etc. Table 1 shows the Properties Of Karanja oil, Karanja Biodiesel, Diesel, [9].

Properties	Karanja oil	Karanja Biodiesel	Diesel
Density at **25ºC (kg/m^3)**	926	880	860
Kinematic viscosity **at 40ºC (cSt.)**	32.1	6.88	2.44
Acid value **(mg KOH/g)**	0.62	1.12	0.2
FFA **(mg KOH/g)**	-	0.56	-
Calorific value **(MJ/kg)**	34	36.12	44.2
Cetene no.	42	56.64	47
Specific gravity	0.91	0.88	0.84

Flash point **(ºC)**	240	218	63
Fire point **(ºC)**	230	146	78
Cloud point **(ºC)**	7	6	-12
Pour point **(ºC)**	-3	-2	-18

Table 1: Properties of Karanja oil, Karanja Biodiesel, Diesel, [5]

(a)



(b)

Fig. 1: (a) Karanja seeds and (b) plant("Millettia pinnata seed and pods.jpg," 2016)[28]

Fig. 2: Oil expelled from seeds of Karanja(Sharma & Singh, 2008)[2]

B. Cost criterion of Karanja biofuels:

The suitability of Karanja Biodiesel in the direct CI engine as per economical consideration clearly shows that substitute fuel for diesel engine. The rip of Karanja seeds for 1000 trees planted, giving 250 kg of oil and 750 kg of oil cake per hectare. This oil cake used as fertilizer. As per the recent retail store and sales outlet price this will give an income of Rs.60k per hectare. Let us 25% oil will outcome in the Karanja seeds and 4000 gm. of seeds are needed to produce 1000 gm. of biodiesel. So, as per the market survey and valuation, Karanja oil cost is much less than that of diesel. Hence, Karanja Biodiesel has completely substituted fuel.

The result of the experiment testifies that Karanja (B100) has an upright potential of Existence used as CI engine fuel. Usage of these fuels will assist to preserve the exhaustible resources and finance dependence of the other foreign countries. Desolate and may be utilized to set up the oil producing plants. It reduces employment and help to poor people to live a better life. Only a 20 % blending will lead to a downsizing of about Rs.100000 Crore in foreign dealing to India,[5]

II. LITERATURE REVIEW

The main purpose of the literature review is to guide the new researchers in the proper way to Finding out the outcome in less time span. It helps to find the problem solution a proper way, proper format. It is useful for modifying the exist methodology or can find a new way of same research. It gives the rough idea about the practical done on the CI engine in the laboratory. From this Literature survey helps novice researchers to define and introduce the problem and finding the correct way to solve the problem.

A. Review on Blending:

Murugan et al. used TPO Biodiesel blend at a variable injection pressure (210 bar, 230 bar, 250 bar) terminated that TPO 30 best suitable alternative biofuel in direct CI with small engine modification, [1]. Liaquat et al. Investigated the significance of coconut biodiesel blended fuels on engine performance and Exhaust features and outcome of the practical set up shows that CB5 and CB 15 put up in CI engines without any engine design alteration, [8].S. Nagraja et al. Concluded that 20% BD of Preheated Palm oil & 20:1 CR give the optimum engine Performance used at entire load condition, [10]. De et al. Used Jatropha Biodiesel in CI engine as substitute fuel and shows that blends of Biodiesel adequate to 30 % by weight with C.R 18 put up successfully as relief fuel with less or no alteration in CI engine, [14]. Ozener et al. Practical set up shows effect of soybean Biodiesel on CI engine performance, Exhaust and exhaust features and end result proved that blends decreased the ignition delay and engine used without any alternation, [16]. Reddy et al. Experimented on palm oil and stuff Oil Blend in several compositions were added to base SAE20W40 mineral oil gives better lubrication than Convectional diesel engine, [17]. Kumar et al. Investigated Performance, Exhaust and burning features of CI engine use with hydrogen Biodiesel concluded that diesel fuel enriched with hydrogen gives close performance to CI engine and give off less pollution relate to diesel fuel, [21]. Patel et al. Experimented on CI engine by using palm seed oil and Diesel blend and concluded that B30 blend gives closer Exhaust features and engine operation to crude diesel,[23]. Kumar et al. Utilize the Karanja and used

Fried oil Biodiesel blend with diesel fuel shows the ternary blend has improved engine performance to a greater extent as relate to that of diesel,[27]. S. Nagraja et al. Discover the Effect of CR over the Performance and Emission Characteristics of VCR Fuelled with Preheated Palm Oil - Diesel Blends and Practical outcome depicted that engine performance was found to be optimum when using O20 as fuel at compression ratio 20:1 during the full load condition, [22]

B. Review on Parameters:

Jindal et al. Found issue of CI engine using Jatropha concluded that advances the injection timing, by applying fuel early, delay the injection timing by 3degree found to increase the thermal efficiency by 8% and highest exhaust temperature and IP and in other hand reduce the SFC by 9% and lower the cylinder pressure, [4]. Patel et al. Take up Plastic Pyrolysis Oil (PPO) blend for parametric improvement of CI engine using Taguchi method for the optimization of the Factors and experimental outcome clearly exhibit that injection pressure 200 bar, blend Biodiesel 30 and engine Load of 10 kg are suitable parametric Setting for less BSFC, [11]. Rao et al. Utilize Honge- Ethanol blend with diesel fuel to vary the design Factors at 3 levels and result reveals that a coalition of injection pressure and timing at 220 bar and 27° before TDC respectively at a CR 18 gives highest BTE and lowest exhaust smoke, [15]. Rathod et al. utilize Mahuva oil blend for parametric improvement of CI engine using L-16 orthogonal array of the Taguchi method result shows that 0% blend ratio, engine load 10 kg and injection pressure 160 bar are best setting for down play SFC,[24]. Ganji et al. Conducted practical on Parametric Improvement with the help of converge Computational Fluid Dynamics (CFD) code in VCR CI Engine to investigated a mathematically varying the System factor like CR (18–14), SOI (17–26 before TDC) and EGR (0–15 %) by keeping FIP of 230 bar constant and engine speed of 1500 rpm in state to minimize NO_X and Soot Exhausts and holding the same efficiency as of base mark CI engines, [26]. Arumugam et al. Carried out practical Improvement of Engine Factors using L18 orthogonal array by taking rapeseed oil as both Bio lubricant and Biofuel in VCR CI Engine and terminated that suggested levels of engine Factors for raising the engine performance and understate the harmful Exhausts of oxides and nitrogen at the same duration are lubricant at level 2 (bio-lubricant), compression ratio at level 1 (CR-12), and engine load at level 3 (100 % load-full load), [25]. Bora et al. Performed on CI engine generate power with twin fuel (biogas + diesel) CI Engine multi-response improvement at different C.R (17.5 to 18) to find effect of load level and finishing set up show that at 100 % load, with CR 18 and 17.5 BTE is 20.04 % and 18.25 % respectively. At 80 % (CR 18) and 60 % (CR 17.5) load, CO and HC Exhaust were found minimum respectively. But little demerit is higher Exhaust gas temperature, cylinder pressure, $CO_2$and NO_X Exhaust due to the rise in load, [30].

C. Review on Karanja Biodiesel:

Bajpai et al. Investigated the practicability and utility of Karanja Biodiesel in CI Engine shows that B10 gives higher BTE at a 60% load and entire harmful Exhaust features sustainable for the globe in a whole range of engine performance, [3]. Nagarhalli et al. Performed on CI engine to find the performance and affordability of Karanja Biodiesel practical outcome shows that for B20 CO, NO_X drastically down and HC & BSFC slightly up with the expense of loss of efficiency And for B40 CO, NO_X decreased with slightly more HC & BSFC, [5]. Pandian et al. Investigated the Effect of Injection system Factors in multi cylinder CI engine blend with Karanja by RSM and concluded that BTE is higher and NO_X were lesser using the RSM, [6].Naidu et al. Critically reviewed on Exhaust and Performance of CI Engine Utilize Karanja Biodiesel outcome shows that Exhaust features of Biodiesel is better than neat petroleum Diesel excluding NO_X Exhaust, [7]. Pohit et al. Optimize the Performance and Exhaust feature of CI engine utilize Karanja Biodiesel by Grey-Taguchi Method result revealed that B50 was best suitable substitute fuel for CI engine used without any change in system ECU, [12]. Thennarasu utilize Karanja Biodiesel Blends to find Burning features result depicted that B10 is suitable substitute fuel for a CI engine at lightly higher CR, [13]. Agarwal et al. Found the notion of Fuel Injection Pressure & Timing on CI engine utilize Karanja Biodiesel terminated that Adequate to 10% Biodiesel blends in CI engines improves BTE and reduces Exhausts, adequate to 20% blend lower the BSFC & CO compared to crude diesel, [18]. Datta Experiment on parametric Optimization of VCR CI Engine blend with Karanja Biodiesel and result shows that B50 is Advantageous blend,[19]. Mohite et al. Practically shows the suitability of Karanja Biodiesel in direct CI engine concluded that B20 is practically more suitable blend among all testify blends for the BTE and exhaust smoke reduction, [29].

III. CONCLUDING REMARKS

Most of the piece of writing outcome shows that the NO_X is higher when using Karanja Biodiesel as fuel in CI engine and other and a few of them confirmed that NO_X emission lesser this is due to different parameters were selected for the optimization while performing experiments.

Rather than directly use the Biodiesel of any strength used by blending with diesel provides more promising results and no more alteration is needed in CI engine.

Both Edible and non -edible oils are blended with diesel of different contents can be used as a working fluid in CI Engine effectively.

The Possibility of using Karanja Biodiesel with diesel in few strengths, thus reduce dependency on fossil fuel. Reduce emissions than the diesel engines, hence protect the globe.

The Experimental work under this project includes analysing the effect on performance and emission of engine by using different blends of Diesel-Karanja oil. To suggest best blend based on above results as an optimum blend.

After knowing the good properties, features, advantages, medical important, economics, performance And Exhaust features better than diesel fuel and no alteration needed to use Karanja biodiesel in the DI 4 stroke single cylinder CI engine.

It's a substitute fuel for the diesel engine. After analysis and several literature reviews, In future practical performed in the laboratory in DI 4 stroke, single cylinder CI used and coupled with the eddy current dynamometer.

CI engine run with Karanja Biodiesel emits less Exhaust.

IV. SCOPE OF THE WORK

- Proper blending prepared by chemically altered or blending with some additives.
- It is used in CI engines for an economical power generation.
- Varying blends are tested in the laboratory and the best suitable blend is used for power generation.
- Blend ratio can be increased for the better result.
- The Practical can be run in a turbocharged or supercharged engine with the addition of EGR.
- The Practical can be performed by using the interaction of system parameters in Taguchi Method while choosing the orthogonal array.

REFERENCES

[1] Murugan S and MC Ramaswamy "Running Diesel engine with TPO Biodiesel with different injection pressure" i.j.s.tech., Volume 13 | 2008 | Page 10.
[2] Sharma, Y. C., & Singh, B. Development of biodiesel from karanja, a tree found in rural India. Fuel, https://doi.org/10.1016/j.fuel.2007.08.001Volume 87| Issue(8–9)|2013| Page 1740–1742.
[3] Bajpai S., P.K. Sahoo, L.M. Das "Feasibility of blending Karanja vegetable oil in petro-diesel and utilization in a direct injection diesel engine" | 2009 | Page 07.
[4] Jindal S, B.P. Nandwana, N.S. Rathore, V. Vashistha "Experimental Investigation of the effect of compression ratio and injection pressure in a direct injection diesel engine running on Jatropha methyl ester" | 2011 | Page 07.
[5] Nagarhalli M. V, Nandedkar V. M,and Mohite K.C "Exhaust and Performance features of karanja biodiesel and its blends in a CI engine and its economics" Volume 5| no. 2 | 2011 | Page 05.
[6] Pandian M, S.P. Sivapirakasam , M. Udayakumar "Investigation on the effect of injection system Factors on performance and Exhaust features of a twin cylinder compression ignition direct injection engine fuelled with pongamia biodiesel–diesel blend using response surface methodology" | 2011 | Page 14.
[7] Naidu S.C.V.Ramana Murty, G.Raju, a Critical Review "D.Srinivasulu Exhaust and Performance of Diesel Engine Using Karanja Bio-Diesel" Volume 1 | Issue 5 | 2012 | page 06.
[8] Liaquat A.M., H.H. Masjuki, M.A. Kalam, I.M. Rizwanul Fattah, M.A. Hazrat, M. Varman, M. Mofijur, M. Shahabuddin "Effect of coconut biodiesel blended fuels on engine performance and Exhaust features." | 2013 | Page 08.
[9] Mane Mukesh A. reviewed on "Karanja Oil as an Alternative Fuel for Direct Injection CI Engine" www.ijsr.net Volume 2 | Issue 10 | 2013 | page 4.
[10] Nagraja S, m saktivel and r sudhakaran "burning and performance analysis of VCR engine fueled with preheated palm oil – diesel blend" IJCT| Volume 20 | 2013 | Page 06.
[11] Patel Pragna R., Prof. Tushar M. Patel, Prof. Gaurav R. Rathod "Parametric Optimization of Single Cylinder Diesel Engine for Specific Fuel Consumption Using Plastic Pyrolysis Oil as a Blend" Volume 5 | Issue 4 | 2013 | Page 03.
[12] Pohit Goutam and Dipten Misra "Optimization of Performance and Exhaust Features of Diesel Engine with Biodiesel Using Grey-Taguchi Method" | 2013 | Page 09.
[13] Thennarasu, Prabhakaran., Ganapathy Srinivasan "Burning Features of CI Engine Using Karanja Biodiesel Blends as Fuel" Volume 4 | Special Issue 2 | 2013 | Page 07.
[14] De Biswajit, R.S.Panua "Performance and emission characteristics of diesel and vegetableoil blends in a direct-injection VCR engine" Volume 90 | Issiue 4 | 2014 | Page 09.
[15] Nandkishore D.Rao, Dr. C. Srinath, Chandrashekar Patil, Dr.B. Sudheer Prem Kumar, "optimization of engine operating Factors" Volume 5 | 2014 | Page 07.
[16] Ozener, Yuksek, Ergenc, Ozkan "Effects of soybean biodiesel on a DI diesel engine performance, Exhaust and burning features" |2014 | Page 09.
[17] Reddy,Naval Kabra, Umesh Kunchum, and T. Vijayakumar Experimental "Investigation on Usage of Palm Oil as a Lubricant to Substitute Mineral Oil in CI Engines" | 2014 | Page 06.
[18] Agarwal Avinash Kumar, Atul Dhar, Jai Gopal Gupta, Woong Il Kim, Kibong Choi, Chang Sik Lee, Sungwook Park "Effect of Fuel Injection Pressure and Injection Timing of Karanja Biodiesel Blends on Fuel Spray, Engine Performance, Exhausts and Burning Features" |2015 | Page 34.
[19] Datta Ambarish "Optimization of Engine Performance and Exhaust Features of Variable Compression Ratio Diesel Engine Fueled with Karanja Oil Methyl Ester using Taguchi Method and Grey Relational Analysis" | 2015 | Page 80.
[20] De Biswajit, R. S. Panua1 "Performance and Exhaust features of diesel and vegetable oil blends in a direct-injection VCR engine" |2015 | Page 09.
[21] Kumar R Senthil, James gunasekaran, m .loganathan, "Performance, Exhaust and burning features of CI engine fuelled with diesel and hydrogen" |2015 | Page 09.
[22] Nagarajaa S., K. Sooryaprakash b, R. Sudhakaran "Investigate the Effect of Compression Ratio over the Performance and Exhaust Features of Variable Compression Ratio Engine Fueled with Preheated Palm Oil -Diesel Blends" | 2015 | Page 09.
[23] Patel T M, Maulik A Modi, Gaurav P Rathod "Performance and Exhaust Analysis of Diesel Engine using palm seed oil and diesel blend" Vol. 11 | Issue 2 | Ver. VIII |2015 | page 05.
[24] Rathod Nirav H., Gaurav R. Rathod, Tushar M. Patel "Parametric optimization of single cylinder CI engine for specific fuel consumption using Mahuva oil blend" Volume 12 | Issue 2 |2015 | Page 06.

[25] Arumugam S., G. Sriram, T. Rajmohan and J. Paulo Davim "Multi-objective Optimization of Engine Factors While Bio-lubricant–Biofuel Combination of VCR Engine Using Taguchi-Grey Approach" | 2016 | Page 19.
[26] Ganji Prabhakara Rao, Al-Qarttani Abdulrahman Shakir Mahmood, Aasrith Kandul, Vysyaraju Rajesh Khana Raju , Surapaneni Srinivasa Rao "Parametric Optimization Through Numerical Simulation of VCR Diesel Engine" | 2016 | Page 07.
[27] Kumar Prem, Mahendra Pal Sharma, Dwivedi "Impact of ternary blends of biodiesel on diesel engine performance" | 2016 | Page 07.
[28] Millettia_pinnata_seed_and_pods.jpg. (2016). Retrieved November 18, 2016, from https://upload.wikimedia.org/wikipedia/commons/9/9d/Millettia_pinnata_seed_and_pods.jpg
[29] Mohite Sanjay, Sagar Maji, Sudhir Kumar "Experimental Studies on Use of Karanja Biodiesel as Blend in a Compression Ignition Engine" Volume 6 | No.2 | 2016 | Page 06.
[30] Bora Bhaskor J., Ujjwal K. Saha, S. Chatterjee and Vijay Veer "Effect of Load Level on Performance and Emission Characteristics of a Biogas Run Dual Fuel Diesel Engine" | 2017 | Page 12.

