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Development and Cost Analysisof Bio-diesel from Karanja and Diary Scum

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Abstract— Biodiesel can also be used in blends with conventional diesel, while still achieving substantial reductions in emissions. Technically, biodiesel is Fatty Acid Methyl Ester (FAME). It is formed by replacing the glycerol from each triglyceride molecule of veggie oil. Once the glycerol is removed from the oil, the remaining molecules are similar to petroleum diesel fuel. The biodiesel molecules very simple hydrocarbon chains, containing no sulfur, ring molecules, nor aromatics associated with fossil fuels. Biodiesel is made up of almost 10% oxygen, making it a naturally "oxygenated" fuel. Bio-Diesel is a name of a clean burning alternative fuel, produced from domestic, renewable resources. Bio-Diesel contains no petroleum, but it can be blended at any level with conventional diesel to create a bio-diesel blend. It can be used in compression ignition diesel engine with little or no modifications. In the past several decades, it has been found that biodiesel (esters derived from Vegetable oils) is a very promising one. The most common blend is a mix of 20% biodiesel. And 80% petroleum diesel, called "B20". Here we explain the process involed in the production of bio-diesel.Bio-diesel can be produce cost effectively from karanja oil and diary scum.
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Index Terms—Bio-diesel, brake power, brake specific fuel consumption, compression ratio, carbon monoxide, diary scum, engine,hydrocarbon, karanja.

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1 Introduction

Energy is considered as a critical factor for economic growth, social development and human welfare. Since their exploration, the fossil fuels continued as the major conventional energy source with increasing trend of modernization and industrialization, the world energy demand is also growing at faster rate. To cope up the increasing energy demand, majority of the developing countries import crude oil apart from their indigenous production. This puts extra burden on their home economy. Hence, it is utmost important that the options for substitution of petroleum fuels be explored to control the burden of import bill.

There are limited reserves of the fossil fuels and the world has already faced the energy crisis of seventies concerning uncertainties in their supply. Fossil fuels are currently the dominant global source of CO2 emissions and their combustion is stronger threat to clean environment. Increasing industrialization, growing energy demand, limited reserves of fossil fuels and increasing environmental pollution have jointly necessitating the exploring of some alternative to the conventional liquid fuels, vegetable oils have been considered as appropriate alternatives to the conventional liquid fuels, vegetable oils have been considered as appropriate alternative due to their prevalent fuel properties. It was thought of as feasible option quite earlier.

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However despite the technical feasibility, vegetable oils as fuel could not get acceptance, as they were more expensive than petroleum fuels .This led to the retardation in scientific efforts to investigate the further acceptability of vegetable oils as alternate fuels.Later, due to numerous factors as stated above created resumed interest of researchers in vegetable oils as substitute fuel for diesel engines. In view of the potential properties, large number of investigation has been carried out internationally in the area of vegetable oils as alternate fuels. Some of the vegetable oils from farm and forest origin have been identified. The most predominantly sunflower, soybean, cottonseed, canola, jatropha, corn, peanut oil etc. have been reported(2-7,9-11,13) as appropriate substitute of petroleum based fuels. The vegetables oils can be used in diesel engines by various techniques such as fuel modification by esterification, diesel-vegetable blends, vegetable oil heating etc.

1.1 Energy Resources and Their Status

Globally, about 40% of worlds energy needs are being met from petroleum products as of today. The anticipated growth in demand was expected to be 7%. There has been a significant and impressive growth in this sector which has surpassed and failed all the estimates, forecast and projections made in this regard. It is estimated that the world oil consumption will increase from 68 million barrel per day to 94 million barrel per day in next decade. India is hard pressed for this important modern resources and is making all possible efforts to explore the off and on shore crude and gas production besides having more than required refining capacity. The successful exploration of crude and natural gas from desert area of the country and afterwards building infrastructure for its commercial production and setting infrastructure facilities are given due importance. With the indigenous production of 32 MMT and import of 80 MMT now and 350 MMT by 2025 AD (acc ording in Hydro Carbon Vision 2025) the consumption is likely to increase to 150 MMT by next 8 years, which will be difficult to meet with indigenous reserves, which are only 0.6% of world reserves. This will increase the import bill to an all-time during next decade.

The energy generation sources and capacity in India have some limitations. Starting from 1347 MW of installed power capacity in 1947 and limited food production, today the country is generating about 1,22,000 MW, whereas the need is around 1,50,000 MW power to meet the country's requirements in all sectors, including intensive agriculture. The peak hour shortage is estimated 20%. The agriculture sector is worst effected from shortage of power. Despite of promise and serious efforts many states are unable to provide electricity even for 8 hours during standing crop irrigation period in rural areas.

The demand for petroleum products in India has been increasing at a rate higher than the increase in domestic availability. At the same time there is continuous pressure on emission control through periodically tightened regulations particularly for metropolitan cities. In the wake of this situation there is urgent need to promote use of alternative fuels which must be technically feasible, economically competitive, environmentally acceptable and readily available.

Biodiesel relatively helps to keep the engine afresh throughout the life of the engine there by emitting lesser emission to atmosphere and maintain uniform performance of the engine throughout the life. Biodiesel is a completely natural, renewable fuel applicable in any situation where conventional petroleum diesel is used. Even though "diesel" is part of its name, there is no petroleum or other fossil fuels in biodiesel. Biodiesel is 100% vegetable oil based. Even new or used cooking oil can be used as alternative fuel by recycling which prevents water pollution. This environment-friendly fuel reduces tailpipe emissions, visible smoke and toxic odors.

1.2 Biodiesel

Biodiesel can also be used in blends with conventional diesel, while still achieving substantial reductions in emissions. Technically, biodiesel is Fatty Acid Methyl Ester (FAME). It is formed by replacing the glycerol from each triglyceride molecule of veggie oil. Once the glycerol is removed from the oil, the remaining molecules are similar to petroleum diesel fuel. But there are some notable differences. The biodiesel molecules very simple hydrocarbon chains, containing no sulfur, ring molecules, nor aromatics associated with fossil fuels. Biodiesel is made up of almost 10% oxygen, making it a naturally "oxygenated" fuel. Bio-Diesel is a name of a clean burning alternative fuel, produced from domestic, renewable resources. Bio-Diesel contains no petroleum, but it can be blended at any level with conventional diesel to create a biodiesel blend. It can be used in compression ignition diesel engine with little or no modifications.

Bio-Diesel is simple to use, biodegradable, nontoxic, and essentially free of sulfur and aromatics. Due to problems encountered in the use of neat vegetable oil. Bio-diesel is defined as the mono alkyl esters of long chain fatty acids derived from renewable lipid sources. Bio-diesel, as defined, is widely recognized in the alternative fuels industry as well as by the Department of Energy (DOE), the Environmental Protection Agency (EPA) and the American Society of Testing and Materials(ASTM). This definition has been the topic of some discussion, however, as other materials (tree oil derivatives, other woody products, or even biological slurries) have sometimes been referred to as "biodiesel." Although these other materials are biological in nature, and are a substitute for diesel fuel worthy of additional research and attention, they are not deemed biodiesel as accepted by the DOE, ASTM, or diesel engine manufacturers.

Bio-diesel is typically produced through the reaction of a vegetable oil or animal fat with methanol in the presence of a catalyst to yield glycerin and methyl esters. The reaction is depicted in below. Virtually all of the biodiesel used and produced in the U.S. to date has been made by this process, however, one additional process of importance is the direct reaction of a fatty acid with methanol, also in the presence of a catalyst, to produce a methyl ester in water.

1.3 Biodiesel as an Alternative Fuel

In the past several decades, it has been found that biodiesel (esters derived from Vegetable oils) is a very promising one. The most common blend is a mix of 20% biodiesel. And 80% petroleum diesel, called "B20". The widespread use of biodiesel is based on the following,

- Biodiesel is potentially renewable and non-petroleum-based
- Biodiesel combustion produce less greenhouse gases
- Biodiesel is less toxic and biodegradable
- Biodiesel can reduce tailpipe emissions of PM, CO, HC, air toxics, etc
- Little modifications are needed for the traditional CI engine to burn biodiesel.

1.3.1 Operating performance

The operating performance and characteristics of bio-diesel are similar to that of conventional diesel fuel. Research results indicate that power, torque, and fuel economy with B20 are comparable to petro-diesel. In addition, tests have demonstrated that the lubricity characteristics of bio-diesel are markedly superior to that of conventional diesel fuel. There are, however, precautions to consider when utilizing bio-diesel, or high percentage bio-diesel blends. Bio-diesel is a natural solvent and will soften and degrade certain types of elastomers and natural rubber compounds. Precautions are needed to ensure that the existing fueling system, primarily fuel hoses and fuel pump seals, does not contain elastomeric compounds incompatible with bio-diesel. If they do, replacement with bio-diesel compatible elastomers is recommended. Fortunately, due to the introduction of low sulfur diesel in 1993, virtually all the diesel OEM's have gone to a fluorocarbon (Viton) type seal that is bio-diesel resistant. Over the past three years, however, there have been no reported elastomer problems with 20% blends of bio-diesel with petro-diesel, even with older engines.

The greatest driving force for the use of bio-diesel and bio-diesel blends is the need to have a fuel that fulfils all of the environmental and energy security needs previously mentioned which does not sacrifice operating performance. One of the largest roadblocks to the use of alternative fuels is the change of performance noticed by users. Bio-diesel has many positive attributes associated with its use, but by far the most noted attribute highlighted by fleet managers is the similar operating performance to conventional diesel fuel and the lack of changes required in facilities and maintenance procedures. Bio-diesel is readily biodegradable and non-toxic. These characteristics make it a valuable fuel, particularly in environmentally sensitive areas. It has been demonstrated that bio-diesel blends will improve the biodegradability and reduce toxicity of petro-diesel. The effect on biodegradability when bio-diesel is blended with petro-diesel in varying percentages has been shown.

Animal fats, other vegetable oils, and other recycled oils can also be used to produce bio-diesel, depending on their costs and availability. In the future, blends of all kinds of fats and oils may be used to produce bio-diesel. Bio-diesel is made through a chemical process called transesterification whereby the glycerin is separated from the fat or vegetable oil. The process leaves behind two products methyl esters (the chemical name for bio-diesel) and glycerin (a valuable by-product usually sold to be used in soaps and other products).

1.3.2 Environmental impact

- Toxicity: Biodiesel is non – toxic. Biodiesel is the only alternative fuel to complete EPA Tier I Health Effects Testing under section of the Clean Air Act, which provide the most through inventory of environmental and human health effects attributes that current technology will allow. The acute oral LD 50 (deadly doses for 50% of all test animals) is larger then 17.4g/kg bodyweight. The LD50 for table salt (NaCl) 3 – 4g/kg of bodyweight, indicating that biodiesel is approximately 5 times less toxic than salt.
- Skin irritation for human beings. A 24 hours testing shows undiluted Biodiesel producing fewer skin irritations when compared to 4% of dissolved soap in water.
- Flash point: Flash point is measured in degrees at that point, when open fire or sparks ignite a certain matter. Biodiesels flash point is at 1800C much higher (therefore safer) when compared to mineral diesel 500C. Thus, storage, transport and handling of Biodiesel are cheaper and less dangerous than mineral diesel.
- Biological degradability: Biodiesel degrades about 4 times faster than mineral diesel. Within 28 days pure biodiesel solved in water will be degraded by 85 to 88 per cent – which is exactly the same value as dextrose. Blending biodiesel with conventional mineral diesel enhances degradability of mineral diesel significantly. For example B20 (20% Biodiesel, 80% Mineral diesel) is degraded faster than B 100 (100% mineral diesel).

1.4 Karanja

Karanja (Pongamiapinnata) is deciduous tree that grows to about 15-25 meters in height with a large canopy that spreads equally wide. The leaves are a soft, shiny brugundy in early summer and mature to a glossy, deep green as the season progresses. Small clusters of white, purple, and pink flowers blossom on their branches throughout the year, maturing into brown seed pods. The tree is well suited to intense heat and sunlight and its dense network of lateral roots and its thick, long taproot make it drought tolerant. The dense shade it provides slows the evaporation of surface water and its root structures promote nitrogen fixation, which moves nutrients from the air into the soil.

Withstanding temperatures slightly below 00C to 500C and a minimum annual rainfall of 500 mm, the tree grows wild on sandy and rocky soils, including oolitic limestone, but will grow in most soil types, even with its roots in salt water. Trees is said to yield 9-90 kg seed per tree, indicating a yuield potential of 900-9000 kg seed/ha. Pongamia seeds contain 30-40% oil. Pongamia seed oil as bio-fuel has physical properties very similar to conventional diesel. Emission properties, howevery, are cleaner for Bio-fuel than for conventional diesel. It has no polyaromatic compounds and reduced toxic smoke and soot emissions. A drastic reduction in sulphur content (<350ppm) and higher cetane number (>51) will be required in the petroleum diesel produced by refineries. However, bio-fuel meets these two important specifications and would help in improving the lubricity of low sulphur in (0.13-0.165) diesel. The present specification of flash point for petroleum diesel is 3500C which is lower than some other.

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Fig. 1 Karanjaseed

Fig. 2 Karanja oil and Karanja Bio-diesel

1.5 Diary Scum

Diary scum is a less dense floating solid mass usually formed by a mixture fat, lipids, proteins, packing materials etc. A large dairy, which processes 5 lakh litres of milk per day, will produce approximately 200–350 kgs of effluent diary scum per day, which makes it difficult to dispose. Most of the dairies dispose this diary scum in solid waste disposal site or by incinerating. By doing so, it is economically wasteful and generates pollutants. Further, diary scum causes direct as well as indirect operational difficulties for effluent treatment.

Annual production of milk in India is 150 million tons per year. Thousands of large dairies are engaged in handling this milk across the country. Raw chilled milk of cows and buffalos are standardized into market milk and milk products such as Butter, Ghee, Cream, Peda, Paneer, Cheese, Yoghurt, Ice cream and other products. Large dairies are handling number of equipments for processing, handling, storage, packing and transportation of milk and milk products. Enormous quantities of water are used for housekeeping, sterilizing and washing equipments, during this process residual butter and related fat which are washed and get collected in effluent treatment plant as a diary scum. It is because of the large production of milk in our country and due to commercialization of diary business availability of dairy scum is not a problem. Hence dairy scum can be used as an alternative due to its availability.

This diary scum is collected from the diary scum removing area of the effluent treatment plant in a fresh condition and processed immediately to avoid increase in free fatty acid further by biological action. Diary scum is turbid white in colour and semi solid in texture.

Fig.3 Diary scum and scum oil

Fig. 4 Scum biodiesel

Dairy scum karanja Bio-Diesel is made by mixing the karanja oil and the dairy scum oil in equal proportion. This mixture is then subjected to esterification and transesterification processes to reduce the free fatty acid contents, then methanol is recovered from the oil and the product is washed, to obtain the Dairy scum-karanja Bio-Diesel.

TABLE 1 PROPERTIES OF DIESEL, SCUM, SCUM-KARANJA AND KARANJA BIODIESEL

Fig, 5 Scum-karinja oil And SK Biodiesel

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Sl.No.	Characteristics	Scum Biodiesel	Skdiesel	Karanja Biodiesel	Diesel
01.	Calorific Value (Kj/Kg)	44321	41675	40059	43500
02.	Viscocity At 40^0C (Mm^2/S)		5.2	5.71	2-5
03.	Cetane Number	60	-	52.8	45-55
04.	Flash Point (^{0}C)	130	154	170	56
05.	Cloud Point (^{0}C)	10	4	8	
06.	Specific Gravity	.87	0.875	.88	.85
07.	Density (Kg/M^3)	870	875	880	850

2. TRANSESTRIFICATION

Transesterification is a chemical reaction used for the conversion of vegetable oil/Seed oil to biodiesel. In this process vegetable oil is chemically reacted with an alcohol like methanol or ethanol in presence of a catalyst like H2SO4. After the chemical reaction, various components of vegetable oil break down to form new compounds.The triglycerides are converted into alkyl esters, which is the chemical name of biodiesel.

If methanol is used in the chemical reaction, methyl esters are formed, but if ethanol is used, then ethyl esters are formed. Both these compounds are Bio-Diesel fuels with different chemical combinations. In the chemical reaction alcohol replaces glycerin.Glycerin that has been separated during the transesterification process is released as a byproduct of the chemical reaction. Glycerin will either sink to the bottom of the reaction vessel or come to the surface depending on its phase. It can be easily separated by centrifuges, and this entire process is known as transesterification.

The biodiesel produced by the process of transesterification has much lower viscosity, which makes it capable of replacing petroleum diesel in diesel engines. In earlier years when the process of transesterification was not known, the viscosity of vegetable oil was the major hindrance for its use as a fuel for motor engines. The transesterification process has been able to remove this problem.The by-product of the transesterification chemical reaction is the glycerin that originally formed the bond between the chains of fatty acids. Glycerin can be used for various purposes. Thus during trans-esterification process nothing goes to waste. All the products and byproducts are utilized for various purposes.

The engine has a compression ratio of 17.5 and a normal speed of 1500 rpm controlled by the governor. An injection pressure of 200 bar is used for the best performance as specified by the manufacturer. The engine is first run with neat diesel at loading conditions such as 7, 14, 21 and 28 N-m. Between two load trials the engine is allowed to become stable by running it for 3 minutes before taking the readings. At each loading condition performance parameters namely speed, exhaust gas temperature, brake power, peak pressure are measured under steady state conditions. The experiments are repeated for various combinations of diesel, Scum, Karanja and SK biodiesel blends. With the above experimental results, the parameters such as total fuel consumption, brake specific fuel consumption, brake mean effective pressure; brake specific energy consumption, brake thermal efficiency are calculated. Finally graphs are plotted for brake specific fuel consumption, brake thermal efficiency with respect to loading conditions for diesel, bio-diesel and its blends. From these plots, performance characteristics of the engine are determined.

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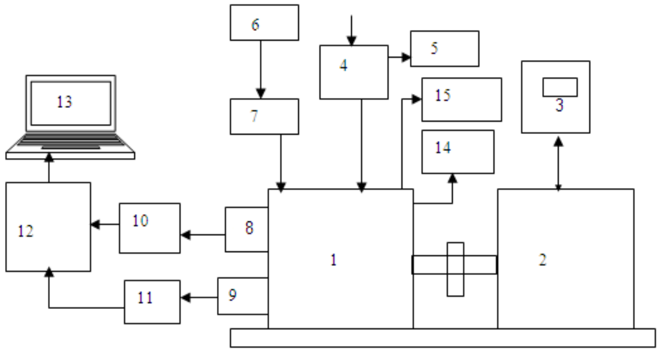

Fig.6 Experimental Setup

1.Diesel engine	2. Electrical Dynamometer
3.Dynamometer controls	4.Air box
5.U – tube manometer	6.Fuel tank
7.Fuel measurement flask	8.Pressure pickup
9.TDC position sensor	10.Charge amplifier
11.TDC amplifier circuit	12.A/D card
13. Personal computer	14.Exhaust gas analyzers
15.AVL smoke meter	

1) Switch on the mains of the control panel and set the supply voltage from servo stabilizer to 220volts.

2) Open the cooling water line to the dynamometer

3) Engine is started by hand cranking under no load condition and allowed to run for a 20 minutes to reach steady state condition.

4) The engine soft version V2.00 is run to go on ONLINE mode.

The main purpose of this study is to produce the scum and SK biodiesel and to perform an experiment whose results will show a significant reduction in harmful emission and also compare the performance and combustion characteristics.

Transesterification

Transesterification is a chemical reaction used for the conversion of vegetable oil/Seed oil to biodiesel. In this process vegetable oil is chemically reacted with an alcohol like methanol or ethanol in presence of a catalyst like H2SO4. After the chemical reaction, various components of vegetable oil break down to form new compounds.

The triglycerides are converted into alkyl esters, which is the chemical name of biodiesel. If methanol is used in the chemical reaction, methyl esters are formed, but if ethanol is used, then ethyl esters are formed. Both these compounds are Bio-Diesel fuels with different chemical combinations. In the chemical reaction alcohol replaces glycerin.

Glycerin that has been separated during the transesterification process is released as a byproduct of the chemical reaction. Glycerin will either sink to the bottom of the reaction vessel or come to the surface depending on its phase. It can be easily separated by centrifuges, and this entire process is known as transesterification.The biodiesel produced by the process of transesterification has much lower viscosity, which makes it capable of replacing petroleum diesel in diesel engines. In earlier years when the process of transesterification was not known, the viscosity of vegetable oil was the major hindrance for its use as a fuel for motor engines. The transesterification process has been able to remove this problem.

The by-product of the transesterification chemical reaction is the glycerin that originally formed the bond between the chains of fatty acids. Glycerin can be used for various purposes. Thus during trans-esterification process nothing goes to waste. All the products and byproducts are utilized for various purposes.

2.1 Steps Involved In Transesterification

- Measuring the Free fatty acid content in the oil, heating the oil up to 338K.
- Adding required amount of Sodium Hydroxide and methanol.
- Heating the solution using a magnetic stirrer (ref.figno) for two hours.
- Keeping the oil for settling process in a settling funnel for five hours.
- After settling methanol is recovered from the solution through distillation.

2.3 Factors Affecting Transesterification Process

(a) Oil temperature: The oil used in the preparation of biodiesel should be heated to 60^{0}C. The temperature has to be strictly maintained for best results. If the used is waste oil, it should be heated to 130^{0}C. Further heating of oil above the mentioned temperatures will result in poor quality bio-diesel.

(b) Reaction temperature: The reaction temperature of oil alcohol and catalyst should be limited between 55^{0}C to 60^{0}C. Increase in reaction temperature will result in loss of methanol during the reaction and increase in darkness of the product.

(c) Type of catalyst and concentration: The concentration of alkaline catalyst used should vary between 0.5% to 1.0% by weight. The concentration of acidic catalyst used in the two stage trans- esterification process should be between 0.45% to 2.0%.

(d) Intensity of mixing:

Oil, alcohol, catalyst should be mixed thoroughly by stirring it for 5 to 10 minutes.

(e) Purity of reactants: The reactants used in the preparation of bio-diesel should be highly pure; any impurity present will adversely affect the quality of bio-diesel prepared. Wax like impurities should be completely absent.

The required amount of NAOH and H2SO4 for esterification andtransesterification can be taken from the below chart.

TABLE 2: FFA-NaOH chart

F.F.A(of oil)	NAOH(in gm)
0	3.5
1	4.5
2	5.5
3	6.5
4	7.5

TABLE 3 FFA-H_2SO_4 chart

F.F.A(of oil)	H2SO4(in gm)
1	0.25
2	0.5
3	0.75
4	1
5	1.25
6	1.5
7	1.75
8	2
9	2.25
10	2.5
11	2.75
12	3
13	3.25
14	3.5
15	3.75
16	4

Fig. 7 Magnetic stirrer used for transesterification

2.4 Methanol Recovery from Bio-Diesel

- Transfer the Bio-diesel into the reaction vessel (3 neck flask).
-
- Make the necessary arrangement for the distillation set up, like heating and fixing the double wall condenser along with the recovery flask.
- Maintain the temperature at 343K.
- Methanol stars evaporating.
- Collect the methanol in a conical flask.
- Switch off the system when the methanol condensation stops.

Fig. 8Methanol recovery through distillation

2.5 Washing of Bio-Diesel

- Transfer the Bio-Diesel after methanol recovery into the plastic washing funnel.
- Spray 300 ml of warm water slowly into Bio-Diesel.

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- Water gets collected in the bottom of funnel.
- Keep 15 minutes for settling for each trail.
- Remove the water and check the pH value.
- Repeat the process till PH of water reaches7.

Fig. 8 Washing Of Biodiesel

TABLE .4
Item cost per unit

2.6 Heating of Bio-Diesel

Item	Cost per unit(lit/Kg
Karanja seeds	18 Rs/Kg
Raw scum	2 Rs/kg
NAOH	400 Rs/kg
H_2SO_4	50 Rs/lit
Methanol	35 Rs/lit

- Transfer the washed Bio-Diesel from the washing funnel to the 1 liter beaker.
- Add the magnetic pellet and adjust rpm to suitable speed.
- Heat the Bio-Diesel to the temperature of 393K(moisture evaporates)
- Allow the Bio-Diesel to cool gradually.
- Measure the quantity of final finished Bio-Diesel.
- Store it in a clean and dry container.

Fig. 9 Biodiesel Heating

3. COST ANALYSIS

For the cost analysis purpose the average FFA of the scum oil is taken as 7 and for karanja oil it is taken as 8.The cost analysis is made for the production of 1 lit of scum karanja Biodiesel as well as the scum biodiesel

3.1 The Cost Analysis for the Scum Biodiesel

To produce 1 lit of raw scum oil for the production of scum biodiesel required 3Kg of scum from the diary. So for 3 kg of scum, it cost 6 Rs

Cost factors

- Cost of the raw scum from diary
- Cost of the materials required for the processing
    - NAOH
    - H_2SO4
    - Methanol
- Miscellaneous cost includes Transportation, power required for processing

For the processing of 1 lit of scum oil of FFA 7 it requires

- 300 ml of Methanol
- 1.75 ml of H_2SO_4
- 6 gm of NAOH

So total processing cost = ((35*0.3) + (400*0.006) + (0.00175*50))

= 12.98

= 13 Rs

The miscellaneous cost for the processing of 1 liter of scum biodiesel could be calculated as 10 RS

So the total cost per lit = Rs (6+13+10)

= 29 Rs/lit

The by-product glycerin can also be sold hence the cost can

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again be decreased

3.2 The Cost Analysis for the Scum -Karanja Biodiesel

Cost factors

- Cost of the raw scum from diary
- Cost for processing 1 lit karanja oil
- Cost of the materials required for the processing
  - o NAOH
  - o H_2SO4
  - o Methanol

Miscellaneous cost includes Transportation, power required for processing

Table. 5 Item cost per unit

Item	Cost per unit(lit/Kg)
Raw scum	2 Rs/kg
NAOH	400 Rs/kg
H_2SO_4	50 Rs/lit
Methanol	35 Rs/lit

Cost for processing 1 lit karanja oil (transporting, equipment power labour)

= 22 Rs per lit (value has been provided by bio fuel department SIT TUMKUR)

For the processing of 1 lit of karanja oil of FFA 7 it requires

- 300 ml of Methanol
- 1.75 ml of H_2SO_4
- 6 gm of NAOH

So Total processing cost = ((35*0.3) + (400*0.006) + (0.00175*50))

= 12.98

= 13 Rs

Total production karinja cost per lit = (22+13+24) Rs

= 29.5Rs/lit

But for the production of 1 lit of karanja oil it requires 3 kg of seeds. After the production oil there will be 2 kg of karanja cake left over and the price of karanja cake in the market is 15 Rs/kg (value has been provided by bio fuel department SIT TUMKUR)

Hence Karanja oil cost will be = (18*3)-(15 X 2))

= 24 RS/lit

For scum Karanja biodiesel 500 ml of scum oil as well as 500 ml of karanja oil is taken after that the processing cost is same that of scum. Hence for one lit of **scum karanja oil** the cost can be taken as

= (6+13+10) + (20+13+24)/2

= **44 Rs/lit**

4. CONCLUSION

Biodiesel can also be used in blends with conventional diesel, while still achieving substantial reductions in emissions. Technically, biodiesel is Fatty Acid Methyl Ester (FAME). It is formed by replacing the glycerol from each triglyceride molecule of veggie oil. Once the glycerol is removed from the oil, the remaining molecules are similar to petroleum diesel fuel. The biodiesel molecules very simple hydrocarbon chains, containing no sulfur, ring molecules, nor aromatics associated with fossil fuels. Biodiesel is made up of almost 10% oxygen, making it a naturally "oxygenated" fuel. Bio-Diesel is a name of a clean burning alternative fuel, produced from domestic, renewable resources. Bio-Diesel contains no petroleum, but it can be blended at any level with conventional diesel to create a biodiesel blend. It can be used in compression ignition diesel engine with little or no modifications. In the past several decades, it has been found that biodiesel (esters derived from Vegetable oils) is a very promising one. The most common blend is a mix of 20% biodiesel. And 80% petroleum diesel, called “B20”. The process involed in the production of bio-diesel is economical for mass production. Bio-diesel can be produce cost effectively from karanja oil and diary scum.The cost compared to the diesel is very much lesser and will be highly profitable if it is mass produced.

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