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PREPARATION AND PERFORMANCE ANALYSIS OF NERIUM OIL BLENDED WITH DIESEL

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***Abstract*: Diesel engine plays a vital and indispensable role in human life. At the same time, they contribute to atmospheric pollution substantially. This is a very tentative situation where in both the environment comfort is inter-related. One cannot reduce the usage of diesel. If the current scenario continues, there might come a day when there would be no more diesel left. Hence, this is the correct time to produce an alternate fuel which can perform like diesel. In this present work, Nerium oil is extracted and it is converted into bio-diesel as an alternative fuel for diesel engine. The testing is done by running a diesel engine with the biodiesel blends with base fuel in various proportions to find out the optimum blend ratio. Our present work is of 3 phases. The first phase is the manufacture of bio-diesel from Nerium oil. In the second phase, bio-diesel is tested and some important fundamental characteristics such as Calorific Value, Flash and Fire point and Viscosity of the bio-diesel were intended. The third phase is the most vital phase. Here, the performance characteristics of bio diesel are compared with base fuel. From the, it is found that the bio-diesel produced from Nerium oil can be successfully used as an alternate fuel for diesel in a diesel engine. It is also seen that the performance of the diesel engine has been increased.**

Keywords: **Soxhlet apparatus, Nerium oil, Biodiesel, Transesterification**

I. INTRODUCTION

Products from oil helps us do many things. We use them to fuel our logistics. Even though it makes life easier – finding, producing, moving, and using can cause problems to our environment. Recently, rising oil prices and concerns over the environmental impacts of oils use, have prompted research into alternative fuels. Bio diesel is one such type, which act as an alternate for conventional diesel. Bio diesel is made from the resources vegetable oils, animal fats, seeds and other oils. All vegetable oils and fats are made up of tri glycerides, which chemically react with alcohol in the presence of catalyst to produce chemical compound known as fatty acids and esters (Bio Diesel). Bio-diesel is an alternate fuel that requires no engine modifications and provides power similar to conventional diesel fuel. Bio-diesel is an ecologically friendly fuel and it contains no sulphur. (0.001%). Bio-diesel considerably decreases soot emissions. (Up to 50%) and contains no benzole or other carcinogenic polyaromatic components. Bio-diesel easily decomposes biologically and hence no greenhouse effect and global warming. Many researchers suggested that fuels if derived from vegetable oils can be used successfully as an alternate for Diesel.

[1] B. Yeo et al they stated that spent vegetable oil can be successfully used as an alternate fuel. The performance of this fuel derived from spent vegetable oil is better than conventional diesel and the emissions of this fuel is much lesser than conventional diesel. [2] A.G. Phadatare they stated that fuels can be prepared by esterification of oils. Also, the fuels prepared from this process have lesser emissions than that of conventional diesel. [3] S. Saka et al stated that the

transesterification process can be done successfully by methanol. Also, methanol can be used as a successful alternate for ethanol. Surgical spirit can also be used as a transesterification agent successfully. [4] Subba Reddi K describes us a lot of data related to the emissions when an IC Engine was fuelled by alcohol. It stated that the emissions were under control when an engine was fuelled by alcohol. [5] Desai K.P et al gave us the details that Methyl and Ethyl alcohols can be successfully used as an alternate fuel. Alcohols are good solvents for gums and carbon residues that arise due to engine operation. Hence, it is proved that alcohol blended fuels are cleaner than ordinary petroleum products. [6] J. Sarangan, stated that Bio-Diesel has properties better than Diesel which can substantiate it to give better performance than Diesel. Performance tests conducted on Diesel and Bio-Diesel proved that the characteristics of Bio-Diesel were far better than conventional Diesel. Also, the review stated that the emissions were much lower than Diesel.

Hence in this work, we carried out using Nerium oil as an alternate fuel for Diesel engine. Initially, Nerium oil was extracted from the Nerium seeds by using Soxhlet apparatus. Then the Nerium oil is Trans esterified into biodiesel and is used in a diesel engine.

II. PRODUCTION OF NERIUM OIL

The apparatus required for extraction of oil from Nerium seeds are Soxhlet apparatus, Condenser, Round bottom flask, Stirrer, Heating mandrel and the integrities required for extraction of Nerium oil are Hexane solution and Crushed seeds. Fig 1a & 1b shows Nerium seeds with and without outer shell. The procedure required for production of Nerium oil is illustrated in the following steps. Initially the crushed seeds are placed into the main chamber of the Soxhlet extractor which is shown in Fig 2. The Soxhlet extractor is then placed onto a round bottom flask containing the extraction solvent (hexane) which is then equipped with a condenser. Here the solvent is heated to about 40-50 degree Celsius. Due to this heat, the solvent vapour travels up to a distillation arm to condenses, and drips back down into the main chamber, then, the oil dissolves in the warm solvent and runs back to the distillation flask. This cycle is carried out for about 4-5 hours.

Figure 1(a) & 1(b) shows Nerium seeds with and without outer shells.

Figure 2 Soxhlet apparatus.

III. PREPARATION OF BIODIESEL

The apparatus required in preparation of the bio diesel are Reaction vessel with water bath, washing cum settling tank, Beaker, Stirrer, a Heating mandrel and the integrities required for preparation of bio diesel are Nerium oil, Methanol and 5 to 7 grams of sodium hydroxide which acts as a catalyst. The following steps are involved in the preparation of biodiesel as shown in Fig.3, namely reaction process, separation process, washing with de-mineralized water and moisture removal process.

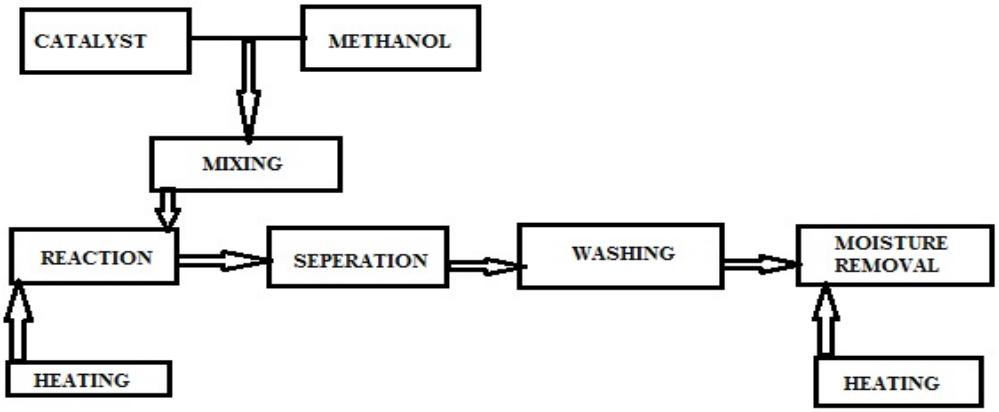

Figure 3 shows Steps involved in preparation of Biodiesel.

The main reaction for converting oil to biodiesel is called transesterification as shown in Fig.4. Transesterification is the process of reacting a triglyceride molecule with an excess of alcohol in the presence of a strong base catalyst such as KOH, NaOH, NaOCH3 etc. to produce fatty ester and glycerol. In this reaction process the Methanol and catalyst are added to the oil to produce methyl ester with glycerin as the by-product. At the start, Pour the oil in flask, then heat it for 65 degree Celsius and stir continuously for 20 minutes. Mix the methanol with sodium Hydroxide in a separate beaker to form sodium meth oxide. After 20 minutes add the sodium ethoxide mixture with oil in flask and Stir it for 20 minutes at uniform temperature. Pour this mixture in settling tank. After the completion of reaction process, the methyl ester is separated from the glycerin naturally as shown in Fig.5 which is due to density difference. Allow Glycerin to settle at the bottom and biodiesel at the top. After settling process, the impurities such as free glycerin and catalyst remaining in the methyl ester are removed using cleaning water and it is continued till all the impurities removed completely as shown in the Fig.6. After washing with de mineralized water the next step is the moisture removal. Methyl ester is separated from waste cleaning water using the density difference. Then, moisture remaining in the methyl ester is removed by heating the bio diesel for 110 degree Celsius which is shown in Fig.7.

Figure 4 shows Reaction process.

Figure 5 shows Settling process.

Figure 6 shows Washing process.

Figure 7 shows Moisture removal process.

Contaminants in the refined Methyl ester are filtered to remove as many impurities (up to 10 microns) are possible. Thus, the refined methyl ester namely Bio diesel fuel, is stored in an air tight stainless steel tank. This bio diesel has been used to run the diesel engine to execute the performance testing.

IV. PHYSICAL PROPERTIES OF PREPARED BIODIESEL

The important physical properties of bio-diesel like Calorific value, Flash point, Fire point and Viscosity is determined by various testing methods.

Calorific Value

This is the most significant value of the fuel. It is the amount of energy liberated when a kilogram of fuel is burnt completely. The calorific value of fuels is found out by the device called Calorimeter. The calorific value of our fuel is found out to be 8750 Kcal /Kg. that is 8750 Kcal of energy is liberated when a kilogram of our Bio-diesel is burnt completely. From this value, it is evident that the calorific value is not very odd and it is acceptable.

Kinematic Viscosity

This is also a very important property as this property determines the ease with which the fuel can be transported from the fuel tank to the engine. The Indian government has a set of a norm that kinematic viscosity should range from 3.5mm^2 /s to 10mm^2/S. Also, the ASTM has set a standard that kinematic viscosity of a fuel should lie somewhere between 1.9mm^2/s and 10.5mm^2/s. However, the kinematic viscosity of our Bio-Diesel which was found out by redwood viscometer was 4.2mm^2 /S. This satisfies both the Indian and ASTM standards.

Cetane Number

Cetane number is a numerical value by which a Diesel is represented. The Cetane Number should be an optimum to disclose that a given Diesel is effective. The Indian government has set a norm that the Cetane number of a Bio- Diesel should more than 35. Successfully, the Cetane number of our Bio-Diesel was out to be 39. Hence our Bio-Diesel has successfully passed this.

Flash & Fire Point

The Flash point is also a very vital property to represent a fuel. This is the temperature at which a flash is produced even when the fuel is not in contact with the flame. Lesser the Flash Point, better the fuel is. This is because the fuel can be ignited easily. There are also certain standards for Flash point. The ASTM has set a standard that the Flash Point should not be less than 38° C. However, the Indian government has set of standard that the Flash point should in no way exceed 130° C. The Flash Point of our Bio-Diesel was found by Cleveland Open Cup apparatus and the valve was found out to be 110° C. This value is acceptable both by Indian and ASTM standards as it lies well between the ranges. The Fire point is usually more than the Flash Point by approximately 10˚ C. From these conclusion, it is evident that the fuel satisfies all the basic fundamental properties effectively.

IV. PERFORMANCE ANALYSIS OF PREPARED BIODIESEL

The performance analysis of the engine is tested for various proportions of biodiesel and the specification of the engine are tabulated in the Table.1. Initially the engine is started at no load by engaging the decomposition lever, then the time taken for 10 cc fall of fuel is noted and values are tabulated. The engine is loaded gradually and similarly the time taken for 10cc fall of fuel is noted and the values are noted. The above procedure is repeated and the values for different loads are noted and shown in following figure 8.

Table 1 shows Specification of used Diesel engine.

Type	Four cylinder, inline
Bore	84 mm
Stroke	90 mm
Capacity	1995 cc
Compression ratio	21:1
Maximum power	41 kw at 4500 rpm
Maximum torque	107.9 kw at 2500 rpm
Cooling	Water cooled
Fuel tank capacity	5litres

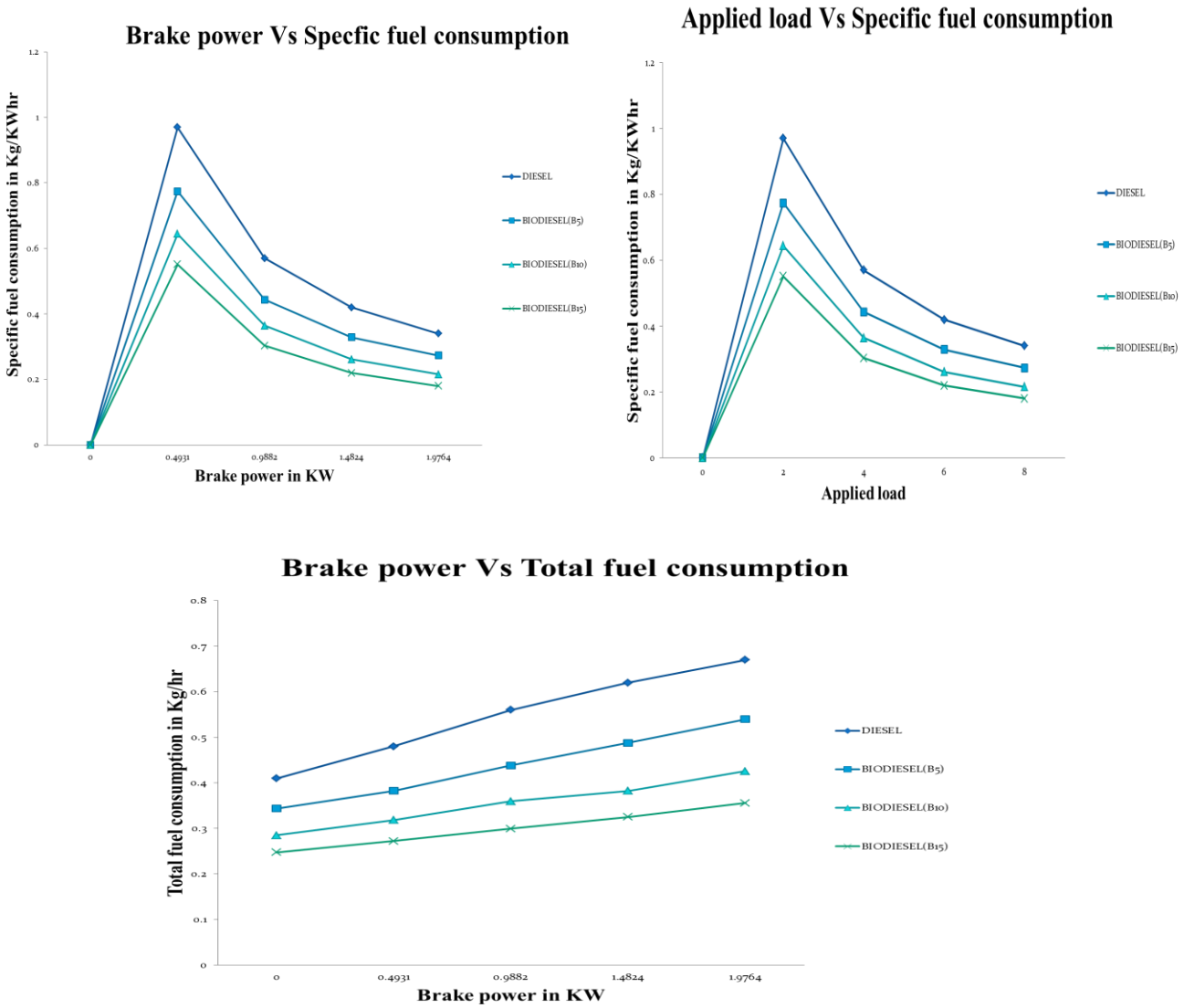

Figure 8 shows Performance curves.

Brake Power

The brake power is defined as the usable energy that is available at the crank shaft. It is the power after the losses due to friction. For an applied load, the brake power is similar for both diesel and biodiesel. But, biodiesel has a very slight advantage over diesel. There is an increase of 0.12% of brake power when Biodiesel was used. This proves that Biodiesel provides better brake power than conventional diesel.

Total Fuel Consumption

Total Fuel Consumption is the amount of fuel consumed in kg/hr. At the end of the experiment, it is evident that the same engine consumed less Biodiesel than Diesel. The TFC value was decreased by 0.1622 Kg/ hr when Biodiesel was used at no load. It means that less amount of Biodiesel is spent for the same load when compared with Diesel. This is an advantage over conventional fuel.

Specific Fuel Consumption

Specific Fuel Consumption is the amount of fuel consumed in per brake power per second of work. It is desirable that the Specific Fuel Consumption must be as low as possible. The SFC value was decreased by 0.4187 Kg/KWhr when Biodiesel was used at no load. This is desired as the amount of fuel consumed per brake power would be lower and this would increase the mileage of an engine.

V. CONCLUSION

The first phase was the preparation of Bio-Diesel from Nerium oil. This phase was a success as the preparation was done by simple process. It was very successful and the Biodiesel was obtained. When one compares this preparation process with that of fossil fuels, this method was very simple and quick. Also, this method has an added advantage that this fuel is renewable and does not deplete. The second phase is comparing the physical properties of Biodiesel with that of Diesel. Here also, there wasn't much a difference. Also, the physical properties of the Biodiesel prepared from Nerium oil contemporarily satisfied both the Indian and ASTM standards. Hence, this phase was also a success. The third and vital phase was the performance testing of the prepared Biodiesel. The experiments were conducted on a matador, 4 cylinder, 4 stroke, and vertical inline engine. Here, first the readings were taken by using diesel as fuel and then with biodiesel. The results showed that the Brake Power obtained by using Biodiesel were higher than that used from conventional diesel. Also, the fuel consumptions per load of biodiesel was lower than conventional diesel. Hence, the third phase was also a successful one and it stated that this fluid obtained from Nerium oil can be used successfully as an alternate for diesel.

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