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The Effect in NEEM Oil Biodiesel Properties Due To the Blending Of Cerium Oxide Nanoparticles

A. Rajalingam^{1*}, S.P. Jani¹, A. Senthil Kumar², A. Adam Khan³

1-Department of Mechanical Engineering Ponjesly College of Engineering, Nagercoil, Tamilnadu.

2- Department of Mechanical Engineering Sethu Institute of Technology, Viruthunager, Tamilnadu.

3- International research Centre Department of Mechanical Engineering Kalasalingam University. Viruthunager, Tamilnadu

Abstract - *The physiochemical properties are analyzed for the neem oil biodiesel and its cerium oxide nanoparticles blend. The neem oil biodiesel are produced from neem seed oil through transesterification process. The cerium oxide nano particles (30 ppm) are blended with neem oil biodiesel by ultrasonic agitation process which disperses the cerium oxide nanoparticle into the biodiesel permanently. Then the physiochemical properties such as kinematic viscosity, specific gravity, cetane number, gross calorific value and flash point are finding out by appropriate apparatus and equipment. From this analysis all the property of both neem oil biodiesel and its cerium oxide blends satisfies the ASTM standard. But the cerium oxide blended fuel gave very nearest value to the diesel and this lead to direct use in unmodified diesel engine.*

Key words- *Neem oil, Transesterification, Biodiesel, Cerium oxide Nanoparticle and Ultrasonic agitator.*

I. INTRODUCTION

Due to the population growth, the requirement of fuel is increasing day by day especially diesel fuel, because the diesel makes a biggest contribution in transportation and power generation. The diesel fuel is obtaining from petroleum crude oil. But it starts to deplete in near future and increasing emissions also. So an alternative should be found to compensate fuel need and reduce the emission. The biodiesel can be the alternative fuel because of its availability, bio degradable nontoxic and cleaner burning with fewer emissions. Recently some countries are starts to produce and use biodiesel for various applications. The most of developing country like India importing petroleum to meet their fuel need this is affecting the economy of country. So the alternative should be locally available. The neem oil could compensate the future demand by its various characteristics such as non-edible seed oil, plenty availability, adaptability, low generation period, low requirement of water, high seed yield and oil content. The biodiesel can produce from the neem oil through the transesterification process. [1,2]. The neem oil biodiesel characteristics satisfy the ASTM specifications. The performance characteristics are increasing compared with mineral diesel which includes break thermal efficiency and break specific fuel consumption. The emission characteristics such as hydrocarbons and carbon monoxide are reducing whereas nitrous oxides increasing [3,4].

In this experimental study the neem oil biodiesel was produced through the single step alkali catalyst transesterification process. Then the cerium oxide nanoparticle was doped with neem oil biodiesel using ultrasonic agitation process to make biodiesel blend. After that the biodiesel blend and pure biodiesel involved into the property analysis, which is compared with diesel.

II. MATERIALS AND METHOD

A. Materials Required

The neem oil is selected as feedstock oil and then the neem oil was purchased from local market at Nagercoil. Some other chemical compounds also need along with it to produce biodiesel through transesterification process, the chemicals such as methanol and potassium hydroxide (KOH). The materials required for this biodiesel production is listed below. The experimental set up was shown in fig. 1.

- Electric heater
- Stirrer
- Beaker
- Separating funnel

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Fig.1 Experimental setup for biodiesel production

B. Biodiesel (Methyl Ester) Production Process

The transesterification process is used to produce biodiesel from neem oil. In this transesterification process the methanol reacts with triglycerides in oil, which produce methyl ester as a biodiesel and glycerol as a byproduct. Here one litre of neem oil was taken in a beaker and it was heated upto 60°C and makes a stirring at 500 rpm. After obtaining required temperature and stirring speed the 200 ml methanol and 10 gram KOH added with preheated oil. Then this temperature and stirring speed was maintaining for one hour because enough time period required completing the reaction with good properties and high yielding efficiency. After that the reacted oil was poured in to the separating funnel and placed over a 12 hours to separate biodiesel and glycerol. This separating process was happening due to its density difference and gravitational force only. Now the reacted oil was settled in two layers. The biodiesel was obtained from the upper layer in yellowish brown colour and the glycerol was settled in the bottom layer with black colour. The biodiesel is left after the drawing of glycerol from the bottom layer. The experimental arrangement of biodiesel production process was shown in Fig.2.



Fig.2 Biodiesel and glycerol after settle

C. Preparation of biodiesel blend with cerium oxide nanoparticle

The biodiesel blend with cerium oxide nanoparticles was produced using ultrasonic agitation process, because this is an efficient method for dispersing of nanoparticles in biodiesel. Here 20 Hz frequency is used to blend biodiesel a cerium oxide nanoparticles and this frequency was maintaining over a time period of 30 minutes. Now the biodiesel blends was prepared for further analysis.

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III. RESULT AND DISCUSSION

The prepared biodiesel and its blends was makes an analyses of properties such as kinematic viscosity, calorific value, density, flash point and specific gravity. The various biodiesel properties are listed in table1.

TABLE 1: PROPERTIES OF NEEM OIL BIODIESEL, DIESEL AND BIODIESEL BLENDED WITH CeO₂

S.NO	Name of the properties	Biodiesel (B100)	Biodiesel + CeO ₂ (30 ppm)	Diesel	ASTM Code
1	Kinematic Viscosity @ 40 ^o C, cSt	5.7	4.3	2.83	D 2217
2	Specific Gravity	0.88	0.8620	0.8298	D 445
3	Gross Calorific Value, MJ	39501	41052	42250	D 4809
4	Flash Point, ^o C	152	146	60	D 93
5	Cetane Number	53	53.5	46	D 613

A. Kinematic Viscosity

Kinematic viscosity is an important property which is defined as resistance of fluid to flow. It plays a big role in the performance of the engine and fuel. The viscosity leads to poor atomization and pumping loss. The lower viscosity is also not too good, because the lower viscosity of fuel has bad lubrication properties and this leads to abnormal wear in engine and injector system. The neem oil biodiesel has good kinematic viscosity and the blending of cerium oxide nanoparticle had made a significant change. It was reducing the property of kinematic viscosity value about 24.56 %.

B. Specific Gravity

The specific gravity of biodiesel depends upon its density. The high denser fuel has high energy density. The specific gravity of neem oil biodiesel is always higher than diesel. Due to the doping of cerium oxide nanoparticles reduced the specific gravity value by 2%.

C. Gross Calorific Value

The total quantity of heat liberated by completely burning of one unit mass of fuel is called as calorific value. The calorific value of a substance is the amount of energy released when the substance is burned completely to a final state and has released all of its energy. A good fuel should have a high heating value. The neem biodiesel have a good calorific value and the cerium oxide nanoparticles also increasing about 3.9%.

D. Flash Point

The flash point is a temperature point at which the fuel starts to ignite when it is exposing to the flame. The lower flash of fuel is difficult so handle and store the fuel. Mostly, the biodiesel has a high value in flash point. The neem oil biodiesel also has high flash point but the cerium oxide blend reduces upto 6^oC.

E. Cetane Number

The value of cetane number defines the ignition delay between injection and ignition of fuel. The neem oil biodiesel has high cetane number value than diesel which leads to smooth combustion. The cerium oxide nanoparticles also little bit increasing it.

IV. CONCLUSION

In this study investigates the various physiochemical properties of neem oil biodiesel and its cerium oxide blend. The neem oil is renewable oil and its availability also high in our country compared with other feed stock. The neem oil biodiesel properties satisfy the ASTM standard. So the neem oil could be the alternative source for diesel. The cerium oxide nanoparticle also had done a

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considerable change in the neem oil biodiesel which properties are very closer to the diesel fuel. So the cerium oxide blended neem oil biodiesel can be use directly in diesel engine without any modification.

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