A critical review on the Neem – Oil Based Biofuels as an alternative to the Conventional Fuel in India

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Abstract

Biodiesel can be used in engines which are presently existing, vehicles and infrastructure without any amendments. As storage, pumping and burning of petroleum diesel fuel takes place, just like in similar fashion all these activities can easily be achieved by using Biodiesel either in pure form or by making blends of biodiesel with gasoline fuel. rust fungi. Neem seed oil has also been used as a renewable source for the preparation of polymeric coatings. It has been converted into various polymeric resins, including polyester amides and polyether amides. These resins may be utilized further for preparation of polyurethane coatings. A review on the depletion of conventional fuels and possibilities for the Neem biofuel is conducted in the present study.

Keywords: Biofuel, transesterification, diesel, petrol, emissions.

INTRODUCTION

Biodiesel can be used in engines which are presently existing, vehicles and infrastructure without any amendments. As storage, pumping and burning of petroleum diesel fuel takes place, just like in similar fashion all these activities can easily be achieved by using Biodiesel either in pure form or by making blends of biodiesel with gasoline fuel. There is no impact on life time of engine and also it will provide better economy, provided suitable blend is used. The proper lubrication of any fuel is determined by its lubrication parameter. Low lubricated petroleum diesel fuel can cause premature failure of injection system components and decreased performance. Biodiesel provides excellent lubricity to the fuel injection system.

There has been significantly loss in terms of emissions of harmful gases on application of biodiesel in vehicles. The amount of carbon monoxide, particulate matter, unburned hydrocarbons, and sulphates was lower than that of it is from diesel fuel. Carbon dioxide produced from biodiesel combustion does not contribute to new emissions of CO_2 as it is part of the carbon cycle. Closed carbon cycle - 80% reduction in CO_2. Example: growing oil feedstock consumes four to six times more CO_2 than biodiesel exhaust.

Compared to diesel, biodiesel effects on engine exhaust are in the table that follows: B100 refers to neat biodiesel; B20 refers to 20% biodiesel blended with 2 Diesel:

HC	36.73% reduction with B100	7.35% reduction with B20
CO	46.23% reduction with B100	9.25% reduction with B20
PM	68.07% reduction with B100	13.61% reduction with B20
SO_x	100% reduction with B100	20% reduction with B20

The above data on HC, CO, PM, and SO_x is based on data reported by Dr. Groboski in 1998 paper "Combustion of Fat and Vegetable Oil Derived Fuels in Diesel Engines."OAE-BIO3 formulation with low-NOx additive will bring NOx to diesel baseline and it has been found that effect of biodiesel on NOx is scattered. Test involved use of diesel engines, which showed NOx reductions of 10-18% in comparison to diesel. Cleaning of injectors is achieved through biodiesel use in diesel engines results in cleaning of injectors which restores the original spray patter (also improves fuel economy), resulting in lowering of NOx. Testing of heavy-duty laboratory engines by research scientist has not shown the reduction levels achieved with the in-use engines. There are many alternative different techniques which can reduce emission by 30-40%. A great deal of research has been conducted on vegetable oils and the researchers have concluded that neat vegetable oil hold promises as alternative fuels for Diesel engines. Although, biodiesel is gaining popularity, more than 95% of renewable resources used for its production are edible oils (Gui et al., 2008), which will in long term have serious implications on food availability. Current studies have focused on the use of non-edible oil from plants in order to avoid the aforementioned problem. Research studies on the utilization of neem oil methyl ester as an alternative diesel engine fuel has been carried out by various researchers. Agrawal et al. (2006) and Anjana et al. (2007) have highlighted the suitability of NOME for diesel engines. Narun et al. (2007) have conducted experiment with diesel fuel and diesel NOME blends in four stroke naturally aspirated diesel engine. Pramanik (2003) reported that up to 50% Neem oil could be substituted for diesel for use in diesel engine without any major operational difficulties. Prabhu (2013) analyzed combustion, performance and emission characteristics of single cylinder Diesel engine with NOME and its diesel blends. This research reported that brake thermal efficiency (BTE) and brake specific fuel consumption (BSFC) for B20, B40 and 100% NOME are lower than that of diesel fuel at full load and from the emission analysis it was observed that there was 10, 15 and 20% increase in NO emission for B20, B40 and 100% NOME at full load as compared to diesel fuel respectively. The whole report concluded that B20 blend was better compared to 100% NOME and can be used as substitute for diesel fuel. S Sivalakshmi and T Balusamy (2013) conducted experiment on four-cylinder four stroke diesel engine and reported that lower percentage of NOME blends (B10 and B20) gave better engine performance and improved engine emissions. Higher percentage of biodiesel blends (B30, B50, and B100) reduced CO, HC and smoke emissions. But they increased NO_X emissions slightly and gave lower performance characteristics than that of diesel fuel. Carraretto et al. (2009) carried out investigations on a sixcylinder direct injection diesel engine using biodiesel blends. The increase of biodiesel percentage in the blends led to slight reduction in both power and torque over the whole speed range. Raheman et. al. evaluated the performance of biodiesel blends at different compression ratio and injection timings of the engine. With the increased compression ratio and advanced injection timing, engine performance was comparable with that of diesel engine. Nabi et al investigated the performance and emission characteristics of neem oil.

RAW MATERIALS INTRODUCTION

Azadirachta indica, also known as neem, Nimtree, and Indian Lilacis a tree in the mahogany family Meliaceae. Neem is one of two species in the genus Azadirachta, and is native to India and the Indian subcontinent including Nepal, Pakistan, Bangladesh and Sri Lanka. Besides growing neem in tropical and subtropical areas, Neem trees now also grow in islands in the southern part of Iran.

Figure 1: Seeds of neem tree

Its fruits and seeds are the source of neem oil. Neem oil is a pressed from the fruits and seeds of the neem, an evergreen tree which is unique to the Indian subcontinent and has been introduced to many other areas in the tropics. It is the most important of the commercially available products of neem for organic farming and medicines. Neem oil varies in colour. It can be golden yellow, yellowish brown, reddish brown, dark brown, and greenish brown. It contains mainly triglycerides along with many triterpenoid compounds, which causes bitter taste. It is hydrophobic in nature; for emulsifying it in water for application purposes, it must have a formulation with appropriate surfactants.

Azadirachtin is the most popular and studied triterpenoid in neem oil. There is variation of neem oil content from 300 ppm to over 2500 ppm depending on the extraction technology and quality of the neem seeds crushed. Nimbin is triterpenoid which has been credited with some of neem oil's properties as an antiseptic, antifungal, antipyretic and antihistamine. Neem oil also composed of several sterols, including (campesterol, beta sterol). Neem oil is widely used as insecticides, lubricant, drugs for variety of diseases such as diabetes and tuberculosis. This oil could also prolong leather goods when it is applied on them. There are several methods to obtain Neem oil from the seeds like mechanical pressing, supercritical fluid extraction, and solvent extraction. Mechanical extraction is the most widely used method to extract neem oil from neem seed. The oil produced with this method usually has a low price, since turbidity is possessed by it and also contains a significant amount of water and metals contents. Supercritical fluid extraction gives very high purity of oil. However, operating and investment cost is high. This technique has several advantages. It provides higher yield and less turbidity of oil than mechanical extraction, and relatively low operating cost compared with supercritical fluid extraction. The method of processing is likely to affect the content of the oil composition, since the methods used, such as pressing (expelling) or solvent extraction are unlikely to remove exactly the same mix of components in the same proportions. The neem oil yield that can be obtained from neem seed kernels also varies widely in literature from 25% to 45%. The oil can be obtained through pressing (crushing) of the seed kernel either through cold pressing or through a process incorporating temperature controls 40^o to 50^o C. Neem seed oil can also be obtained by solvent extraction of the neem seed, fruit, oil, cake. An Indian industry extracts the oil remaining in the seed cake using hexane. This solvent-extracted oil is of a lower quality as compared to the cold pressed oil and is mostly used for soap manufacturing. The by-product of solvent extraction process for neem oil is neem cake. Neem oil is not used for cooking purposes. In India, neem oil acts as raw material for the production of cosmetics and it is also used in medical fields.

In Aryurveda, neem oil can cure skin related diseases, and many other various fatal diseases. Formulations made of neem oil also find wide usage as a bio pesticide for organic farming, as it can kill pests which are harmful for the crops. Neem oil is not harmful for mammals until it is not present directly into habitat or in their food. Sometimes, neem oil also acts as household pesticide and kills ants, mosquitos etc. It can also act as remedy for controls black spot, powdery mildew, anthracnose and rust fungi. Neem seed oil has also been used as a renewable source for the preparation of polymeric coatings. It has been converted into various polymeric resins, including polyester amides and polyether amides. These resins may be utilized further for preparation of polyurethane coatings. Studies done when Azadirachtin (the primary active pesticide ingredient in neem oil) was approved as a pesticide showed that when neem leaves were fed to male albino rats for 11 weeks, 100% (reversible) infertility resulted biodiesel blends in direct injection (DI) diesel engine and reported reduction in smoke and CO emissions, while NO_X emissions increased with the biodiesel blends. Anand et. al. reported an increase in particulate matter emissions for blends of neem oil methyl esters with diesel. Avinash Kumar Agrawal (2002) reported that blending the vegetable oil with diesel and alcohol oxygenates have improved the thermal efficiency than neat vegetable oil. Elango T. and Senthilkumar T. performed experiments on single cylinder air cooled compression ignition (CI) engine and concluded that variation in the peak pressures is not significant but an increase in ignition delay of about 6 to 8 degrees in crank angle was observed for the blends when compared with diesel. Banapurmath (2009) checked combustion characteristics of a 4-stroke CI engine operated on Honge oil, Neem and Rice Bran oil when directly injected and dual fuelled with producer gas induction and confirmed that HO/CO emissions of producer gas injected fuels in dual fuel engine are found to be more than single fuel engine operation.

CONCLUSIONS

Biodiesel may not require an engine modification. Biodiesel can be blended with diesel so as to improve the efficiency of the engine without any hassles. Biodiesel is cheap. It is cost effective as it can be produced locally also. The growing cost of fuels across the globe has triggered an interest in biofuels and other alternative sources of energy. The reserves of fossil fuels like coal and petroleum products are reducing. It is the burning of these fossil fuels that are contributing to the greenhouse effect. Added to this, the energy security and climate change issues being debated in governments across countries make the use of biofuels an important alternative. Bio fuel has huge potential to stimulate rural development and to generate employment. Benefits to the environment as well as energy security are key factors working in favor of bio fuels.