Biodiesel: An alternative Potential fuel to the conventional fuel for the betterment of humankind

RASHI KOUL

Abstract- *As we all are aware that the fossil fuel resources are on the verge of depletion and the bad environmental effects caused due to it, the biodiesel has become a new age fuel in more recent years. The research carried in the field of biodiesel production is quiet advantageous as if produced on a large scale and when commercialised, the prices will reduce and moreover it is good for the environment. This paper focuses on the history and recent developments of biodiesel. The application of biodiesel in automobile industry, the present challenges of the industry, the various technologies and new policies laid down.*

Key words: *Biodiesel, technologies, emissions, applications, challenges.*

I.INTRODUCTION

Over the ages, unlimited use of fossil fuels has led to the global warming, degradation and various health hazards which has reached its peak. Reduction in engine emissions becomes a major task in engine development due to increasing concern of environment protection. Many aspects of everyday life rely on fuels, be it transport of good or people. Main energy resources come from fossil fuels such as petrol oil, coal and natural gas. Fossil fuel contributes 80% of the world's energy needs. [1]. In transportation sector, private vehicles, buses, trucks, ships, aeroplanes consume significant amount of gasoline and diesel. This situation leads to a indispensable dependence of everyday life on fossil fuels. However, growth of the population is not covered by domestic crude oil production [2-3]. The formation of fossil fuel takes millions of years and it belongs to non-renewable sources of energy. In some of the developing countries, fossil fuel will be consumed in next 60 more years. In addition to this, the emissions produced by the combustion of fossil fuel contributes to the air pollution and global warming [1-4]. Most of the countries are already dealing with the international global warming pressure. Due to these factors it's important and worthwhile to focus our attention on the immediate need of clean alternative fuels.

Biodiesel is one promising alternative to fossil fuel for diesel engines due to environmental consequences of petroleum-fuelled diesel engines and the decreasing petroleum resources. Biodiesel is produced by chemical reactions from natural oil, alcohols, fats etc. A good amount of work shows that a diesel engine can be run on these oils when blended in small percentage with the diesel without undergoing any modification on the engine. In fact the energy density of biodiesel is quite close to regular diesel. There are some similarities between the combustion properties of biodiesel and petroleum derived diesel have made the former one of the most promising renewable and sustainable fuels for the automobile [7].

II Blends

Blends of biodiesel and conventional hydrocarbon-based diesel are products most commonly distributed for use in the retail diesel fuel marketplace. Much of the world uses a system known as the "B" factor to state the amount of biodiesel in any fuel mix:

- 100% biodiesel is referred to as B100
- 20% biodiesel, 80% petro diesel is labelled B20
- 5% biodiesel, 95% petro diesel is labelled B5
- 2% biodiesel, 98% petro diesel is labelled B2

Blends of 20% biodiesel and lower can be used in diesel equipment with no, or only minor modifications, although certain manufacturers do not extend warranty coverage if equipment is damaged by these blends. The B6 to B20 blends are covered by the ASTM D7467 specification. Biodiesel can also be used in its pure form (B100), but may require certain engine modifications to avoid maintenance and performance problems. Blending B100 with petroleum diesel may be accomplished by:

1. Mixing in tanks at manufacturing point prior to delivery to tanker truck.
2. Splash mixing in the tanker truck (adding specific percentages of biodiesel and petroleum diesel).
3. In-line mixing, two components arrive at tanker truck simultaneously.
4. Metered pump mixing, petroleum diesel and biodiesel meters are set to X total volume, transfer pump pulls from two points and mix is complete on leaving pump [8].

The feedstock of biodiesel to great extent depends on soil conditions, climate etc. In United States soya bean oil is mainly used as raw material, whereas Germany uses mainly rapeseed oil which even set up a special economic sector in order develop biodiesel. Currently biodiesel has already emerged in 1500 German gas stations. In the US, biodiesel is specified by ASTM D6751, an authoritative body in 1996 and 2000 published standards [9, 10].

III Conversion Technologies

Conventional methods of the application of vegetable oil in diesel engines are [6] direct mixing and micro emulsion. These two physical methods lowers the viscosity of vegetable oil. At the same time, there are few challenges with these, it can not overcome the problem of carbon deposits, high temperature pyrolysis cracking is hard to control at high temperatures. The other important parameters are reaction temperature, ratio of alcohol to vegetable oil, amount of catalyst etc. Now a days, the most common method followed is ester exchange. In the transesterification process, the viscosity is reduced and temperature value maintained. Transesterification is the chemical reaction between triglycerides and short chain alcohol in presence of a catalyst to produce mono-esters. The long and branched chain molecules are transformed to mono-esters and glycerines [7]. Not only are the short chain alcohols like methanol, ethanol, butanol but higher carbon chain like octanol also being used. However the short c-chain have been used commercially also. Amongst all these, methanol is used mostly due to its low price.

It follows that that higher usage of methanol leads to higher output of biodiesel but the higher density can lead to poly condensation reaction which in turn will cause difficulty in the separation of biodiesel.

Lipase catalyst, acid catalyst and alkali catalyst are commonly used for ester reaction. They all have their own set of advantages and disadvantages.

IV Biodiesel Emissions

Biodiesel can replace fossil fuel as a clean energy source. It can protect the environment by reducing CO_2, SO_2, CO, HC [9].

The carbon cycle of biodiesel is a dynamic through the photosynthesis process. Plants absorb CO2, which is more than those discharged by the biodiesel combustion process. Thus, using biodiesel can more effectively reduce the emission of CO2, protect the natural environment and maintain the ecological balance, compared to the use of fossil fuel [5].

There are a number of new technologies being phased in to control the production of diesel emissions. The exhaust gas recirculation system, E.G.R., and the diesel particulate filter, D.P.F., are both designed to mitigate the production of harmful emissions [4].

A study performed by the Chonbuk National University concluded that a B30 biodiesel blend reduced carbon monoxide emissions by approximately 83% and particulate matter emissions by roughly 33%. NOx emissions, however, were found to increase without the application of an E.G.R. system. The study also concluded that, with E.G.R, a B20 biodiesel blend considerably reduced the emissions of the engine. Additionally, analysis by the California Air Resources Board found that biodiesel had the lowest carbon emissions of the fuels tested, those being ultra-low-sulphur diesel, gasoline, corn-based ethanol, compressed natural gas, and five types of biodiesel from varying feedstocks. Their conclusions also showed great variance in carbon emissions of biodiesel based on the feedstock used. Of soy, tallow, canola, corn, and used cooking oil, soy showed the highest carbon emissions, while used cooking oil produced the lowest [11].

While studying the effect of biodiesel on a D.P.F. it was found that though the presence of sodium and potassium carbonates aided in the catalytic conversion of ash, as the diesel particulates are catalyzed, they may congregate inside the D.P.F. and so interfere with the clearances of the filter. This may cause the filter to clog and interfere with the regeneration process [11]. In a study on the impact of E.G.R. rates with blends of jathropa biodiesel it was shown that there was a decrease in fuel efficiency and torque output due to the use of biodiesel on a diesel engine designed with an E.G.R. system. It was found that CO and CO2 emissions increased with an increase in exhaust gas recirculation but NOx levels decreased. The opacity level of the jathropa blends was in an acceptable range, where traditional diesel was out of acceptable standards. It was shown that a decrease in Nox emissions could be obtained with an E.G.R. system. This study showed an advantage over traditional diesel within a certain operating range of the E.G.R. system [6]. Currently blended biodiesel fuels (B5 and B20) are being used in many heavy-duty vehicles especially transit buses in US cities. Characterization of exhaust emissions showed significant emission reductions compared to regular diesel [1].

V The Biodiesel Policy

In recent years, incentives exist within energy policies in various countries so as to promote the use of clean fuel. The policy and government incentives will directly influence the development of biodiesel industry. The policies laid down for such acts is very crucial as it plays an essential role. The government can exempt them from the taxes, direct subsidies price control etc. Some of the incentives offered by the government are as under:

1. Implementation of carbon tax
2. Exemption from the oil tax
3. Crop plantation in abandoned and fallowed agricultural lands
4. Subsidizing the cultivation of non-food crops or the usage of waste oil as feedstock
5. Mandatory biodiesel blend use in gas station

As government are focusing on the ways to improve biodiesel production and consumption, they should give enough attention to unresolved issues like rainforest depletion, food price increase etc[7].

VI Application

Biodiesel is a promising clean fuel which has numerous benefits related to energy security, economics and expansion of agriculture sector and reduction of pollutant emission. Despite its many advantages as a renewable alternative fuel, biodiesel presents a number of problems that must be resolved before it will be more alternative as an alternative to petroleum fuel [2].

It requires improving the poor low temperature properties as well as monitoring and maintaining the quality of biodiesel for long term storage. The cost effective means for improving oxidative stability of the biodiesel is the treatment with anti-oxidants additives. Care must also be exercised in cleaning storage tanks such as temperature, moisture content, exposure to direct sunlight and the atmosphere in which the fuel is stored.

In spite of the technological advances that have been made over the last decade in the field of biodiesel, a great deal of research remains to be accomplished fully.