Biodiesel: A Glance over the Potentiality

Lakshya Sharma

Abstract: ***This paper provides an introduction to biodiesel, the various processes involved in the making of it . It also involves the various crop products and techniques currently being used. The paper analyses the advantages and disadvantages of biodiesel along with its application in vehicles.***

Keywords: Biodiesel, Transesterification

1. History

Rudolf Diesel, a German engineer, devised the diesel engine in the 1890s. The diesel engine had one edge over its petrol equivalent from the start. It could run on a number of fuels, including vegetable oil, from a number of sources. Indeed, a diesel engine powered by peanut oil was displayed during the 1900 Paris Exposition. Petrochemical diesel, on the other hand, quickly became the most common source of diesel fuel and remained so until the end of the twentieth century. Alternatives were not commercially viable due to the readily available petrochemical fuel. Scientists, on the other hand, continued to experiment. In the 1930s, several researchers attempted to make a viable diesel fuel by separating the fatty acids in vegetable oils from the glycerine it also contained. G. Chavanne received a Belgian patent for an ethyl ester of palm oil in 1937. (which today we would call biodiesel). A passenger bus powered by palm oil ethyl ester ran between Brussels and Louvain in 1938. Several countries, notably Brazil, Argentina, China, India, and Japan, utilised vegetable oil as a fuel during World War II (1939–45) when petroleum fuel supplies were disrupted. Vegetable oil fuel, on the other hand, was forgotten after the war ended, and petroleum supplies were once again cheap and plentiful.

2. Sources of Biodiesel

Canola and Rapeseed

Rapeseed thrives on low-fertility soils with high sulphur levels. It may be cultivated as a winter cover crop and allows for twofold cultivation and crop rotation due to its high oil output (40–50%).In the European community, it is the most significant raw source for biodiesel manufacturing. However, several Central and South American countries faced technological challenges when it came to planting and harvesting, owing to a lack of information on fertilisation, seed management, and storage (the seeds are very small and require specialised agricultural machinery). Furthermore, its usage has been limited because of low costs compared to wheat (its major rival for crop rotation) and poor productivity per unit area. Rapeseed flour is utilised as a protein supplement in cow feeds because it has a higher nutritional value than soybean flour. Canola (Canadian oil low acid) is the product of genetic modification of rapeseed in Canada over the last 40 years to lower the concentration of erucic acid and glucosinolates in rapeseed oil, which creates problems when used in animal and human consumption. Canola oil is prized for its great quality, and it is regarded as one of the greatest cooking oils, alongside olive oil, since it lowers blood cholesterol levels.

Soybean oil

It's a legume that comes from East Asia. The height of the plants varies greatly depending on environmental circumstances and genetic types. The United States, Brazil, Argentina, China, and India are the top soybean producers. Other useful sub-products of soybean biodiesel manufacturing, in addition to glycerin, include soybean meal and pellets (used as livestock feed) and flour (which have a high content of lecithin, a protein). Grain yields range from 2,000 to 4,000 kg per acre. Because the seeds are high in protein, the oil content is roughly 18%.

Palm oil

Oil palm is a tropical plant that grows to a height of 20–25 metres and has a 25-year life cycle.

Eight years after planting, the full output is achieved. The fruit produces two types of oil: palm oil proper, which comes from the pulp, and palm kernel oil, which comes from the fruit's nut (after oil extraction, palm kernel cake is used as livestock food). Several cultivars with significant oil yields have been created. The major manufacturers are Indonesia and Malaysia. Palm oil's international demand has continuously risen in recent years, with the oil being used for cooking, as a raw material for margarine manufacture, and as a butter and pastry product addition. It's worth noting that pure palm oil is semisolid at room temperature (20–22°C) and is often combined with other vegetable oils, sometimes partly hydrogenated, in various applications.

Sunflower

Sunflower seeds are actually fruit, with an inedible husk enclosing the seed in the kernel. The edible oil derived from sunflower seeds is of exceptional quality, which is why it is so important. In terms of nutritional content, taste, and flavour, it is well appreciated. Furthermore, the residual cake is utilised as animal feed following oil extraction. It's worth noting that sunflower oil has relatively little linoleic acid, thus it may be kept for a long time. Sunflower is a resilient crop that does not require specialist agricultural equipment and may be utilised in crop rotation with soybean and maize. The present hybrids have an oil output of 48–52 per cent.

Peanut butter

Weather conditions during the harvest have a significant impact on peanut quality. Peanuts are primarily utilised for human consumption, as well as in the production of peanut butter and as a component in confectionary and other processed goods. Peanuts of inferior quality (including confectionary rejects) are utilised in the manufacturing of oil, which is in high demand on the worldwide market.

Peanut oil is used in culinary mixes as well as in the confectionery sector as a flavouring additive. Following oil extraction, the flour leftover is of excellent quality and protein content; it is utilised as a livestock feed in pellet form.

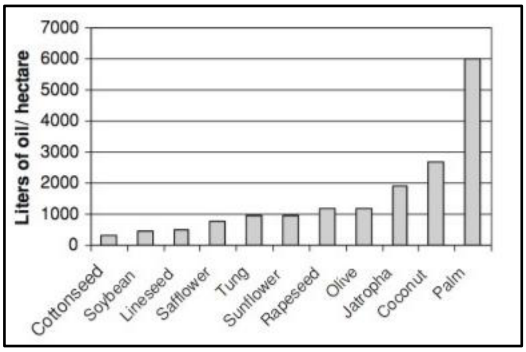


Figure 1: Approximate oil yields for different crops

3. Processes Involved

The following are the several biodiesel manufacturing methods: direct use/blending, micro-emulsion, pyrolysis, and transesterification.

Direct Use/Blending

Vegetable oil may be used as diesel fuel without requiring any engine modifications. Vegetable oil was used to test the very first engine (by Rudolf Diesel). The main issue with using vegetable oil as a fuel is its high viscosity (it's difficult to atomize vegetable oil), which causes issues in the long run: Vegetable oil as diesel fuel has the following advantages: liquid nature and mobility, high heat content (80% of diesel fuel) and ready availability. Problems do not arise until after a significant length of time has passed. Coking and trumpet development on injectors to the point that fuel atomization becomes problematic, carbon deposits, oil ring sticking, and thickening and gelling are some of the most typical issues.

Micro Emulsions

A microemulsion is a colloidal dispersion of fluid microstructures (1-150 nm) in a solvent that separates into two immiscible phases. Methanol and ethanol are the most often used solvents. Micro-emulsions are a possible solution to vegetable oil's excessive viscosity. Because of their decreased viscosity, atomization is quite simple.

Pyrolysis

Pyrolysis is the process of converting one material into another using heat. Catalysts are used to accelerate the reaction. Because multiple products can be generated from the same source depending on the reaction route, pyrolytic chemistry is challenging. Vegetable oil may be pyrolyzed to produce a variety of lower hydrocarbons that can be used as fuel.

Transesterification

Transesterification is an organic process in which the alcohol group of an ester is replaced. It can also be the result of a reaction between vegetable oil/fat and alcohol, yielding ester and glycerol. The use of transesterification is not limited to the laboratory. This reaction is used in a variety of industrial operations to create various chemicals. PET (polyethylene terephthalate) manufacture, for example, requires a phase in which dimethyl terephthalate is transesterified with ethylene glycol in the presence of zinc acetate as a catalyst. Furthermore, transesterification of methyl acrylate with various alcohols in the presence of acid catalysts produces a huge variety of acrylic acid derivatives.

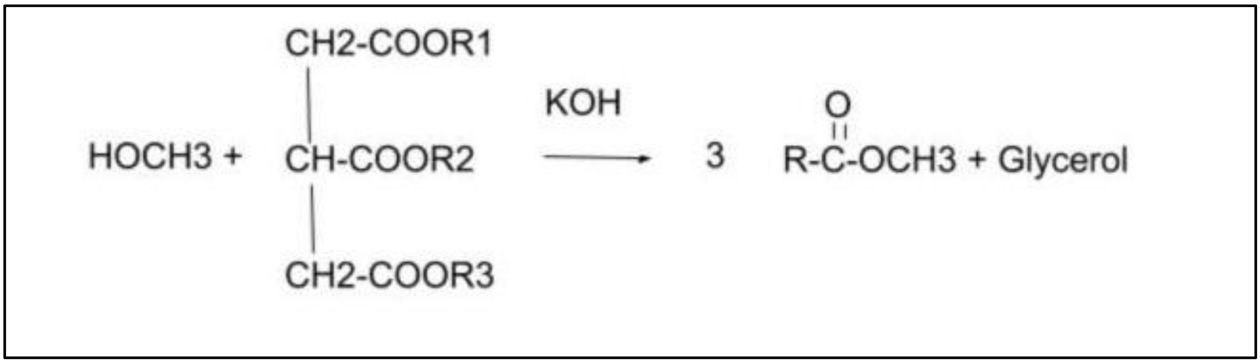


Figure 2: Transesterification Reaction of methyl esters from methanol and soy oil

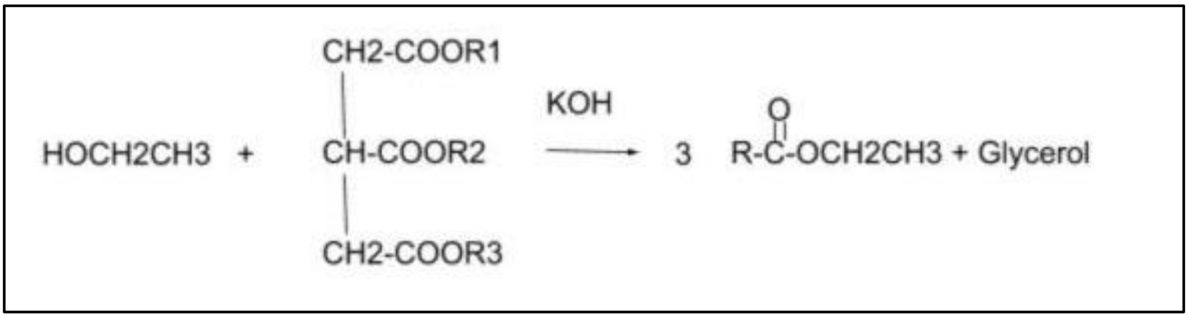


Figure 3: Transesterification Reaction of ethyl esters from ethanol and soy oil

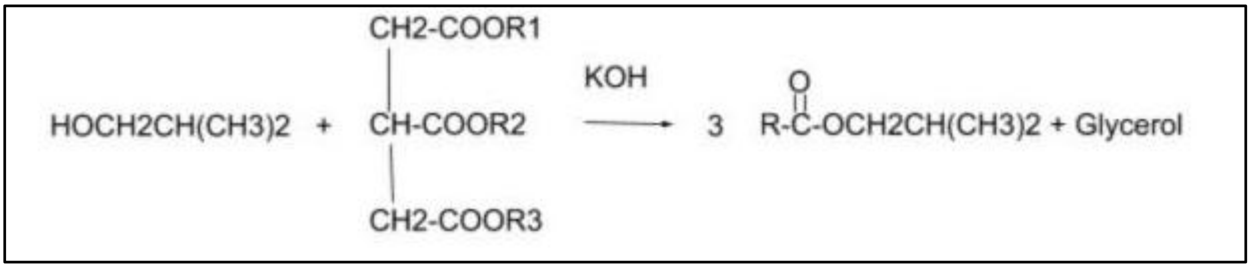


Figure 4: Transesterification Reaction of isobutyl esters from isobutanol and soy oil

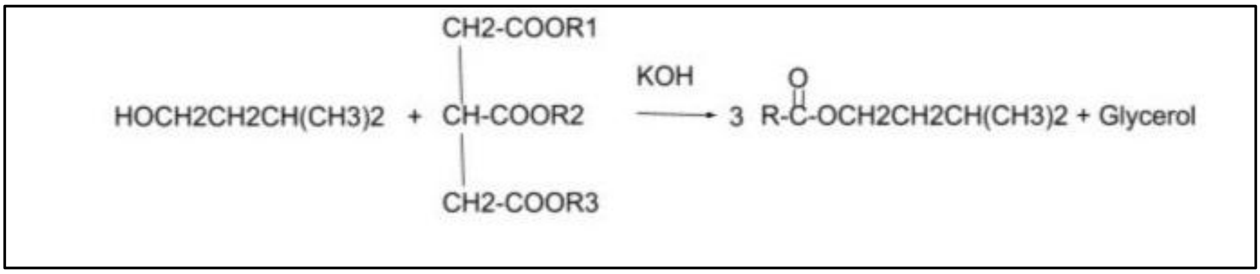


Figure 5: Transesterification reaction of iso-pentyl esters from iso-pentanol and soy oil

Transesterification in vegetable oils

A triglyceride combines with three molecules of alcohol in the presence of a catalyst to produce a mixture of fatty acids alkyl esters and glycerol during transesterification of vegetable oils.

Oils (triglycerides) + Methanol → Biodiesel + Glycerol

Die- and monoglycerides are generated as intermediates in the overall process, which consists of three sequential reactions. Because transesterification is a reversible process, extra alcohol is employed to boost alkyl ester yields and allow phase separation from the glycerol produced. Several factors influence the conversion of vegetable oil to biodiesel, including (i)Time of reaction, (ii) Reactant ratio (Molar ratio of alcohol to vegetable oil), (iii) Catalyst kind, (iv) Catalyst amount, and (v) Reaction temperature

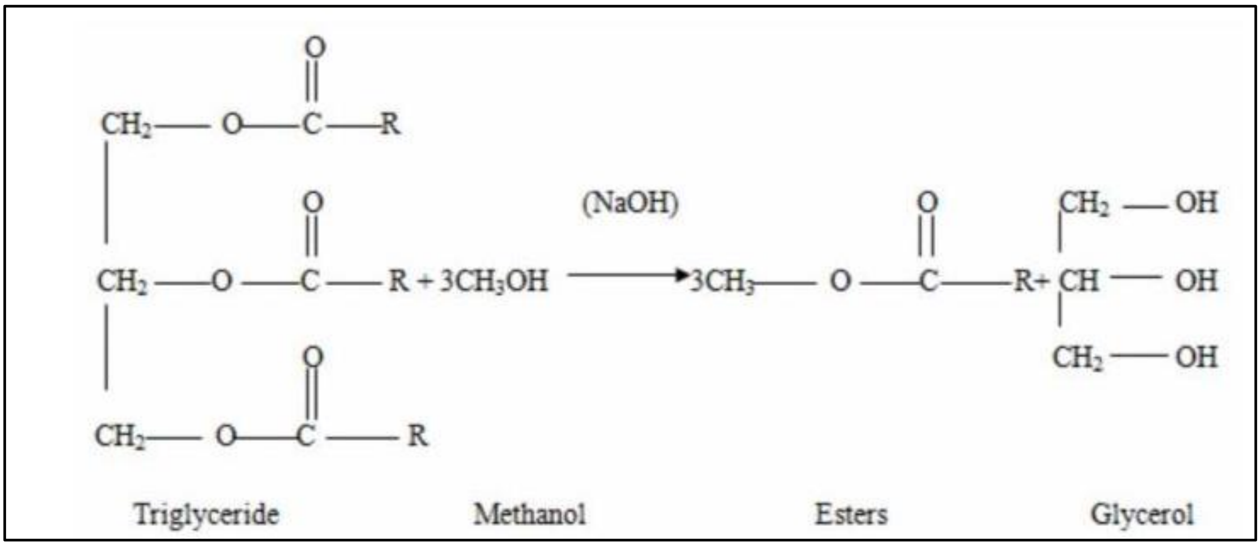


Figure 6: Transesterification reaction of a triglyceride

Acid-Catalyzed Transesterification

Bronsted acids accelerate transesterification. These catalysts provide good yields in alkyl esters, but the reaction is sluggish, necessitating temperatures above 100 °C and more than 3 hours to complete conversion. The acid catalyst H2SO4 is widely used.

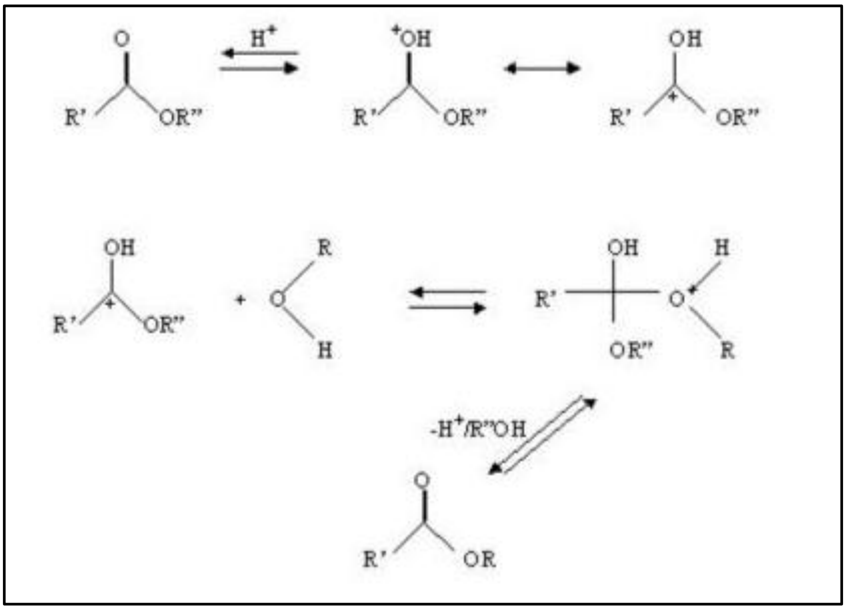


Figure 7: Mechanism of Acid-Catalyzed Transesterification

Base-Catalyzed Transesterification
Base-catalyzed transesterification of vegetable oils is quicker than acid-catalyzed transesterification. Because of the preceding rationale, as well as the fact that bases are less corrosive than acidic catalysts, base catalysts such as alkaline metal alkoxides and hydroxides, as well as sodium or potassium carbonates, are commonly used in industrial processes. The most active catalysts are alkaline metal alkoxides (for transesterification), which offer very high yields in short reaction periods even when used at low molar concentrations. They do, however, necessitate the lack of water, making them unsuitable for most industrial procedures. Metal alkoxides are more expensive than alkaline metal hydroxides (KOH and NaOH), but they are less active. Because of the production of emulsions, an undesirable side reaction (saponification) decreases ester yields and makes glycerol recovery difficult.

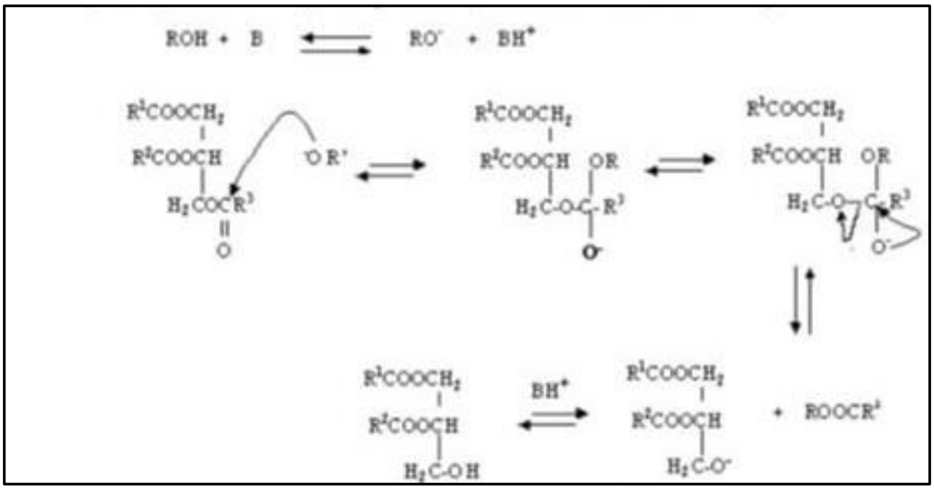


Figure 8: Mechanism of Base Catalyzed Transesterification

Alcohols involved in the Transesterification process
Methanol, ethanol, butanol, and amylic alcohol are examples of short-chain alcohols that can be utilised in biodiesel manufacturing. Because of their low cost and characteristics, methanol (CH3OH) and ethanol (C2H5OH) are the most often utilised alcohols. Despite its high toxicity, methanol is frequently chosen to ethanol in biodiesel synthesis because it requires less complex technology; extra alcohol can be recovered at a cheap cost, and reaction rates can be increased. It's important to note that biodiesel, rather than being a petrochemical product, should be made from vegetable oils and animal fats, as well as alcohol made from biomass, such as bioethanol. Several countries, including Spain and Brazil, are doing research to achieve this goal.

Transesterification from Jatropha Seeds
Jatropha curcas is a plant that is typically grown for the purpose of obtaining jatropha oil. The oil is taken from the seeds, which constitute the principal source. Humans do not consume jatropha seeds due to their toxicity. As a result, the primary purpose of jatropha cultivation is to obtain jatropha oil. The chemical components of Jatropha curcas seed are as follows: 6.20 per cent moisture, 18.00 per cent protein, Fat content: 38.00%, Carbohydrates make up 17.00% of the total, 15.50 per cent fibre & 5.30 per cent ash. The oil content of the seed is between 25 and 30%. Saturated fatty acids account for 21% of the oil's content, while unsaturated fatty acids account for 79%. Oil has a high saponification value and is often used in the manufacture of soap in various

Paper ID: SR21606230131 DOI: 10.21275/SR21606230131

countries. Oil is also utilised as an illuminant in lamps since it burns cleanly and produces no smoke. It can also be used in place of, or in conjunction with, kerosene stoves. The oil cake of Jatropha curcus is high in nitrogen, phosphorus, and potassium and may be utilised as organic manure. The thermodynamic conversion process, pyrolysis, may be used to extract valuable compounds from the jatropha oil cake. It is possible to get liquid, solid (char), and gaseous products. The liquid can be utilised as a source of heat in a furnace or boiler. Transesterification can be used to improve it to a higher-grade fuel.

Oil presses have been used for oil extraction as basic mechanical devices that may be either motorised or manually operated. The Bielenberg ram press is one of the most regularly used oil presses for extracting jatropha oil among the several oil presses available. The Bielenberg ram press extracts oil using the classic press method and produces oil cakes and soaps. It's a basic apparatus that produces around 3 litres of oil every 12 kg of seed input. Since jatropha has been recognised as an alternative energy source (namely, biofuel), jatropha oil extraction processes have gained prominence in the market. Because jatropha oil is the key element in the manufacturing of biofuels, the invention of oil extraction technologies and the optimization of current methods have become critical.

The procedure of base catalysed transesterification is chosen to produce biodiesel from Jatropha oil.

In a batch reactor, the transesterification-ion process takes place. 500 cc of Jatropha oil is heated to 700°C in a round bottom flask to drive out moisture and aggressively agitated during the transesterification process. Methanol with a purity of 99.5 per cent and a density of 0.791 g/cm3 is utilised. In a separate vessel, 2.5 gramme of catalyst NaOH was dissolved in Methanol in a bi molar ratio and put into a round bottom flask while continually stirring the liquid. For 60 minutes, the combination was kept at atmospheric pressure and 60 degrees Celsius. After the transesterification process is completed, the mixture is allowed to settle in a separating funnel for 24 hours under gravity. Jatropha oil methyl ester and glycerin were the end products of the transesterification process. Glycerin, excess alcohol, catalyst, contaminants, and residues of unreacted oil make up the bottom layer. Biodiesel, alcohol, and some soap make up the top layer. Simple distillation yields 80-88 per cent pure glycerin from the evaporation of water and alcohol, which may be sold as crude glycerin. Jatropha methyl ester (biodiesel) is combined, rinsed with hot distilled water to remove unreacted alcohol, oil, and catalyst, then allowed to settle for 25 hours under gravity. Characterization is done on the isolated biodiesel.

Item	Value
Acid Value	38.2
Saponification value	195.0
Iodine Value	101.7
Viscosity (at 31°C), Centistokes	40.4
Density (g/cm³)	0.92

Fatty acid composition

Palmitic acid (%)	4.2
Stearic acid (%)	6.9
Oleic acid (%)	43.1
Linoleic acid (%)	34.3
Other acids (%)	1.4

Figure 9: Fatty acid compositions, acid value, saponification value, iodine value, viscosity and density of Jatropha

After transesterification, the specific gravity drops to 57 centistokes and the viscosity drops to 4.73 centistokes, which is acceptable according to ASTM Biodiesel standards. The flashpoint and fire point are critical temperatures for transportation, storage, and handling safety. Biodiesel's flash point and fire point were discovered to be 128°C and 136°C, respectively. After transesterification, the flashpoint of Jatropha oil falls, indicating that its volatile qualities have improved and that it is also safe to handle. When comparing vegetable oil to diesel oil, higher density equals a larger mass of fuel per unit volume. The larger the mass of the fuel, the more energy is available for work production per unit volume. Vegetable oil's higher viscosity is a big issue when it comes to utilising it as a diesel engine fuel. Cloud and pour point are two criteria for determining how well gasoline performs at low temperatures. Diesel's cloud point is 40 degrees Celsius, which is quite low, and the fuel operates well even in cold weather. Under freezing climatic circumstances, a greater cloud point can have a negative impact on engine performance and emissions. Diesel has a pour point of -40 degrees Celsius. In general, their usage as fuels for Diesel engines in cold climates is limited due to their greater pour point. Wax precipitates in vegetable oils when the ambient temperature falls below the oil's pour point, causing them to lose their flow properties. Wax can also clog filters and fuel supply lines. Fuel cannot be pumped through the injector when these circumstances exist. In India, winter temperatures can drop below 0 degrees Celsius. Fuels with a flash point greater than 660°C are deemed safe.

Microwave-Assisted Process

The microwave procedure for biodiesel generation with transesterification reaction may be summarised as follows: the oil, methanol, and base catalyst all include both polar and ionic components. Microwaves stimulate the tiniest degree of variation in polar molecules and ions, causing molecular friction and allowing chemical reactions to begin (Nuechter et al., 2000). Microwave heating is particularly efficient and quick because the radiation interacts with the sample on a molecular level. Because the energy interacts with the molecules at such a rapid rate, the molecules do not have time to relax, and the heat created can be significantly larger than the total recorded temperature of the bulk reaction mixture for brief periods of time. In microwave heating, there occurs immediate localised superheating, and the bulk temperature may not be an accurate indication of the temperature at which the actual reaction is taking place (Barnard et al., 2007; Refaat et al., 2008). Transesterification is efficiently accelerated in a short response time when the reaction is carried out in the presence of microwaves. As a consequence, there is a significant reduction in the number of by-products and a quick separation time (Saifuddin & Chua, 2004; Hernando et al., 2007), as well as large yields of very pure products in a short period (Saifuddin & Chua, 2004; Hernando et al., 2007). (Nuechter et al., 2000). As a result, the cost of manufacturing drops, and there are fewer by-products produced with this process (Öner & Altun, 2009). Because transferring energy into a sample is dependent on convection currents and the thermal conductivity of the reaction mixture (Koopmans et al., 2006; Refaat et al., 2008), microwave heating compares extremely favourably to traditional approaches, where heating may be very sluggish and inefficient.

Aside from the numerous benefits, microwave aided biodiesel synthesis may have a few disadvantages.
Microwave synthesis may be difficult to scale up from small-scale laboratory synthesis to large-scale commercial manufacturing. The most major constraint to scaling up this technique is the microwave radiation's penetration depth into absorbing materials, which is just a few centimetres depending on their dielectric characteristics. Another disadvantage of microwave reactors in the industry is their safety (Yoni & Aharon, 2008; Vyas et al., 2010).

Biodiesel production from various oils has been studied using microwave assisted methods, including cottonseed oil (Azcan& Danisman, 2007), safflower seed oil (Düz et al., 2011), rapeseed oil (Hernando et al., 2007; Geuens et al., 2008), soybean oil (Hernando et al., 2007; Hsiao et al., 2011; Terigar (Han et al., 2008; Kong et al., 2009), macauba oil (Nogueira et al., 2010), waste frying palm oil (Lertsathapornsuk et al., 2008), micro algae oil (Patil et al., 2011), karanja oil (Venkatesh et al., 2011), jatropha oil (Shakinaz et al., 2010), yellow horn oil (Zhang et al., 2010), canola oil (Jin et al., 2011), camelina sativa oil (Patil et al., 2009), castor oil (Yuan et al., 2009), waste vegetable oils (Refaat et al., 2008), maize oil (Öztürk et al., 2010) and sunflower oil (Han et al., 2008; Kong et al., 2009).

Ultrasonic Radiation

Under ultrasonic irradiation, numerous edible and non-edible oils were explored as homogenous (alkaline, acid), heterogen, and enzyme catalysts in ultrasonic aided biodiesel experiments. Corn oil (Stavarache et al., 2007a; Lee et al., 2011), grape oil (Stavarache et al., 2007a), canola oil (Stavarache et al., 2007a; Thanh et al., 2010a; Lee et al., 2011), palm oil (Stavarache et al., 2007a), tung oil (Hanh et al., 2011 (Thanh et al., 2010b; Hingu et al.,2010). In general, KOH was favoured over NaOH for transesterification processes. NaOH was used to transesterify soybean (Ji et al., 2006), plain vegetable oil (Stavarache et al., 2005), jatropha curcas L. (Deng et al., 2010) (in the second transesterification phase), and triolein (Hanh et al., 2009b). For ultrasound aided transesterification of plain vegetable oil, KOH and NaOH were utilised. They employed a 0.5 percent, 1%, and 1.5 percent alkali catalyst, as well as a 6:1 molar ratio of methanol to oil and room temperature. The researchers found no significant variations in the time it took for two types of catalysts to complete conversion (Stavarache et al., 2005). With 0.5 percent NaOH and KOH catalysts, yields of 98 percent and 96 percent were attained, respectively. They also said that when KOH was utilised, good yields were obtained even at a catalyst concentration of 1.5 percent. Potassium soap is softer, more water-soluble, and does not produce as much froth as sodium soap. When employing potassium hydroxide, it is simpler to wash esters and the yields of the separated product are greater. In alkali catalyzed ultrasonic transesterification for biodiesel production, 0.3-1.5 % alkali catalyzed amounts were used. Cintas et al., (2010) created a novel ultrasonic flow reactor to scale up biodiesel production from soybean oil in the presence of water (Na or K methoxide). Because of the stronger hydroxide group, Na and K methoxide, which are alkaline metal alkoxides (like CH3ONa for methanolysis), are the most active catalysts. Oil (1.6 L), methanol, and sodium methoxide 30 percent in methanol (wt/wt ratio 80:19.5:0.5, respectively) were entirely transesterified at roughly 45°C in 1 h (21.5 kHz, 600 W, flow rate 55 mL/min) in their reaction mixture. In a few investigations, researchers experimented with heterogen catalysts (Ye et al., 2007; Salamatinia, 2010; Mootabadi et al., 2010; Kumar et al., 2010b).

Ultrasound, as is widely known, improves oil and alcohol mixing with catalyst phases while also increasing catalytic surface area. Ultrasonic irradiation can break down the catalyst into tiny particles, resulting in additional reaction sites. As a result, in the ultrasonic-assisted process, the solid catalyst should persist longer (Mootabadi et al., 2010).

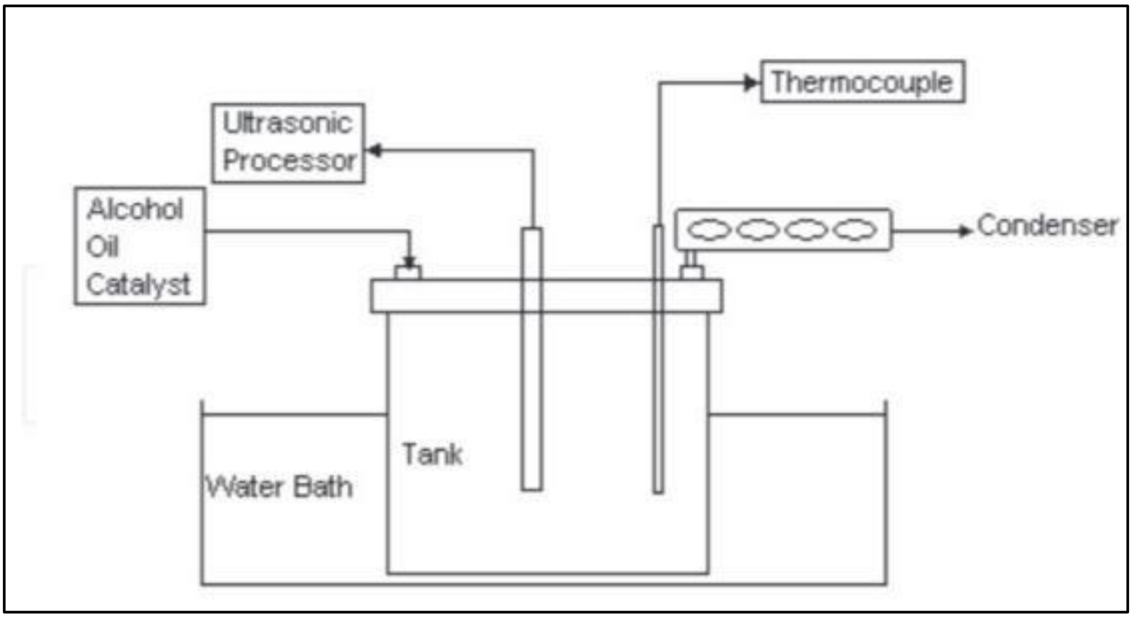


Figure 9: Biodiesel production process via the ultrasound-assisted method

4. Advantages and Disadvantages of Biodiesel

Advantages:
Analysing impact & benefits in the United States of America:

The key benefits of biodiesel include the fact that the vegetable oil part is a renewable energy source, that its use reduces reliance on foreign oil supplies, and, most crucially, that it reduces emissions. According to EPA testing, biodiesel reduces carbon monoxide emissions by up to 48 percent and particulate matter emissions by up to 47 percent, depending on the proportion of vegetable oil in the fuel blend. In addition, sulphate emissions (which can include sulphur dioxide and sulfuric acid) from conventional diesel fuel can be decreased by up to 100%. Domestic biodiesel output was anticipated to reach between 200 and 250 million gallons in 2006, up from 75 million gallons just one year before. The implementation of a federal tax credit for fuel consumers who use renewable fuels like biodiesel, as well as movement on the state level to use renewable fuels that reduce emissions and improve the air quality of urban areas within the state that regularly violate the EPA's air quality standards, are two major reasons for biodiesel's growing popularity (such as many areas of Texas). In late 2005, the state of Minnesota approved a rule requiring all diesel fuel sold in the state to include at least 2% soy or vegetable oil, which might be a sign of future developments (commonly known as a B2 blend.) The usage of biodiesel will undoubtedly grow if additional states follow Minnesota's lead.

5. Further Comments

As a "clean energy source," biodiesel can take the place of fossil fuels. It can help the environment by lowering CO2, SO2, CO, and HCl levels. Through the photosynthetic process, the carbon cycle of Biodiesel is dynamic. Plants absorb more CO2 than is released during the biodiesel combustion process.

In comparison to the usage of fossil fuel, biodiesel may efficiently reduce CO2 emissions, safeguard the natural environment, and preserve ecological equilibrium. Because biodiesel has a low sulphur concentration, it emits far less SO2 during the combustion process than regular diesel oil. Thus, using biodiesel instead of regular diesel oil will effectively reduce acid rain, which poses a serious threat to the environment and human infrastructure in the form of acidification of soil, surface and groundwater, forest and vegetation damage, and increased corrosion of buildings and historical monuments made of calcium carbonate. Furthermore, because biodiesel's ester components include oxygen, which promotes clean-burning, CO, HCL, and particulate matter will be released in lower amounts. Using biodiesel can also help to clean the air. When biodiesel is used in a standard diesel engine, the amount of hydrocarbons, aromatic hydrocarbons, carbon monoxide, alkenes, aldehydes, ketones, and particulate matter produced is significantly reduced. If the engine management is left intact, nitrogen oxide emissions are marginally enhanced. This, however, may be improved with the use of specific software and biodiesel sensors.

Biodiesel reduces particle matter in the solid carbon fraction and removes the sulphate fraction. Sulfates are gradually eliminated by increasing the quantity of biodiesel combined with petroleum diesel fuel.

Disadvantages
For biodiesel users, water pollution is also a serious issue. Biodiesel fuel absorbs and retains water, either in its pure form or as a milky emulsion. This water can freeze in cold conditions, causing issues with operation. The water in an emulsion can have a detrimental impact on the diesel fuel's auto-ignition qualities. It can boost the development of bacteria and germs in either form. Slime and bacterial growth thrive on the bio- (vegetable oil) part of the fuel. Bacterial growths in biodiesel bloom fast and can cause huge filter blockage if not managed. Microbial species also release chemicals during reproduction and respiration that

might hasten the degradation of biodiesel blends that are already unstable.

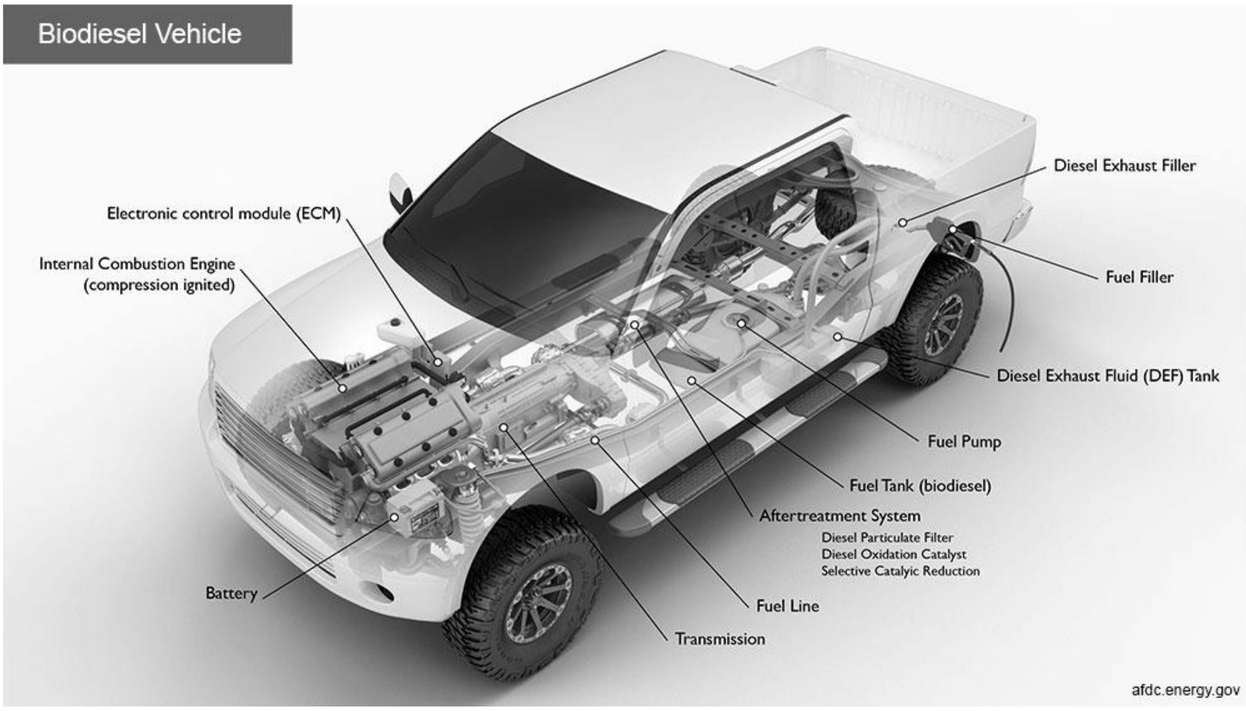
In cold weather, the most popular type of biodiesel, B20, does not flow efficiently; at temperatures between 30 and 50 degrees Fahrenheit, it can create a thick, hazy bio-mass. B20 blends, according to the National Biodiesel Board, can enhance the fuel's cold filter plug point value by 10 degrees Fahrenheit. As a result, several biodiesel providers advise against using fuel during the cold months.

Biodiesel in Vehicles

According to the Alternative Fuels Data Center of the US Department of Energy:

Vehicles that run on biodiesel and regular diesel are identical. Although light, medium, and heavy-duty diesel vehicles are not strictly alternative fuel vehicles, they can virtually all operate on biodiesel mixes. The most popular biodiesel mix is B20, which contains anywhere from 6% to 20% biodiesel and petroleum fuel. However, B5 (a biodiesel mix containing 5% biodiesel and 95% diesel) is widely utilised in fleet cars. Many diesel cars can run on B20 and lower-level blends without any engine modifications. Biodiesel increases the fuel's cetane number and enhances its lubricity. A greater cetane number indicates that the engine will start more easily and with less delay. To keep moving components from wearing down prematurely, diesel engines rely on the lubricity of the fuel. Improved lubricity decreases friction between moving parts, resulting in less wear. Biodiesel has a number of advantages, one of which is that it can increase the lubricity of the gasoline at mix levels as low as 1%.

A Biodiesel Vehicle's Major Components:



A model developed by Alternative Fuels Data Center of the US Department of Energy has the following components :

Electronic control module (ECM): The electronic control module (ECM) regulates the fuel mixture, ignition timing, and emissions system, as well as monitoring the vehicle's performance, protecting the engine from abuse, and detecting and troubleshooting issues.

Fuel filler: A gasoline filler hooks a nozzle from a gasoline dispenser to the vehicle's receptacle to fill the tank.

Fuel line: Fuel is transferred from the tank to the engine's fuel injection system through a metal tube or flexible hose (or a mix of these).

Fuel pump: A pump that uses the fuel line to move fuel from the tank to the engine's fuel injection system.

After-treatment system: This system is made up of many components that are responsible for filtering engine exhaust gas in order to fulfil tailpipe pollution standards. Diesel exhaust fluid (DEF) is injected into the exhaust gas mixture after the engine's exhaust gas is filtered through the diesel particulate filter (DPF) and the diesel oxidation catalyst to reduce particulate matter, and then reduced to nitrogen and water by chemical conversion within the selective catalytic reducer (SCR) before being released into the atmosphere via the vehicle's tailpipe.

Diesel exhaust filler: This port is used to fill the diesel exhaust fluid tank.

Diesel exhaust fluid (DEF) tank: This tank carries diesel exhaust fluid, which is an aqueous urea solution that is fed into the exhaust stream during selective catalytic reduction.

6. Conclusion

A number of countries are instituting regulations and mandates that call for the additional usage of biofuels to help mitigate emissions, primarily in the transportation sector. Although the International Agency Association's forecast increase in global biofuels consumption is relatively moderate—the agency forecast an increase of 1%, reaching 5% of the global transportation sector by 2023—many regions are focusing their efforts to increase the use of biofuels in their total energy mix. Biodiesel proposes both difficulties as well as advantages that can be dealt with upcoming technological advances in fuel production. A number of substances have been identified from where biodiesel can be derived and further research can be conducted in this particular area. Numerous researches are underway to make the processes and the final product more environmentally friendly.

References

[1] Biodiesel/Biofuel: Rental Centre Create
[2] History of Biodiesel: Farm Energy (2019)
[3] Analysis of Biodiesel Fuel: Sara Velleca
[4] Biodiesel Advantages & Potential Problems: Bell Performance
[5] Introduction to Biodiesel Production: College of Agricultural & Natural Resources, Michigan State University
[6] Biodiesel and its Properties from Various Feedstocks: Elangovan Thangapandian & Jeryrajkumar Lucas, Research Gate
[7] Alternative Fuels Data Centre, US Department of Energy: Diesel Vehicles Using Biodiesel, How Do Diesel Vehicles Work Using Biodiesel?
[8] Biodiesel production from jatropha oil and its characterization: S.Antony Raja, D.S.Robinson smart, and C.Lindon Robert Lee (2011)
[9] Novel Methods in Biodiesel Production: Didem Özçimen and Sevil Yücel, YıldızTechnical University, Bioengineering Department, Istanbul Turkey
[10] Biodiesel: an Alternative to Conventional Fuel: Daming Huang, Haining Zhou, Lin Lin