

## Impacts of Biodiesel on the Environment

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### Abstract

The world is presently confronted with the twin crises of fossil fuel depletion and environmental degradation. Excessive use of fossil fuels has led to global environmental degradation effects such as greenhouse effect, acid rain, ozone depletion and climate change. The search for alternative fuels, which promise a harmonious correlation with sustainable development, energy conservation, efficiency and environmental preservation, has become highly pronounced in the present context. Biodiesel is a globally biorenewable liquid transportation fuel. Biodiesel has become more attractive recently because of its environmental benefits. Biodiesel provides more usable energy than the fossil energy needed for its production, reduces greenhouse gases (GHGs), reduces several major air pollutants, and has minimal impact on human and environmental health through N, P, and pesticide release.

**Keywords:** Biodiesel, Fossil fuel, Environmental Benefits, etc.

### 1. Introduction

The world is presently confronted with the twin crises of fossil fuel depletion and environmental degradation. The search for alternative fuels, which promise a harmonious correlation with sustainable development, energy conservation, efficiency and environmental preservation, has become highly pronounced in the present context. The fuels of bio-origin can provide a feasible solution to this worldwide petroleum

crisis. Gasoline and diesel-driven automobiles are the major sources of greenhouse gases (GHG) emission. Scientists around the world have explored several alternative energy resources like biomass, biogas, primary alcohols, vegetable oils and biodiesel. These alternative energy resources are highly environment-friendly but need to be evaluated on case-to-case basis for their advantages, disadvantages and specific applications. Some of these fuels can be used directly, while some others need to be formulated to bring the relevant properties closer to conventional fuels. Environmental concerns have increased significantly in the world over the past decade, particularly after the Earth Summit-92. Excessive use of fossil fuels has led to global environmental degradation effects such as greenhouse effect, acid rain, ozone depletion and climate change. So there is need to develop or find alternative ways to power the world's motor vehicles. There are two global bio renewable liquid transportation fuels that might replace gasoline and diesel fuel. These are bioethanol and biodiesel. Bioethanol is good alternate fuel that is produced almost entirely from food crops. Biodiesel has become more attractive recently because of its environmental benefits. Transport is one of the main energy consuming sectors. It is assumed that biodiesel is used as a fossil diesel replacement.

## 2. Materails and Methods

Biodiesel production is a very modern and technological area for researchers due to the relevance that it is winning every day because of the increase in the petroleum price and the environmental advantages. Different studies have been carried out using different oils as raw material, different alcohol (methanol, ethanol, butanol) as well as different catalysts, homogeneous ones such as sodium hydroxide, potassium hydroxide, sulphuric acid and supercritical fluids, and heterogeneous ones such as lipases. One of the advantages of this fuel is that the raw materials used to produce it are natural and renewable. All these types of oils come from vegetables or animal fat, making it biodegradable and nontoxic.



**Figure 1:** Main oils for Biodiesel Production.

Conventionally, biodiesel is produced either in single-stage or double-stage batch process or by continuous flow-type transesterification process. A number of methods are currently available and have been adopted for the production of biodiesel fuel. There are four primary ways to produce biodiesel

1. Direct use and blending of raw oils.
2. Micro-emulsions.
3. Thermal cracking.
4. Transesterification.

**2.1 Advantages of biodiesel**

The advantage of biodiesel as diesel fuel are its portability, ready availability, renewability, higher combustion efficiency, lower sulphur and aromatic content, higher cetane number and higher biodegradability.

**2.2 Disadvantages of biodiesel**

Disadvantages of biodiesel as diesel fuel are its higher viscosity, lower energy content, higher cloud point and pour point, higher nitrogen oxide emission, lower engine speed and power, injector coking, engine compatibility, high price, and higher engine wear.

**3. Biodiesel Combustion**

The waste gas emissions associated with the biodiesel Combustion must be considered when determining its overall environmental impacts .Biodiesel would beblended with fossil diesel by a petrochemical company according to a given fractional volumetric ratio(1:19) for vehicle use. According to the current average vehicle fuel consumption level inChina, the diesel fuel consumption was8.4L/100km (mixed condition) when a compression ignitiondirect injection vehicle was used.

**Table 1:** Waste gas emission from the combustion of 1ton Biodiesel.

|   |                  | Biodiesel Combustion |
|---|------------------|----------------------|
| Waste gas emission (g/ton of Biodiesel) | VOC              | 1041.08              |
|   | CO               | 45599.74             |
| SO <sub>x</sub>                         | No <sub>x</sub>  | 1203.25              |
|   | PM 10            | 384.06               |
|   | 0                |                      |
|   | CH <sub>4</sub>  | 22.24                |
| CO <sub>2</sub>                         | N <sub>2</sub> O | 102.43               |
|   | 2566183.3        |                      |

The calorific value of biodiesel was about 37.2 MJ/kg, and the oxygen content was approximately 10 wt% of the biodiesel. The combustion efficiency of the internal combustion engine could reach 95%, and the CO<sub>2</sub> emissions during combustion could be obtained from the carbon balance calculation. The SO<sub>2</sub> emission was regarded as zero because no sulphur was contained in them biodiesel. A study Liao Yanfen et al., shows waste gas emission from Biodiesel combustion in Table 1.

#### **4. Environmental Impacts of Petro-Diesel**

Pollution from older diesel engines has the potential to harm human health and the environment.

- Diesel exhaust contains pollutants that contribute to ozone formation (or smog), acid rain, and global climate change.
- Diesel exhaust contains significant levels of small particles, known as fine particulate matter. Fine particles are so small that several thousand of them could fit on the period at the end of this sentence.
- Fine particles from diesel engines contribute to haze which restricts our ability to see long distances.
- Diesel exhaust contains both carbon particulates and 40 chemicals that are classified as “hazardous air pollutants” under the Clean Air Act.
- Fine particles pose a significant health risk because they can pass through the nose and throat and lodge themselves in the lungs. These fine particles can cause lung damage and can also aggravate conditions such as asthma and bronchitis.
- According to EPA, particulate matter from all sources, especially fine particles, is responsible for thousands of premature deaths every year nationwide. EPA has determined that diesel exhaust is a likely human carcinogen. Diesel exhaust can also contribute to other acute and chronic health effects (see EPA’s Health Assessment Document for Diesel Exhaust).

#### **5. Environmental Benefits of Biodiesel**

##### **5.1 Emissions**

Biodiesel is the only alternative fuel to voluntarily perform EPA Tier I and Tier II testing to quantify emission characteristics and health effects. That study found that B20 (20% biodiesel blended with 80% conventional diesel fuel) reduced total hydrocarbons by up to 30%, Carbon Monoxide up to 20%, and total particulate matter up to 15%. Typically, emissions of nitrogen oxides are either slightly reduced or slightly increased depending on the duty cycle of the engine and testing methods used. Increases in NO<sub>x</sub> can be effectively eliminated with the use of normal mechanical remediation techniques (e.g. catalysts or timing changes). Research also documents the fact that the ozone forming potential of the hydrocarbon emissions of pure biodiesel is nearly 50% less than that of petroleum fuel. Pure biodiesel does not contain sulphur

and therefore reduces sulphur dioxide exhaust from diesel engines to virtually zero. Figure 2 shows a bus run by pure Biodiesel.

Biodiesel can also help meet national goals for the net reduction of atmospheric carbon. As a renewable fuel derived from organic materials, biodiesel and blends of biodiesel reduce the net amount of carbon dioxide in the biosphere. A study by the US Department of Energy has found that biodiesel production and use, in comparison to petroleum diesel, produces 78.5% less CO<sub>2</sub> emissions. Carbon dioxide is “taken up” by the annual production of crops such as soybeans and then released when vegetable oil based biodiesel is combusted. This makes biodiesel the best technology currently available for heavy-duty diesel applications to reduce atmospheric carbon. Biodiesel reduces GHGs by 41% compared with diesel, reduces several major air pollutants, and has minimal impact on human and environmental health through N, P, and pesticide release.



**Figure 2:** Bus run by pure Biodiesel.

## **5.2 Health Effects**

Biodiesel is safer for people to breathe. Research conducted in the US shows biodiesel emissions have decreased levels of all target polycyclic aromatic hydrocarbons (PAH) and nitrated PAH compounds, as compared to petroleum diesel exhaust. PAH and nPAH compounds have been identified as potential cancer causing compounds. Targeted PAH compounds were reduced by 75 to 85 percent, with the exception of benzo(a) anthracene, which was reduced by roughly 50 percent. Target nPAH compounds were also reduced dramatically with biodiesel fuel, with 2-nitrofluorene and 1-nitropyrene reduced by 90 percent, and the rest of the nPAH compounds reduced to only trace levels. All of these reductions are due to the fact the biodiesel fuel contains no aromatic compounds.

## **5.3 Energy Balance**

Biodiesel helps preserve and protect natural resources. For every one unit of energy needed to produce biodiesel, 5.5 units of energy are gained. Because of this high

energy balance and since it is domestically produced, biodiesel use can greatly contribute to domestic energy security. Among current food-based biofuels, soybean biodiesel has major advantages over corn grain ethanol. Biodiesel provides 93% more usable energy than the fossil energy needed for its production.

#### **5.4 Biodegradability and Toxicity**

Biodiesel is nontoxic and biodegradable. Tests sponsored by the United States Department of Agriculture confirm that biodiesel is ten times less toxic than table salt and biodegrades as fast as dextrose (a test sugar).

### **6. Conclusion**

Biodiesel has become an attractive diesel fuel substitute due to its environmental benefits since it can be made from renewable resource. Biodiesel is much less polluting than petro-diesel, resulting in much lower emissions of almost every pollutant: carbon dioxide, sulphur oxide, particulates, carbon monoxide, air toxics and unburned hydrocarbons. Blending biodiesel into petro-diesel can help reduce emissions.

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