# A Review on Emission Parameters of Bio-diesel Extracted from Waste Cooking Oil

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**ABSTRACT**: Due to increase in global energy demand, adverse effect of conventional fuel emissions on environment, causes of global warming and greenhouse gases, all these led to search of sustainable and eco friendly source of energy has gained interest in recent years. Bio-fuel is proved to be best replacement for a conventional fuel in that bio-fuel bio-diesel proved its unique properties like sudden reduction of greenhouse gas emissions, non-sulphur emissions, non- particular matter pollutants, low toxicity and biodegradability. This paper reviews the preparation of bio-diesel by waste cooking by transesterification, determining properties of bio-diesel, waste cooking oil, and testing exhaust emission parameters of waste cooking oil bio-diesel and also using waste cooking oil for direct blend with petroleum diesel and compared with pure diesel.

**KEYWORDS**: Bio-diesel, Waste cooking oil, Transesterification, Direct use and Blending, Exhaust Emissions.

## 1. INTRODUCTION

In recent years, due to fast growing development across world consuming enormous amount of energy such conventional fuel like, petroleum products which are releasing tons of toxic gases to atmosphere due to burning fuels and vehicular consumption may leads to an environment disaster. Which reacts on living environments such as short life span of plant and animals, causing various diseases and also creates unhealthy conditions for humans such as respiratory problems, cancer, asthma, skin diseases, and genetic disorders etc., This led to search of environment friendly fuel which emits less non-toxic gases, biodegradable, and renewable fuel. Since availability petroleum products are in a decreasing rate which makes rise in rate of fuel, whereas petroleum fuel causes toxic gases, global warming and greenhouse gases. So the research have been started in search alternative fuel for conventional fuel after too many years of study the bio-fuel proves to be best alternative and renewable source of energy. Bio-fuel is noting but the fuel which is extracted from plant material, which is proved as non-toxic, biodegradable and renewable source of energy. In the family of bio-fuel the bio-diesel was found to sustainable alternative fuel for petroleum diesel, the bio-diesel can be extracted by plants, algae, animal fats and seed oil. For production of bio-diesel there are four methods such as direct use and blending, micro emulsion process, thermal cracking process, and transesterification. In our paper among above methods we are using the direct use and blending, transesterification.

In this paper we have chosen waste cooking oil for production of bio-diesel, since waste cooking oil are dumping on land or water leads to pollution, the recycled waste cooking oil is not economical. The numbers of carbon chain presence in fresh cooking oil are 18-20 after using for several times in used or waste cooking oil it contain 32-35 carbon chain, the diesel contains 11- 13 carbon chain. To produce a bio-diesel from waste cooking oil the carbon chains needs to be reduced, this can be achieved by transesterification.

## 2. RELATED WORK

Dr. Rudolf Diesel invented the diesel engine to run on a host of fuels including coal dust suspended in water, heavy mineral oil, and, vegetable oils. Dr. Diesel's first engine experiments were catastrophic failures, but by the time he showed his engine at the World Exhibition in Paris in 1900, his engine was running on 100% peanut oil. Dr. Diesel was visionary. In 1911 he stated ''the diesel engine can be fed with vegetable oils and would help considerably in the development of agriculture of the countries, which use it''. In 1912, Diesel said,' the use of vegetable oils for engine fuels may seem insignificant today. But such oils may become in course of time as important as petroleum and the coal tar products of the present time''. Since Dr. Diesel's untimely death in 1913, his engine has been modified to run on the polluting petroleum fuel, now known as ''diesel''. Nevertheless, his ideas on agriculture and his invention provided the foundation for a society fuelled with clean, renewable, locally grown fuel.

In the 1930s and 1940s, vegetable oils were used as diesel substitutes from time to time, but usually only in

emergency situations. Recently, because of increase in crude oil prices, limited resources of fossil oil and environmental concerns, there has been a renewed focus on vegetable oils and animal fats to make biodiesel. Continued and increasing use of petroleum will intensify local air pollution and magnify the global warming problems caused by carbon dioxide. In a particular case, such as the emission of pollutants in the closed environment of underground mines, biodiesel has the potential to reduce the level of pollutants and the level of potential for probable carcinogens.

## 3. METHODOLOGY

a) Filtration: In first step the waste cooking oil collected from restaurants will contain some food particle and impurities need to be removed by filtering.
b) Preheating: after filtering of waste cooking oil it should be heated up to $65^0$C + or – $5^0$C for one hour to remove the water content presence in oil.
c) Determination of FFA (free fatty acids: By titrating the heated waste cooking oil sample with 0.1N NaoH (sodium hydroxide) solution till the colour changes from pale yellow to pale pink, add NaoH based on obtained FFA.
d) Methoxy solution: Add NaoH to methanol of 200ml per litre to yield 90% of result, mix thoroughly to form methoxy solution, add solution to waste cooking oil. After adding mix, it properly and heat it in a rota mantle with rotating magnetic bit at $60^0$C for 30 to 60 min.
e) Transesterification: Transesterification is carried out in 3 neck rounded flat based flask with temperature controller and water condenser. In this process the methyl ester and glycerol will be formed. In gravity separator the methyl ester(bio-diesel) and glycerol is allowed to settle down for 4 to 8 hrs. the top layer was mainly composed of FFA and methyl ester and bottom deposit was mostly glycerol, soap, salts, other impurities and excess methanol.
f) Wash the bio-diesel: Wash the bio-diesel by water bath method using hot water sprinkling over biodiesel for 4 to 6 cycles till the ph of water is neutral.
g) Heat the bio-diesel foe $110^0$C for 30mins to remove moisture content trapped during wash of bio-diesel. Store bio-diesel in storage tank.

(a)

(b)&(c)

(d) & (e)

(f)

(f)

## 4. EXPERIMENTAL RESULTS

Table 1

| Properties | ASTM limits | D100 | B100 | B25 | WCO | W25 |
|---|---|---|---|---|---|---|
| Density(kg/m$^3$) | 860-900 | 834 | 866 | 858.2 | 918.4 | 880.6 |
| Viscosity(mm$^3$/s) | 1.90-6 | 1.90-4 | 5.37 | 4.73 | 63.47 | 5.87 |
| Cloud point($C^0$) | -15 - 5 | -15 to 5 | -9 | -6 | 23 | -13 |
| Sulphur content | 0.05 | 0.05 | 0 | 0 | 0.15 | 0.02 |
| Flash point($C^0$) | >130 | 60-80 | 162 | 66 | 294.3 | 185 |
| Acid value | <.8 | .5 | .38 | .33 | 1.89 | .72 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Water content | - | - | 0.01 | - | 0.5 | - |
| Pour point | -15 to 10 | -35 to 15 | 9 | 3 | 12 | 10 |

Table 1 shows the results of physical and chemical properties of bio-diesel ASTM standard range, petroleum diesel, Waste cooking oil biodiesel, B25 bio-diesel 25% blend with 75% petroleum diesel, waste cooking oil, and W25 waste cooking oil 25% direct blend with petroleum diesel. From the table 1 results of pure bio-diesel obtain from waste cooking oil all properties are in limits except higher flash point and lower cloud point, so itt can be use for low concentric engines. To get better results we have tried B25 bio-diesel 25% blend with 75% of petroleum diesel. The raw waste cooking oil is not in limits its not recommendable, so we have taken 25% of raw waste cooking oil blend with to compare its properties with ASTM standards, since W25 is within limits we have further continued to exhaust emission parameter's.

## 5. EMISSION PARAMETER RESULTS AND DISCUSSION

The engine test was conducted to examine emission parameters of the fuels were tested in GKVK university of Bengaluru. The below chart 1 will shows us relative comparison among petroleum diesel (D 100), waste cooking oil (wco) bio-diesel (B 100),waste cooking oil (wco) bio-diesel blend (B 25) with petroleum diesel, and waste cooking oil (wco) blend (W 25) with petroleum diesel. With respect exhaust emission parameters such as carbon di oxide (CO2), nitrogen oxide (NOx), unburned hydrocarbons (HCs), carbon mono oxide (CO), particulate matters (PM), and sulphur oxides (Sox). The chart 1 represent respective emissions of different type fuel composition comparisons with petroleum diesel.

Carbon di oxide (CO2) emission generally, the C02 emits from diesel engine. In the chart we can observe for pure wco biodiesel have been reduced up to 75%, for B 25% the CO2 has reduced up to 55%, for W 25% CO2 reduced up to 15%.

Nitrogen oxides (NOx) emission from diesel engine, for wco biodiesel may reduce or excess based trapped oxygen content during transesterification. NOx content will vary or may exceeds more than petroleum diesel.

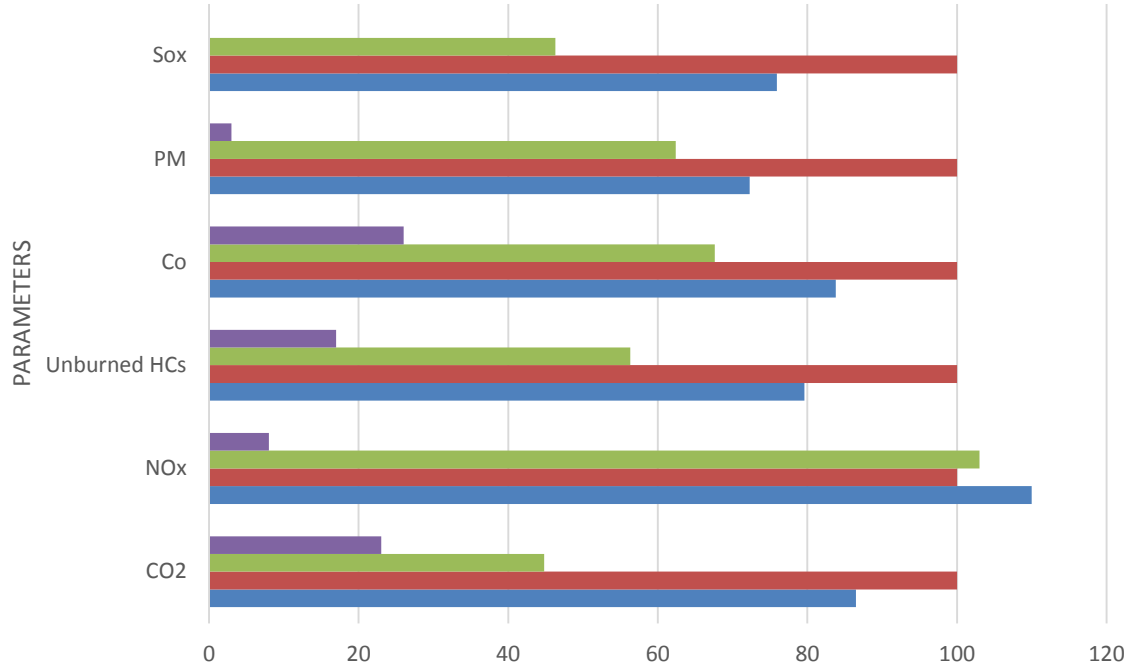
Unburned Hydrocarbons (HCs) emissions from diesel engine, for wco biodiesel have reduced up to 80%, for B 25 blend the HCs have reduced up to 40%, W 25 wco blend have reduced up to 20% with co,pare to petroleum diesel.

Carbon Monoxide (CO) emission from diesel engine, for wco biodiesel CO have been reduced to70%, for B 25 blend CO have been reduced to 40%, for W 25 wco blend 15% CO have reduced with compare to petroleum diesel.

Particulate Matters (PM) emissions from diesel engine, for wco biodiesel have reduced to 90%, for B25 blend PM have reduced to35%, for W25 wco blend have reduced to 20% with compare to petroleum diesel.

Sulphur oxides (Sox) emissions from diesel engine, for wco biodiesel;l have reduced to 100%, for B25 blend Sox have reduced to 50%, for W 25 wco blend Sox have reduced to 20% with compare to petroleum diesel.

CHART 1 : Relative emission of petroleum diesel, wco bio-diesel, B25 bio diesel blend with diesel, W25 wco blend with diesel




| | CO2 | NOx | Unburned HCs | Co | PM | Sox |
|---|---|---|---|---|---|---|
| B 100 | 23 | 8 | 17 | 26 | 3 | 0 |
| B 25 | 44.8 | 103 | 56.3 | 67.6 | 62.4 | 46.3 |
| D 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| W 25 | 86.5 | 110 | 79.6 | 83.8 | 72.3 | 75.9 |

## 6. CONCLUSION

In this experimental study, the conversion of waste cooking oil to bio diesel and use direct blend of waste cooking oil into fuel and their result found to be effective. Where as bio diesel from waste cooking oil proves to be nontoxic and biodegradable fuel. Except Nox results was not compromising which can try to reduce next paper. B 25 waste cooking oil blend was also given effective results. For the W 25 waste cooking oil direct blend fuel was not satisfactory due its results not showing much reduction in emissions, in next paper further investigation will be carried to achieve good results from an direct blend fuel sample. So we hope in further study we are able concentrate on emissions of NOx and CO2. Since conversion waste cooking oil to bio diesel have been given good yield up to 90% without any reduction in volume. The effective solution is given for avoiding waste disposal of waste cooking oil and so far now the waste cooing oil may be collected for low rate without any pollution to ware and land. For B 100 fuel the particulate matters have reduced which may reduce rate respiratory and cancer issues. Since no sox in B 100 which eventually reduces greenhouse gases reduction in CO2 and CO may reduce global warming effect. B 100 bio diesel produced from the waste cooking oil is less toxic than table salt and less biodegradable than sugar. Use more biodiesel leads increase in nations energy consumption which renewable, which also leads to more production in agriculture field.

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