



Short Communication

# Study of NOx Emission in Diesel Engine Operating with Biodiesel under Different Engine Parameters

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## Abstract

The need of bio origin fuel is continuously increasing with depletion of petroleum fuel and rising concern of environmental degradation. Biodiesel is one of the bio origin fuel obtained from vegetable oil or animal fat in a process of trans-esterification. Many research have proved that biodiesel is a promising fuel in terms of performance of diesel engine and exhaust emission of CO<sub>2</sub>, CO, HC component..The only penalty with biodiesel is higher NOx emission with some exception. This research work focuses on the study of the engine working parameters i.e. engine fuel and speed of engine on NOx emissions with biodiesel as fuel in a diesel engine. The results shows that use of biodiesel and at high engine speed causes lower NOx emissions in comparison with conventional diesel fuel.

**Keywords:** Biodiesel, NOx, Emission.

## Introduction

Depletion of fossil fuel and increasing pollution forces us to look into the renewable and green energy Technology. Biodiesel is obtained from vegetable oil<sup>1-5</sup> and one of the promising fuel in terms of CO, CO<sub>2</sub>, HC emission<sup>6-7</sup>. The bio-fuels have low greenhouse effect because carbon dioxide released during combustion of fuel in the engine is reprocessed in the photosynthesis process in the plants. Most of fuel properties of biodiesel is similar with conventional diesel and may be directly used as an alternative to fossil diesel with minimum modification in engine hardware<sup>8-9</sup>. Trans-esterification is a well known process by which biodiesel can be obtained in pure form<sup>10-13</sup>. Biodiesel are blended with petroleum diesel and directly used in CI engine. Preheating of biodiesel causes the lowering of density of biodiesel which further affects brake power and efficiency of engine and emission as well when using higher blends of biodiesel<sup>14-19</sup>. The objective of this research work is to study the various engine working condition with biodiesel on NOx emissions from engine exhaust.

## Methodology

**Engine:** Water cooled 4 Stroke CI engine having dead weight loading arrangement and a rope brake dynamometer was used in the work for the experiment purpose. The engine specification used in this work are given in Table-1.

**Fuels specification:** Jatropha Biodiesel was obtained locally in CREDA Raipur and petroleum diesel was obtained from nationalized local petrol pump.

**Table-1**  
**Engine Specification**

Fuel	Diesel
Type	VRC-1
BHP	5 HP
Engine Speed	1500 RPM
No. of cylinder	one
CR	16.5:1
Bore(mm)	80
Stroke (mm)	110
Loading	Rope brake type
Starting	Crank shaft started
Diameter of brake drum (mm)	355
Diameter of rope (mm)	16

**The properties of Jatropha Biodiesel:** Following are the properties of Jatropha<sup>20</sup>: i. Specific gravity - 0.875, ii. Density - 0.876g/cm<sup>3</sup>, iii. Flash point - 1700<sup>0</sup>C, iv. Kinematics viscosity (400<sup>0</sup>C) - 4.8cts, v. Iodine value - 7.64.

**Experimental procedure:** The experiment data were obtained by doing the experiments in a water cooled 4 stroke diesel engine with a dead weight loading arrangement .The engine was operated for different load and blended fuel. No modification was done on engine hardware as obtained from manufacturer.

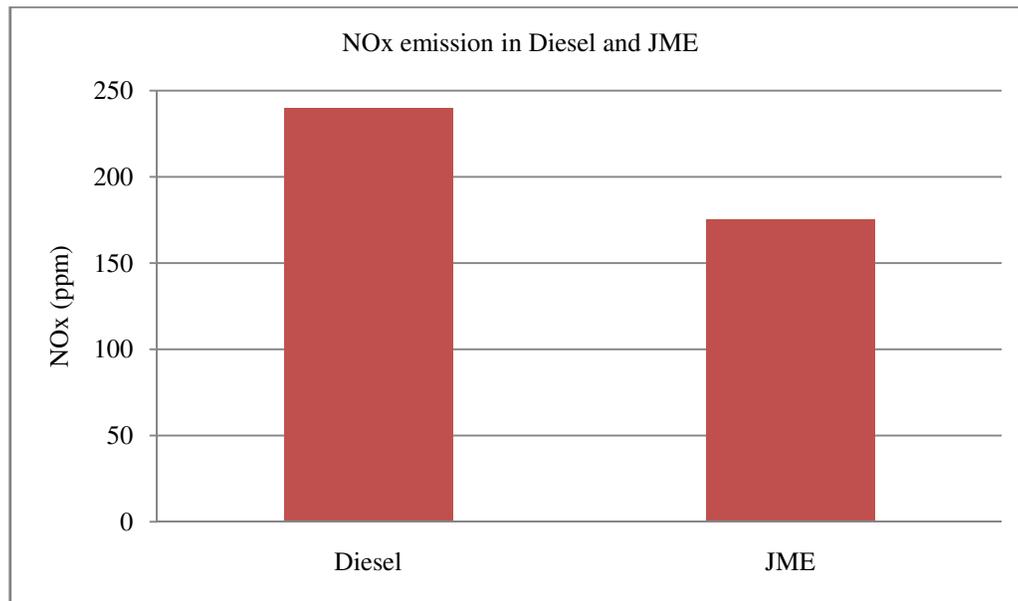
### Results and Discussion

The experiments data obtained during experiments were analyzed and feasible data are further processed for study. The study carried out in the work reveals following results.

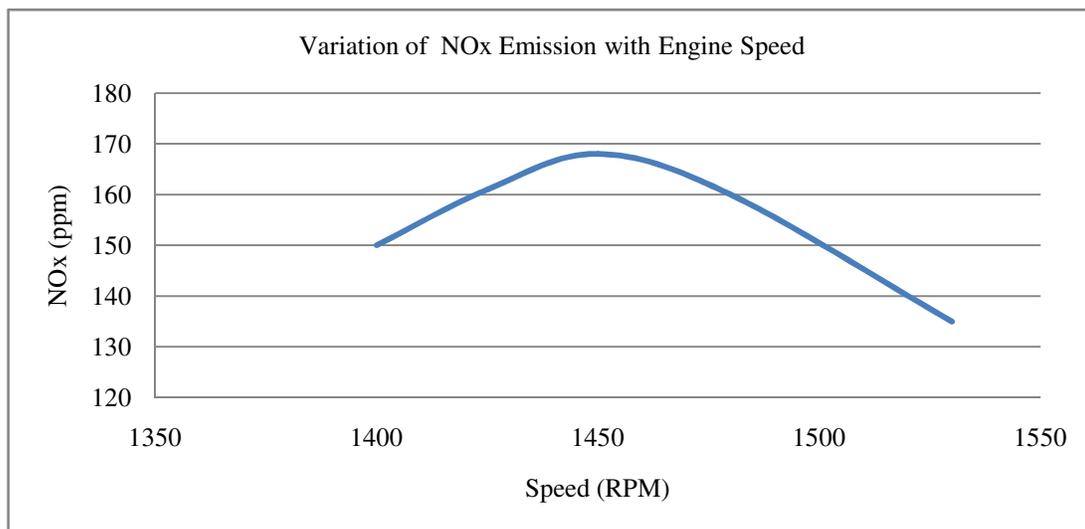
**Effect of biodiesel:** The Experimental results indicate that values of NOx emission with JME is low compared to diesel

(Figure-1). Knothe et al<sup>19</sup> also observed that addition of biodiesel causes the NOx gas emission to be lower than conventional diesel.

**Effect of Speed of Engine:** With Jatropha biodiesel the emissions of NOx from engine exhaust were examined and it is observed that NOx emission from engine exhaust decreases when the speed of engine is lowered and at speed around 1420 it is high and further reduces with increase in speed. Variation is shown in Figure-2 and is interesting to know at the same speed the temperature of exhaust gases is also highest which satisfies one of the major reasons of NOx formation.



**Figure-1**  
NOx emission with biodiesel and conventional diesel



**Figure-2**  
Variation of NOx emission with Engine speed

## Conclusion

Studies of NO<sub>x</sub> gas from the exhaust of CI engine reports reduction in emissions of NO<sub>x</sub> but a large number of studies also reports increase in NO<sub>x</sub> while using biodiesel made from different vegetable oil. The work carried in this paper studies the engine working condition i.e. engine fuel and speed of engine on NO<sub>x</sub> emissions with biodiesel fuel in a diesel engine. The result shows that use of biodiesel and at high engine speed results in low NO<sub>x</sub> gas emitted from engine exhaust in comparison with conventional diesel.

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