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Emission Characteristic of Diesel and Bio-diesel Fuelled C.I Engine

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Abstract - In Today life, increase in vehicle number increase the CO emission which increases the Greenhouse gases which is major growing concern nowadays. Biodiesel is chosen as alternative choice for detailed study as it is renewable, sustainable and biodegradable which also reduced the engine noxious emission. Disadvantages of biodiesel are higher density; higher fuel consumption and higher NO_x emission which is restriction on usage of biodiesel but biodiesel reduce the global warming and reduce engine emission. This article is literature review on effect of biodiesel/diesel blend on emission and engine performance in detail. The review demonstrates the influence of biodiesel on the engine emission. The results shows the reduction in the NO_x formation when water percentage in biodiesel-diesel increased from 5% to 10%. Further. This review paper discusses the performance and emission results of biodiesel-diesel blends.

Keywords: Transesterification, Emission Characteristic, Biodiesel Blend, Diesel Blend.

Abbreviation	
PM	Particular Matter
HC	Hydro Carbon
NO_x	Nitrogen Oxide
CO	Carbon Monoxide
CO_2	Carbon Dioxide
PPM	Parts Per Million

1. Introduction

In past few decades the CI engines popularities increasing tremendously because of its higher thermal efficiency and reliability [1]. It is used in industrial application, agriculture, Road vehicles, Marine transportations and Air transportation [2, 3]. The diesel engine increased the emission of greenhouse gases which adds up to reason for global warming [1]. NO_x and soot are the main pollutants from Diesel engines [4]. Therefore scientists put their effort to find the alternative fuel which reduce the emission and slightly varies the thermal efficiency. Going through the various parameters and criteria, Biodiesel and its diesel blend have one of the best alternatives for the diesel [1, 5]. Biodiesel is mainly produced through transesterification process. In this process triglyceridies reacts with alcohol in the presence of catalysts to produce fatty acids alkyl esters [6]. Biodiesel reduce the PM, CO and HC but it increases the NO_x emission. Any addition of water in biodiesel-diesel blends also reduces the NO_x emission [7]. So to reduce the smoke and NO_X emission water-diesel emulsification technique is widely used and it is one of the simple and economic solutions for reducing the amount of hazardous emission.

2. Transesterification and its types

Transesterification can be defined as the chemical reaction between triglycerides and alcohol in the presence of a catalyst to produce monoesters. It can be used to synthesize biodiesel and it can be classified as below [8]:

(a) Base-catalyzed Transesterification
(b) Acid-catalyzed Transesterification
(c) Enzyme-catalyzed Transesterification
(d) Supercritical Transesterification

Base-catalyzed and Acid-catalyzed Transesterifications both are divided into two types:-

(1) Homogeneous Catalyst
(2) Heterogeneous Catalyst

K.Narasimharao et al. [8] synthesis the biodiesel with the help of homogeneous alkaline catalysts because the transesterification reaction by an acid catalyzed is much slower than base catalyzed reaction. In base catalyzed transesterification the most common catalysts are potassium hydroxide (KOH) and Sodium Hydroxide (NaOH). Use of solid catalysts such as MgO, CeO2, and ZnO instead of Homogeneous catalysts reduces the production cost and re- uses the catalysts. Through Homogeneous catalyzed biodiesel production process are relatively fast. In Acid-Catalyzed transesterification catalyzed are sulfronic and sulfuric acids. Acid-catalyzed transesterification is performing in absence of water. Most common Homogeneous Acid catalyzed is HCL and H_2SO_4. Main objective of enzyme catalysts is improvement in temperature, pH value and solvent. It is costly method. Supercritical transesterification process carried at 350°C. Main benefit of this method was that free fatty acids present in oil esterified in supercritical solvent.

3. Engine specification and evaluation of its performance characteristics

For evaluation of the performance of CI engine a four stroke, single cylinder and constant compression ratio, water-cooled diesel engine, AVL 444 Di-gas analyser, AVL 437 smoke opacity meter and a data-acquisition system comprising of Kistler piezoelectric sensor and a crank-angle encoder. For the measurement of exhaust gases like CO, unburnt HC and NO_X Di-gas analyser is used whereas mechanical stirrer is used to stir continuously water-diesel emulsion. Smoke opacity meter is used for measuring the smoke opacity of exhaust gases. To maintain the smooth airflow in the engine, a settling chamber is provided which is connected at the inlet. Piezoelectric sensor is mounted on the cylinder head by which pressure signal are collected and given as an input to data acquisition system through signal conditioning unit [9]. The engine specifications are given in table.

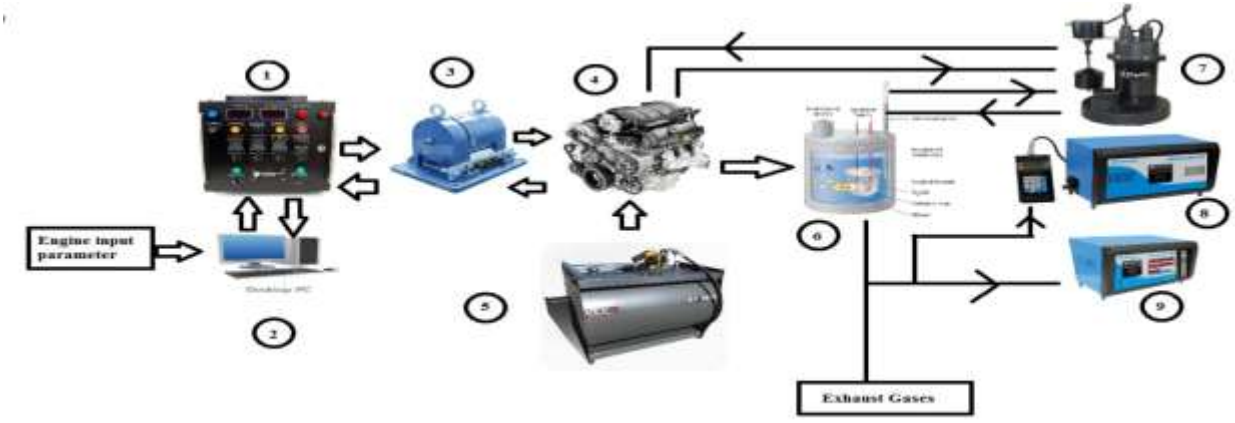

Fig-1: Schematic Diagram of experimental setup

1) Control Panel
2) Computer
3) Eddy Current Dynamometer
4) Engine
5) Diesel tank
6) Calorimeter
7) Sump
8) Smoke Meter
9) Exhaust Gas Analyser

Table 1: Specification of Engine [9]

Engine Type	Kirloskar, Single Cylinder, 4-Stroke, Water Cooled, Engine
Bore and Stroke	87.50 mm and 110.00 mm
Capacity	6616cc
Compression ratio	18:1

4. Engine exhaust characteristic

4.1 Nitrogen Oxide NO_x

Emission of NOx is increases as the load is increasing. Addition of Ferro fluid found a decrease in NO_x compared to non-additive fuel. Biodiesel-diesel blend have a higher NO_x emission because of its higher oxygen content and slightly higher cetane number compared to pure diesel [1]. The temperatures, oxygen content, ignition delay, N2 % in fuel and residence time are the major factors which mainly affect the NO_x emission [1, 7, 10]. NO_x is increases with increases in heat release rate. N_{Ox} emission of b20 is 2.87% higher than diesel [10].

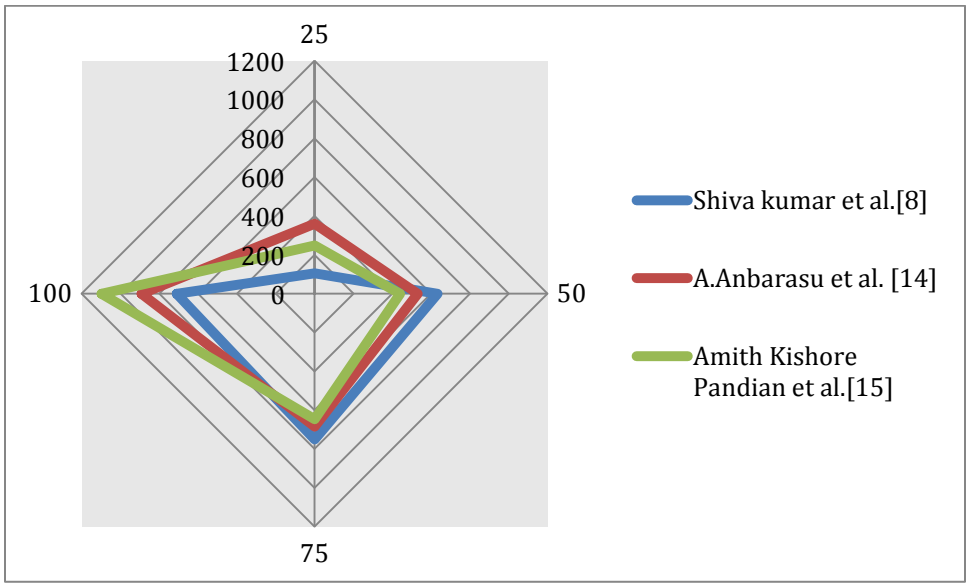

Fig.2:- NO_x emission for Diesel in PPM vs load

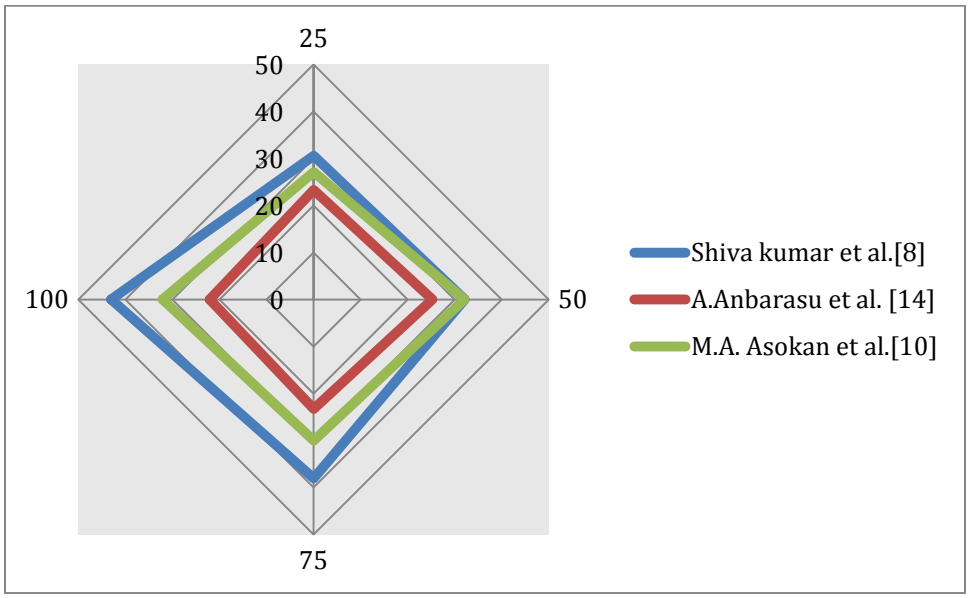

Fig.3:- NOx emission for B20 in PPM vs load

4.2 Hydrocarbon (HC)

Due to higher cetane number, ignition delay is reducing for biodiesel which consecutively reduce the HC emission [7]. Biodiesel-diesel blend has lower HC compared to diesel fuel. AS the load and speed is increases HC is decreasing [11].Combustion efficiency and temperature are the main factor affect HC [11, 12].

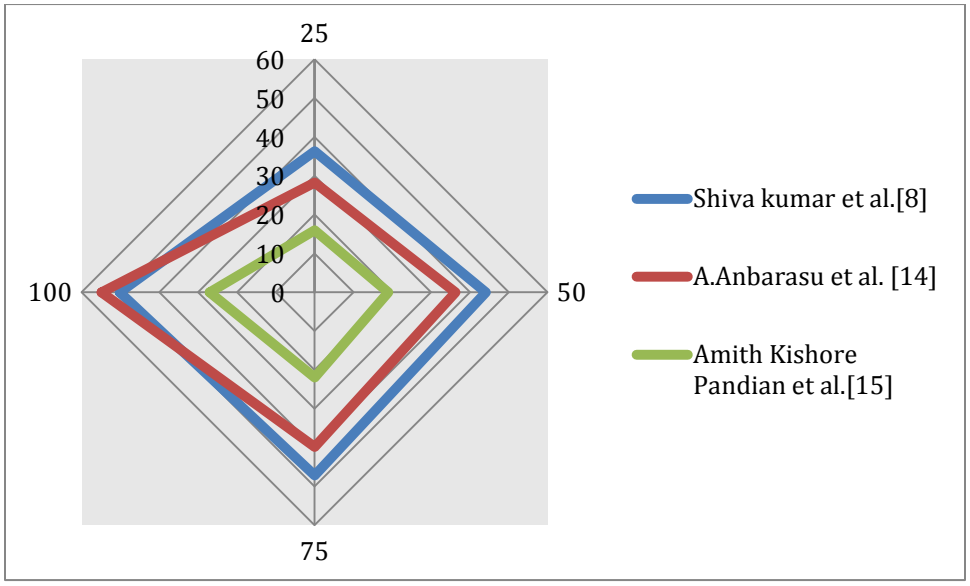

Fig.4:- HC emission for Diesel in PPM vs load

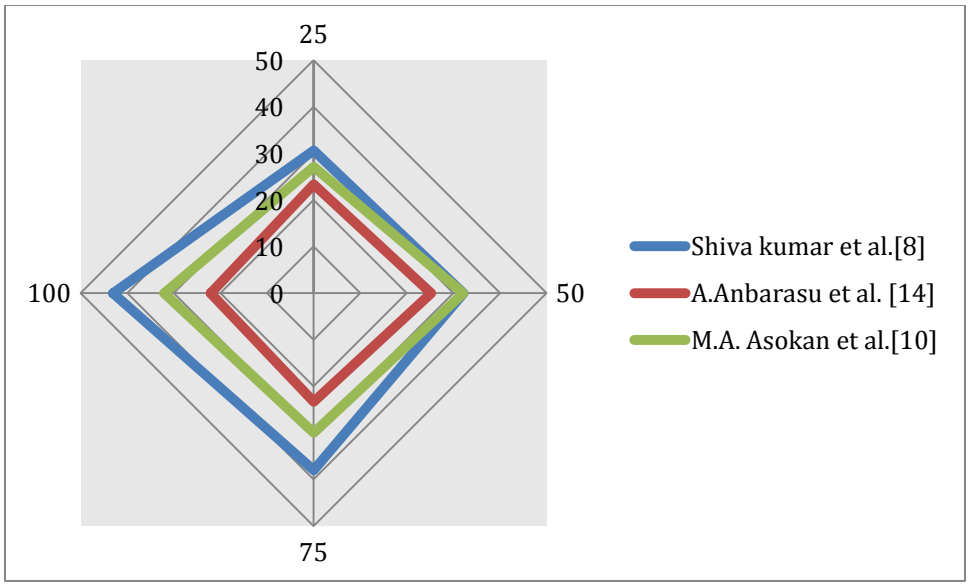

Fig.5:- HC emission for B20 in PPM vs load

4.3 Carbon Monoxide (CO)

CO increases as the load is increases. Air fuel ratio, temperature and unburned mixture are mainly factor which affect the CO emission [1, 7]. CO percent is increases with increase in water percent [7].Biodiesel have larger amount of oxygen compare to diesel which reduce the CO emission [1]. Oxidized biodiesel had 15% less CO compared to unoxidized biodiesel [13].

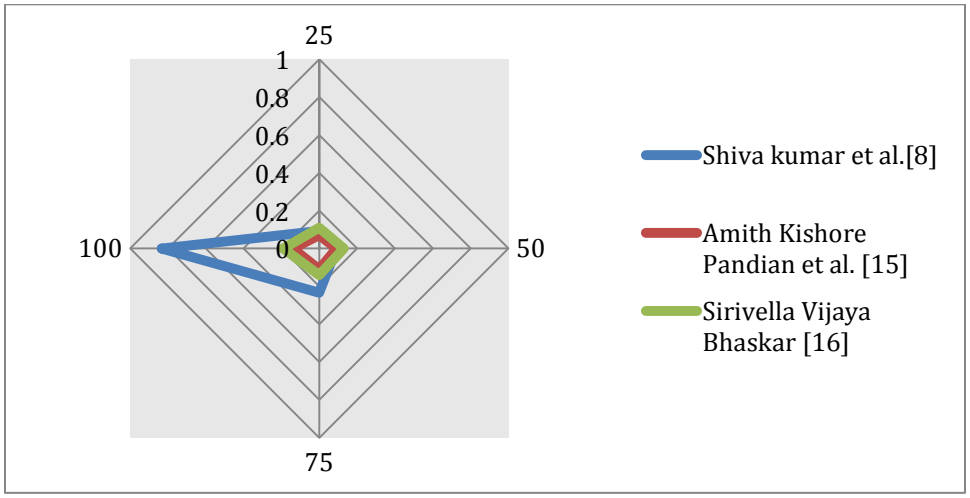

Fig.6:- Co emission for Diesel in % Volume vs load

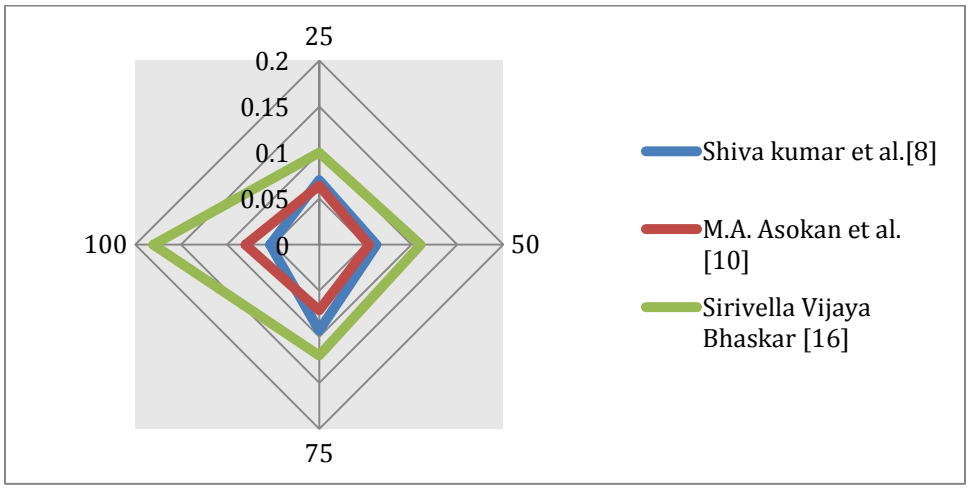

Fig.7:- Co emission for B20 in % Volume vs. load

5. Conclusions

- It is concluded that two-step alkaline-catalysed transesterification reaction is economic method for the production of biodiesel using vegetable oil.
- It can be conclude that CO emission of all biodiesel blends is lower than diesel fuel as the blend ratio is increase CO emission is also increases.
- The vast majority of literatures agree that HC, CO_2 and NO_x emission of biodiesel is lower than diesel.
- It is predominant view point that as the biodiesel percentage is increases the NO_x percentage increases and soot decreases.
- Enhancement of NO_x formation with biodiesel can be resolved by addition of alcohol into biodiesel but it has no effect on CO_2 formation whereas PM and smoke increases with addition of alcohol.

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