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Parametric Optimization of Four Stroke Single Cylinder Diesel Engine using Jatropha and Turpentine Blends: A Review

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Abstract - *In the present day the energy is essential need of human life. The main sources of the energy are fossil fuel such as gasoline, petroleum product and coal. The petrol demands increasing day by day so the environmental concern and health problem of the human life. Also increasing demand of the fossil fuel is also increase the price of the fuel so the alternate fuel essential to search. The alternate fuel much necessary renewable fuels to generation of the power to prove good substitute and environmental friendly. The renewable fuels are best alternative to reduce today's power crisis. The renewable fuels are easily available such as solar energy gets from the sun, wind energy gets from the wind motion and bio diesel gets from the plants and animals waste.*

This paper investigates the feasibility of a new combination of the bio diesel. The diesel engine operated with blends of jatropha biodiesel and turpentine oil to overcome dependency on fossil fuel. Jatropha biodiesel (methyl ester) and turpentine oil is a lower density difference so completely mixed with each other and combustion smoothly. Here are explore performance parameters and emission parameters of the jatropha and turpentine bio diesel from the experiment.

Key Words: Jatropha bio diesel, performance parameters, emission parameters, CI engine.

1. INTRODUCTION

In day today life energy has become one of the important necessity of the life. From Urban to rural life everyone is dependent upon energy. Petroleum is found to be one the dominant energy source in fulfilling human basic needs. Bio diesel have such similar physical characteristic like diesel. It is renewable, cleaner burning, alternative for petroleum based diesel fuel. It is safe to handle and transport because it is biodegradable as sugar. Also when biodiesel is used in diesel engine unmodified engines. Bio diesel is very commonly used bio fuel and it is primarily derived from plants and animals, the supply can be prepared by farming and recycling. The byproduct of bio fuel can be used as manure, fertilizers and pharmaceutical and cosmetic industries. Methanol and free fatty acids are the two major impurities contained in crude glycerol obtained as byproduct during biodiesel production. The two most widely used bio fuel ethanol and bio diesel. Others include butane, methanol, and gasoline. Gaseous are hydrogen and methane. Gaseous are hydrogen and methane.

1.1 Classification of bio fuel

1.1.1 According to their sources

Derived from forest, agricultural or fishery products or municipal wastes, including by products and wastes originated from agro industry, food processing and food industrial services.

1.1.2 According to their type

- Solid pellets such as fuelwood, charcoal and wood pellets
- Liquid such as ethanol, bio diesel and pyrolysis oils
- Gaseous such as biogas

The United State and Brazil are largest bio diesel producers in the world 6 and 4.3 billion liters respectively in 2017.the United State has planned to reach production over 1 billion gallons of biodiesel by 2025. For the Energy Policy Act 2005 provides taxes incentives for certain types of energy, so bio diesel production increase in the U.S. Spice jet is India's first biofuel flight from Dehradun to Delhi to use of the hydrogen and jatropha in the 2018. Also Indian Air Force is trial first flight of the transport aircraft AN 32 in the year 2018. The national policy on biofuel 2018 expect target of 20% blending of ethanol in petrol by 2030.

2. Details of bio fuel production

2.1 Jatropha seed and plants

It is small tree with smooth grey bark color. It grows between three to five meters in height, but some time favorable condition height up to ten meters. It has large green to pale green leaves, alternate to sib opposite three to five lobed with a spiral phyllo taxi. Flowers are formed terminally individually with female flowers usually slightly larger and occurs in the hot seasons. Fruits are produced in winter season. The seeds become mature when the capsule changes from green to yellow offer two to four months.

2.2 Jatropha biodiesel from transesterification

Transesterification method used to reduce viscosity of Jatropha oil. In this process, the chemical reaction occurs between triglyceride and alcohol (methanol is widely used due to its lower cost and effectiveness). The mixture is stird and heated near to boiling temperature of methanol in the presence of a catalyst. It method is reaction of fat or oil triglyceride with alcohol to form esters and glycerol. Catalyst is used to improve reaction rate and yield. At the end of the process, biodiesel and glycerol are produce. The presence of catalyst improves the reaction rate and yield. Catalysts like NaOH, KOH etc. are used for transesterification.

The reaction equations of this process are shown below.

(1) Triglyceride + ROH ↔ Diglyceride + $RCOOR_1$

(2) Diglyceride + ROH ↔ Monoglyceride + $RCOOR_2$

(3) Monoglyceride + ROH ↔ Glycerol + $RCOOR_3$

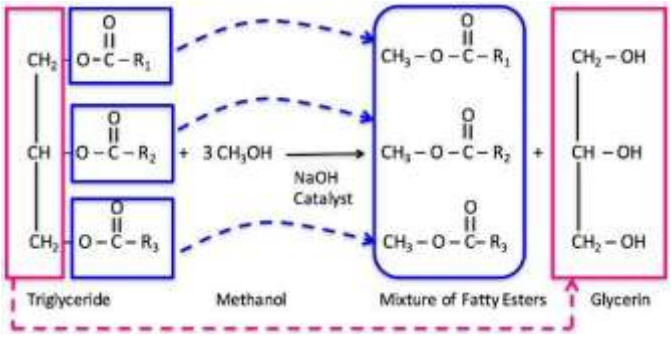

Fig -1: Chemical Reaction of Bio Diesel

3. Literature Review

R. Mohsin [2014] investigated on 6 cylinder, 6278cc HINO H07C using CNG and bio diesel fuel. Here, the test conducted pure diesel, B05, B10, B20, B25 and CNG taken as a fuel. This paper focused on the emission parameter and engine operation reliability. This test discovered the improvement of the exhaust emission and engine performance. CO and NOx emission can be reduced by having proper combustion in the cylinder. Unburned Hydro Carbon also reduced when amount of biodiesel increase. B20 and CNG are showed greatest performance in the power and torque of the engine. But bio fuel increased emission of the CO2. The calorific value of the both fuel is higher compared to pure diesel.

K. Agarwal [2006] investigated pure diesel and Ethanol additive diesel. The additive of the ethanol is 5%, 10%, 20%, 30%, 50% and 75%. Here, we are studied the performance parameter, combustion parameter and emission parameters. The ethanol additive in the fuel causes an improvement in the engine performance and exhaust emissions. The break power, break thermal efficiency, volumetric efficiency and fuel consumption are increase in the ethanol additive of fuel.

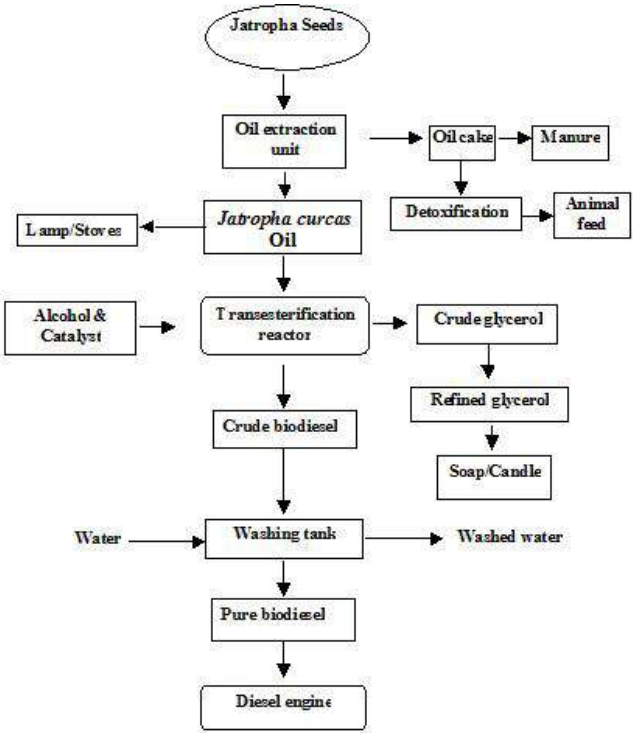

Fig -2: Production of Jatropha oil

But the break specific fuel consumption and equivalence air fuel ration decrease due to lower calorific value of the gasohol. CO and HC reduced emission with the ethanol diesel blends but CO2 emission increase marginally in all speed of the engine. Ethanol diesel blends up to 20% can very well be used in the present day in the CI engine. The engine started both hot and cold condition. Also emission of the CO and NO_x is reduced ethanol diesel blends.

B. Premanand [2009] is tested on single cylinder four stroke engine to discover value of the performance parameters, emission parameters and combustion parameters. In this experiment, we use the pure diesel, 50:50, 60:40, 70:30 diesels: turpentine oil fuel.

The turpentine oil fuel and diesel fuel properties are same so mixed with properly each other. Break power of turpentine oil and diesel fuel are same. 30% Turpentine oil fuel blends produce high break power and heat release rate compare to diesel fuel. Turpentine oil fuel blends increases the exhaust emission decrease but the CO2 emission increase. Carbon deposit was not found in the injector nozzle tips.

S. Jindal [2009] is experimented on engine with Jatropha methyl ester as fuel. The experiment perform was three injection pressure (150, 200 and 250) and three compression ratio (16, 17 and 18). The standard values set by the manufacture for diesel 210 IP and 17.5 CR. The higher performance of the engine is 250 bar injection pressure and 18 compression ratio at which BSFC 10% and BTHE 8.9% increase compare to the conversional diesel engine. Compression ratio increases the emission of HC increase but

the smoke and CO reduce. NOx emission was affected with injection pressure. The higher injection pressure was reducing emission of HC, NOx and smoke but the increase CO and exhaust temperature. Emission of the HC, NOx, smoke and exhaust temperature are lower to the pure diesel for all combination of the blends. The higher compression ratio and injection pressure are created the detonation and nocking problem so the engine vibration and noise.

M. Senthil Kumar [2002] was performed performance parameters, combustion parameters and emission parameters. Pure diesel, pure Jatropha and duel fuel are used in the experiment. Jatropha oil resulted slightly reduced thermal efficiency as compared to pure diesel. The maximum brake thermal efficiencies are 27.4%, 29% and 30.2% with Jatropha oil, Jatropha methyl ester and diesel.

HC emission of the Jatropha oil and diesel are maximum output as 130 ppm and 100 ppm respectively. Also similar case in the CO emission. The maximum smoke level of the Jatropha oil, Jatropha methyl ester and diesel are emission 4.4 BSU, 4 BSU and 3.8 BSU. Ignition delay and combustion duration are increased with Jatropha oil and Jatropha methyl ester as compared to diesel. Duel fuel are operated with methanol and Jatropha oil at the peak efficiency from 27.4% and 28.7% respectively. Duel fuel are increased HC and CO emission.

Abhishek Sharma [2012] was investigated on the behavior of a diesel engine fueled with Jatropha methyl ester and Tyre Pyrolysis oil blends. We are using pure diesel, Tyre Pyrolysis oil, JMETO 10, JMETO 20, JMETO 30, JMETO 40 and JMETO 50 (Jatropha methyl ester and Tyre Pyrolysis oil) for the experiment. JMETPO blends can be used directly without any engine modification in the diesel engine. The brake thermal efficiency is same at the full load for Jatropha and diesel. At the full load, BSEC of the JMETPO20 is increased compare to the diesel. Also HC, CO and smoke emissions are lower by 9.09%, 8.9% and 26% respectively for JMETPO20 compared to diesel. NOx emission higher about 24% JMEPO20 in comparison with diesel at full load.

Pankaj Dubey [2016] was investigation of the performance parameters and emission parameters on the four stroke diesel engine. Here, the experiment is used fuel Jatropha biodiesel and turpentine oil but pure diesel and JBT 50 (Jatropha biodiesel and turpentine oil) are mainly comparison in this paper. The duel fuel blends are operated successfully and smoothly and performed better. BSFC and BTE was higher and lower as compared to the diesel fuel. BT50 gave lower CO2, NOx, CO and higher HC emission lower as compared to the pure diesel fuel. The Jatropha methyl eater has lower volatility and higher viscosity compared to the turpentine oil. The turpentine oil is proper mixing and complete combustion with the Jatropha methyl ester. So the duel fuel blend (BT50) is considering as the most effective to replace the diesel fuel.

Pankaj Dubey [2017] was experimented the performance and exhaust emission of the variable compression ratio engine fueled with 100%, 90%, 70% and 50% Jatropha bio diesel and turpentine oil. Here, the compression ratio was investigated range of 15.5, 17, 18.5 and 20 for the constant speed of 1500 rpm at the full load. The BTE of JBT50 is higher than diesel and lower than JBT70, JBT90 and JB fuels at full load and higher compression ratio. At full load and compression ratio 20, JBT50 experimented increase brake thermal efficiency and decrease CO, HC, NOx and smoke but CO2 emission increase 11.04%. Here, the engine smoothly running because of the proper mixing of the Jatropha and Turpentine oil and lower emission.

Pankaj Dubey [2016] experimented on the diesel engine which was loaded in the range of no load, 35%, 65% and full load for constant speed of 1500 rpm. Here, we are discussion of the performance parameters and exhaust parameters. Break thermal efficiency is lower compared to the pure diesel fuel but BT50 and BT70 are BTE same. Heat release rate of the BT50 is higher than conventional diesel fuel. Also ignition delay is higher of the BT50. Full load condition BT50 was emitted lower NOx, CO, HC and smoke compared to diesel fuel but the CO2 emitted rate 10.5% higher than diesel fuel.

4. CONCLUSIONS

From the above research paper studied, we have concluded below point.

1. Jatropha methyl ester and turpentine oil blends gets higher calorific value and specific density as same to the pure diesel fuel.
2. Bio diesels are emitted less smoke, HC, CO and NOx but the CO2 emission is higher compare to diesel fuel.
3. Jatropha methyl ester and Turpentine oil are proper mixing with each other so engine running smoothly and successfully without any modification.
4. Bio diesel can be reduced the pollution of the environment and also reduce cost of the conventional sources of the energy.
5. Jatropha easily available in the today's market in the India and the production of the Jatropha also easy.

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