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Literature Review on Production of Jatropha Biodiesel & Reducing NO_x Emission

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Abstract**—**Air pollution becoming the biggest thread to the environment. Air pollution mainly occur due to combustion of fuels like petrol &diesel , but petroleum diesel engine exhibits many air pollutants like sulfur dioxide, carbon dioxide etc. Minimum this air pollutants biodiesel is introduce because of itswell known, environmentally low polluted easily. One of the well known method producing bio diesel using jatropha curries in this review paper we obtain an detail production of JBD(Jatropha biodiesel) were it is blended with petroleum ,diesel from 10- 60% . Also we include some methodology to reduce the percentage NOx emission.

Keywords*-Air pollution,Biodisel,Jatropha seeds, Blending ,*NO_x.

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I. INTRODUCTION

Jatropha carcass is a renewable non-edible plant. Jatropha is a wildly grooving hardy plant in arid in semi aired regions of country on degraded soils having low fertility and moisture The seed of jatropha containing 50-60% oil . From jatropha seeds jatropha oil can be extracted which has similar properties as diesel but some properties as a diesel but some properties such as kinematic viscosity, solidifying point, flash point and ignition point is very high in jatropha oil Vegetable oil is one of the best substitute fuel to petroleum. by some chemical reaction jatropha oil can converted into biodiesel But the direct use of vegetable as a fuel in diesel engine it is high viscosity. The viscosity of the vegetable can cause serval engine problem like poor combustion, atomization and pumping, If increasing the percentage of jatropha biodiesel then increase in the percentage of NOx which is harmful for environment. Therefore the NOx balancing by a two steps first is to reducing blending and other is rhodium catalytic convertor. The exhaust gas recirculation (EGR) is one of the effective method reducing NOx. The exhaust gas contain mixture of carbon monoxide , nitrogen, water vapor etc.

II. PRODUCTION PROCESS OF JATROPHA BIODIESEL

Figure 1- Jatropha Seeds

A. *Oil Extraction Process*

Firstly collect the jatropha seeds, the jatropha seeds contain 40-60 % of oil depending upon the verity or seeds quality. After collecting jatropha seeds cleaning process can be done , in the cleaning Process removal of outer shells from the seeds after collecting the seeds from the trees. Seed oil can be extracted manually, mechanically, chemically, & enzymatically. Oil can be extracted by mechanical pressure, solvent extraction and enzymatic degradation. Mechanical extraction yield about 90% of total oil from the seed. Solvent and enzymatic extraction yield almost 100% of oil from the seed. After the extraction the oil cleaning process is done

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in this process the sediment is removed from the oil & oil is goes for further process. In the degumming process the unwanted phosphorus is removed from the oil. After all this process the oil get purified and it is ready for the neutralization process.

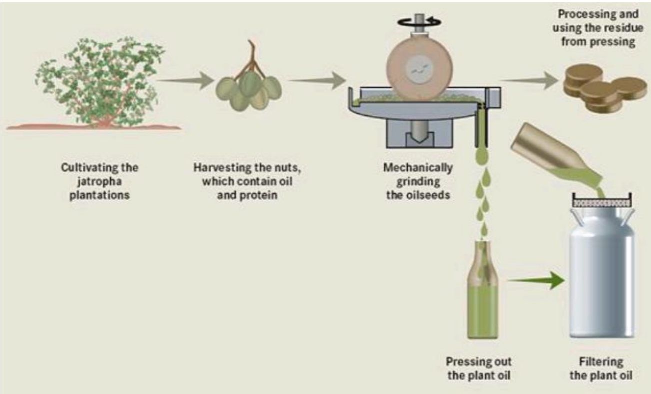


Figure 2- Oil Extraction Process

B. *Neutralization Process*

The jatropha seeds contains about 14-19.5 % free fatty acids in nature, it must be freebefore taken into actual conversion process. The Presence of about 14% of free fatty acid makes Jatropha oil not comprehensive for industrial biodiesel production.4% of HCl solution is mix with the dehydrated oil solution for 25 minutes and 0.82 gram of NaOH was added per 100 ml of oil to neutralize the free fatty acids and to coagulate by the following reaction.

$$\mathbf{RCOOH + NaOH \rightarrow RCOONa + H_2O}$$

C. *Biodiesel Production*

In this study, to make biodiesel from jatropha oil. Catalyzed transesterification process is done. Transesterification-ion reaction is carried out in a batch reactor.

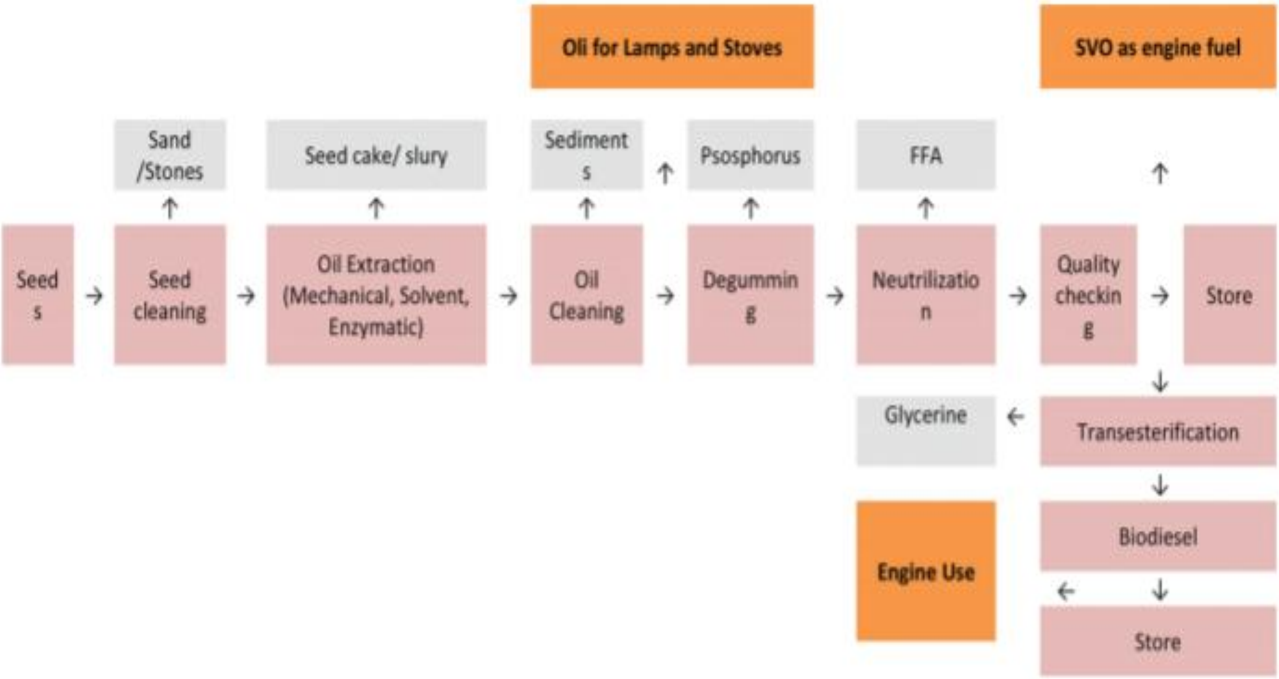
For transesterification process 500 ml of Jatropha oil is heated up to 70ºC in a round bottom flask to remove off moisture and stirred vigorously. Methanol of 99.6% purity having density0.791 g/cm³ is used. 2.5 gram of catalyst NaOH is dissolved in Methanol in bi molar ratio, in a separate vessel and was poured into round bottom flask while stirring the mixture continuously. The mixture was maintained at atmospheric pressure and 60°- 61°C for 60- 65 minutes.

After completion of transesterification process, the mixture is allowed to settle under gravity for 1 day in a separating funnel. The products formed

During transesterification were Jatropha oil methylester and Glycerin. The bottom layer consists of Glycerin, excess alcohol, catalyst, impurities and traces of unreacted oil. The upper layer consists of biodiesel, alcohol and some soap. The evaporation of water and alcohol gives 81-89 % pure glycerin, which can be sold as crude glycerin is distilled by simple distillation.

Jatropha biodiesel is mixed, washed with hot distilled water to remove the unreacted alcohol; oil and catalyst and allowed to settle under gravity for a day . The separated biodiesel is taken for characterization.

Figure 3- Production Process of Jatropha Production



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III. CONVERSION CHALLENGES IN CHEMICAL REACTION

There are two types of methods, which are generally used for the conversion of hydrocarbon fuels from the renewable source. I.e. feedstock.

1) Thermochemical process.
2) Biochemical process.

In the thermochemical process is conversion of biomass into the hydrocarbon in the presence of temperature and pressure. In biochemical process biomass is converted into carbohydrates over some steps by the method of fermentation using some enzymes and microorganisms. Thermochemical reactions are also carried out by transesterification, hydrolysis micro emulsion, gasification, and esterification. In which pyrolysis and transesterification mainly used for jatropha biofuel, mainly biodiesel and bio jet fuel.

1) ***Transesterification Process :***

Transesterification also called the alchoholysis is the reaction where the oil converts into corresponding fatty ester. This is similar process to hydrolysis but here , alcohol is used instead of water . So, transesterification is organic reaction when one ester is transfer into another ester by interchanging the moiesty .The basic reaction involved in transesterification is as shown in given fig.

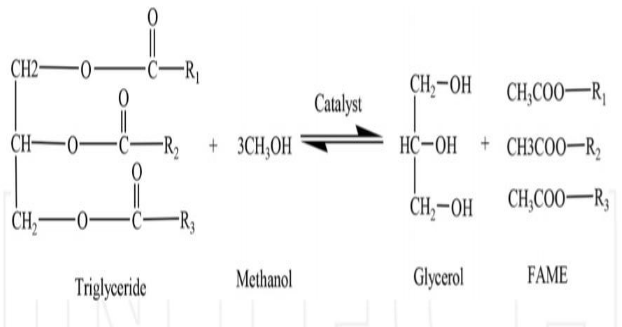

Figure4 – Catalytic Transesterification of Triglyceride

The reaction is used to decrease the high viscosity of triglyceride. Due to the reversible nature of reaction, extra alcohol is used to move the equilibrium towards the product. A catalyst are used in transesterification reaction. The acid used catalyst makes the carbonyl group more reactive by donating a proton while the base catalyst remove a proton from alcohol to make it more reactive.

The transesterification process of jatropha oil produces mono fatty acid alkyl esters and the glycerol as the by-product. In this process ,methanol is used because of low price, low temperature reaction ,minimum reaction time and high yield of fatty acids methyl esters.This reaction is affected by several factors, such as molar ratio of glycerides and alcohol,reaction temperature, time, catalyst and also the free fatty acid content and moisture content in the Jatropha seed oil. Generally, the homogeneous base catalysts, NaOH and KOH, are used because of their higher yield and quality fatty acid methyl esters (FAMEs) . However,homogeneous base catalyst for transesterification of Jatropha oil associates some problems. Itis very difficult to separate the catalyst from the product and the purification step produces alarge amount of alkaline wastewater. Treatment of this water also increases the productioncost .Because of the presence of the higher free fatty acid content and the moisture content in Jatropha oil, the base catalyst induce saponification reaction which decrease the production rate .yield .To overcome this problem, an acid catalyst used in transesterification jatropha vegetable oil, but with the acid catalyst, the reaction requires more oil-methanol molar ratios and the reaction will be very slow .Another possible solution to overcome this problem is a two-step procedure for the treatment of Jatropha oil. First step is esterification offree fatty acid and the second step is transesterification of Jatropha oil triglyceride But this is also not cost effective Instead of a homogeneous catalyst, a heterogeneous catalyst is abetter option for transesterification of higher FFA containing vegetable oil because it can result in good conversion and a high yield of FAME with optimum reaction conditions.

2) ***Biochemical process***

Pyrolysis or cracking of vegetable oil is one of the promising routes to produce biofuel l(biodiesel and bio-jet-fuel) because of the straight chain alkanes and high cetane number ofthe product . Pyrolysis is defined as the thermal conversion of vegetable oils by heating absence of air in favor of a catalyst into alkanes, alkenes, aromatics, carboxylic acids andlittle amounts of gaseous productsThe major problems with Jatropha bio-jet-fuel are its freezing point and low yield. The freezing point of Jatropha hydrocarbon produced by catalytic cracking is higher than zero degreewhereas the freezing point of conventional jet fuel is less than −40°C . To overcome this problem, a new catalyst system has to be create for hydro processing Jatropha oil. There are many advantages of using metal supported on microporous zeolite catalysts for hydro-cracking Jatropha oil due to the versatile characteristics of zeolite .Zeolite catalysts have ion-exchange abilities with high porosity, broad surface area and concurrent-base character.It can solve the diffusion limitation and increase the production yield due to its uniquestructure. For cracking reactions, high temperature (280–300°C)

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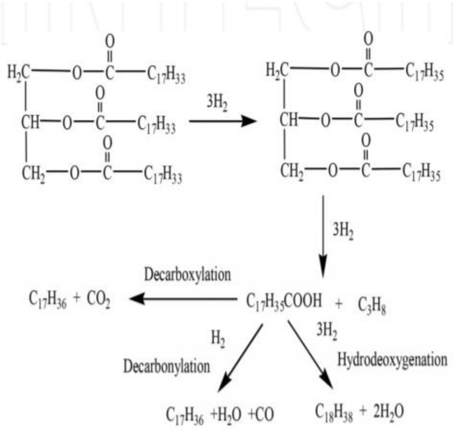

Figure 5 – Pyrolysis of Triglyceride

IV. REDUCTION IN NO_x EMISSION

In most of the researchers states that higher NOx emission by using jatropha biodiesel. Jatropha biodiesel has average off 19.6% of higher NOx is mainly due to the factors like higher oxygen molecules and availability of temperatures .NOx increases in the temperature and pressure inside the cylinder of an engine.

This increased in amount of fuel delivery inside the cylinder may reduces the combustion interval of fuel and engine cooling results in the formation of higher temperature. In addition presence of oxygen content of biodiesel fuel facilitates the oxidation of nitrogen resulting in the formation of
NOx.

The NOx emission increases with increase in load on the engine.

Comparison of various pollutants emitted such as Carbon Monoxide (CO), and Carbon dioxide (CO2), Nitrogen oxide (NOx),Exhaust gas temperature (EGT) ,hydrocarbon (HC) etc from diesel engine using various combination Of JBD blends as follows

As tabulated in table as blending percentage increases the No_x emission increase so to obtain the less No_x emission we have to blend less amount of JBD with diesel to overcome the effect of Sulphur dioxide .

According to some researchers 20% JBD blending with diesel in engine ca inherently reduce the percentage of nitrogen oxide.

Another method we can use is that introducing the layer of Rhodium metal layer in catalytic converter.The main use for rhodium is in catalytic converters designed to clean vehicle emissions. Rhodium often together with palladium and/or platinum — accomplishes this by reducing nitrogen oxide in exhaust gas.

Our research is going on to introducing the another layer of Rhodium metal in catalytic converter(another layer is because rhodium metal layer with platinum is already present in the catalytic converter) such that it reacts with nitrogen oxides and eliminates it with some other gases through exhaust so that the effect of No_x is reduced in environment which indirectly reduces some amount of air pollution

These are two methodologies with which we can reduce the percentage of No_x i.e. reducing percentage of JBD blending and introducing Rhodium metal layer.

source	**JBD 10%**			**JBD 20%**			**JBD 30%**			**JBD 40%**			**JBD 50%**			**JBD 60%**		
Load	0	5	10	0	5	10	0	5	10	0	5	10	0	5	10	0	5	10
SD	8	22.5	51.3	7.6	21.9	45.3	7.1	21.2	41.4	7.1	21.2	41.4	6.9	20.7	39.2	6	20.1	36.8
EGT	137	194	284	128	208	292	129	199	306	139	201	314	128	187	194	128	187	329
CO	0.04	0.04	0.03	0.05	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.04	0.03	0.04	0.06
CO	3.20	5.10	7.30	3.30	5.00	7.10	3.03	5.00	6.90	3.03	5.20	7.10	2.60	4.70	7.30	2.60	4.70	7.30
HC	15	18	20	12	13	14	12	10	12	11	9	8	11	10	9	8	10	9
NOx	381	955	1329	290	735	1296	296	716	1316	295	658	1137	309	743	1353	231	594	1379

Table 1- Comparison of various pollutant emitted using various Of JBD blending

V. CONCLUSION

Jatropha oil is found to be a promising alternative fuel for CI engines. It can be used for blending up to 20% Jatropha oil without any reduction in thermal efficiency. Emissions of CO2 with Jatropha oil blends up to moderate loads are lower than that with diesel fuel.In the current investigation, it has confirmed thatJatropha oil may be used as resource to obtain biodiesel. The experimental result shows that alkaline catalyzed transesterification is a promising area of research for the production of biodiesel in large scale. Effects of different parameters such as temperature, time, and reactant ratio and catalyst concentration on the biodiesel yield were analyzed.

While doing our research we come to know that biodiesel increase the NOx emission percentage which is harmful to nature cause an air pollution. It is necessary to reduce the NOx emission so primary method is that by blending less percentage of JBD with diesel can reduce the NOx emission, apparently introducing the large rhodium metal in catalytic converter (Rhodium already present in catalytic converter) will restrict the rate of NOx emission.

Our research work is continued on this concept of adding layer of rhodium metal in catalytic converter.

This research paper helps the researchers/ students to know basic about the Jatropha production and its chemical reaction and methodology to reduce the nitrogen oxide.

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