THE IMPACT OF BIOFUEL ON IC ENGINE AND THE ENVIRONMENT

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Abstract – *This paper contains Extracting esters from oil of Argemone Mexicana with additive n-Butanol using esterification and trans- esterification technique. Mexicana is a herbaceous medicinal plant belonging to the family papaveraceae, It is indigenous to mexico. Nowadays it is distributed throughout the of India, up to 1500m elevation of weed. Mexicana seeds were collected from the Agasthiyamalai Biosphere Regions Reverse Forest of South Western Ghats regions. The seeds were crushed by using Mortar and Pestle. The oil was extracted with hexane by using Soxhelt apparatus. The oil blended with conventional diesel at 10%(B10) & 20% (B20) proportions physic chemical analysis.*

Key Words: Biodiesel, Argemone Mexicana, Additive, Engine Testing, Biodiesel Production.

1. INTRODUCTION

Biodiesel has become more attractive recently because of its environmental benefits and the fact that the biodiesel is made from renewable energy source. The world energy crisis is a result of population growth and increasing energy consumption in both developed countries and emerging economics. The greater demand of petroleum products are as a result of enormous increase in the number of automobile serves the growing problem of the developing countries. With crude oil reserves estimated to last only few decades, therefore efforts are on way to find out new alternatives to diesel. Depletion of crude oil could cause a major impact on the transport sector. Diesel engines are widely used because of their higher power output, fuel economy and lower hydrocarbons (HCs) and carbon monoxide (CO) emissions than gasoline engines. However, emissions of particulate matter (PM), nitrogen oxides (NOx), Sulphur oxide (SOx), polycyclic aromatic hydrocarbons (PAHs) and exhaust odor from diesel engines have always been of great concerns. Biodiesel are gaining popularity owing to increased environmental awareness and the rising price of fossil fuel.

The Mexicana Oil with n-Butanol additives has been considered as a promising option for diesel engines because of friendliness.

1.1 Problem Statement

In today's world, alternative fuels are needed more than ever. Conventional fuels, such as coal, natural gas, and fossil fuel, are constantly being depleted; however, the world's dependence on these fuels is still growing. Additionally, the price on foreign fuels is ever increasing. For these reasons, the US and the world are pursuing alternative fuel sources to lessen the dependency on conventional fuels. One alternative fuel is biodiesel; biodiesel can be produced from vegetable oil or animal fat and thus can be used to alleviate the foreign fuel dependency. In order for biodiesel to be a viable alternative fuel source, an industrial-scale biodiesel production process needs to be improved. Compared to current designs and fossil fuel, the process must be cost competitive.

The purpose of this project is to develop an industrial process to create biodiesel from oil extracted from Mexicana seeds. Mexicana oil has been a main focus for many research efforts for the last couple of decades because it is not primarily used as food, can be grown quickly, and does not require much area to grow. Mexicana-based biodiesel is still early in development and companies have had issues efficiently lysing, or extracting, the oil from the seeds. While no one has found a way to do this efficiently, many believe that Mexicana seed oil could be the answer to lessening the world's dependency on fossil fuels.

1.2 Objectives

1) Identification and selection of feed stock for preparation of biodiesel.

2) Extraction of oil from seed of Mexicana with the help of soxhelt apparatus.

3) Preparation of biodiesel by using esterification and trans-esterification reaction.

4) Preparation of blends of biodiesel with diesel fuel. (BlendsB00, B06, B12, B18, B24).

5) Quality testing of all biodiesel with blends along with diesel fuels. (Density, viscosity,

Flash point, fire point, cetane no., calorific value, cloud point, pour-point, moisture)

6) Engine performance analysis of all blends (brake power, brake thermal efficiency,

Indicated power, brake specific fuel consumption braking torque,)

7) Combustion analysis-preparation of heat balance sheet.

8) Search of best blends that will substitute diesel fuel without modification in diesel engine.

9) Smoke analysis for all blends with diesel fuel

2. PROCEDURE OF BLENDS PREPARETION AND ENGINE TESTING

- **Collection of Mexicana Seeds**
- **Drying of Mexicana Seeds**
- **Crushing of Seeds**: The seeds are Crushed by Mortar and Pestle.
- **Extraction of oil**: Prior to the extraction process Mexicana seeds were dried at 50^0 C for 12 hours in the oven to remove the excess moisture. The dried seeds were then weighed and powdered. The fine seed powder was then subjected to Soxhlet apparatus using methanol as a solvent. The duration of each batch was 10 hours for complete extraction. The solvent required for extraction of per kg seeds was in the ratio of 5:1 (5L solvent for 1kg seeds). The oil was recovered from the solvent by distillation process. The extracted oil was then measured to calculate the percentage oil in the seeds.
- **Esterification:** This process is used to reduce acid value of the oil. In this process there are following steps:

  A. First oil is preheated to 40^0C

  B. Then 0.5 to 0.7% (5 to 7gm per liter) of H_2SO_4 is added.

  C. After 2 min nearly 13% (130gm per liter) of methyl/ethyl alcohol is added.

  D. And temperature is maintained constant about 55^0 to 65^0C for abouy 45 to 50 minutes.
- **Trans-Esterification**: 1.5% (15gm per liter) of aluminum oxide will be added to 130 ml of Methyl alcohol. Then this mixture will be added in unit called trans-esterification unit. Again temperature will be maintained at 55^0 to 60^0 C for about 1hr30 min.

Figure -1: Esterification and Trans-esterification unit

- **Settling and seperation**: In this process glycerin and alcohol mixture is settled at various levels. For this settling apparatus is used. The mixture in apparatus is kept over night. Another day separate layers of glycerin oil and alcohol mixture and unreacted Alcohol is obtained. The layers obtained in settling will be removed one by one separately.
- **Blends preparation with addition of N- Butanol:** As we know oil and diesel being varying in densities cannot be mixed easily. To mix them homogenously following steps should be followed:

  A. Diesel and oil are mixed in required proportion and then constantly heated at 40^0 to 45^0 C for 20 min unless two layers form homogenous mixture.

  B. Blends prepared will be B00, B06, B12, B18 and B24.

  C. n-Butanol is particular interest as a renewable biofuel as it is less hydrophilic, and possesses higher energy content, higher cetane number, higher viscosity, lower vapour pressure, higher flash point and higher miscibility than ethanol, making it more preferable than ethanol for blending with diesel fuel. Therefore, the problems associated with ethanol mentioned in the previous sub-section are solved to considerable extent when using n-Butanol, which is also less corrosive.

  D. The literature concerning the use of n-Butanol/diesel fuel blends in diesel engines and its effects on their steady-state performance.

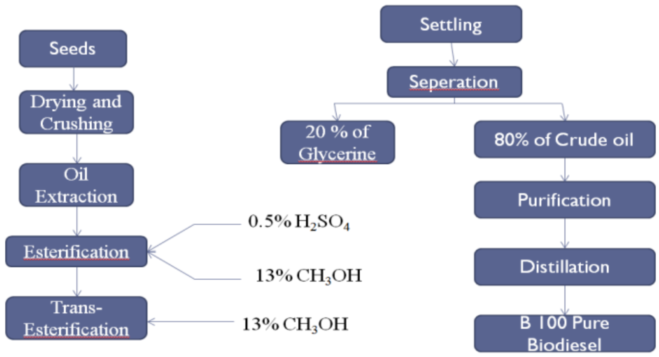

Figure -1: Flow chart of Extraction of Biodiesel

Table -1: Analysis of Diesel and Bio-Diesel

Test Description	**Ref. Std .ASTM 6751**	**Diesel**	**Bio-Diesel (B24)**
Density(gm/cc)	D1448	0.830	0.834
Calorific Value(MJ/Kg)	D6751	42.50	42.06
Viscosity(mm^2/sec)	D445	2.700	2.81
Flash point (^{0}C)	D93	64	76.00
Fire Point(^{0}C)	D93	71	92.00
Cloud Point(^{0}C)	D2500	-4	2.000
Pour Point(^{0}C)	D2500	-9	-1.000
Ash(%)	D	0.05	0.050

Engine testing: Engine testing was carried out on IC Engine with following specifications-

Fuel	Diesel
No. of Cylinders	1
No. of Strokes	4
Cylinder Diameter	87.5mm
Stroke length	110mm
Connecting rod length	234mm
Orifice Diameter	20mm
Dynamometre arm length	185mm
Power	3.5kw
Speed	1500rpm
CR	18:1

As above engine specifications carried as C.R.18 readings been taken. The fuel tank and pipe were cleaned before inserting each blends of biodiesel. The emission testing were carried on AVL 437 smoke meter operating Unit.

3. RESULTS

Gas Analysis of Blends

Table-2: Gas Analysis Chart

Blends	Load (in kg)	CO (%)	CO2 (%)
B00	0.3	0.024	0.5
	3	0.027	0.9
	6	0.016	1.2
	9	0.015	1.6
	12	0.016	1.9
B06	0.3	0.04	0.4
	3	0.045	0.8
	6	0.023	1.1
	9	0.023	1.5
	12	0.042	1.9
B12	0.3	0.042	0.5
	3	0.043	0.9
	6	0.033	1.2
	9	0.031	1.7
	12	0.032	2
B18	0.3	0.035	0.5
	3	0.043	0.9
	6	0.034	1.3
	9	0.025	1.5
	12	0.036	2
B24	0.3	0.038	0.5
	3	0.048	0.9
	6	0.037	1.2
	9	0.038	1.6
	12	0.045	2

Graphical Presentation of Gas Analysis

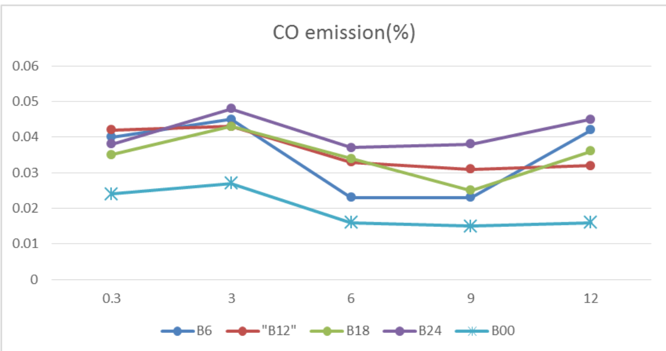

Chart -1: CO Emission (%) v/s Load(Kg)

For CO emission B6 is better at load 6kg and 9kg. B12 is better at load 12kg. For CO emission this 2 blends are better than other blends.

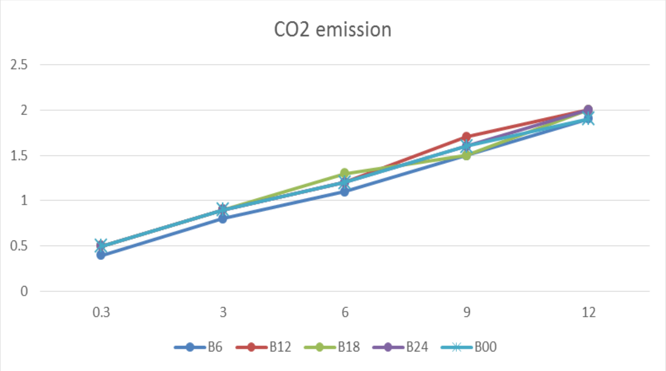

Chart -2: CO_2 Emission(%) v/s Load(Kg)

In the above graph it is clearly seen that all blends having less CO_2 emission. For CO_2 emission B6 is better blend than other blend at load 12kg.

Engine Analysis of Blends:

Graphical Representation of Blends

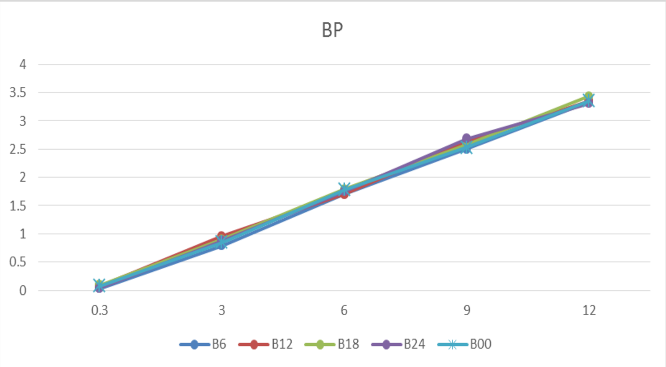

Chart -3: Brake Power(Kw) v/s Load(kg)

It is clearly seen that all blends having approximately same Brake Power as that of the pure diesel.

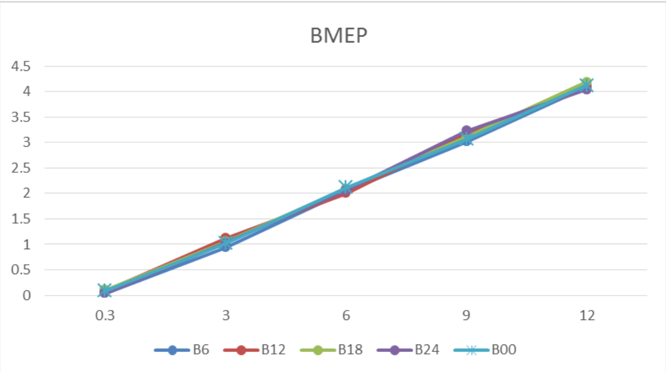

Chart -4: BEMP (Bar) v/s Load(Kg)

All blend shaving almost same break mean effective pressure near to pure diesel blends are showing slight changes the value between B6 to B12.

Table-3: Engine Analysis Charts of Blends

Blends	Load (Kg)	Torque (Nm)	BP (KW)	IP (KW)	BEMP (bar)	BTHE (%)
B00	0.3	0.48	0.08	1.13	0.09	2.15
	3	5.36	0.85	1.91	1.02	16.26
	6	11.18	1.78	2.69	2.12	25.38
	9	16.15	2.53	3.19	3.07	28.89
	12	21.67	3.35	3.97	4.12	31.92
B06	0.3	0.21	0.03	1.16	0.04	1.14
	3	4.97	0.79	1.84	0.94	16.95
	6	10.78	1.71	2.66	2.05	24.45
	9	15.92	2.5	3.24	3.02	28.5
	12	21.58	3.34	3.97	4.1	31.74
B12	0.3	0.48	0.08	1.18	0.09	2.21
	3	5.91	0.96	2.05	1.12	18.32
	6	10.52	1.7	2.69	2	26.53
	9	16.71	2.64	3.35	3.17	28.25
	12	21.6	3.35	4.04	4.1	33.71
B18	0.3	0.54	0.09	1.18	0.1	2.51
	3	5.53	0.9	1.97	1.05	17.21
	6	11.01	1.79	2.8	2.09	25.48
	9	16.41	2.58	3.37	3.12	27.57
	12	22.08	3.43	4.1	4.19	30.89
B24	0.3	0.21	0.04	1.15	0.04	1.01
	3	5.4	0.88	1.88	1.03	16.66
	6	10.83	1.75	2.89	2.06	24.97
	9	17.01	2.68	3.49	3.23	30.6
	12	21.27	3.31	4.01	4.04	29.86

4. CONCLUSIONS

In this project we have tested the various types of blends of Mexicana seed oil with the n-Butanol as an addition and their performance characteristics on IC Engine. To compare between the all different blends we have created and choosing the best blend one of them on the basis of performance, economy and safety for the environment.

The use of Mexicana seed oil as a raw material for Bio-Diesel production has proved as a good option as compared with other types of Bio-Diesel seeds like Jatrofa and Neem oil.

As Mexicana is wild plant it gets available easily and at high quantity do production of Mexicana seed is easy and economical.

With addition of n-Butanol the qualities of the oil like higher cetane number, higher viscosity, low vapour pressure, higher flash point and higher missibility and another good quality is its less corrosive nature which increase the life of engine.

With the analyzing the result of various blends as in case of performance the B12 and B24blends are best, but the emission of B24 blend is higher as compare to the B12 blend among all this.

Hence, there has been always a need for alternate better fuel option for Diesel and Petrol and Bio-Diesel can solve this problem and can be a good option for Diesel.

Mexicana oil can be used for making Bio-Diesel with the use of additives to get more efficient blends some more blends should be tested.

5. FURTURE SCOPE

Solving world's energy problem with Bio-Diesel is slightly difficult but it can play very important role as an option to Conventional Energy Resources.

With the help of some extra research, marketing and government policies Bio-Diesel can be use in our daily routine and demand for diesel can be reduced.

This research will also help for further studies and research related to Bio-Diesel made by crops or oil seeds. This research is about Mexicana seeds with n-Butanol additive this studies can be the base for the research on Mexicana because there is not so research has been done on Mexicana.

In preparation of Bio-Diesel a countable amount of glycerin can be use in many ways. A co-operative pharmaceutical company can be handled with more beneficial outcome with glycerin as main ingredient. This will lead to development of initial chain of industries working in condition.

It is expected that the best of Bio-Diesel will be lower than the conventional diesel fuel as Bio-Diesel are the key target for future energy market they can play important role in maintaining energy security.

Mexicana is a wild plant and does not need more attention for cropping of Mexicana is not difficult and economical. Mexicana seeds are also get available easily. Therefore Mexicana can be very good option for preparing Bio-Diesel.

Overall Bio-Diesel production and consumption especially for all blends with small portion of Bio-Diesel is technically reasonable as in alternative fuel in CI Engine without any modification of engine with considerable cost reduction.

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