COMPARATIVE ANALYSIS FOR THE PERFORMANCE AND EMISSIONS OF C.I. ENGINES USING BIODIESEL BLENDS

Putike Rajanna[1], Dr E Subba Reddy[2]

[1]*P.G. Scholar, Department of Mechanical Engineering, KKIT, Kurnool, India*

[2]*Professor, Department of Mechanical Engineering, KKIT, Kurnool, India*

---***---

Abstract – ***The economic development in developing countries has lead to the huge increasing energy demand in India, the energy demand is increasing 6.5 % per annum. The diesel vehicles are banned in New Delhi for serious problem of air pollution due to the higher emissions of polluted gas. The acid rains, global warming and health hazards are results of ill effects of increased polluted gases like CO, HC, NO_x and particulate matter in atmosphere. The various alternative fuels that can be used directly an existing unmodified diesel engine, because it has similar properties in diesel fuel. Jatropha, palm and cotton seed oils are the non edible and edible renewable fuels among all the alternative fuels existed. An attempt has been made in the present work to find out the suitability of jatropha oil in CI engines with the combination with diesel. Experimental work was carried out on 5bph single cylinder four stroke water cooled kirloskar diesel engine at the rated speed of 1500 rpm with different blends of jatropha oil with diesel.***

Key words: *blends, diesel, emissions, jatropha, performance*

1. INTRODUCTION

Majority of the words energy needs are supplied through petrochemical sources, coal and natural gases, with the exception of hydroelectricity and nuclear energy, of all, these sources are finite and at current usage rates will be consumed shortly. Diesel fuels have an essential function in the industrial economy of a developing country and used for transport of industrial and agricultural goods, operation of diesel tractor and pump sets in agricultural sector.

Diesel engines are the most efficient prime movers. From the point of view of protecting global environment and concerns for the long term energy security, it becomes necessary to develop alternative fuels with properties comparable to petroleum based fuels.

An alternative fuel must be technically feasible, economically competitive, environmentally acceptable, and readily available. One possible alternative to fossil fuel is the use of oils of plant origin like vegetable oils and tree borne oil seeds. This fuel is biodegradable and non-toxic and has low emission profiles as compared to petroleum diesel.

1.1 Need of alternative fuels

Rising gas in prices is having dramatic negative effects on many parts of the world. Recently in Iran, rioting was sparked when the government introduced gasoline rationing; Iran is one of the world's largest oil producers. In Belgium, farmers protested by taking 500 tractors on a fuel price protest onto the streets of Brussels. In Britain and many other parts of Europe, farmers, truck drivers and fishermen have all held protests about the crippling effect rising fuel cost is having on their livelihood. Similar riots and protests have taken place in the Asia, Far east and Rising oil prices also means increase in other products and services, none more so than food because it touches and affects the lives of every single person.

1.2 Advantages of vegetable oils as diesel fuel

- Liquid nature portability
- Ready availability
- Renew ability
- High cetane number
- Lower sulphur content
- Lower aromatic content
- Biodegradability

1.3 Disadvantages of vegetable oils as diesel fuels

- Higher viscosity
- Lower volatility
- The reactivity of unsaturated hydrocarbon chains

2.BIODIESEL

Bio diesel is a domestic, renewable fuel for diesel engines derived from natural oils like vegetable oils. Biodiesels can be used in any concentration with petroleum based diesel fuel in existing diesel engines with little or no modification. Biodiesel is not the same thing as raw vegetable oil. It is produced by a chemical process, which removes glycerol from the oil.

2.1 significance of biodiesel

Burning biodiesel helps in reducing National dependence on foreign petroleum and moves us toward a more economically sustainable and environmentally responsible future.

With production based upon waste cooking oils and from agricultural products which are high in natural oils like soybeans and palm oils, increased consumption of biodiesel creates economic development and additional markets for agricultural products.

In turn, this creates new jobs in rural communities and keeps money circulating throughout the domestic economy. Producing a percentage of our fuel at home increases our nation's energy independence.

2.2 Advantages of Biodiesel

There are numerous advantages of bio-diesels. Some of the most important are listed:

- Biodiesel runs in any conventional, unmodified diesel engine. No engine modifications are necessary to use biodiesel and there is no "engine conversion". In other words, "you just pour it into the fuel tank".
- Biodiesel can be stored anywhere that petroleum diesel fuel is stored. All diesel fuelling infrastructure including pumps, tank and transport trucks can use bio-diesel without any major modifications.
- Biodiesel reduces carbon dioxide emissions, the primary cause of the greenhouse effect by up to 1005. Since biodiesel comes from plants and plants breathe carbon dioxide, there is no net gain in carbon dioxide from using biodiesel.

sno	properties	Blend1	Blend2	Blend3	Blend4	diesel
1.	KV (cSt)	3.082	4.496	4.95	6.2515	2.5
2.	GCV (kj/kg)	28103	29138	28563	32495	44800
3.	F P (°C)	48	52	52	52	56
4.	Fi P(°C)	60	60	60	60	76

- Biodiesel is more lubricating than diesel fuel, it increases the engine life and it can be used to replace sulphur, a lubricating agent than, when burned, produces sulphur dioxide the primary component in acid rain.
- Biodiesel is safe to transport. Biodiesel has high flash point, or ignition temperature of about 150deg.C compared to petroleum diesel fuel, which has flash point of 52 deg.C.
- Engines running on biodiesel run normally and have similar fuel mileage to engines running on diesel fuel. Auto ignition, fuel consumption, power output and engine torque are relatively unaffected by biodiesel.

2.3 Disadvantages of Biodiesel

The NO_X emission is somewhat higher than the conventional diesel engines.

sno	CO%	HC ppm	CO_2 %	O_2%	NO_X ppm	Smoke density mg/m^3
1	0.1	37	3.33	15.96	108	0
2	0.09	44	3.51	15.53	163	10
3	0.08	45	4.36	14.41	326	228
4	0.07	46	5.17	13.42	539	80
5	0.06	47	6.02	11.96	829	140

Since the biodiesel contains O_2 the specific fuel consumption would be higher than that of pure diesel oils.

3. SPECIFICATIONS OF ENGINE

- Engine ------------------------- kirloskar
- Break horse power----------- 5hp
- Type --------------------------- single cylinder
- Speed -------------------------- 1500rpm
- Compression ratio ----------- 16.5:1
- Method of loading ----------- mechanical loading
- Method of starting ----------- manual cranking
- Method of cooling ------------ water
- Type of ignition --------------- compression ignition
- Lubricated oil ----------------- SAE 40

3.1 List of oils and Blends for testing

- Pure diesel
- Pure jatropha
- Blend1 = 20% jatropha + 80% diesel
- Blend2 = 40% jatropha + 60% diesel
- Blend3 = 60% jatropha + 40% diesel
- Blend4 = 80% jatropha + 20% diesel

4. TABULATION

Table 4.1 Properties for blends and diesel

In the above table abbreviations are given as below

KV = Kinematic Viscosity

GCV = Gross Calorific Value

FP = Flash Point

Fi P = Fire Point

Table 4.2 Readings for diesel

Specific gravity of the fuel = 0.836

Calorific value = 10500 cal/g

sno	N rpm	W kgf	S kgf	Time sec	m_f kg/hr	SFC kg/kwhr
1	1580	0	0.00	60	0.5028	0
2	1565	3	0.10	53	0.5692	0.474
3	1554	6	0.15	45	0.6704	0.3352
4	1538	9	0.25	40	0.7542	0.2514
5	1520	12	0.25	34	0.8873	0.2398

Table 4.3 Emissions Table

sno	N rpm	W kgf	S kgf	Time sec	m_f kg/hr	SFC kg/kwhr
1	1580	0	0.00	75	0.4053	0
2	1565	3	0.10	60	0.5066	0.4229
3	1554	6	0.15	45	0.6755	0.3377
4	1538	9	0.25	40	0.7599	0.2533
5	1520	12	0.25	34	0.894	0.2416

sno	BP (kw)	IP (kw)	FP kw	Mech.Eff η_m%	Bth.eff% η_{bth}%
1	0.0	1.41	1.41	0.00	0
2	1.2	1.41	2.61	46.0	19.54
3	2.0	1.41	3.41	58.6	24.43
4	3.0	1.41	4.41	68.0	32.57
5	3.7	1.41	5.11	72.4	34.15

Table 4.4 Readings for Blend1

Specific gravity of the fuel = 0.836

Calorific value = 6713.895 cal/g

sno	CO %	HC ppm	CO_2 %	O_2%	Smoke density mg/m
1	0.08	23	2.83	16.43	0
2	0.07	24	3.48	15.39	8
3	0.07	29	4.61	13.98	11
4	0.06	31	5.72	12.63	42
5	0.05	33	6.97	10.85	110

5.GRAPHS

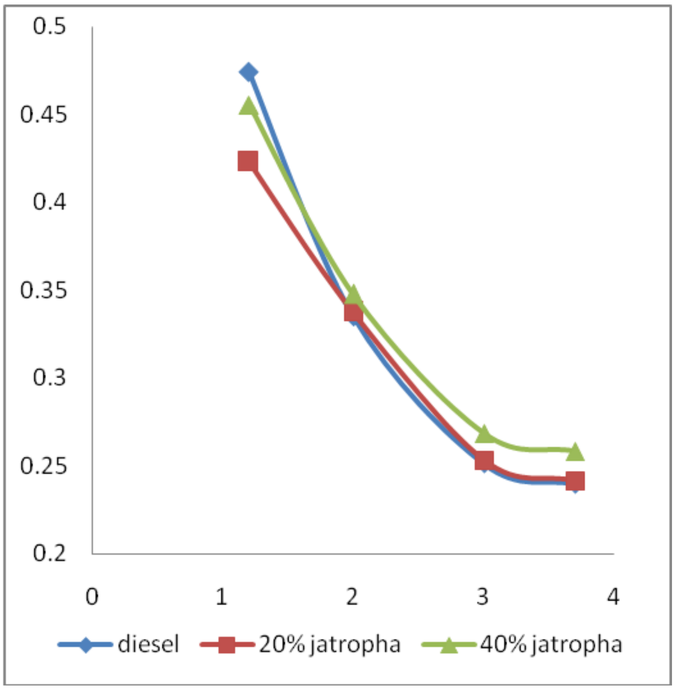

Chart 5.1 Brake Power Vs Specific Fuel Consumption

The graph is drawn between Brake power and specific Fuel Consumption by comparing the values of Diesel, 20% jatropha and 40% jatropha oil blends.

Sno	BP kw	IP kw	FP kw	η_{bth}%	η_m%
1	0.0	1.41	1.41	0	0
2	1.2	2.61	1.41	18.318	46.0
3	2.0	3.41	1.41	23.98	58.6
4	3.0	4.41	1.41	31.07	68.0
5	3.7	5.11	1.41	32.27	72.4

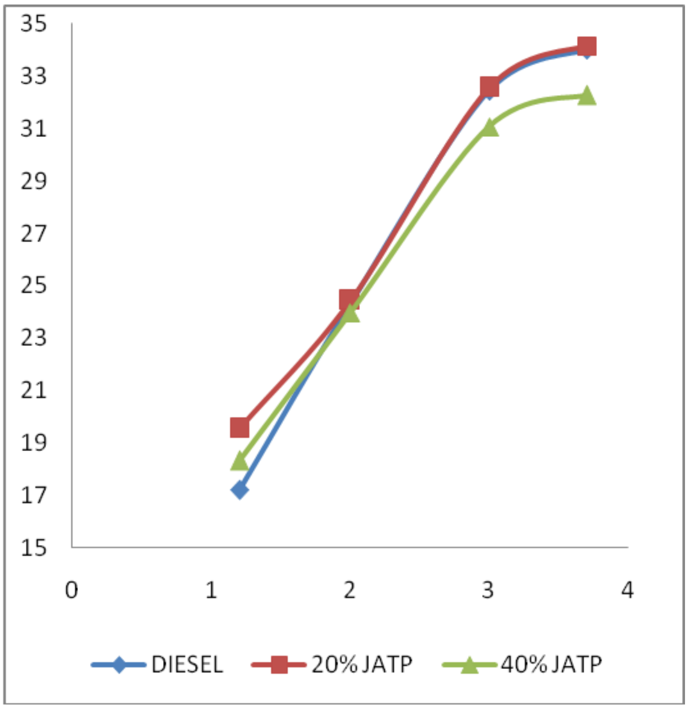

Chart 5.2 Brake Power Vs Brake Thermal Efficiency

The graph is drawn between Brake power and Brake Power thermal efficiency by comparing the values of Diesel, 20% jatropha and 40% jatropha blends.

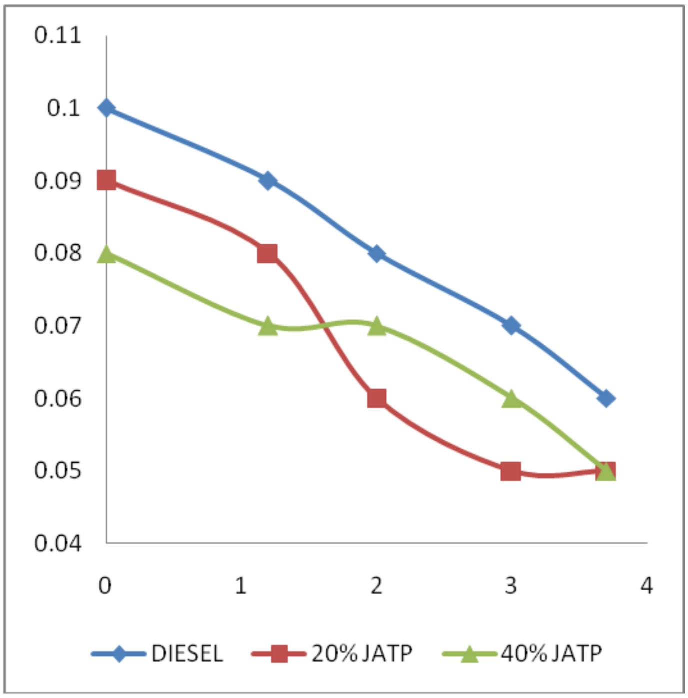

Chart 5.3 Brake Power Vs CO

The graph is drawn between Brake power and carbon monoxide emission by comparing the values of Diesel, 20% jatropha and 40% jatropha blends.

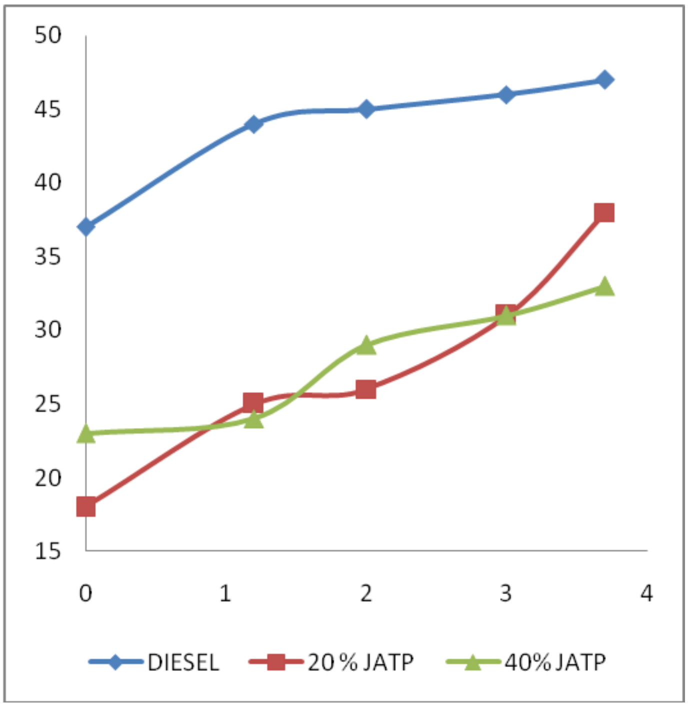

Chart 5.4 Brake Power Vs HC

This graph is drawn between brake power and HC emission by comparing the values of Diesel, 20% jatropha and 40% jatropha blends.

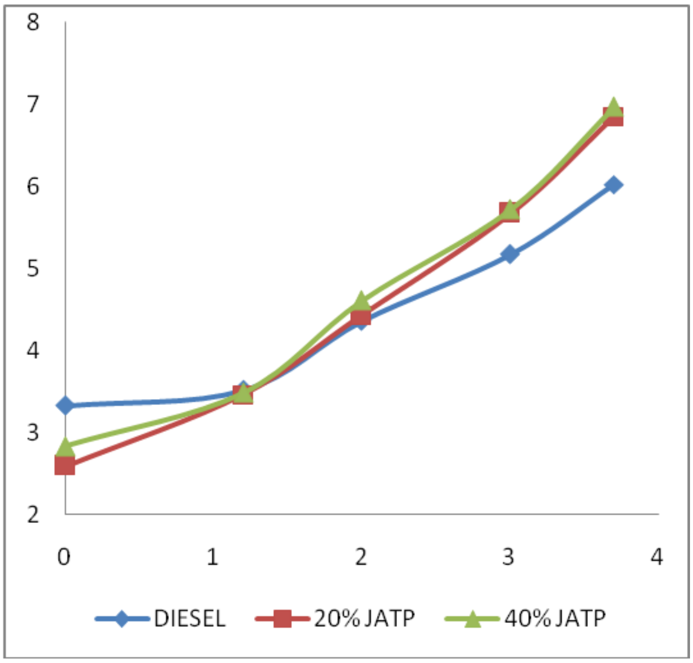

Chart 5.5 Brake Power Vs CO_2

This graph is drawn between Brake Power and carbon dioxide emission by comparing the values of Diesel, 20% Jatropha and 40% Jatropha blends.

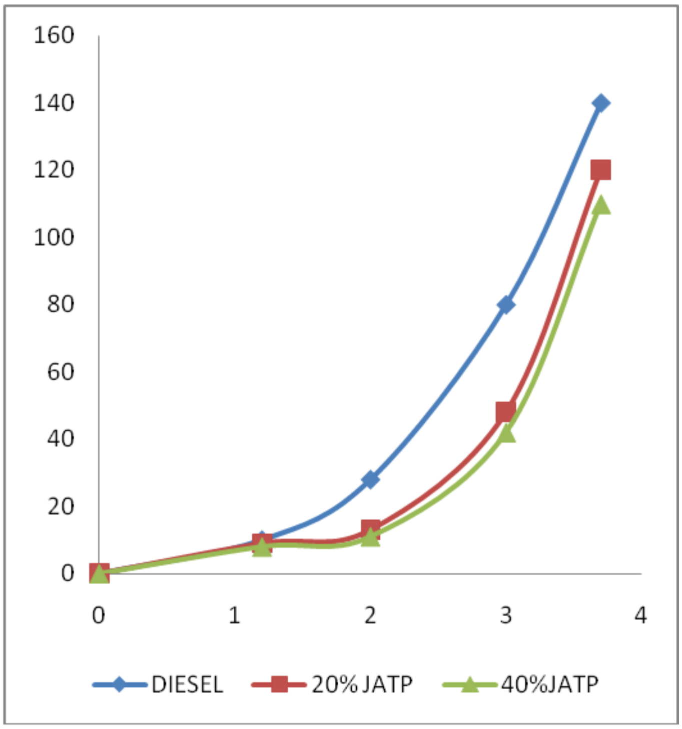

Chart 5.6 Brake Power Vs SMOKE DENSITY

This graph is drawn between brake power and smoke density by comparing the values of Diesel, 20% jatropha and 40% jatropha blends.

6. RESULTS AND DISCUSSIONS

6.1 Brake thermal efficiency

The variation of break thermal efficiency with break power was shown in graphs. The break thermal efficiency at different percentages of gas flows and at different loads was calculated. From it was observed that, with increasing the gas flow rate the break thermal efficiency of the engine also increase because of the fuel consumption will be decreased as compare to diesel. Brake thermal efficiency will gives idea about the output generated by the engine with respect to heat supplied in the form of fuel.

From the graph it was observed that the dual fuel system at 220 bar injector pressure gives maximum efficiency 25% to 30% when compared to diesel at different injector pressures. The main reason for increasing brake thermal efficiency with increasing load is due to high calorific and less heat losses.

6.2 Specific Fuel Consumption

The variation specific fuel consumption with load is shown in graphs. From the graph it was observed that specific fuel consumption decreases with increase of loads at different blends of jatropha oil, when compared to diesel with different injector pressures.

6.3 Exhaust Gas Temperature

It was observed that the exhaust gas temperature increase with increasing loads and brake power and also slightly higher than the diesel fuel, because of higher calorific value of vegetable oils having 10% more oxygen as compared to diesel fuel. So that complete combustion takes place.

7. CONCLUSION

Experiment has been done by blending biodiesel (jatropha) in different volumes with diesel. The engine performance indicating parameters like brake power, indicated power, break thermal efficiency, mechanical efficiency, etc., have been observed for various blends at different loads.

It is clear that, at 20% blending of biodiesel the engine performance is found to be very appreciable. At this blending trial particularly at all full load conditions the specific fuel consumption is very closer to the values obtained without blending.

From the experiments conducted, it is concluded that biodiesel and its blends as a fuel for diesel engine have better emission characteristics compared with diesel.

The NO_X emissions are high due to presence of oxygen content in the fuel.

The HC and CO emissions are less compared with diesel.

Thus biodiesel may be the promising fuel for the future.

REFERENCES

[1] Moore A. Biofuels are dead: long live biofuels(?) – part two. New Biotechnology 2008;25(2-3):96-100.

[2] Chertow MR. "Uncovering" industrial symbiosis. Journal of Industrial Ecology 2007;11(1):11-30.

[3] Chertow MR. Industrial symbiosis: Literature and taxonomy. Annual Review of Energy and the Environment 2000;25:313-37.

[4] Chertow MR, Lombardi DR. Quantifying economic and environmental benefits of colocated firms. Environmental Science and Technology 2005;39(17):6535-41.

[5] Green BN, Johnson CD, Adams A. Writing narrative literature reviews for peer-reviewed journals: secrets of the trade. Journal of Chiropractic Medicine 2006;5(3):101-17.

[6] Champagne P. Feasibility of producing bio-ethanol from waste residues: A Canadian perspective: Feasibility of producing bio-ethanol from waste residues in Canada. Resources, Conservation and Recycling 2007;50(3):211-30.

[7] Robinson PH, Karges K, Gibson ML. Nutritional evaluation of four co-product feedstuffs from the motor fuel ethanol distillation industry in the Midwestern USA. Animal Feed Science and Technology 2008;146(3-4):345-52.

[8] Klopfenstein TJ, Erickson GE, Bremer VR. Feeding Corn Milling Byproducts to Feedlot Cattle. Veterinary Clinics of North America: Food Animal Practice 2007;23(2):223-45.

[9] US researchers investigate use of ethanol co-products as fillers for plastics. Additives for Polymers 2008;2008(8):4-.

[10] Saunders JA, Rosentrater KA. Survey of US fuel ethanol plants. Bioresource technology 2009;100(13):3277-84.

BIOGRAPHIES

Mr. Putike. Rajanna received B.E (Mechanical engineering) from SV University in 2011and pursuing M.E (Thermal engineering) in JNTU Anantapur.

Dr E Subba Reddy completed Phd and working as a principal in KKIT engineering college affiliated under JNTU Anantapur.