International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 4, Issue 5
May 2017

Effect of Fuel Injection Pressure on a CI Engine with Karanja Blends in Combination with Diesel: An Experimental Investigation

Pabbathi Vijaya Rao[1*], B. Sudheer Prem Kumar[2], K. Vijaya Kumar Reddy[3]

[*1,] Research Scholar, Department of Mechanical Engineering, JNTUH, Hyderabad, Telangana State, India.

[2, 3]Professor, Department of Mechanical Engineering, JNTUH, Hyderabad, Telangana State, India.

Abstract: *Karanja oil is one a bio-fuel which can be extracted from seeds and used renewable sources of power generation and propulsion. In our present experimental investigation karanja oil is substituted in the Diesel in various proportions such as 5%, 10%, 15% and 20% by volume and tested under various Injections pressures and compared with that of performance of Diesel. The performance and emission are presented in the paper.*

Introduction:

The researchers suggest that the oil that is being drilled out of the earth would exhaust within few decades. This shows, the world is in the requirement of fuels that are renewable and can be indigenously produced in a country to save the economy. The bio fuels are considered to be best of the renewable fuels and are can be produced indigenously. Bio-fuels are both gaseous fuels that which are called Bio gas and liquid fuels that which are termed as bio-diesels.

Karanja Oil

Karanja Oil or Pongamia oil is derived from the seeds of the Millettia. Pinnata tree, which is native to tropical and temperate Asia. Millettia pinnata is native to South and Southeast Asia. Known in various languages as Indian beech, Pongam, Karanja, Honge, Kanuga, and Naktamala, it is now grown all over the world. Typically the plant starts yielding pods from the fifth year on with the yields increasing each year until it stabilizes around the tenth year. Milletti pinnata is native to South and Southeast Asia. Known in various languages as Indian beech, Pongam, Karanja, Honge, Kanuga, and Naktamala, it is now grown all over the world. Typically the plant starts yielding pods from the fifth year on with the yields increasing each year until it stabilizes around the tenth year.

Pongamia oil is extracted from the seeds by expeller pressing, cold pressing, or solvent extraction. The oil is yellowish-orange to brown in color. It is toxic and will induce nausea and vomiting if eaten, but it is used in many traditional remedies. It has a high content of triglycerides, and its disagreeable taste and odor are due to bitter flavonoid constituents including karanjin, pongamol, tannin and karanjachromene.

The physical properties of the Karanja oil are as given below.

A researcher has conducted an experimental investigation of performance and emission of karanja oil and its blend(10%,20%,50% and 75%) visa-vis mineral diesel in a single cylinder agricultural diesel engine. In this study physical and thermal properties of karanja oil were evaluated. Author conducted two set of experiment, one set for unheated and second for preheated fuel samples. Without preheating set of experimentation shows higher brake thermal efficiency except B100 and BSFC up to 50% was lower than diesel .pre-heating set of experimentation shows higher brake thermal efficiency and lower BSFC for all blends as compared with

International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 4, Issue 5
May 2017

diesel fuel. BSFC for unheated and heated karanja oil were lower and exhaust gas temperature was generally higher than diesel for all blends. NOx emission was found to be less as compared with diesel for both set oil.

Table 1: Properties of Karanja Oil

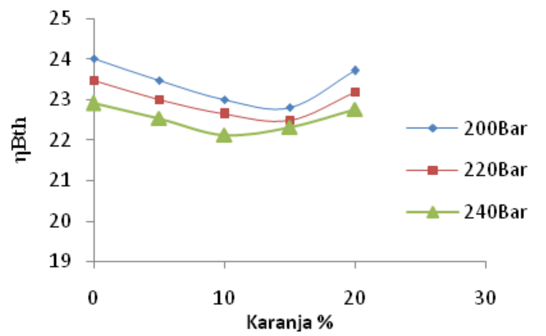
Property	**Methyl esters**	**ASTM D6751**	**EN 14214**
Acid value(mg KOH/g)	0.46 - 0.5	<0.8	<0.5
Calorific value(kcal/kg)	3700		
Cetane Number	41.7 - 56	>45	>51
Density at 15°C (g/cm3)	0.86 - 0.88	0.87 - 0.89	0.86 - 0.90
Viscosity at 40°C(mm2/s)	4.77	1.9 - 6.0	3.5 - 5.0
Boiling point (°C)	316		
Cloud point(°C)	19		0/-15
Fire Point(°C)	230		
Flash point(°C)	174	>130	>101

Results and Discussions:

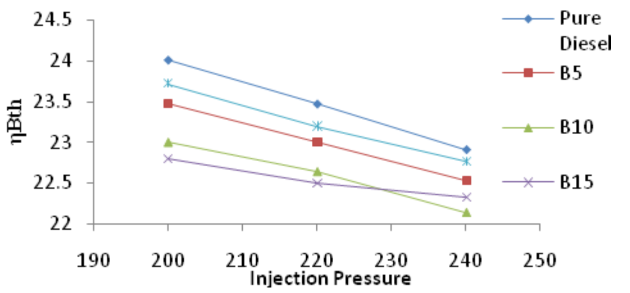
Significant results were drawn out of the obtained readings and compared as below.

Brake thermal efficiency:

Brake thermal efficiency is an important performance parameter of an IC engine; it determines or evaluates the suitability of a particular running condition.



Graph 1: BTE Vs Karanja substitution in the blend at various injection pressures

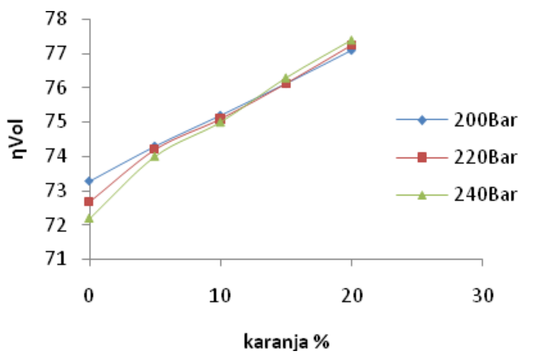


Graph 2: BTE Vs Injection pressures at various blends

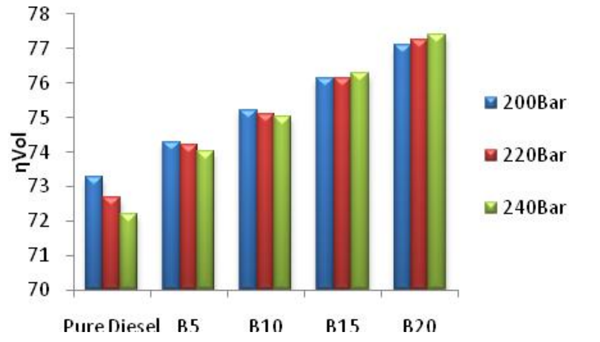
The Graph 1 presenting the break thermal efficiency at various blends of Karanja at various injection pressures illustrate that; at all the injection pressures the trend of break thermal efficiency remains same. There is decrease in 8% of break thermal efficiency from pure diesel to 15% of karanja substitution blends. The 20% substitution blend has equal performance as pure diesel. The graph 2 has details of performance at injection pressures; the decreasing trend of the break thermal efficiency is seen with increasing injection pressures at all the blends including the pure diesel. The mode value of 14% drop in the break thermal efficiency is found in 200Bar to 240Bar pressure. The blend B15 has less effect with increasing injection pressures with 11% drop in the break thermal efficiency.

Volumetric efficiency:

The volumetric efficiency is the breathing capacity of the engine, good volumetric efficiency indicates healthy engine. The volumetric efficiency at all the karanja blends is shown in the graph 3, the 7% raise in the volumetric efficiency is observed from 0% to 20% karanja substitution in the blends at all the injection pressure conditions.



Graph 3: Volumetric efficiency Vs Karanja substitution in the blend at various various injection pressures

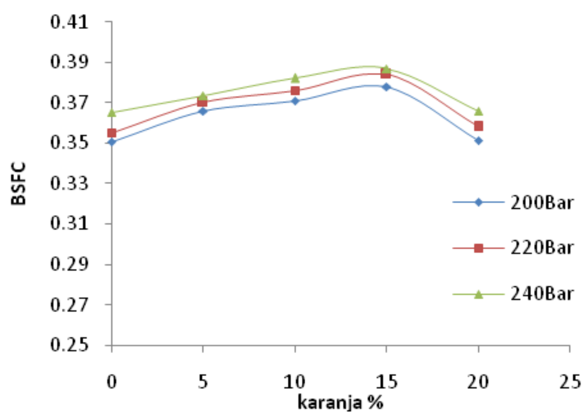


Graph 4: Volumetric efficiency Vs Injection pressures at blends

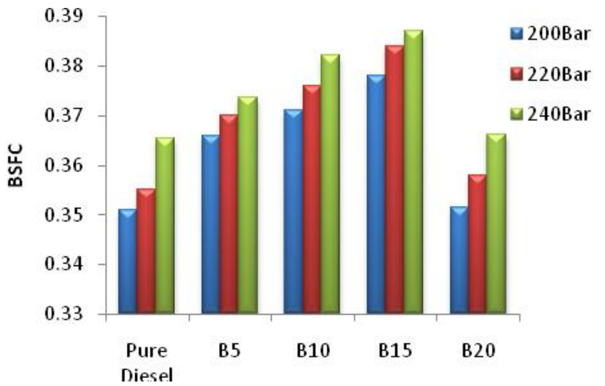
The clear picture of the effect of injection pressures the volumetric efficiency is at all blends is focussed in the graph 4. From pure diesel to the lower blends of B5 and B10 the volumetric efficiency is increased with the injection pressure, whereas at higher blends of B15 and B20 the volumetric efficiency is increased with the injection pressure.

Break Specific Fuel Consumption:

Break Specific fuel consumption is another important parameter that determines the performance of any engine. It is the specific quantity of fuel used to generate a unit of power.



Graph 5 : BSFC Vs Karanja substitution in the blend at various injection pressures



Graph 6: BSFC Vs Injection pressures at various blends

The Graph 5 presenting the BSFC at various blends of Karanja at various injection pressures illustrate that; at all the injection pressures the trend of break thermal efficiency remains same. There is increase in 8% of BSFC from pure diesel to 15% of karanja substitution blends. The 20% substitution blend has equal performance as pure diesel.

The graph 6 has details of performance at injection pressures; the decreasing trend of the break thermal efficiency is seen with increasing injection pressures at all the blends including the pure diesel. The mode

International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 4, Issue 5
May 2017

value of 13% increase in the BSFC is found in 200Bar to 240Bar pressure. The blend B15 has less effect with increasing injection pressures with 11% increase in the break thermal efficiency.

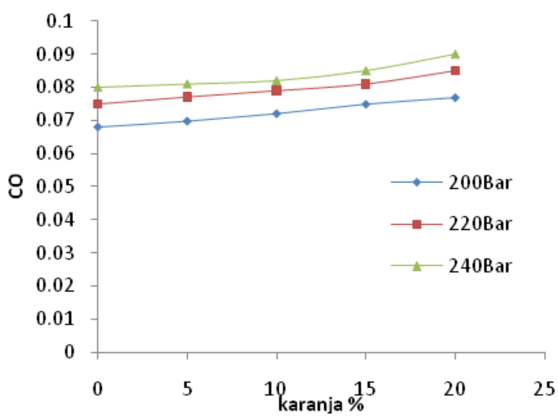
Emissions:

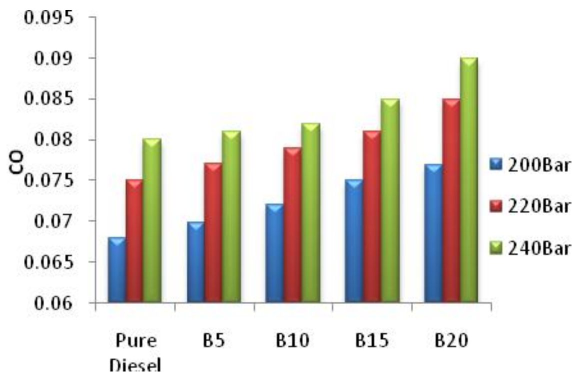
After validation of performance parameters emissions stand to determine the suitability of a running condition of an Engine. Below given are the emissions that are measured and compared at the focussed running conditions.

Oxides of Carbon (CO and CO2):

Carbon Monoxide (CO):

Carbon monoxide is an oxide of carbon that is partially oxidized during the combustion process and has adverse effect on the environment and human health.





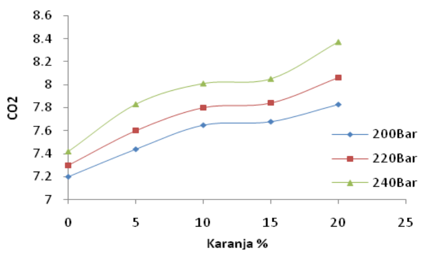
Graph 7: CO Vs Karanja substitution in the blend at various injection pressures **Graph 8:** CO Vs Injection pressures at various blends

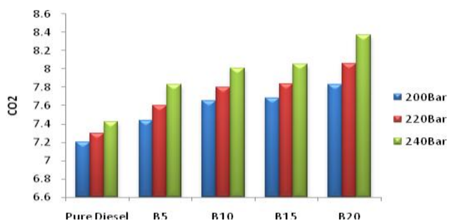
The CO at all the karanja blends is shown in the graph 7, the minute raise of 2 % in the CO is observed from 0% to 20% karanja substitution in the blends at all the injection pressure conditions. The clear picture of the effect of injection pressures the volumetric efficiency is at all blends is focussed in the graph 8. From pure diesel to blend B20 the CO emissions are increased with the injection pressure.

Carbon-Dioxide (CO_2):

Carbon Dioxide is another oxide of carbon that is the complete oxidized form of carbon in the combustion chamber. Emissions of CO_2 also need to be considered serious as it is one of green house gas.

The clear picture of the effect of injection pressures the CO_2 emissions is at all blends is focussed in the graph 10. From pure diesel to the B20 the CO_2 emission is increased with the injection pressure.



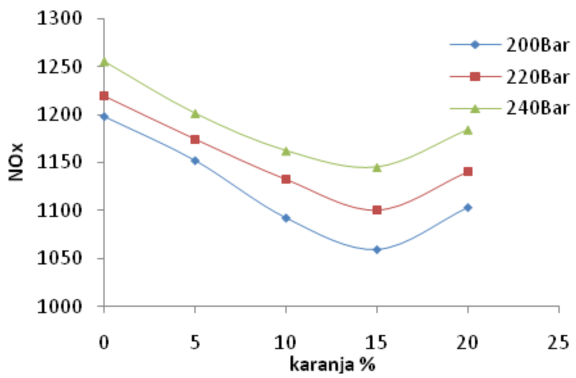


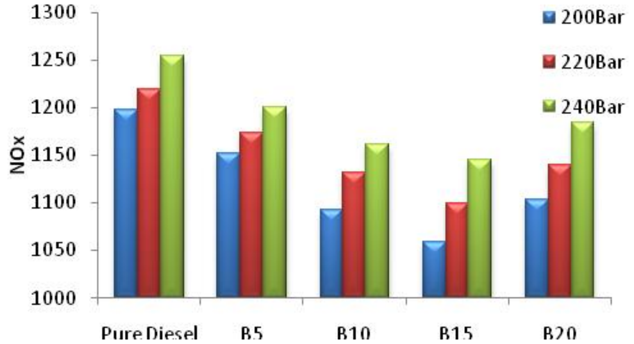
Graph 9: CO_2 Vs Karanja substitution in the blend at various injection pressures **Graph 10:** CO_2 Vs Injection pressures at various blends

International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 4, Issue 5
May 2017

Oxides of Nitrogen (NOx):

Oxides of Nitrogen are the automotive emissions that need to be adversely considered in engine life and environmental stand point.





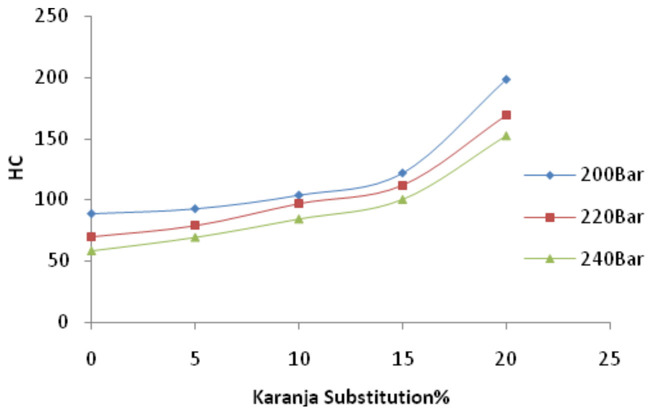
Graph 13: NO_X Vs Karanja substitution in the blend at various injection pressures **Graph 14:** NO_X Vs Injection pressures at various blends

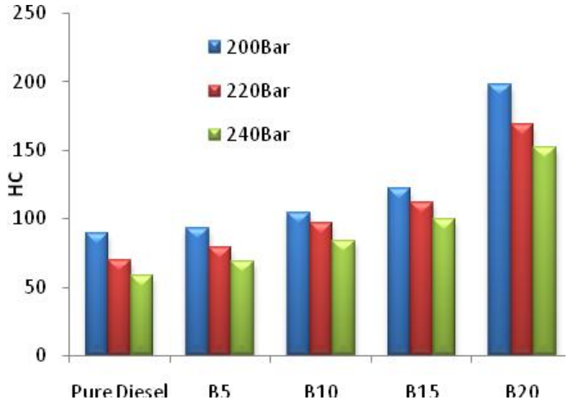
The Graph 13 presenting the NO_X at various blends of Karanja at various injection pressures illustrate that; at all the injection pressures the trend of break thermal efficiency remains same. There is decrease in 8% of NO_X from pure diesel to 15% of karanja substitution blends. The 20% substitution blend has only 9% less NO_X than pure diesel. The graph 4.30 has details of performance at injection pressures; the decreasing trend of the NO_X is seen with increasing injection pressures at all the blends including the pure diesel. The mode value of 16% increase in the NO_X is found in 200Bar to 240Bar pressure.

The HC at all the karanja blends is shown in the graph 14, the 120% raise in the volumetric efficiency is observed from 0% to 20% karanja substitution in the blends at all the injection pressure conditions.

Un-burnt hydro Carbons (HC):

The fuels used in the engine are hydro carbon fuels, the fully burnt or reacted hydro carbons generate power where as the un-burnt hydro carbons come out of tail pipe as harmful emissions.





G

raph 15: HC Vs Karanja substitution in the blend at various injection pressures **Graph 16:** Break thermal efficiency Vs Injection pressures at various blends

The clear picture of the effect of injection pressures the volumetric efficiency is at all blends is focussed in the graph 16. The mode value of 80% drop in the break thermal efficiency is found in 200Bar to 240Bar pressure.

Conclusions:

The significant conclusions are drawn after the analysis of the results of the experiment. The variation of injection pressures has shown a significant effect on all the performance parameters. The fall in the performance is noted under the increasing injection pressures, all the performance parameters are affected by the injection pressures. Injection pressure variation also has shown negative effect on the emissions at majority of Karanja blends, except on un-used oxygen.

References:

[1] İsmet Çelıkten, "An experimental investigation of the effect of the injection pressure on engine performance and exhaust emission in indirect injection diesel engines", Applied Thermal Engineering, Volume 23, Issue 16, November 2003, Pages 2051–2060.
[2] A.K. Agarwal, Biofuels (alcohols and biodiesel) applications as fuels for internal combustion engines, Progress in Energy and Combustion Science, 33,(2007) 233–271
[3] Abu-Qudais, M., Haddad, O. and Qudaisat, M., ''The effect of alcohol fumigation on diesel engine performance and emissions,'' Energy Conversion & Management, Vol. 41, pp. 389–399, 2000.
[4] Al-Baghdadi, M.A.S., ''Performance study of a four-stroke spark ignition engine working with both of hydrogen and ethyl alcohol as supplementary fuel,'' International Journal of Hydrogen Energy, Vol. 25, pp. 1005–1009, 2000.
[5] B.S. Chauhan, N. Kumar, H.M. Cho, H.C. Lim., A study on the performance and emission of a diesel engine fuelled with Karanja biodiesel and its blends, Energy, 56, (2013) 1-7.
[6] Bakar, R. A., IsmailA. R., and Semin, 2008, "Fuel Injection Pressure Effect on Performance of Direct Injection Diesel Engines Based on Experiment," American Journal of Applied Sciences, 5 (3), pp. 197–202.
[7] Bo, Z., Weibiao, F. and Jingsong, G., ''Study of fuel consumption when introducing DME or ethanol into diesel engine,'' Fuel, Vol. 85, pp. 778–782, 2006.
[8] Can Çinara, Tolga Topgüla, Murat Cinivizb, Can Haşimoğlu, "Effects of injection pressure and intake CO2 concentration on performance and emission parameters of an IDI turbocharged diesel engine", Applied Thermal Engineering, Volume 25, Issues 11– 12, August 2005, Pages 1854–1862.
[9] DYC Leung, Development of a clean biodiesel fuel in Hong Kong using recycled oil. Water, Air, & Soil Pollution, 130, (2001) 277–82.
[10] G. Sakthivel, G. Nagarajan, M. Ilangkumaran, A.B. Gaikwad, Comparative analysis of performance, emission and combustion parameters of diesel engine fuelled with ethyl ester of fish oil and its diesel blends, Fuel, 132, (2014) 116–124.
[11] J. A. Bittle and T. J. Jacobs, "On the Relationship Between Fuel Injection Pressure and Two-Stage Ignition Behavior of Low Temperature Diesel Combustion", Author and Article InformationJ. Energy Resour. Technol.134(4), 42201(Aug31,2012)(6pages) doi:10.1115/1.4007252 History: R
[12] Li, D., Zhen, H., Xingcai, L., Wu-gao, Z. and Jian-guang, ''Physico-chemical properties of ethanol–diesel blend fuel and its effect on performance and emissions of diesel engines,'' Renewable Energy, Vol. 30, pp. 967–976, 2005.
[13] M. Nagarhalli, V Nandedkar, K. Mohite. Emission and performance characteristics of karanja biodiesel and its blends in a CI engine and it's economics. ARPN J Eng Appl Sci, 5, (2010) 52–6.