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Pongammia Oil as a Biodiesel in India

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Abstract

The increasing industrialization and modernization of the world is leading to a steep rise in the demand of petroleum products. The petroleum-based fuels are stored fossil fuels in the earth. There are limited reserves of these fossil fuels. It is feared that they are not going to last long. In this paper, the authors have made an attempt to introduce Pongammia Pinnata Perry oil, which is blended with diesel in its production and properties (when used in I.C. engine). The performance characteristics compared with conventional (diesel) fuel and their environmental pollution characteristics are also discussed.

Keywords: Pongammia Pinnata Perry, water-cooled engine, single cylinder of Kirloskar, Methyl ester, catalyst.

1. Introduction

There are near about 300 varieties of non-edible oil seed bearing trees in our country. Many of the foresters were of the view that the Pongammia Tree is God's gift to India. It is very versatile tree that grows in land as well as in coastal area and all these without much care. Growing these trees enhances the maintenance of environment of the surrounding and offers employment opportunities. Pongammia oil is extracted from the seed of Pongammia tree, whose Latin name is Pongammia Pinnata and whose international name is Pongammia Pinnata Perry. Pongammia oil can be produced on a commercial scale provided the right strategies are followed. The performance of the engine with Pongammia oil is found to be satisfactory. The viscosity of Pongammia oil has to be corrected by preheating the oil. The output of the engine remains almost the same though the calorific value is slightly lower. Taken into account the sale value of cake which is a good fertilizer, Pongammia oil works out to be cheaper (i.e. Rs 20 per kg) compared to current price of diesel. The high viscosity of Pongammia oil interferes

with injection process and leads to poor fuel atomization. The high viscosity has to be overcome by using methyl ester Pongammia oil. The transformation of Pongammia oil to its methyl ester reduces molecular weight to one third, reduces viscosity to one eighth and increases the diesel index.

An approach more likely to be successful is to use methyl ester Pongammia oil diesel blend without engine modification.

2. Manufacturing Process

1. Pongammia oil is filtered to remove solid particles.
2. Pongammia oil is then heated to remove water content.
3. Titration is done to
4. Pongammia oil is heated if required (during winter) and mixed in the potassium methaoxide while with agitator running.
5. It is then alloy, led to settle and glycerine is removed from the bottom.
6. Biodiesel fraction is then washed and dry.
7. It is then checked for quality.

In trans-esterification KOH and methanol are mixed to create potassium methaoxide when mixed in it. These strong polar-blended chemicals break the transfatty acid into glycerine and ester chain (biodiesel).

3. Extraction of Oil

The oil is separated from its food source with hexane as other petroleum solvents and then boiled to drive off the toxic solvents. The oil is next refined bleached and deodorized by heating it to over 400 degrees Fahrenheit. The oil extracted this way still contains some undesirable solvent residue. While the amounts of many key nutrients especially Vitamin E) are significantly reduced. Antioxidants and preservatives are then frequently added. The resulting product lacks flavour, aroma, pigments and nutrients. All that can be said for such oil is that it has an extended shelf life has a clear uniform colour and oily texture. This method is universally being used by the big commercial oil processors because it gets more oils out in quicker and cheaper manner. About 98% of the soy oil in the U.S. is solvent extracted.

4. Esterification

The process of converting plant oil into biodiesel fuel is called as esterification. Estherification is a chemical reaction aims substituting glycerol of glyceride with mole of molecules of monoalcohol such as methanol. Then by obtaining molecules of methyl ester of Pongammia oil.

5. Reasons for Esterification

1. Reduction of viscosity

2. The transformation of Pongammia oil to its methyl ester reduces the molecular weight to one third, reduces viscosity to one eighth and increases its volatility leading to increase the diesel engine.

6. Properties of Diesel and Methyl Ester Pongammia Oil

Properties	Diesel	Methyl Ester Pongammia oil
Calorific Value (C. V.)	42000	362000
Pour Point	230 C	60 C
Flash Point	780 C	1790 C
Viscosity	3.6 cst	5.612cst
Density	836 kg / m3	852kg /m3
Anline Point	700 C	410 C
Diesel Index	55	41.91

7. Experimental Analysis

A single cylinder, Kirloskar make, diesel engine was used for performance calculation. Testing is carried out at various loads starting from no load condition to the rated full load condition at 1300 rpm. The tests are conducted at constant speed. The engine was loaded by band brake dynamometer. The different blend with diesel starting from 20% of biodiesel and 80%diesel for Pongammia oil methyl ester was used. Successively proportion of biodiesel is increased by 20% and finally engine was run using 100% biodiesel as fuel. For comparison purpose 100% diesel is also used as fuel. Fuel consumption rate were measured by Burette. Exhaust gas temperature and speed were measured by electronics micro voltmeter and tachometer respectively. The engine tests were conducted for entire load range at constant speed of 1300rpm. The performance such as fuel consumption and exhaust gas temperature were measured after attaining a steady state (approximately 20 min).

Data for B-80 (80% Pongammia methyl Este + 20% Diesel)

Load L(Kg)	Fuel Cons. Mf.(kg/hr)	Break Power (kW)	BMEP BSEC (BAR)	BSFC (kg/kW/hr)	Break Thermal Efficiency (%)	BSEC
0	1.358	0	0	0	0	0
3	1.455	0.808	2.25	1.8	5.522	18.037
5	1.63	1.3481	3.15	1.209	8.334	12.11
7	1.6979	1.8874	4.5	0.899	11.06	9.0175
10	1.771	2.696	2.696	0.6568	15.13	6.581
15	1.94	4.044	6.7512	0.4797	20.73	4.8
17	2.397	4.583	7.6511	0.521	19.06	5.227

8. Experimental Result

A single cylinder, kirloskar make water cool, vertical diesel engine was used. The test was Carried out at constant speed and at different load by using diesel and blend of Pongammia methyl ester.

9. Conclusion

Following conclusions were drawn

1) Brake thermal efficiency of Blend 80 of methyl ester Pongammia oil higher than diesel.
2) Flash and fire point of ester was higher than diesel, making it safer to store from fire point of view.
3) Exhaust smoke density and NOx emissions were lower than diesel.
4) Blended with diesel gave better performance than solo running.
5) No engine modification is required.

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