GRADE ANALYSIS OF PYROLYSIS OIL BY STEP DISTILLATION

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Abstract - Cost of fossil fuel is high compare to the alternative fuels. One such the oil by pyrolysis of waste could not only be a fuel for consumption but also an option to dispose offs the waste and promotes recycling. This study is aimed at designing the setup for the oil pyrolysis and come out through trials with better distil output as per the need of the business in question.

Keywords - pyrolysis, pyrolysis oil, distillation, alternative fuel.

I. INTRODUCTION:

Plastic is non-decomposable material due to this developed and developing countries are facing land filling problems. Burning of plastics emits Dioxins gases which are poisonous in nature and effects on human organisms. Similarly, these gases are settled on crops and waterways where they eventually end up in nutrition and gather in bodies. To overcome those problems, pyrolysis process is adopted. Basically this word is derived from the "Greek" where, pyro means "fire" and lysis means "Decomposition". The main advantages of this process which is nontoxic in nature and ability to handle unsort and dirty plastics. This technology is not so much complicated so it is all around the globe companies and individuals are starting to produce fuel from waste plastics. Basically, this process is consisting of three main components Reactors, Condenser, and storage tank. This technology is thermal degradation process in the absence of oxygen. Catalysts are used to prevent the formation of Dioxins gases.
After pyrolysis process, distillation process takes place for obtaining pure form of products. This well-known process of distillation is based on different modes of heat energy transfer.

1.2 Distillation principle-

In this process, the presence of volatile compound is higher in vapor phase. To separate this mixture, liquid can be heated at different boiling points. These vapors are condensed back into liquid form. Less volatile components predominantly remain into the liquid phase.

1.3 Application of distillation process

Commercially, distillation has many applications for example.

1. The application of distillation can be divided into four groups: herbal distillation, food processing, laboratory scale and industrial distillation.
2. For industrial use, the distillation helps to separate the air into its components – notably argon, oxygen, nitrogen etc.
3. The distilled beverages with high alcohol content, can be produce by distillation of fermented products.
4. In fossil fuel industry distillation plays important role for obtaining useful products from crude oil.

II. LITERATURE SURVEY

2.1-Plastic to Diesel conversion process:

- According to research papers the first step of waste plastic to oil conversion is collection of plastics and shredding of plastic waste.
- Feed this plastic into the reactor at a different temperature obtained from following authors

Author's name	Temperature
Pawar and Lawankar]	300°C-350°C
C. Wongkhorsub and N. Chindaprasert [2].	300°C-500°C at atmospheric pressure.
Jane Pratoomyod and Dr. Ing.Krongkaew Laohalidanond .	400°C-500°C

- Addition of catalyst is preventing the formation of dioxins, as the plastic get melted and starts evaporating. These gases get transferred into cooling pipe.
- In cooling pipe gases are converting into liquid and some of the gases remains as it is.
- Bubbler is present at exit way of the cooling pipe which contains water to capture the last liquid form of fuel and leaves only gases which burns afterwards.
- If the refrigeration of the cooling tube is sufficient, there will be no fuel in bubbler, but if not, then water will capture all the remaining fuel that will float above the water.
- On the bottom of the cooling tube steel reservoir is present that collects all the liquid and it has release valve which poured out the liquid fuel.

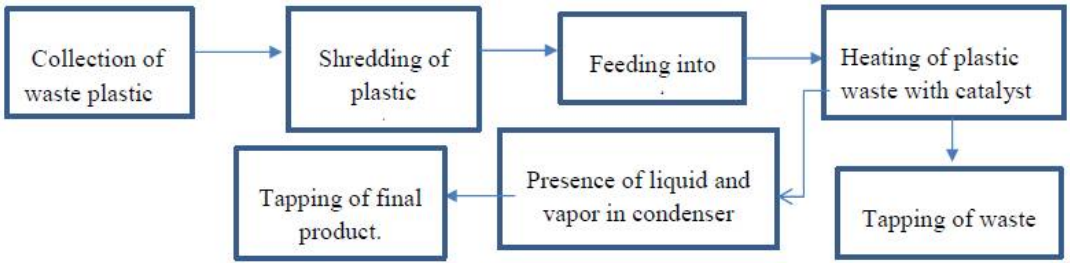

Figure 1- Schematic of conversion process of waste plastic to pyrolysis oil

III. EXPRIMENT ON WASTE PLASTIC

This section will discuss about the experiment performed on the waste plastic.

3.1 Aim-

To performed pyrolysis process on the waste plastic.

3.2Raw material & standard material

SR NO	PART NAME	MATERIAL	QTY
1	Frame	MS	1
2	Tank	MS	1
3	Heating coil 3KW	STD	1
4	Temperature indicator	STD	1
5	Heating chamber	MS	1
6	Condenser	MS	1
7	Insulation	Glass wool	1
8	Wiring	STD	1
9	Nut bolt washer	STD	12
10	Red oxide	STD	1

Table 1-part list for the set up Dimensions

(i) Diameter of cylinder: 190mm
(ii) Length of cylinder: 500mm
(iii) Thickness of condenser wall = 3mm
(iv) Length of condenser vessel= 530mm
(v) Diameter of condenser = 250mm
(vi) number of turns are approximately 15.

3.3- Plastic to Diesel conversion process:

1) According to research papers the first step of waste plastic to oil conversion is collection of plastics and shredding of plastic waste.
2) Feed this plastic into the cylinder at 410 °C temperature.
3) Addition of catalyst is preventing the formation of dioxins &benzene ring as the plastic get melted and starts evaporating. These gases get transferred into cooling pipe.
4) In cooling pipe, gases are converting into liquid and some of the gases remain as it is.
5) Bubbler is present at exit way of the cooling pipe which contains water to capture the last liquid form of fuel and leaves only gases which burns afterwards.
6) If the refrigeration of the cooling tube is sufficient, there will be no fuel in bubbler, but if not, then water will capture all the remaining fuel that will float above the water.
7) On the bottom of the cooling tube steel reservoir is present that collects all the liquid and it has release valve which poured out the liquid fuel.
8) This fuel again heated in cylinder at different temperature and vaporized liquid cooled in condenser, and obtained pure product.

Figure 2- schematic of experimental set up

IV. RESULT

As reviewed, the pyrolysis oil i.e., the oil from the plastic waste could well prove to be an alternative to diesel basis the cost and the emissions as well. The scope for the study lie distillation process of the plastic waste oil to get to the best alternative fuel.

4.1Comparisonof properties of waste plastic oil and distilled oil:

4.1.1-Calorific value: It is defined as the amount of energy produced by complete combustion of quantity of fuel. It is also called as Heating value or Energy value.

$CV= (mw \times dT \times c)/mf$

Equation 1- calorific value

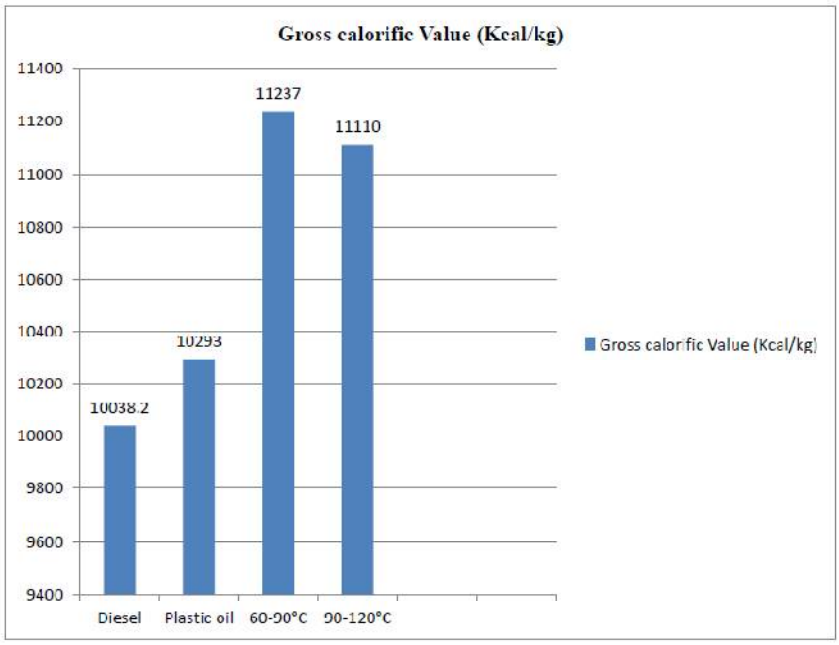

Figure 3- comparison basis calorific value

4.1.2-flash point: The temperature at which a particular organic compound gives off sufficient vapor to ignite in air.

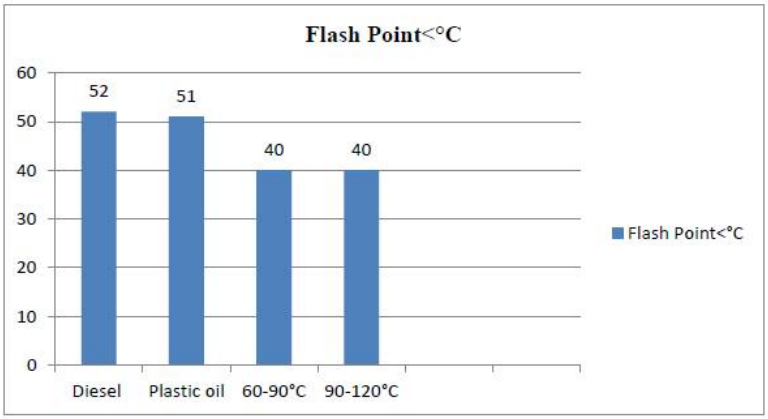

Figure 4- comparison basis flash point

4.1.3-Viscosity: It is defined as a quantity expressing the extent of internal friction in a fluid, as measured by the force per unit area resisting uniform flow.

$T = \mu \frac{du}{dy}$

Equation 2-viscosity

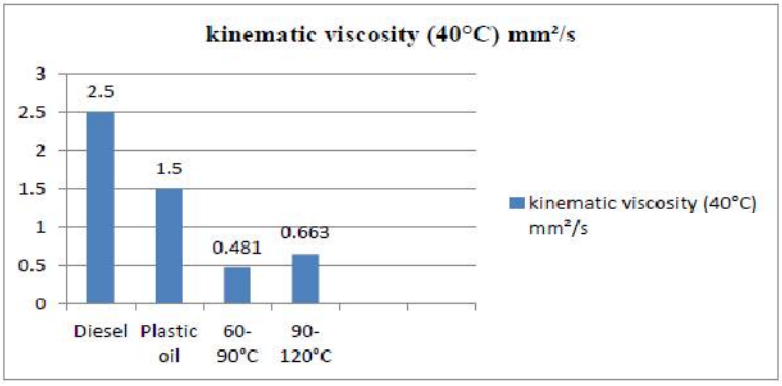

Figure 5- comparison basis kinematic viscosity

4.1.4 Density

Density is defined as its mass per unit volume.

$\rho = m / v$

Equation 3- Density

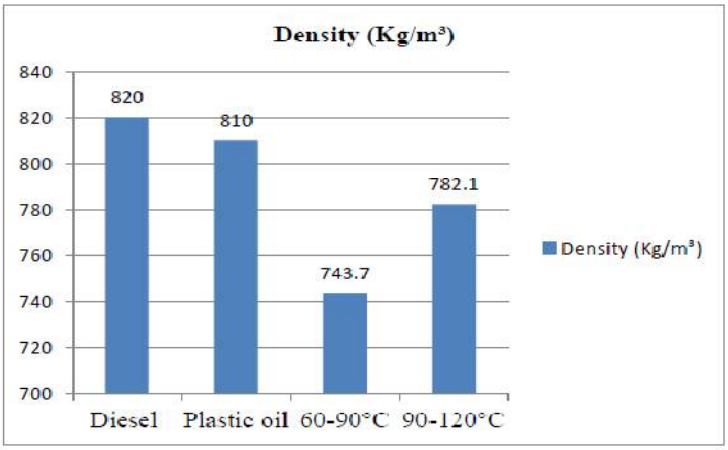

Figure 6 - comparison basis density

4.2 Emission characteristic:

I.C engines are major supporter to air pollution. Mainly include sulphur, carbon and ash etc.

4.2.1- Ash

An ash is occurring due to incomplete combustion of fuel in I.C engines. Basically, ash mainly contains solid hydrocarbons. The excessive amount of ash is found in light load vehicles

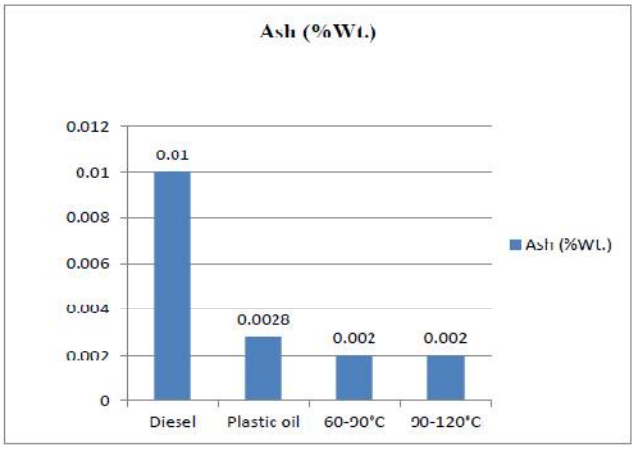

Figure 7- comparison basis emission of ash.

4.2.2 Sulphur contents

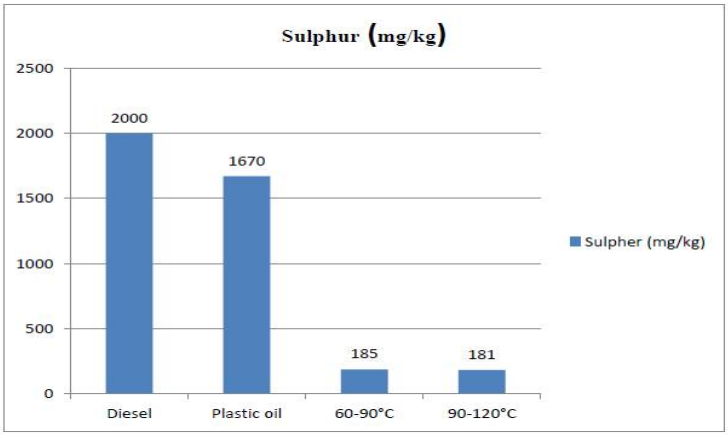

Figure 8- comparison basis sulphur

4.2.3-carbon contents

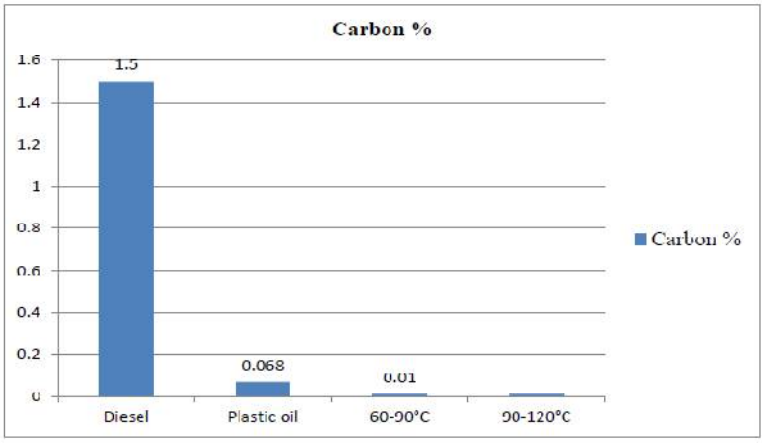

Figure 9- comparison basis carbon contents

CONCLUSION

In this project the experiment on waste plastic was carried out to develop for plastic oil. The results obtained from the plastic oil are in good agreement with experimental results. Hence, the validation is done successfully. And it is concluded that distillation process developed for modified plastic oil using same technique will also show good results. By comparing the results developed for plastic oil and distilled oil it is concluded that, the better performance characteristics are obtained.

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