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A review on waste plastic pyrolyzed oil.

Una revisión sobre residuos de aceite pirolizado de plástico

Amina Shajahan*, Aysha Basheer, Arun George, Stephan Emil, Benoy Benjamin

Department of Civil Engineering KMEA Engineering College, Ernakulam(Kerala), India

Corresponding author mail id(*): aminashajahan1234@gmail.com, bbm.ce@kmeacollege.ac.in

ABSTRACT

The present rate of economic growth is unsustainable without saving of fossil energy like crude oil, natural gas or coal. Plastics have become an integral part of our daily lives which causes hazardous impact on wildlife and human populations. About 380 million tons of plastic is produced worldwide. The conversion of waste plastic into fuel decreases a huge environmental and economic issues. Pyrolysis process becomes an option of waste energy technology to deliver fuel in order to replace fossil fuel. One of the main advantage of pyrolysis process is its ability to handle the unsorted and dirty plastic. This review focuses on producing pyrolyzed oil from waste plastic termed as plastic pyrolyzed oil which can be marketed at cheaper rates compared to that present in market like diesel.

Keywords— fossil energy, pyrolysis, crude oil.

RESUMEN

La tasa actual de crecimiento económico es insostenible sin el ahorro de energía fósil como el petróleo crudo, el gas natural o el carbón. Los plásticos se han convertido en una parte integral de nuestra vida diaria, lo que causa un impacto peligroso en la vida silvestre y las poblaciones humanas. Se producen alrededor de 380 millones de toneladas de plástico en todo el mundo. La conversión de residuos plásticos en combustible reduce un enorme problema medioambiental y económico. El proceso de pirólisis se convierte en una opción de la tecnología de energía residual para suministrar combustible con el fin de reemplazar el combustible fósil. Una de las principales ventajas del proceso de pirólisis es su capacidad para manipular el plástico sucio y sin clasificar. Nuestro proyecto tiene como objetivo producir aceite pirolizado a partir de residuos plásticos denominados aceite plástico pirolizado que se puede comercializar a precios más baratos en comparación con los presentes en el mercado como el diésel.

Palabras clave: energía fósil, pirólisis, petróleo crudo.

INTRODUCTION

Plastic pollution increasingly affects the lands, waterways and oceans, building a large-scale environmental problem that needs an urgent response. Countries search for solutions that support the idea of closed loop waste management by converting the waste into a valuable resource. Plastic plays an integral role in our daily life. Plastics are synthetic or semi synthetic material in which polymers are their main component. It can be molded into any desired shape under the application of heat. Plastics are of many types. The main classification of plastics include:

high density polyethylene (HDPE), low density polyethylene (LDPE), polystyrene, polypropylene, etc. the chemical structure of plastic is such a way that, be resistant to degradation. From the records, it is seen that one billion tons of plastic waste have been discarded since 1950.

Since plastic is non-biodegradable, we should look for alternative methods to dispose it. Pyrolysis is the process of thermal decomposition of materials at elevated temperature in the absence of oxygen. By this method, the plastic can be converted into energy. The product obtained from this pyrolysis process are in liquid, solid and gaseous form.

The waste to energy technology is investigated to process the potential materials in waste which are plastic, biomass and rubber tire to oil. Pyrolysis process becomes an option of waste-to-energy technology to deliver bio-fuel to replace fossil fuel. Pyrolysis is found to be a non-toxic or no environmental harmful emissions unlike incineration process.

Appropriate waste management strategy is an important aspect of sustainable development since waste generation problem is concerned in every city.

MATERIAL AND METHODS

Pyrolysis is the thermal decomposition of materials at elevated temperatures in an inert atmosphere. It involves a change of chemical composition. The word is coined from the Greek-derived elements pyro "fire" and lysis "separating". In the pyrolysis of plastic, plastic wastes are fed into a closed chamber and heated at a high temperature in the absence of oxygen. The pyrolysis is a simple process in which the organic matter is subjected to higher temperature in order to promote thermal cracking of the organic matter in the absence of oxygen.

The experimental setup consists of closed chamber in which the plastic wastes are fed. It is made air tight with help of a covering lid. From the lid, an aluminium pipe of suitable diameter is connected to a transparent bottle in which the pyrolyzed oil is obtained which is also made air tight.

The first step is collection and segregation of waste plastic. The collection of waste plastic is quite an easy task as compared to other waste since plastic waste are abundant and can be obtained in large quantities from the household, roadsides, hotels etc. The type of plastics used are high-density polyethylene, (HDPE) like milk cover, detergent & oil bottles, toys, plastic bags etc. Low density polyethylene (LDPE) like plastic bags, shrink-wraps, garment bags or containers. The collected wastes are dried and it is fed into the close chamber and pyrolysis process is carried out with the help of wood. The closed chamber used is an aluminium tin container. The vapour from the closed chamber passes through the pipe into the transparent bottle which is placed on the condensing chamber. The vapour is then condensed to get the pyrolyzed oil. Once the raw fuel is obtained, it is further subjected to distillation process so as to obtain the fuel in the purest form by removing the impurities present in it which can be then tested and compared with the diesel fuel.

The obtained fuel can be utilized in diesel generators, vehicles etc. It can also be used as replacement of kerosine. Since there is a high demand of crude oil and due to its high prices and its shortage, this fuel can be made in large scale industry and marketed at a cheaper rate there by benefiting the national economy. Also, it helps to

reduce the problem of increasing amount of waste plastic around the world.

Figure 1: Experimental setup of Pyrolysis

WHY PYROLYSIS PROCESS IS ADOPTED?

Comparison of Green House Gas (GHG) emission by pyrolysis process with other processes.

- Emission associated with manufacture of other raw materials (excluding the waste plastic stream) are 13kg CO_2. For the case of pyrolysis, these are owing to hydrogen that is consumed within the process.
- Site emission from incineration of pyrolysis gases, distillation residues and 3% of diesel product generated are 56kg CO_2.
- Emission associated with all elements of transport (products and waste) are 197kg CO_2.
- Displacement savings associated with replacing fossilised diesel production are 426kg CO_2.
- Overall, the net emission for pyrolysis is only 160kg CO_2.

REVIEW ON TEST CONDUCTED ON PYROLYZED OIL

Physical manifestation may be like a viscous fluid with dim yellowish colour with an obnoxious odor. Flammability is that highly flammable, furthermore smoldered completely without any left-over residue. Starting with those outcomes it can be finished up that those specific gravity of claiming plastic fuel will be more than that of petrol and less than the diesel. Furthermore, density of plastic fuel is more than that of petrol and less than the diesel may be indicated in Table 1. From the figure 3, it should be obvious that those kinematic viscosity and dynamic viscosity from claiming plastic fuel is more than that of petrol and less the diesel, it need closest esteem of the standard petrol. The figure 4 indicates that the sulfur content of plastic fuel may be about equivalent to diesel more than that of petrol

and there will be a absent of carbon residue in plastic-fuel. From the figure 5, we can see that the flash point and fire point of plastic fuel is more than the petrol and less than the diesel. From the figure 6, we can see that the gross calorific value of plastic fuel is less than the petrol and more than the diesel (Mantesh Basappa Khot et.al., 2017).

Figure 2: Pyrolyzed Oil Obtained

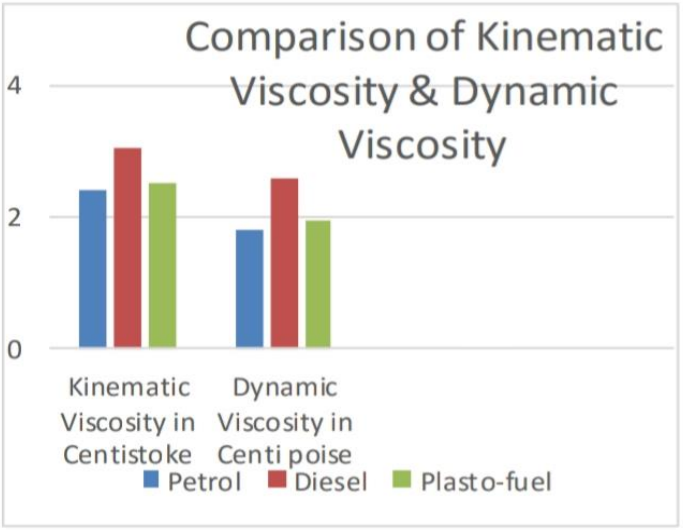

Figure 3: Comparison of Kinematic and Dynamic Viscosity

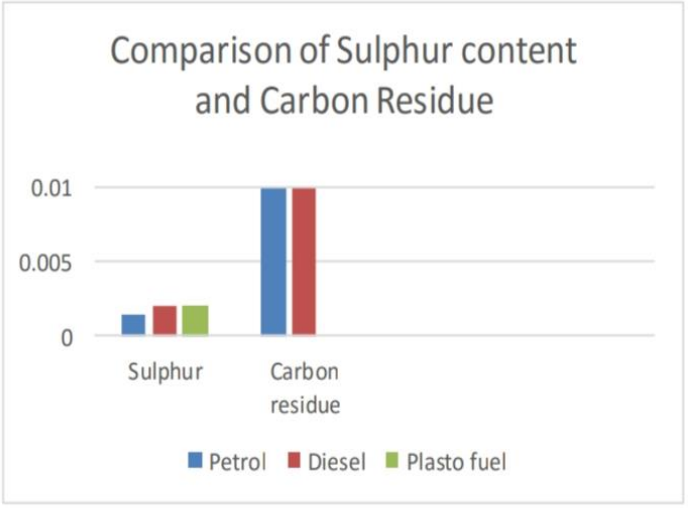

Figure 4: Comparison of Sulfur Content and Carbon Residue

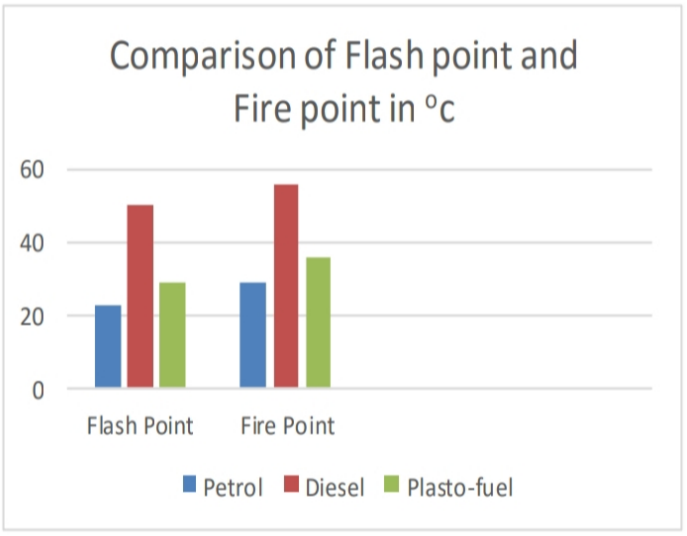

Figure 5: Comparison of Flash and Fire Point

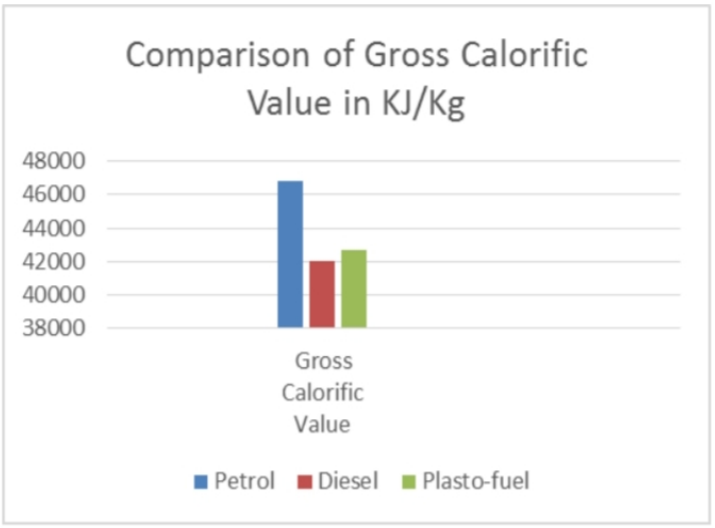

Figure 6: Comparison of Gross Calorific Value

Table 1: Comparison of Obtained Pyrolyzed Oil with Regular Petrol and Diesel

Sl. No.	Properties	Regular Petrol	Regular Diesel	Pyrolyzed oil
1.	Specific gravity	0.742	0.85	0.775
2.	Density (Kg/m^3)	742	850	775
3.	Kinematic viscosity (centistoke)	2.42	3.05	2.525
4.	Dynamic viscosity (centipoise)	1.796	2.592	1.957
5.	Gross calorific value (KJ/Kg)	46858	42000	42686
6.	Flash point (^{0}C)	23	50	29
7.	Fire point (^{0}C)	29	56	36
8.	Sulphur (% w/w)	0.0015	<0.002	0.002
9.	Carbon residue (% w/w)	<0.01	0.01	Nil

Pyrolysis process is found to be an efficient, clean and very effective means of removing waste plastic that we have left behind over the last several decades. Through this conversion of waste plastic into fuel, two major issues are tackled, one is disposal of large amount of waste plastic and the other is shortage of fuel. Thus, it helps in the problem of disposal of waste plastic, extraction of high value fuels and reduction of environmental pollution. It is easily assumed that, when the use of waste plastic increases then the solid waste management will search more ways to find out to collect them. About 600 to 750ml of fuel can be obtained by pyrolysis of 1kg of plastic. Direct burning of 1kg of plastic in an open environment produces around 3kg of CO_2, whereas by converting it into fuel through pyrolysis could reduce 80% CO_2 emissions, which results it in to be quite environment friendly. From the test results it is seen that the purified pyrolyzed oil has similar properties of diesel/petrol. Hence it will be well suitable fuel for diesel/petrol engine. It could be concluded that, thermal pyrolysis of plastic waste leads to the production of fuel oil, valuable resource recovery and reduction of waste problem.

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