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Generation of Plastic Oil Fuel from High density Waste Plastics

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Abstract : The wasted plastic material is produced in India only 15000 tons per day. The wasted plastic materials hurt the humans, animals, birds, earth and environment. For eradicating wasted plastic material may require around 500 years in the globe. Every year 65% waste plastic is dumped in the natural environment system (River, Lake and ocean). The technology is used to convert these waste plastic into oil fuel by using pyrolysis method. The pyrolysis method is the heating waste plastic substance in the absence of oxygen gas. In this study high temperature is needed for this process. Plastic oil properties are like Petrol, diesel and kerosene. By performing this hypothesis, It can be reduced 70-80% of waste plastic and can be provide 55% oil for diesel vehicles. The plastic oil fuel does not discharge sulfur dioxide and increases vehicle efficiency. By transforming plastics to oil fuel and solve two issues, one of the large waste plastic seas, and the other of the shortage of fuel.
Key words : Waste plastic oil, Pyrolysis method and Plastic diesel.

1. Introduction

Petrol engines and Diesel engines are the most effective prime movers, from the point of view of saving global environment and concerns for long term energy certainty it becomes mandatory to improve alternative fuels with the properties comparable to petroleum based oil fuels. Unlike rest of the world, India's stipulation for diesel fuel is cruelly six times that of gasoline hence aiming alternative to diesel is a natural possibility. Alternative fuels should be easily available at low cost, be environment friendly and fulfill energy certainty needs without sacrificing engine's operational performance.

Wasted plastic material to energy is the recent mode in the selection of alternative fuels. Fuel like alcohol, biodiesel, liquid fuel from wastedplastic material etc. are some of the alternative fuels for the IC engines. Plastics have been used in our daily lives now whicharecreating a great threat to the world environment. Plastic material consumption is growinggreatly every year, due to low production cost. In 2015 plastic manufacturing industriesproduced around 322 million tones worldwide [1].

Polyethylene is categorized into two types: low density polyethylene and high density polyethylene. Most of the plastics have very low degradation rate because of the molecular bonds of carbon, hydrogen and few other elements that make them very durable resulting in a very big environmental issue by land filling

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them. By using the plastic at the end of their life the issue of disposal can be reduced. However, wasted plastics can become a source of enormous energy with the correct treatment. There are basically two recycling process: mechanical, chemical.Feed stock recycling can be used to treat significantly higher amount of wastedplastics. Pyrolysis process is considered as a chemical recycling technique and it is a very favourable technology for the wasted plastic treatment [2-4].

At present wasted plastics are becoming a major portion of municipal solid waste and amount of wasted plastic is growing in every day. The world production capacity of polyethylene is around 80 million tons per year and main application in toys, plastic bags, oil containers, bottle sand wrapping foil for packaging [3].

Mechanical recycling method is a technique that applies sorting, grinding, washing and extrusion and can be recycled to reuse single polymer waste, which represent the 15-20% of the total waste plastics [5].Pyrolysis is a thermal degradation process that comprises cracking of the complex organic molecules into smaller molecules and long hydrocarbon chains into shorter chains [6].

The process takes place in the absence of oxygen gas at elevated temperatures. The major products from the pyrolysis process are in liquid, gaseous and solid material from while the amount of each product mainly depends on the feed stock composition and the pyrolysis process parameter such as temperature, residence time, heating capacity rate and catalyst [7,8].

Marcilla investigated that the excessive yields of liquid fuels in the boiling temperature range of 100°-480°C and gases were acquired along with a small quantity of heavy oils and insoluble material such as coke and gums. The result received on the co-processing of polypropylene with coal and petroleum remnants are very inspiring as this method appears to be quite viable to transform plastic material into liquefied coal products and to improve the petroleum remnants and wasted plastics [8].

On the other hand, the pyrolysis process of polyethylene had been studied by various authors and the oil composition results suggest that is promising fuel for power and heat generation [8]. According to the literature review, the EVA (ethylene-vinyl acetate) pyrolysis had not been investigated in depth and the basic properties of the produced liquid oil had not been reported yet [9].

Miskolczi analyzed the pyrolysis of wasted plastics material in theexperimental setup of pilot scale horizontal type tube reactor at 520°C temperatures. Experiment had been tested also in the presence and absence of ZSM-5 catalyst. It was investigated that the produced gases, gasoline and light liquid oil could be improved in the presence of catalyst. They also judged that the wasted plastic could be transformed into gasoline and light liquid oil with yields of 20-48% and 17-36% respectively depending on the used parameters value [10].

F. Murphy [11] from the current literature, it is observable that the process of transforming wasted plastic to oil fuel is a present research topic. Hence this paper, analyzed the viscosity, density, fire point and flash point of this plastic fuel.

2. Materials and Experiment method

High density polyethylene of wasted plastic materials, Electric Furnace and condenser equipment for cooling purpose.Pyrolysis is mainly described as the controlled heating of the wasted plastic material in the absence of oxygen gas. In Pyrolysis, the macromolecular structures of polymers are transformed into smaller molecules and sometimes monomer units. Further degradation of these subsequent molecules depends on a number of different conditions including residence time, temperature, presence of catalysts and other chemical process conditions. Since, extensive research had been done on types of polymers which had beentabulated as below. HDPE (High density polyethylene)had been used as feed stocks and transformed into good quality oils via the pyrolysis method.

Pyrolysis technology is thermal degradation of wasted plastics in the absence of oxygen gas in the cylindrical reactor. Wasted Plasticwas heated in a cylindrical shape reactor at temperature of 300°-360° C. The wastedplastic was gently broken into gases by including catalyst and the gases were condensed in the condenser apparatus to give a low sulphur content distillate. The pyrolysis schematic layout of equipment that

had been used is exhibited in Fig. 1.The pyrolysis cylindrical shape reactor setup with cooling condenser had been used is exhibited in Fig. 2.

Table 1 :Types of plastics items

Type	Recyclable	Container types
1	Polyethylene Terephthalate	Beverages
2	Polyvinyl chloride	Vegetable oil, Food wrap, bottles, automotive parts
3	High density polyethylene	Oil bottles, milk, detergent, toys, containers used outside partsand plastic bags.
4	Low density polyethylene	Shrink wraps, Plastic bags, garment bags, bottles.
5	Poly-propylene	Some bags, Refrigerated containers, most bottle tops, some carpets

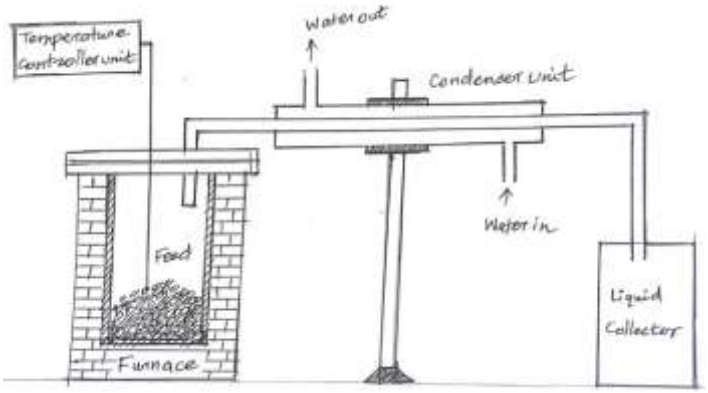

Figure 1:Pyrolysis schematic layout of equipments

All this happens continuously to transform the wasted plastics material into oil fuel that can be used for power generators.

Figure 2 : Pyrolysis cylindrical shape reactor setup with cooling condenser

From this method, all the gases were purified before it is let out in environment. The flue gas waspurifiedwith the help of scrubbers and water/ chemical treatment process for neutralization. The non-condensable gas went through water before it was used for burning. Since the wasted plasticswas handled about 300°-360°C and there was no oxygen gas in the reactor, most of the toxics were burnt.

3. Result and Discussion

In the result discussions, we analyzed the properties of wasted plastic oil fuel and compared with diesel properties. Table 2 revealed the both the properties of diesel and waste plastic oil fuel.

Table 2: Comparison of fuel properties from waste plastic Oil fuel and diesel fuel

Property	**Waste plastic oil fuel**	**Diesel**
Density	0.836	0.840
Flash point, (°C)	41	50
Fire point, (°C)	46	56
Calorific value	44.330	46.500

4. Conclusion

From the experimental investigations it is clear that the waste plastic oil is a good alternative fuel for the diesel engine and for the future transportation vehicle it can be used. Flowing conclusions were derived from the experimental study. Plastics present a major threat to today's society and world environment. Over 14 million tons of wasted plastics are dumped into the oceans every year, destroying about 1,000,000 species in the oceans. Howeverhumankind has great awareness to this warning and responded with new developments in creating degradable bio-plastics material, there is still no finaleffort done to rectify the harm already created. In this regard, the Pyrolysis had been studied here presents an efficient, clean and very effective means of removing the debris that we had left behind over the last several decades. By transforming plastics to fuel, we are solving two problems, one of the large quantity of plastic seas, and the other of the high fuel shortage. This dual advantages, though will exist only as long as the waste plastics last, but will firmlyproduce a strong platform for us to make on a sustainable and green future. By taking into account the financial advantages of such a work, it would be a significant boon to our nation economy. So, from the experimental studies conducted we can conclude that the properties of the fuel received from wasted plastics material are similar to that of diesel and further experimental studies on this area can revealgood results.

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