CONVERSION OF WASTE PLASTIC INTO FUEL THROUGH PYROLYSIS

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Abstract-The present work involves the synthesis of a petroleum-based fuel by the pyrolysis of waste plastics. Pyrolysis involves the degradation of the polymeric materials by heating. In the present study different oil samples are produced from waste plastics. The synthesized oil samples are subjected to a parametric study based on the oil yield. Polythene bags are selected as the source of waste plastics.

Keywords: Pyrolysis, Extraction of Fuel, Plastics.

Introduction: Plastic have great demand in market, despite knowing its effects on the environment. Plastics present a major threat to today's society and environment. The globally increasing demand for plastics is causing the increase in plastic wastes landfill which has serious environmental harms. Demand for plastic is increasing, the waste plastic is generated in India 15000 tons per day (as per government survey) .The waste plastic affects the humans, animals, birds' earth and environment. For dissolving (breakdown) plastic may require around 500 years in the earth. Every year 65% waste plastic is land filled or in the natural environment. Though mankind has awoken to this threat and responded with developments in creating degradable bioplastics, there is still no conclusive effort done to repair the damage already caused. Using Pyrolysis process we can convert plastic waste into liquid hydrocarbon fuel as this fuel has matching characteristics with the fuels like diesel or petrol, the process of pyrolysis is considered for conversion. The plastic wastes are subjected to depolymerisation pyrolysis, thermal cracking & distillation to obtain usable fuel. This process will relieve some stress from the environment & also fulfil the need of the society. The main aim of this work of this work is to convert plastic waste into plastic fuel & compare its properties with petrol & diesel.

Experiment: The system consists of a pyrolysis reactor, metal condenser, collection tank and bubbler. For the feedstock, plastics of high volatile matter are selected. They include polypropylene, polyethylene, High density polyethylene,Low density polythelene, polystyrene. PET and PVC type of plastics are not used as they need rather different type of chemical degradation.

As the first step, the recommended plastics are collected and made into small pieces. These grated plastics are filled In the reactor. And the reactor is fitted air tight. The reactor is a closed anaerobic system that does not use oxygen. The column that comes up the reactor is fitted to the condenser. The condenser is connected to the collection tank. Finally, the collection tank has an opening to collect the fuel. And on the other side it is connected to a bubbler for safe disposal of the gas.

Once the reactor is fitter tightly, the heat source is ignited. The temperature can be measured with a digital thermometer. After reaching 290^{o}C we can see the oil coming. The oil is collected from the collection tank. The yield of oil stops at about 400- 450^{o}C. The reaction time depends upon the weight of the input. For a kilogram of plastic waste it will take 2 to 3 hours to complete the process. The reaction time and the temperature range can be reduced if we use a catalyst. By using catalyst we can also increase the quality of the fuel. The collected fuel can be called as crude because it needs to be distilled.

The obtained fuel is filled in another air tight container for distillation. The column of the distillation unit is connected to a condenser and then to a collection tank. The distillates are obtained at various temperatures.

Results and Discussion: For a kilogram of plastic, 600ml of liquid fuel is generated. 10 – 20% of the input is converted into gas. It also depends on the type of plastic we use in the input. This leaves 10 -15% of char or carbon residue.

From distillation, four types of distillates are obtained. First distillate is obtained at a temperature range of 80^{o}C -130^{o}C. Second distillate is obtained at a temperature range of 130^{o}C-170^{o}C. Third distillate is obtained at a temperature range of 170^{o}C – 230^{o}C. Fourth distillate is obtained between a temperature range of 230^{o}C -310^{o}C and the left over oil was heavy oil.

Based on the calorific values and boiling points from the results of the testing of the distillates we can match them in following aspects. Distillate I is known as straight run gasoline which yields in very low quantities. Distillate II would be alternative to Naptha. Distillate III would be alternative to Kerosene. And distillate IV would be alternative to High speed diesel. But further testing and confirmation of fuels is required.

From the literature survey petrol, diesel and plastic fuel properties are tabulated in table 1.

Table1: Comparison of the Properties among Petrol, Diesel and Plastic Fuel

Properties	**Petrol**	**Diesel**	**Plastic Fuel**
Density (gm/ml)	0.736	0.834	0.7645
Specific Gravity	0.70	0.85	0.7645
API Gravity	65	25	53
Kinematic Viscosity (centistokes)	5	3.5	1.306
Dynamic Viscosity (centipoise)	0.775	2.5	1.096
Aniline Point (K)	338	344	340
Flash Point (K)	311	330	314
Fire Point (K)	314	332	319

The experiment was carried out in the laboratory and extracted 3 samples.These samples were tested in Vimta laboratory, Hyderabad. The results were given in table 2. Plastic fuel properties are almost coincide with the properties of diesel.

Table2: Comparison of the Properties among Three Samples

Properties	Sample 1	Sample 2	Sample 3
Sulphur content	<0.10	<0.10	<0.10
water content	<0.10	<0.10	<0.10
Flash point	<40	<40	54
Kinematic Viscosity at 40^{o}C(centistokes)	0.85	1.11	2.22
Kinematic Viscosity at 100^{o}C	0.50	0.61	0.99
Density(gm/ml)	0.7625	0.7836	0.8171
Gross calorific value	10581	10518	10357

Further Scope: Right now we have developed an experimental, small scale model of the project. We further want to develop our method and build a bigger plant.

The liquid fuels we have obtained are good. But with more sophisticated equipment and optimized conditions we can generate best fuels. Catalyst plays an important role in the reaction temperature, time and in getting lighter and cleaner fuels. For using catalyst a bit more development in the model is required. By doing so, we can reduce the amount of plastic waste that ends up in the landfills in West Godavari area.

Conclusion: In view of survey for our project, it may be closed that those waste plastic pyrolyzed oil represents a good alternative for diesel Due to rise in the population the rate of consumption of petrol and diesel is increasing simultaneously so as the rate of fuel day by day. The conversion of plastic waste into usable fuel. On the other hand this method will also help to decrease the pollution caused by the incineration of plastic waste. Based on our research we compared the properties of plastic fuel with petrol and diesel. Plastic fuel is basically used

diesel electric generators, boilers, hot air generators, hot water generators etc. This method is superior ecologically and economically.

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