

# Generating of Fuel from Plastic Waste

J. Naga Ganesh<sup>1</sup>, S. Dinesh<sup>2</sup>

1. Student, Department of Automobile Engineering,  
Saveetha School of Engineering, Saveetha University, Chennai.

2. Associate professor, Department of Automobile Engineering,  
Saveetha School of Engineering, Saveetha University, Chennai.

**Abstract:-**Waste plastics from municipal solid waste were collected. It was sorted based on the types like (HDPE, LDPE, PVC etc). They were graded into nearly uniform size by crusher, cutter and shredder. The graded feed was heated just to melt it so that extraneous impurities such as hard metal, clay, sand, glass etc settles in the bottom of the melter, which was removed periodically. The gaseous product during melting can be either dissolved in suitable solvent or incinerated to produce heat. The modern plastic along with catalyst is sent to a reactor, which is maintained at temperature between 350-600 °C and atmospheric pressure. The vapor which comes out of the reactor can be distilled to obtain different fractions of petroleum products. The different fractions dependent upon type of feed, catalyst/feed ratio, temperature and time of heating. Catalyst and the different products are characterized for their usefulness. The various properties of the products obtained were then tested and compared with the actual values for petroleum range products.

**Keywords:** Pyrolysis, Plastic Waste, Flash Point, Fire Point, Viscosity.

## I. INTRODUCTION

Plastics have become an indispensable part of today's world. Due to their light weight, durability, energy efficiency, coupled with a faster rate of production and design flexibility, these plastics are employed in entire gamut of industrial and domestic areas. Plastics are non-biodegradable polymers of for the most part containing carbon, hydrogen, and couple of different components, for example, chlorine, nitrogen and so forth. Because of its non-biodegradable nature, the plastic waste contributes fundamentally to the issue of Municipal Waste Management. The creation of plastics is essentially developing. These days the plastic creation is more than 200MT overall yearly. According to a nationwide survey, conducted in the year 2004, approximately 10,000 tones (ten thousand tones) of plastic waste were generated every day in our country, and only 60% of it was recycled, balanced 40% was not possible to dispose off. So gradually it goes on accumulating, thereby leading to serious disposal problems. The improvement of plastics-to-oil procedures could be

additionally energized by altering the administrative and monetary motivating forces with a specific end goal to give comparative motivators to oil and power created from squander, by cutting edge warm transformation procedures of the sort looked into in this answer, to those (Renewable Transport Fuels Obligation (RTFO), Feed-in Tariff (FiT), Renewable Heat Incentive (RHI)) that are accommodated power and fluid fills delivered from biogenic materials. The recovery and recycling of plastic waste disposed of in landfill has been the subject of much effort over the decades, as it is seen as a valuable resource and is high in the public's perception of what 'waste' is. Progress has been made in the mechanical recycling of postcommercial, industrial and pre-sorted post-consumer waste, but the recovery of value from low-grade mixed plastic waste has always presented technical and economic difficulties. The gasification technology suppliers are more focused on the use of their technology for 'biomass-to-liquids' processes, as biomass is currently the most attractive feedstock to them because it offers the necessary scale of feedstock supply and opportunity for subsidies from the creation of 'biogenic' fuels and oil products. As a result, they have limited data on the suitability of plastic waste as a feedstock and have no demonstration plants routinely using waste plastics.

## II. LITERATURE REVIEW

Following works have been already done in this field by the following scientists:

A. Prof. Alka U. Zadgoanekar

a). Prof. Alka U. Zadgoanekar has invented a process system, which converts polymeric materials into liquid, solid and gaseous fuel. The process consists of two steps:

- Random De-polymerization: Loading of waste plastics into the reactor along with the catalyst system. Random de-polymerization of the waste plastics occurs when plastics are heated along with catalyst.
- Fractional distillation: Separation of various liquid fuels by virtue of the difference in their boiling points.

### b). The Process Description

The waste plastic is sorted based on the physical properties such as hardness, softness, films etc. Size reduction is carried out using shredder and cutter and graded 4 to uniform size. The graded feed is mixed and fed to the melting vessel through a pre heater feeder and heated to 175-250 C. The impurities such as clay, metals, glass etc settles at the bottom and sent to water column for separation of HCl gas and gaseous hydrocarbons. The molten plastic is sent to main reactor which is maintained at (300-350) (C and atmospheric pressure. The reaction takes place in presence of coal and catalyst to convert the molten plastic into hydrocarbons. The gaseous hydrocarbon shall be condensed and separated into liquid gas stream.

### B. Jerzy Walendziewski and Mieczyslaw Steininger

Jerzy Walendziewski and Mieczyslaw Steininger from Wroclaw University of Technology, Wroclaw, Poland cracked waste samples of polyethylene and polystyrene thermally or in the presence of catalyst and hydrogen in closed autoclaves. The obtained products were submitted to analysis; unsaturated hydrocarbons in gasoline and diesel fuel range boiling were hydrogenated over platinum catalyst. It was stated that the optimum thermal cracking temperature of waste polyolefin is 410-430°C, in the case of catalytic Process lower temperature, ca. 390°C, can be used, with reaction time ca. 1.5 an hour. More than 90% yield of gas and liquid fractions with b.p.<360°C was attained. The dependencies between process parameters, feed composition and product yield as well as composition of the obtained fuel fractions were found. On the basis of the obtained results Jerzy Walendziewski and Mieczyslaw Steininger reported a hypothetical continuous process of waste plastics processing for engine fuel production was presented.

## III. MAIN COMPONENTS USED IN THE PROCESS

### A. Condenser

It cools the entire heated vapour coming out of the reactor. It has an inlet and an outlet for cold water to run through its outer area. This is used for cooling of the vapour. The gaseous hydrocarbons at a temperature of about 350°C are condensed to about 30 – 35°C.

### B. Reactor

It is a stainless steel tube of length 300mm, internal diameter 225mm, outer diameter 230mm sealed at one end and an outlet tube at the other end. The reactor is placed under the LPG burner for external heating with the raw material inside. The reactor is made with the following: stainless steel, mild steel and clay for lagging. The reactor is heated to a temperature of about 450°C and more.

### C. Process Description

Warm breaking process without impetus was utilized as a part of changing over waste plastic into fluid fuel. Two sorts of waste plastic are chosen for this specific trial.

By weight half of each Low thickness polyethylene and polypropylene was chosen for the examination. Both waste plastic are strong hard shape. Gathered waste plastic was cleaned utilizing fluid cleanser and water. Amid squander plastics are cleaned is creates squander water. This squander water is cleansed for reuse utilizing waste water treatment process. Washed waste plastics are cut into 3-5 cm size to fit into the reactor moderately. For trial reason we utilized 600gm example 300gm of PP and 300gm of LDPE. A vertical steel reactor utilized for warm splitting and temperature utilized extents from 100° C to 400° C .

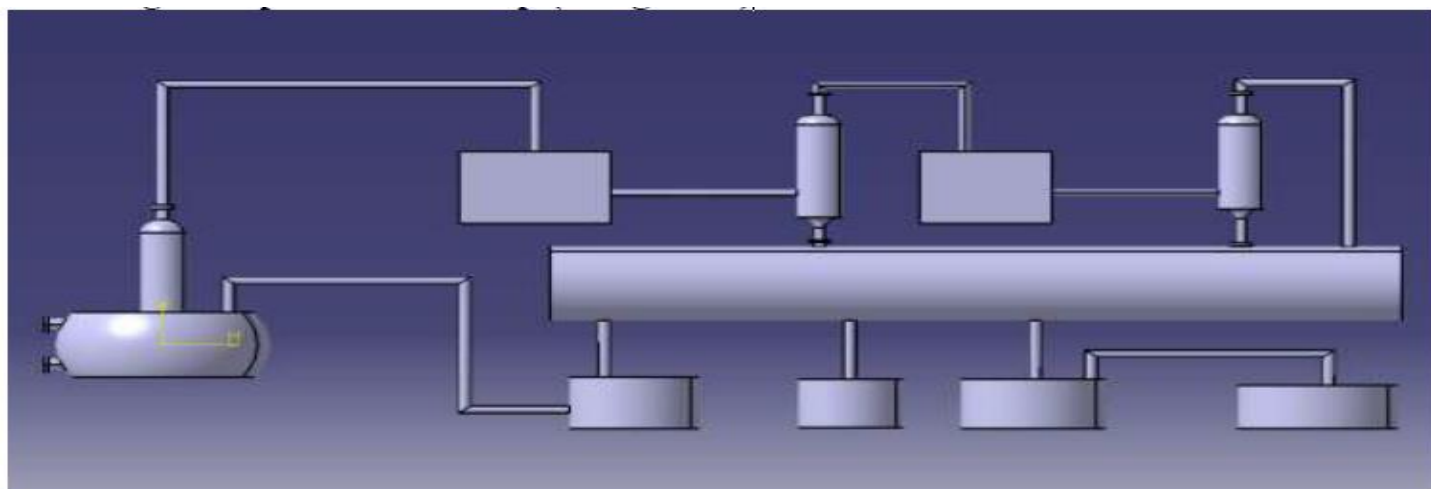


Fig. 1: Modeling of Experimental Setup. (Using Catia)

When temperature is increased to 270° C liquid slurry turns into vapour and the vapour then passes through a condenser unit. At the end we collect liquid fuel. Between 100° C and 250° C around 20 -30% of the fuel is collected and then when raised to 325° C the next 40% is collected and finally when held at 400° C the yield is fully completed.

#### IV. WORK DONE AND PROJECT DESCRIPTION

##### A. Description of Our Experimental Setup

Waste plastics from municipal solid waste were collected. It was being sorted based on the types like (HDPE, LDPE, and PVC etc). They will be graded into nearly uniform size by crusher, cutter and shredder. The next step can be either of the two processes conventional and modified one.



Fig. 2: Plastic waste as Raw Material



Fig. 3: Experimental Setup

In the conventional process the graded feed is heated just to melt it so that extraneous impurities such as hard metal, clay, sand, glass etc settles in the bottom of the melting vessel, which is removed periodically. The gaseous product during melting can be either dissolved in suitable solvent or incinerated to produce heat. The modern plastic along with catalyst is sent to a reactor, which is maintained at temperature between 500-550 °C and atmospheric pressure. The vapor which comes out of the reactor can be distilled to obtain different fractions of petroleum products. The different fractions depend upon type of feed, catalyst/feed ratio, temperature and time of heating. Catalyst and the different products are characterized for their usefulness. In modified one, the catalyst can be added in the melting .beginning of the process and in the melting vessel itself and no more addition of the catalyst is required in the further process. There are certain merits and demerits of both the process. The feed to catalyst ratio and be well controlled in conventional one unlike modified on one in which loss of catalyst may occur but uniformity is well maintained in modified on. Size reduction of the sorted feed is carried out using crusher, cutter and shredder and graded into uniform size using sieves (semi-automatic). The graded feed is mixed and fed to Melting Vessel through pre heater feeder. In Melting Vessel, the feed is heated to 175- 250 °C. The extraneous impurities such as

hard metal, clay, sand, glass etc. settles in the bottom of the reactor, which shall be removed on periodic basis the vapors coming from the reactor are enters into the condenser where these vapors are condenses to liquid hydrocarbon fuels. If we want we may distill these crude oils in a “fractional distillation column. Thus the collected samples are to be tested by appropriate methods. In such a way we analyzed the products for their existence in the range of gasoline, diesel and petroleum.

#### B. Tests Performed on the Products

- Density
- Viscosity
- Flash Point
- Ash Content
- Cloud Point
- Pour Point
- Carbon residue

### V. RESULTS AND DISCUSSION

The project can be concluded in the following table 1.

	<b>Lighter fraction</b>	<b>Heavier fraction</b>
<b>Color</b>	Light bluish	Reddish orange
<b>Density (gms/cc)</b>	0.7185 g/cc	0.8077 g/cc
<b>Flash point</b>	25°C	38°C
<b>Ash content</b>	No ash	Negligible ash
<b>Cloud point (°C)</b>	< -70°C	< -70°C
<b>Pour point (°C)</b>	70°C	70°C
<b>Viscosity (cm<sup>2</sup> / sec)</b>	0.078	3.673
<b>Carbon residue (gin)</b>	0.5	0.8

Table 1: The Project can be concluded.



Fig. 4.

For regular gasoline, density varies from 0.735 to 0.755 g/cc and 0.755 g/cc density for premium gasoline. For diesel density is 0.85. The above readings gives the conclusion that both lighter and heavier fractions' density lie in there respective ranges. For diesel, flash point- 38 and heavier fraction is showing the same. However **the** flash point of gasoline range products have very low flash point can't matched with the light er fractions. The ash content of diesel is less than 0.01(max). The above fractions have no ash. The cloud point and pour point show that the fractions have lower temperatures than those of diesel and gasoline. Kinematic

viscosity of the diesel is 2.4 cm<sup>2</sup> / sec. The viscosity of the heavier fraction is much higher that shows further distillation and purification is required. At last the carbon content of lighter and heavier fractions are much higher than that of gasoline and diesel (0.15 gm of carbon residue on 10% distillation). The project shows some light on the possibility of manufacturing liquid fuels from waste plastics (which is non-biodegradable and dumped or incinerated) can become a very good future source of energy and power as we are on the verge of fuel shortages and environment imbalance.



Fig. 5: Product 1 –Below 180 °C (extracted - 20%) Product 2 –Between 210-340 °C (extracted - 34%) Product 3 –Residue (Tar 46%)

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