DESIGN AND FABRICATION OF FUEL FROM PLASTIC WASTE

B.ARAVINDH
MECHANICAL ENGINEERING
SENGUNTHAR ENGINEERING COLLEGE (AUTONOMOUS)
TIRUCHENGODE, NAMAKKAL
aravindh5062001@gmai.com

D.BARATH
MECHANICAL ENGINEERING
SENGUNTHAR ENGINEERING COLLEGE (AUTONOMOUS)
TIRUCHENGODE, NAMAKKAL
dbarath9062001@gmail.com

Y.RAGAVAN
MECHANICAL ENGINEERING
SENGUNTHAR ENGINEERING COLLEGE (AUTONOMOUS)
TIRUCHENGODE, NAMAKKAL
yragavan2001@gmail.com

MR.N.SARAVANAN,M.E..,
ASSISTANT PROFESSOR
MECHANICAL ENGINEERING
SENGUNTHAR ENGINEERING COLLEGE (AUTONOMOUS)
TIRUCHENGODE, NAMAKKAL
nsaravanan.mech@scteng.co.in

ABSTRAC— **Plastics have been ingrained in our daily lives and are now posing a significant environmental hazard. Plastics are produced in excess of 100 million tonnes per year around the world, and used products have become a common sight in overflowing bins and landfills. Despite efforts to develop futuristic biodegradable plastics, there have been few definitive steps toward resolving the current challenge. The method of transforming waste plastic into value-added fuels is described in this article as a possible alternative for plastic recycling. Pyrolysis occurs in the absence of oxygen and at a high temperature of around 300°C, which is why a reactor was built to generate the requisite temperature. Converting waste plastics into gasoline has a lot of potential in terms of both the environment and the economy. As a result, the process of converting plastics to gasoline has turned challenges into opportunities to gain money from waste. Oil from plastic conversion provides two advantages. First and foremost, the oil produced can be utilised as a home fuel as well as in automobiles and industry after additional refinement. Second, the many types of contamination that waste plastics generate can be reduced.**

I. INTRODUCTION

Plastic was invented in 1860, but it was only in the last 30 years that it became widely used. Plastic is light, durable, adaptable, and hygienic. Polymers are lengthy chains of molecules that make up plastic. When a naturally occurring substance, such as crude oil or petroleum, is changed into another substance with radically different qualities, polymers are created. These polymers can be produced into granules, powders, and liquids, which can be used as plastic product materials. According to a statewide assessment done in the year 2000, India produced around 6000 tonnes of plastic, of which only 60% was recycled and the remaining 40% could not be disposed of. Plastics are produced in excess of

129 million tonnes per year around the world, with 77 million tonnes coming from petroleum.

II. PREPARATION OF FUEL FROM WASTE PLASTIC

Pyrolysis is the controlled burning of plastic waste into fuel. It is a method of heating materials in the absence of oxygen. The plastic polymer's macromolecular structure is broken down into smaller molecules. The presence of a catalyst, residence time, temperature, and other process factors can all tell us if the molecules of plastic waste can be further degraded or not. Catalytic pyrolysis refers to pyrolysis that takes place in the presence of a catalyst, whereas thermal pyrolysis refers to pyrolysis that occurs naturally without the use of a catalyst. Although, there are numerous methods for managing plastic trash, such as recycling, land filling, and depolymerization. HDPE, PP, PE, and LDPE are the most common plastics utilised in this process, and they are all transformed into fuel. These are the types of plastic that are abundant on our world. The method of transforming plastic into fuel is detailed in further detail. We'll need a container to hold all of the waste plastic that will be burned in order for the pyrolysis process to take place and convert the waste. Plastic is converted into a valuable substance called fuel. The pyrolysis apparatus is connected to the container through pipes or tubes in order to remove the fuel. When the container is heated to 500 degrees, vapour forms.

III. METHODOLOGY

The controlled heating of a material in the absence of oxygen is known as pyrolysis. The macromolecular structures of polymers are broken down into smaller molecules or oligomers, and sometimes monomer units, during pyrolysis in plastics. The subsequent degradation of these compounds is influenced by a variety of factors, including (but not limited to) temperature, residence time, the presence of catalysts, and other process variables. The Pyrolysis reaction can take place with or without the need of a catalyst. As a result, the reaction will be Pyrolysis, which is both heat and catalytic. Because polyolefin is the most commonly used plastic, substantial research has been conducted on this polymer, which is presented here.Thermolysis of virgin and waste plastics, as well as other hydrocarbonaceous sources, has been intensively researched in the past. Polyethylene, polypropylene, and polystyrene are the subjects of many of these thermal cracking experiments. Only a few people have studied on the thermal degradation of other common polymers including polyvinylchloride, polymethyl methacrylate, polyurethane, and polyethylene terephthalate, on the other hand. At moderate temperatures, thermal cracking produces liquids with low octane values and greater residue concentrations, making it an inefficient process for creating gasoline range fuels. A few studies have attempted to improve waste polyolefin thermal pyrolysis without using catalysts; however, these alterations either provided modest gains or added another degree of complexity and costs to the system.

IV. OBJECTIVES

The following are the primary goals of this project:

1. To lay the groundwork for the development and implementation of waste plastics recycling using environmentally sound technology (EST) to promote resource conservation and reduce greenhouse gas emissions (GHG).

2. To create awareness in developing nations such as INDIA about plastic garbage and its potential reuse for conversion into diesel or fuel, which may be produced and sold at lower costs than currently available diesel or oil.

3. To minimise the country's reliance on gulf countries for fossil fuels, thereby contributing to the country's economic prosperity.

4. To conduct various tests in order to identify the various qualities of liquid fuel.

5. Compare and contrast the qualities of liquid and diesel fuel. Plastic garbage from the home is converted into liquid gasoline.

6. Using the water washing procedure, purify the liquid fuel produced.

V. PLASTICS

Plastics are synthetic organic compounds created by polymerization, according to a basic introduction to plastics. They usually have a large molecular mass and may contain additional compounds in addition to polymers to increase performance and/or save costs.

Plastics are divided into two categories: rigid and flexible.

1.Thermoplastics

* Thermosetting polymers are a type of thermosetting polymer.

If enough heat is applied, thermoplastics can soften and melt repeatedly, then harden when cooled, allowing them to be made into new plastics products. Polyethylene, polystyrene, and PVC are some examples.

*Thermosets, also known as thermosetting plastics, can only be melted and shaped once. They are not appropriate for repeated heat treatments, thus once solidified, they will remain solid.

Phenol formaldehyde and urea formaldehyde are two examples..

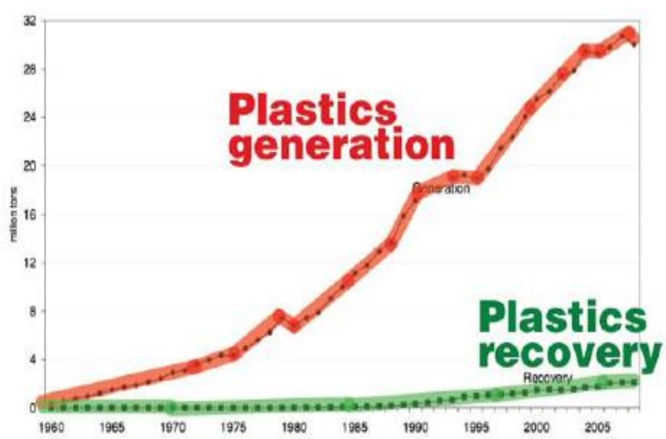
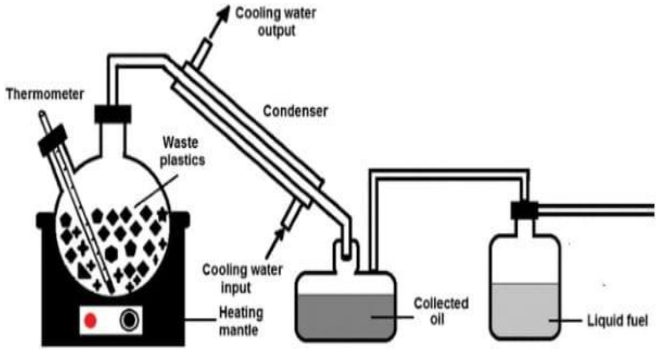


Fig. Plastic Generation

VI. MATERIALS AND METHODS

As they are dumped and collected as household plastic wastes, municipal plastic wastes (MPW) usually remain a part of municipal solid wastes. Domestic products such as food containers, milk covers, water bottles, packaging foam, disposable cups, plates, cutlery, and CD and cassette cases are among the different sources of MPW plastics. Refrigerator liners, vending cups, electronic equipment cases, drainage pipe, fizzy beverage bottles, plumbing pipes and gutters, and flooring The 'Design of solar power powered motor drive for pump application' block diagram is shown above. In this diagram, include the following blocks. In a single community, about 15 tonnes of plastic covers are discarded, resulting in massive plastic waste over the course of four months. The majority of plastic is disposed away in landfills. According to a report, about 150 to 200 tonnes of plastic cover is discarded in a single region. According to estimates, 5000 to 6000 tonnes of plastic will be wasted in the state from residential sources. Before pyrolysis, discarded plastics were shredded and washed, and the raw ingredients were derived from municipal plastic garbage.

PYROLYSIS PROCESS



PLASTIC CANES

PLASTIC COVERS

VII. FOLLOWING SEVEN GROUPS BASED ON THE CHEMICAL STRUCTURE AND APPLICATIONS:

1. PET (Polyethylene Terephthalate)
2. HDPE (High Density Polyethylene)
3. PVC (Polyvinyl Chloride)
4. LDPE (Low Density Polyethylene)
5. PP (Polypropylene)
6. PS (Polystyrene)
7. Others

VIII. MAIN DEVICES USED IN THE PROCESS

A. Condenser

It cools all of the hot vapour that escapes the reactor. It has an entrance and an outlet for running cold water through its exterior. This is used to keep the vapours cold. At a temperature of around 350°C, the gaseous hydrocarbons condense to about 30–35°C.cools the entire heated vapour coming out of the reactor.

B. Reactor

It's a stainless steel tube with a length of 300mm, an inner diameter of 225mm, and an outer diameter of 230mm that's sealed on one end and an outlet tube on the other. The raw material is inside the reactor, which is heated externally with an LPG burner. Stainless steel, mild steel, and clay for lagging are all used to construct the reactor. The reactor is heated to 450°C or higher.

C. Process Description

Waste plastic was converted into liquid gasoline using a thermal cracking method without the use of a catalyst. For this experiment, two different types of waste plastic were used. For the experiment, 50 percent of each Low Density Polyethylene and Polypropylene was chosen by weight. Both types of waste plastic are solid, hard plastics. Liquid soap and water were used to clean the waste plastic that had been collected. Waste water is cerated during the cleaning of waste plastics. The waste water treatment procedure purifies the waste water for reuse. Waste plastics are washed and cut into 3- 5 cm pieces to fit into the reactor safely. We utilised a 600gm sample with 300gm of PP and 300gm of LDPE for the experiment. The temperature ranges from 100° C to 400° C in a vertical steel reactor used for thermal cracking. When the temperature is raised to 270° C, the liquid slurry condenses and passes through a condenser unit. We collect liquid gasoline at the end. Around 20-30% of the fuel is collected between 100o C and 250o C, then another 40% is gathered around 325o C, and lastly the yield is completed at 400o C.

IX. STEPS INVOLVED IN PROCESS

1. Feedstocks are fed to the reactor through a feeder, which is then closed.

2. Heating- To raise the temperature of the reactor, a heating source is used to heat the reactor's product within.

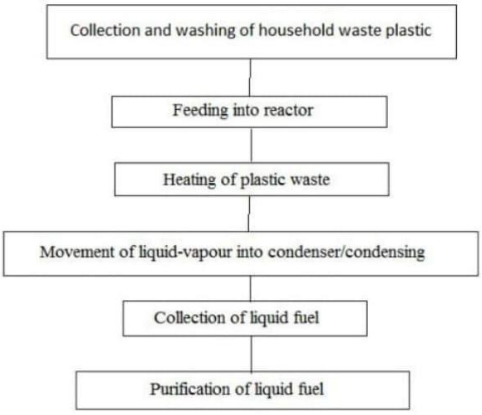
3. Condensing- After the plastic has evaporated at a high temperature, the vapour is condensed into a liquid at room temperature using straight and spiral tube condensers.

4. Liquid collection: The liquid collector collects the condenser's output product. Provide a cyclone

separator at the condenser's end to separate the plastic liquid fuel from non-condensable gases. The pyrolysis unit is heated using these non-condensable gases.

5. Purification- Use filter sheets and filters to purify the plastic fuel.

FLOW DIAGRAM



X. ADVANTAGES

(a) Waste volume is significantly reduced (50–90%),

(b) Solid, liquid, and gaseous fuel can be produced from the waste,

(c) storable/transportable fuel or chemical feed stock can be obtained,

(d) environmental problem is reduced,

(e) Desirable process because energy is obtained from renewable sources such as municipal solid waste or sewage sludge, and

(f) capital costs are low.

XI. RESULTS AND DISCUSSIONS

According to current figures, petroleum oil use and hence cost are on the rise. According to the International Energy Outlook 2008, global petroleum oil consumption is at 84 million barrels per day. A thermal Pyrolysis device was used to convert waste plastics into liquid hydrocarbon gasoline. In every way, this strategy is superior (ecological and economical). By using this technology, you may transform 75 percent of the weight of waste plastics into valuable liquid hydrocarbon fuels while generating no pollutants. It would help deal with dangerous plastic trash and cut crude oil imports. At this point, the depletion of nonrenewable energy sources such as fossil fuels necessitates advancements in this approach. Because the qualities of plastic fuel and diesel fuel are similar, it can be assumed that waste plastic fuel is an excellent replacement fuel for diesel engines and can thus be used in diesel engine vehicles for transportation.

XII. CONCLUSION

According to current figures, petroleum oil use and hence cost are on the rise. According to the International Energy Outlook 2008, global petroleum oil consumption is at 84 million barrels per day. A thermal pyrolysis machine was used to convert waste plastics into liquid hydrocarbon gasoline. In every way, this strategy is superior (ecological and economical). By using this technology, you may transform 75 percent of the weight of waste plastics into valuable liquid hydrocarbon fuels while generating no pollutants. It would help deal with dangerous plastic trash and cut crude oil imports. At this point, the depletion of nonrenewable energy sources such as fossil fuels necessitates advancements in this approach. Because the qualities of plastic fuel and diesel fuel are similar, it can be assumed that waste plastic fuel is an excellent replacement fuel for diesel engines and can thus be used in diesel engine vehicles for transportation.

XIII. REFERENCES

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