Conversion of Waste Plastic into Usable Fuel by Adopting Recycling Techniques

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***Abstract*— From the research aim of this paper is for the production of oils processed in refineries to come from the pyrolysis of real waste from the high plastic. The effect of temperature on the pyrolysis of this sample was studied in the range of 430–490◦C. In order to study the pre-treatment effect, the samples were pyrolyzed at 460◦C for 1 h. The conversion of plastic waste into energy, and in this study the authors focused on using pyrolysis to convert plastic to liquid oil. Accordingly, the volume of the waste was reduced significantly, and the produced liquid oil had a high calorific value in comparison to fossil fuel. The authors managed to develop a profitable business model for a facility producing fuel from plastic waste. Plastic must be kept under control from damaging the environment.**

Degradation of solid waste such as plastic bottles, grocery bags, etc. in nature takes many years. Plastic must be kept under control from damaging the environment. The technique of fueling plastic waste through the pyrolysis process is discussed. Due to plastic production lots of environmental challenges are arising as if it is not disposed properly. In that condition, waste plastic recycling, regeneration and it stabilization are necessary for human life, environment, and nation. The waste plastic to fuel pyrolysis method is commonly used as the process including thermal cracking and vis breaking.

Keyword—Degradation, Pyrolyzed, Regeneration

I.INTRODUCTION

Every year humans produce nearly 280 million tons of plastic, and much of that plastic ends up in the environment, harming marine life and other ecosystems. The chemical bonds that make plastic so durable make it equally resistant to natural processes of degradation.

Plastic is non-biodegradable. It is unable to decompose so we will use this in three methods which are commonly referred to as Reduction, Recycle, Reuse. Generally, the process of plastic degradation is divided into categories such as Physical, Biological and Chemical process. Due to plastic streams and oceans getting blocked. As we know from the latest news, in 2022 flood has come in so many places from that we are able to understand that plastic had blocked the flow of streams, so many plastics have come from river out on the roads. Plastic has advantages such as its light weight, transparency, strong and cheap for manufacturing process. It is collected from a light packing waste sorting plant, paper recycling industry, waste treatment plant of electrical and electronic equipment, medical institute. In refineries the production of oil processed is coming from the pyrolysis of real waste to the high plastic content is rejected by Recycle Industry. Usually, they are manufactured in the form of plastic bags, saline bottles, plastic tools, chairs and other components which we usually come across in our day-to-day life. As there is a high demand of crude oil and due to its sky reaching prices, we could take up this project to setup large- or small-scale industries and produce the fuel locally at much cheaper rates directly benefiting the National economy and a step towards SWAACH BHARAT by recycling the waste plastic.

Types of Plastic

1.1 Polyethylene (PE)

Polyethylene or polythene is the most commonly used plastic. The chemical formula of polyethylene is(C2H4) n. Melting point of polyethylene approximately 110°C (230°F). Products of polyethylene includes blow moulded bottles, household cleaners, grocery bags, construction film, injection-moulded pails, caps, agriculture mulch, and toys. The polyethylene is a type of high-density polythene (HDPE).

1.2 Polypropylene (PP)

Polypropylene is a thermoplastic polymer, also known as polypropene. The chemical formula of polypropylene is (C_3H_6) n.

Its melting temperature 163.8℃ (327℉). Polypropylene uses are ropes, tape, twine, carpets, clothing, and plastic container, reusable water bottles, medical component.

Important Finding

Authors and Affiliations

1) Laura Fulgencio-Medrano, Sara Garcia-Fernandez

Department of chemical Engineering, researcher at Gaiker Technology.

By studying from this research paper, turning plastic into fuel, we can reduce atmospheric CO2 emissions by 80% and burn 1 kg of plastic in the open atmosphere to produce up to 3 kg of CO2, thus solving both problems. The hydrocarbon emissions characteristics of diesel grade fuels in waste plastics vary from less than 36 ppm to 58 ppm at full load.

2) Irene Fahim, Omar Mohsen, Dina Elkayaly.

Department of Industrial Engineering, Nile University.

This project analysis has observed the use of waste plastics, factory planning and its feasibility in Metropolitan City. 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.

3) Sinan Erdogan

Sakarya University

From this paper a pyrolytic fuel can be produced that can be conveniently used in internal combustion engines, when this pyrolytic fuel produced from plastic wastes is used directly in the engine, there is a slight decrease in performance and combustion characteristics. Pyrolytic fuels produced from plastic waste can be used as an engine fuel to pollute the environment.

4) Ram Jatan Yadav, Shivam Solanki, Sarthak Saharna, Jonty Bhardwaj, Ramvijay.

The plastic used is polyethylene, polypropylene, high density polyethylene (HDPE), low density polyethylene (LDPE)

5) Kundan Kumar Jha, T. T. M. Kannan, and Ashutosh Das.

PRIST University.

The important study on this paper is that plastic disposal and its uses is completely described. It is the usage of Swachh Bharat Abhiyan of Government of India and executed plastic waste pyrolysis strategy for oil generation as an elective fuel for running the motor.

6) Ramli Thahir, Ali Atway, Sri Rachmania Juliastuti, Susianto.

Department of Chemical Engineering, Sepuluh November, Surabaya Indonesia.

In this case study bubble cap can plate column is used. Also, they check the characteristics of oils like physical property, viscosity, ash content and wax, density, calorific value, etc. The test was performed at the temperature of 580℃- 650℃. Polypropylene Plastic used for pyrolysis process.

7) P. Sushma

Materials Science and Engineering, Telangana.

The study is based on pyrolysis process.

8) Yuan Xu, Xiangwei Niu.

Johns Hopkins University, Lowa State University.

The study is based on corn stoves (CS) and polyethylene (PE) in tandem micro – pyrolizer. Temperature of two reactor can be maintained from room temperature to maximum at 900℃. Helium was used as carrier gas in the reactor.

9)Aadhik, V. Athmanathan, N. Hari.

Research Scientist, Purdue University

In this research polythene and polypropylene plastic were used. Deep study was done on this project of their chemical composition, cracking temperature, heating rate, etc. The catalyst used in this project was zeolite which is crystalline aluminosilicate with three dimensions of framework.

10)Vijaykumar B. Chanashetty, B.M Patil

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Plastics are synthetic organic materials produced by polymerization. There are two main types of plastics: thermoplastics and thermosetting polymers. It is concluded, by converting plastics to fuel, we solve two

issues, one of the large plastic seas, the other of the fuel shortage and financial benefits of such a project.

II.MATERIALS AND METHODOLOGY

2.1 Materials

The plastic waste used as a row material in the pyrolysis process was collected from college campus and college canteen.

Including drinking water bottle. wafers packet, which consist of polyethylene (PE), polypropylene (PP).

The selection of these plastic materials was made in more quantity, because this type of plastic is more market demand, and they are the primary source of the plastic waste.

All the waste plastic were cut into smaller pieces of around 2 - 3 cm.sq.

2.2 Methodology

' Conversion of plastic waste into usable fuel " this process mainly adopted only two methods.

1. Pyrolysis.
2. Thermal Pyrolysis of Polyolefin.

We are using pyrolysis technique in our project.

1. Pyrolysis Methods

The pyrolysis process is the thermal decomposition of materials, and pyrolysis is the heating of organic material, such as biomass, in the absence of oxygen.

there are three types of pyrolysis

1. conventional/slow pyrolysis
2. Fast pyrolysis
3. ultra-fast/ flash pyrolysisations

Pyrolysis is generally controlled heating of a material in the absence of oxygen. The molecular structure of polymers are broken down into smaller molecules, the pyrolysis reaction can be carried out without the presence of catalyst.

III.EXPERIMENTAL WORK

3.1 Instrument

- Reactor- We used reactor as a steel drum of length 400mm, internal diameter 100mm, outer diameter 120mm. steel drum has center whole which is packed with iron pipe. The steel reactor is placed over the burner for heating.
- Condenser- We used plastic box as a condenser, which cools the entire vapors coming out of the reactor. It has two holes inlet and outlet for entry of liquid and exit of gases.
- Iron pipe - Two iron pipes are provided first pipe having length 12 inch placed vertical to the steel drum. And the second pipe having length 9 inch placed horizontal to vertical iron pipe.
- Plastic pipe - The plastic pipe has a total length of 10 feet. The pipe is cut into three parts, first pipe cut at 4 feet and is connected to iron pipe to plastic container, second pipe cut at 3 feet and is connected to plastic container to rubber tube and last pipe is checking for gas having length 3 feet.
- Last pipe will help us to know which type of gas is produced (by conducting laboratory tests).
- Rubber Tube- The size of rubber Tube 90.100.10. It is used to store gas.
- C -Clamp- It is made up of iron and used to fix the container. It is C type in shape.
- Thermocouple Thermometer – Thermocouple thermometer can typically measure temperatures ranging from - 200℃ to 1730℃. The measurement range depends on the specific thermocouple type used.

Fig.3.1 Experimental Setup

Fig.3.2 Thermocouple Thermometer

3.2 Procedure to make experimental Setup.

- Steel drum is placed over the burner and is packed with the help of rubber sheet, c clamp and nut bolts. Steel drum has centre hole in which one iron pipe is provided inner the drum and outer side of drum. The steel drum is airtight container.
- Another iron pipe is connected to first pipe in (L shaped). Iron pipe is again connected to plastic pipe and is again connected to plastic box
- The plastic box acts as a condenser having two holes on outer side , were one plastic pipe is connected to steel drum and second one connected to rubber tube.
- The plastic box is placed over the container full of water which is provided for cooling of fuel. We will provide heat to reactor at 100℃- 190℃ and then the slurry of plastic waste is emitted from iron pipe to plastic pipe and stored at plastic box.
- In the plastic box liquid and gases are coming through inlet and gases are travelling through outlet pipe. Then these hot gases are stored in rubber tyre tube.

3.3 Process

- At the start of process, the collected waste is cut into 2-3cm to fit in reactor.
- We will provide heat to reactor at 100° - 190° C and then the slurry of plastic waste is emitted from iron pipe to plastic pipe and stored at plastic box.
- In plastic box liquid and gases are coming through inlet and gases are traveling through outlet pipe. Then these hot gases are stored in rubber tube.

IV. PROBLEMS AND SOLUTION

Problems	Solution
Melting Gasket Sheet	We have used plain rubber gasket sheet by replacing this we are using fire gasket sheet.
Gas Leakage	Due to fixing of c clamp and melting of gasket sheet on container due to which gap is formed. So we are changing the container.

Table no.4.1 Problems and Solutions

V. CONCLUSION

Pyrolysis of hydrocarbon polymers is a very complex process, which consists of hundreds of reactions and products. Several factors have significant effects on the reactions and the products. Based on previous research, this chapter investigated the fundamental plastic processes and reactions. With temperature increasing, plastic will go through glassy state, rubbery state, liquid state, and decomposition. Decomposition of plastic in an inert environment into liquid is called pyrolysis. There are four stages of reactions during the plastic pyrolysis process: initiation, propagation, hydrogen transfer, and termination reactions. It was found that heavy molecular weight hydrocarbons produced from primary cracking can be further cracked into light molecular weight products through a secondary cracking process. This secondary cracking process has significantly influenced the distribution of the product. This process converts heavy hydrocarbons into gas or light liquid product.

VI.FUTURE SCOPE

The project shows some light on the possibility of manufacturing liquid fuels which could be used as feed stock refinery for further modification or commercial use. By using this technology, we could solve the waste plastic problem and significantly reduce the landfills-which are the cause of infertility of Agriculture land. Waste plastics can also become a very good source of energy and an alternative to fossil fuel which has caused an environmental imbalance.

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