International Conference on Latest Innovation in Engineering Science and Management
Buddha Institute of Technology, GIDA, Gorakhpur (UP)
30th - 31st March 2019 www.conferenceworld.in ISBN : 978-93-87793-80-4

# Buddha Institute of Technology, GIDA, Gorakhpur

# Mechanical Engineering Department

# Biofuel with the help of Plastic waste

**Gaurav Km. Srivastav[1], Apoorv Saxena[2], Ankur Kedia[3], Anand Vaibhav Tiwari[4], Sharique Hayat[5]**

*[1234]B.tech Scholar, [5]Assistant Professor*

*[12345]Department of Mechanical Engineering*

*[12345]Buddha Institute of Technology, GIDA, Gorakhpur, UP, India*

**Abstract**

The plastic waste reduction is one of the biggest problems growing in the society, as we know plastic is a non-biodegradable object. It is present in our society in many different forms, some of them are polyethene, PVC, thermosetting plastics like bakelite, plastic toys different types of molded objects. This project is the medium to solve such problem. The most important motive of this project is reduction of plastic waste present in the environment by producing different types of valuable by-products. The plastic is reducing in such a way that, none of the pollutants is going in our environment. The process which is used in this reduction of plastic is environment friendly process. As we know the plastic emits harmful and toxic gases while burning and cannot be decomposed, so we are breaking the molecules of plastic into different hydrocarbon in an inert environment i.e. not letting gases to be released in air.

The products that are producing through this method are in three different states, solid, liquid and gaseous state. Solid one is char, liquid one is oil (biofuel) which is flammable in nature and gaseous one is also a flammable gas, which can be burnt directly.

The cost of the setup is also low, because we are using the source of electricity to heat the reactor containing plastic.

**Acknowledgement**

We take this opportunity to express our deep sense of gratitude to my guide, Mr Sharique Hayat, Asst. Prof of Mechanical Engineering for his kind support, guidance and encouragement for this presentation.

I would like to express my sincere thanks to Mr. Ved Prakash Pandey (Seminar Coordinator) for his keen interest and valuable support to this presentation.

Last but not least, thanks to GOD and my parents, my sincere gratitude Mr. Sharique Hayat (Head of Mechanical Department) of Buddha Institute of Technology, for their loving support and concern throughout the making of this project.

**DATE**

**Author**

**Gaurav Km. Srivastav**

**Apoorv Saxena**

**Ankur Kedia**

**Anand Vaibhav Tiwari**

## 1. Introduction

**Pyrolysis** is a **thermochemical** treatment, which can be applied to any organic(carbon-based) product. In this treatment, material which is exposed to high temperature in the combustion chamber, and **in the absence of oxygen** goes through chemical and physical separation into different molecules. Pyrolysis bases on heating in the absence of air. This makes it mostly endothermic process that ensure high energy content in the products received. Pyrolysis of plastic waste could have an important role in converting this waste into economically valuable **hydrocarbons**, which can be used either as fuels or as feed stock in the **petrochemical industry**. An alternative approach to upgrade plastic waste and its further use could be achieved through the application of pyrolysis technology. **The thermal decomposition of plastic residues in an inert atmosphere and at moderate temperature and pressure (about $350^0$ and 3.5 MPa), breaks their structure into smaller intermediate species.** This process differs from the conventional destructive processes, because it allows the recovery of reaction products with added value, which can be used as fuels or as raw materials in several industries by using the well-known technologies developed for petroleum products and its derivatives. Both gaseous and liquid products are complex mixtures of hydrocarbons and other organic compounds, whose composition depends on the plastic waste composition. Plastics pyrolysis may provide for disposal of plastic wastes with recovery of valuable **gasoline-range hydrocarbons**. In pyrolysis, the **polymericmaterials** are heated to high temperatures, so their macromolecular structures are broken down into smaller molecules and a wide range of **hydrocarbons** are formed. These **pyrolytic** products can be divided into a gas fraction, a liquid fraction consisting of **paraffins, olefins, naphthenes** and **aromatics**, and **solid residues**. **Pyrolysis** appears to be a technique which is able to convert PBPWs into gasoline-range **hydrocarbons.**

ISBN : 978-93-87793-80-4

## 2. Problem arising due to plastic

In any society of today's modern world, plastics provide a fundamental contribution to daily activities: **agriculture**, **automobile,industry**,**electricity**, **electronics**,**building**,**materials**,**packing** and etc. As only a small amount of waste plastic is recycled and most plastics are not biodegradable, all these activities have led to the generation of an increased amount of plastic waste, particularly in more industrialized countries.

Incineration of plastic waste to produce heat may be a possibility, but its organic content would totally be destroyed and converted only into $CO_2$ and $H_2O$. In addition, depending on its nature, combustion may produce pollutants like light **hydrocarbons, nitrous and sulphur oxides, dusts, dioxins** and other **toxins** that have a highly negative impact on the environment.

**Pyrolysis** of plastic waste could have an important role in converting this waste into economically valuable **hydrocarbons**, which can be used either as fuels or as feed stock in the **petrochemical industry.**

## 3. Methodology and material used

### Material Used

- Metal Chambers
- PVC pipes
- Grinding blades
- Transparent Container
- Water
- Heating coils
- Electric wires

### Procedure

Plastic Pyrolysis is chemical reaction. This reaction involves molecular breakdown of larger **molecules** into smaller **molecules** in presence of heat. Pyrolysis is also known as **thermal** cracking, thermolysis, depolymerization, etc. At any given temperature the molecule is in vibrating stage.

It converts plastic which are not biodegradable into many gases like **nitrous oxide**, **sulphur oxide**, **volatile carbon compounds(VOCs)** and final **polycyclic carbon compounds** (PCCs as a solid waste). All these gases then quenched in water. This quenching helps these gases to react with water and turns out in **hydrocarbon compounds**. These gases getting cool within water and **condenses** into liquids. There is also a product which is produced while reaction is **oxygen**. This oxygen is supplied to the **combustion chamber** (pyrolysis reactor). The liquid is then separated by water and is finally known as **biofuel**.

4. **Figures and Tables**

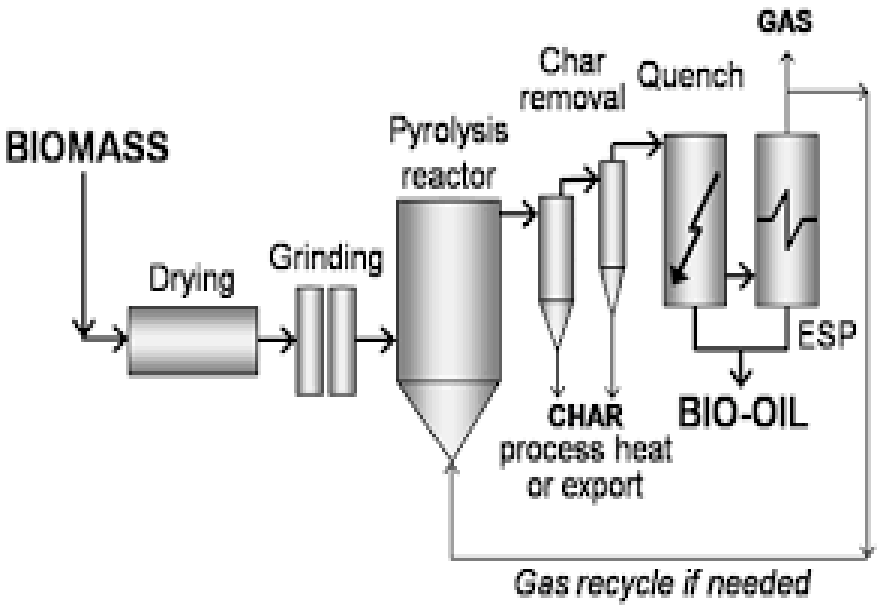


**Figure 1 Block Diagram of Pyrolysis.**

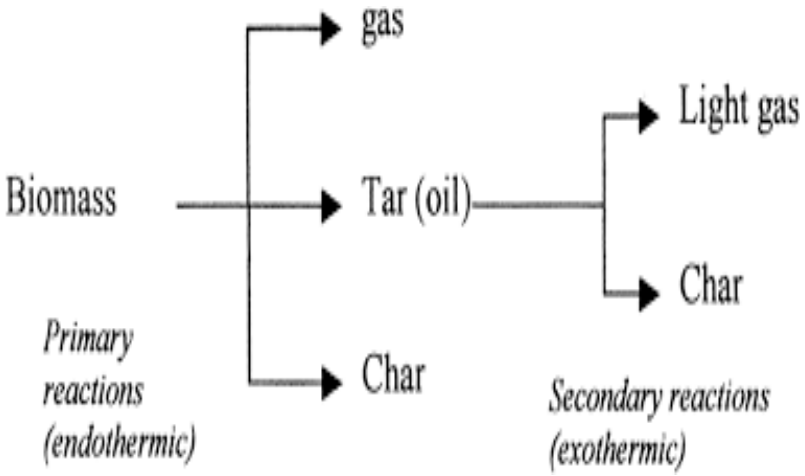


**Figure 2 Product after chemical reaction.**

ISBN : 978-93-87793-80-4

Proximate analysis of plastics [7].

| Type of plastics | Plastics type marks | Moisture (wt%) | Fixed carbon (wt%) | Volatile (wt%) | Ash (wt%) |
|---|---|---|---|---|---|
| Polyethylene terephthalate (PET) | 1 PET | 0.46<br>0.61 | 7.77<br>13.17 | 91.75<br>86.83 | 0.02<br>0.00 |
| High-density polyethylene | 2 HDPE | 0.00<br>0.00 | 0.01<br>0.03 | 99.81<br>98.57 | 0.18<br>1.40 |
| Polyvinyl chloride (PVC) | 3 V | 0.80<br>0.74 | 6.30<br>5.19 | 93.70<br>94.82 | 0.00<br>0.00 |
| Low-density polyethylene | 4 LDPE | 0.30<br>– | 0.00<br>– | 99.70<br>99.60 | 0.00<br>0.40 |
| Polypropylene | 5 PP | 0.15<br>0.18 | 1.22<br>0.16 | 95.08<br>97.85 | 3.55<br>1.99 |
| Polystyrene | 6 PS | 0.25<br>0.30 | 0.12<br>0.20 | 99.63<br>99.50 | 0.00<br>0.00 |
| Polyethylene (PE)<br>Acrylonitrile butadiene styrene (ABS)<br>Polyamide (PA) or Nylons<br>Polybutylene terephthalate (PBT) | 7 OTHER | 0.10<br>0.00<br>0.00<br>0.16 | 0.04<br>1.12<br>0.69<br>2.88 | 98.87<br>97.88<br>99.78<br>97.12 | 0.99<br>1.01<br>0.00<br>0.00 |

*Figure 3 S. D. ANUAR SHARUDDIN. A REVIEW ON PYROLYSIS OF PLASTIC WASTE 2016;115:308-326*

**Table 1.** Comparison of different pyrolysis temperature for product yield.

| Mark | Pyrolysis temperature(°C) | Water temperature of LCS (°C) | Power (kWh) | Heating-rate(°C/min) | Product Yield (wt%) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Liquid | Wax | NCG |
| (a) | 350 | 15.40 | 1.04 | 29.13 | 7.11 | 70.69 | 22.20 |
| (b) | 400 | 16.96 | 0.85 | 30.85 | 24.99 | 52.71 | 22.30 |
| (c) | 450 | 16.15 | 0.86 | 31.14 | 63.82 | 2.50 | 33.67 |
| (d) | 500 | 16.59 | 1.35 | 28.76 | 84.80 | 7.63 | 7.57 |
| (e) | 550 | 16.93 | 1.27 | 27.83 | 56.59 | 5.67 | 37.73 |
| (f) | 350 | 31.18 | 0.86 | 31.34 | 5.88 | 72.72 | 21.41 |
| (g) | 400 | 25.48 | 0.79 | 29.20 | 24.86 | 42.95 | 32.19 |
| (h) | 450 | 26.28 | 0.84 | 30.06 | 60.77 | 8.36 | 30.87 |
| (i) | 500 | 26.58 | 1.04 | 28.13 | 79.17 | 4.97 | 15.86 |
| (j) | 550 | 29.37 | 1.23 | 29.29 | 52.04 | 2.39 | 45.56 |

*Figure 4 NASRUDDIN A ABDULLAH. Influence of temperature onconversion of plastic waste to liquid oil using pyrolysis process 2018;105:012-033*

## 5. Application of this Project

- It can be used further in the large industry with a larger capacity machine for dumping the plastic waste.
- There can be a separate plant for recycling of plastic waste.
- The industry can be setup for the production of biofuel with the help of plastic.

- It can be used by municipal-corporation of each and every district to reduce plastic waste and produce biofuel for other application.

## 6. Conclusion

The thermal pyrolysis of mixed plastic leads to the production of fuel oil which is a valuable resource recovery. It also reduces the problem of disposal of waste plastic. In this machine, thermal pyrolysis of waste plastic is carried out because use of catalyst is costly and regeneration of catalyst is a difficult task. Mixed plastic pyrolysis yields a mixture of oil and gas and produces very small amount of char.Physicochemical properties of obtained fuel oil can be exploited to make highly efficient fuel or furnace oil after blending with other petroleum products .However, further studies are necessary to utilize this oil as fuel or feedstock.

**References**


- [1] B.B. Uzoejinwa. Co-pyrolysis of biomass and waste plastic 2018;163:468-492.
- [2] Nasruddin A Abdullah. Influence of temperature on conversion of plastic waste to liquid oil 2018;105:012-033.
- [3]S.D. Anuar Sharuddin .A review on pyrolysis of plastic waste 2016;115:308-326.
- [4] Ayhan Demirbas .Pyrolysis of municipal plastic wastes for recovery of gasoline range hydrocarbons 2004;72:97–102.
- [5] F. Pinto. Effect of plastic waste composition on product yield 1999;51:39-55.
- [6] Chunfei Wu, Paul T. Williams. Pyrolysis-gasification of plastic ,mixed plastic and real world plastic waste 2010;89:3022-3032.
- [7] S. D. ANUAR SHARUDDIN. A REVIEW ON PYROLYSIS OF PLASTIC WASTE 2016;115:308-326.
- [8] NASRUDDIN A ABDULLAH. Influence of temperature onconversion of plastic waste to liquid oil using pyrolysis process 2018;105:012-033