# FABRICATION AND EXTRACTION OF FUEL FROM WASTE PLASTIC

**E. Nirmala Devi[1], H. Hareesh[2], L. Sudheer kumar[3], G. Bangaru Babu[4], P. Sai[5]**

*[1]Associate professor, Department of Mechanical engineering, Godavari Institute of Engineering and technology (A), Rajahmundry, Andhra Pradesh, India.*

*[2,3,4,5]student, Department of Mechanical engineering, Godavari Institute of Engineering and technology (A), Rajahmundry, Andhra Pradesh, India.*

---

**Abstract-***The present work includes the combination of fuel extracted from the plastic by the catalytic pyrolysis process of waste plastic. The catalytic pyrolysis includes the degradation of the plastic material by applying heat without the presence of oxygen and with the presence of catalysts. This study results in producing an oil sample from the waste plastic. The produced oil sample subjecting to study the fuel properties, calorific value, viscosity, and reaction temperature. On the basis of results achieved by the study, modification of the catalyst and reaction conditions was done. Finally, the produced fuel is analyzed. High density polyethylene (HDPE) pipes are used as a source of waste plastic. The catalyst is used for the process of pyrolysis. The pyrolysis reaction was brought at polymer to catalyst ratio of 4:1. The temperature in the reactor ranges between 400$^0$ C and 500$^0$ C.*

***Keywords:*** **Pyrolysis, Extraction of fuel, Plastic, Catalyst.**

## 1. INTRODUCTION

Now a days, it is very common that plastics are changing to be dangerous. Very soon, the earth is going to be covering completely with plastics and people will live over it. The allegations on plastics finally proved that plastics are hazardous and non-biodegradable in nature. The disposing and decomposition of plastic is very difficult, it is undergoing many researches in this regard. Some methods are used now for Now-a-days, it is very common that plastics are changing to be dangerous. Very soon, the earth is going the disposal of plastic are mechanical recycling, biological recycling, chemical recycling, and landfilling. Recently, known that the chemical recycling earning much interest and also found that the products formed in a chemical recycling process are more advantageous.

Plastic is such a material that has been using extensively. It is referred as the greatest innovation of the world. There are many number ways in which plastic can be used. It has a very extensive market since it is lightweight, cheap, reusable, flexible, do not rot and do not rust. Because of this, the production of plastic is gone up nearly 10% per annum since 1950. Asia holds the record of world's largest consumer of plastic with 36.5% of the global consumption.

The use of plastic is extremely large and has been increasing day by day in the view of advantages derived from adaptability, relatively low cost, endurance (due to their higher chemical stability and low degradability). Most of the plastics are polyolefin (polyolefin, which is made from the olefin propylene) such as polyethylene and polypropylene, which have enormous production and use in many applications such as packaging, electricity, building, agriculture, and health care. The property of high ductility cause disposition of waste plastics a very serious environment headache, land filling being the most recycled dispositioned way. The plastic wastes can be divided as municipal and industrial wastes just as to their influences; these groups have different qualities and properties and are subjected to different management strategies.

## 2. LITERATURE REVIEW

A ton of research has been done in noncatalytic and synergist pyrolysis of plastics which demonstrates that plastics waste can in reality be changed over to helpful synthetic feedstock. The works uncover that the item appropriation can be influenced by various parameters which incorporate the polymer source (plastic sort), impetuses utilized, size of the

impetus, impetus to polymer proportion, response temperature, response time, and reactor type. The impact of different procedure factors is depicted beneath.

### 2.1. EFFECT OF CATALYST

The impetus utilized in the pyrolysis of plastics unquestionably impacts the item. The most ordinarily utilized impetuses in the writing for plastic waste pyrolysis incorporates silica alumina, zeolites (beta, USY, ZSM-5, REY, clinoptilolite, and so forth.), and MCM-41. With expanding number of corrosive locales, the degree of the impetus action in polyolefin pyrolysis likewise increments. Subsequently, zeolite-based impetuses because of their high corrosive quality accomplish higher change than nonzeolitic impetuses. Songip et al. considered the change of polyethylene to transportation fuel utilizing HY, uncommon earth metal-traded Y-type (REY), and HZSM-5 zeolites and silica-alumina (SA). It was discovered that REY zeolite was the most appropriate impetus creating plastic oil with the most elevated octane number and fuel yield. REY had huge pores and had appropriate acidic quality which made it the most reasonable one. Y zeolite and ZSM-5 zeolite created oils having a high research octane number practically identical to that of the oil by REY, yet the fuel yield by the formers was altogether low when contrasted with REY. The reactant corruption of polyethylene by ultra-stable-Y zeolite was concentrated by Manos et al. Low pyrolysis temperature doesn't make the polymer completely corrupt, and a strong buildup is created in the response bed. It indicated that the impetus has fundamentally decreased the corruption temperature as contrasted and unadulterated warm debasement without an impetus. The results of the synergist corruption were hydrocarbons in the $C_3$–$C_{15}$ territory. The impetus was profoundly acidic, creating oil with high octane number. Various research works have been done to discover the impact of silica alumina as impetus for the pyrolysis of plastics. It very well may be seen that with silica alumina, high fluid yield can be acquired. The impacts of silica alumina with two diverse $SiO_2/Al_2O_3$ extents; that is, SA-1 ($SiO_2/Al_2O_3$ proportion of 83.3/16.7) and silica alumina SA-2 ($SiO_2/Al_2O_3$ = 21.1/78.9) were concentrated by Uddin et al. The fluid yield was seen as 68 wt% for SA-1 when contrasted with 77 wt% for SA-2. Along these lines, the SA-1 impetus debased the polyethylene test into a lot lighter hydrocarbon fuel oil than the SA-2 impetus. In this manner, it very well may be presumed that the yield and piece of the fluid items can be constrained by adjusting the $SiO_2/Al_2O_3$ proportion. The fluid items are conveyed in $C_5$–$C_{20}$ territory, that is, fundamentally in the gas and diesel ranges. The impact of nonacidic impetuses for the pyrolysis of plastics was concentrated by Jan et al. On correlation with $MgCO_3$ when utilized as an impetus under 450°C, it could be seen that the % oil yield (33.60%) is higher with $MgCO_3$ when contrasted with the % oil yield (29.60%) acquired with $BaCO_3$ impetus. Additionally, when $CaCO_3$ was utilized as an impetus under a similar response conditions, the got % oil yield was 32.20%.

### 2.2. EFFECT OF CATALYST CONTACT MODE

There exist two strategies by which impetus can be added to the pyrolysis reactor: fluid stage contact and fume stage contact. In the fluid stage contact, the impetus and polymer are combined, and afterward they are set in the reactor and warmed to the response temperature. Be that as it may, in the fume stage contact, the polymer is first exposed to thermolysis to create the unstable portion. The impetus is embedded in the way of the moving fume, and as the fume travels through the impetus, the hydrocarbon fume is debased to get the necessary item circulation. Be that as it may, the item yield is accounted for not to vary fundamentally with the two modes.

### 2.3. EFFECT OF TEMPERATURE

On the off chance that the synergist pyrolysis is occurring at higher working temperature or at high warming rates, it causes the improvement of security breaking and in this way preferring the creation of littler particles. The stretch out of transformation increments with increment of temperature, and it very well may be seen that with higher change the significant items shaped will be the vaporous items and the fluid yield being least or nil. The impact of various impetuses on the fluid yield and the item dispersion turns out to be less noteworthy with expanding temperature. The response occurring will be like warm corruption.

### 2.4. EFFECT OF POLYMER TO CATALYST RATIO

Impact of polymer to impetus proportion has been concentrated by Akpan Udoh et al.. It has been presumed that with the expansion in the measure of impetus, an immediate proportionality as far as the adequacy isn't acquired. The expansion in

impetus sum expands the transformation up as far as possible, however a further increment in the impetus rate doesn't give any considerable increment in the change rate. The ideal polymer to impetus proportion as acquired from examines is 4 : 1. In any case, it is additionally found in the writing that a lesser impetus proportion will likewise give comparative corruption, yet just at higher response temperatures. An advancement must be finished with the impetus proportion and temperature, so the activity stays practical as well.

## 3. DISPLAYING AND FABRICATION OF SETUP

The proposed get together of the trial arrangement was displayed in Solid Works programming with specific details. The need of various segments was dictated by the format and was demonstrated dependent on the holding limit of the warming chamber. The parts have been set apart as per the parts list.

**Table-1:** Parts list for the setup

| Sr. No | Part name | Quantity |
|---|---|---|
| 1 | Heating chamber | 1 |
| 2 | Heat exchanger (condenser) | 1 |
| 3 | Gasket | 3 |
| 4 | Nut & bolt | 14 |
| 5 | Insulation | 1 |
| 6 | Collecting tank | 1 |

The essential parts of the arrangement incorporate a warming unit, a cooling unit and assortment unit. The model of the proposed gathering assists with giving a superior thought and comprehension of the arrangement and aides in the creation of parts.

### 3.1. HEATING CHAMBER

The warming chamber is the most significant part of the arrangement as it needs to continue the warmth created by the heater and furthermore be liberated from any spillage. The warming chamber fundamentally comprises of two primary parts, the funnel shaped area with a rib and the channel with spine. The funnel has an external measurement of 165.5 mm. The thickness of the material utilized is 5 mm.

Fig-1: Heating chamber

A high temperature gasket is chosen to be put in the middle of these spines to guarantee a water/air proof seal. The gasket is roundabout fit as a fiddle with distance across of 220 mm and thickness of sheet is 3 mm.

### 3.2. HEAT EXCHANGER (CONDENSER)

A helical curl heat exchanger comprises of a funnel going through a tank containing water. A standard copper funnel of 9.52 mm distance across and 2 feet length was twisted to manufacture a helical loop pipe utilizing hot working. A condenser is utilized to hold water over the helical curl. The tank is welded to the curl outlet and a water tight seal is applied over the weld.

Fig-2: Heat exchanger

### 4. ASSEMBLY OF PYROLYSIS SETUP

Get together of the arrangement follows the creation and testing of the segments required for the procedure. The stand is put where the arrangement is to be introduced in order to direct the investigation. The trial is performed outside for security. The edge is deliberately put on the stand. The following stage includes cautiously introducing the heater and the protection blocks. At that point cautiously place the heater in the inside. The wires of the electric heater are fixed in protecting material. Blocks are set in the remainder of the space encompassing the heater. This guarantees least warmth misfortune from the heater every which way aside from the top. The edge top is then used to cover the heater inside the edge. The cover forestalls heat misfortune. The penultimate advance is embeddings the warming chamber through the top into the heater. The last advance of the get together is setting the helical curl heat exchanger get together on the stand.

Fig-3: Final setup

For execution of the analysis, the material chose is first added to the warming chamber. The following stage is putting the warmth fixing gasket between the ribs and securing the spines utilizing nut shooting. The latches are fixed so the gasket

appropriately seals the spines. No air spillage is endured as this may result into burning of the polymers being utilized. The vacant water tank is loaded up with water before beginning the test. The water is filled so the significant piece of the loop is inundated submerged. This assists with expanding the viability in heat trade. After conclusive investigation the stock warmth to the heater and the test starts.

A stopwatch is utilized in order to monitor perceptions regarding time. In the wake of turning on the mechanical assembly, roughly 15 minutes after the fact it is seen that heater begins warming extensively. This can be said as the hot exhaust are seen ascending from the little holes in the casing and the warming chamber.

Around 40 minutes after the beginning it is seen that smooth exhaust are gotten from the outlet. Additionally, the warmth fixing gasket apparently emits a few exhausts as it warms up. Anyway, these perceptions keep going for a couple of moments until the whole arrangement achieves high temperature (250°C+).

Utilizing 1 kg of plastic in the experimentation an hour and a half after the beginning of the test it is seen that drops of oil begin tumbling from the outlet. A channel and a jar for oil assortment are set underneath the outlet.

## 5. RESULTS AND DISCUSSION

The arrangement is manufactured for performing tries different things with high thickness polyethylene plastic sort. Investigation is led with pyrolysis process utilizing waste plastic and we got 600 ml of paraffin oil by utilizing 1 kg of waste hdpe type plastic.We calculate flash point and fire point temperatures of the obtained oil. And also calculate the calorific value of the oil.

## 6. CONCLUSION

The pyrolysis procedure was done of high thickness polyethylene plastic material. 600 ml of paraffin oil is gotten by utilizing 1 kg of plastic. Amount and nature of oil can be shifted by changing diverse amount of plastics of different kinds of plastic material. We got flash and fire point temperatures of paraffin oil and we noticed that the flash point temperature is lower than the flash point temperature.

## 7. REFERENCES

1) Alka Zadgaonkar, “Waste plastics to liquid hydrocarbon fuel project” final report published in the website, www.envis-icpe.com/Envis-Aug-04.pdf, December 2005.

2) ICPE projects published by Environmental Information System in the site, http://www.envisicpe.com/recyclingprojects.html

3) Norbert Miskolczi. “Investigation of thermal recycling of plastics and further utilization of products” Thesis of PhD dissertation, University of veszprem, Department of Hydrocarbon and Coal Processing, 2005.

4) Buekens, A.G. and Huang, H., “Catalytic Plastic Cracking for Recovery of Gasoline- Range Hydrocarbons from Municipal Plastic Wastes” Res. Con. Recycling., 23, 163 (1998).

5) Kyong-Hwan lee and Dae-Hyun Shin., “Catalytic Degradation of Waste Polyolefinic using Spent FCC Catalyst with Various Experimental Variables”, Korean J. Chem. Engg., 20, 89-93(2003)

6) A Review of the Options for the Thermal Treatment of Plastics, report by Environment and Plastics Industry Council (EPIC**),** Dec 2004. Its available in the following URL: www.plastics.ca/epic

7) Mochamad Syamsiro, Fuel Oil Production from Municipal Plastic Wastes in Sequential Pyrolysis and Catalytic Reforming Reactors, Conference and Exhibition Indonesia Renewable Energy & Energy Conservation [Indonesia EBTKE CONEX 2013].

8) Muhammad Kunta Biddinika & Mochamad Syamsiro, Technology for public outreach of fuel oil production from municipal plastic wastes, 9th International Conference on Applied Energy, ICAE2017, 21-24 August 2017, Cardiff, UK.

9) M. A. Hazrat & M. G. Rasul, Utilization of polymer wastes as transport fuel resources a recent development, The 6th International Conference on Applied Energy – ICAE2014.

10) Edy Hartulistiyoso & Febri A.P.A.G. Sigiro, Temperature distribution of the plastics Pyrolysis process to produce fuel at 450oC, The 5th Sustainable Future for Human Security (SustaiN 2014).

11) Songchai Wiriyaumpaiwong, Distillation of Pyrolytic Oil Obtained from Fast Pyrolysis of Plastic Wastes, 2017 International Conference on Alternative Energy in Developing Countries and Emerging Economics 2017 AEDCEE, 25-26 May 2017, Bangkok, Thailand.

12) Antony Raja and Advaith Murali, Conversion of Plastic Wastes into Fuels, Journal of Materials Science and Engineering B 1 (2011) 86-89, Formerly part of Journal of Materials Science and Engineering, ISSN 1934-8959.

13) Vijaykumar B. Chanashetty & B.M.Patil, Fuel from plastic waste, International Journal on Emerging Technologies(Special Issue on NCRIET-2015) 6(2): 121-128(2015).

14) Moinuddin Sarkar & Mohammad Mamunor Rashid, First Simple and Easy Process of Thermal Degrading Municipal Waste Plastics into Fuel Resource, IOSR Journal of Engineering (IOSRJEN).

15) Aditya Machiraju & V. Harinath, Extraction of Liquid Hydrocarbon Fuel From Waste Plastic, National Conference On Trends In Science, Engineering & Technology by Matrusri Engineering College & IJCRT.