

PRODUCTION OF PETROLEUM BY PLASTIC OF WASTE USING PYROLYSIS AND CATALYTIC REFORMING PROCESSES

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ABSTRACT

In the present scenario the production and consumption of the plastic is increasing rapidly. Due to increase in plastic waste it is major problem for society. Even the cities with low economic growth have started producing more plastic waste due to plastic packages, plastic shopping bag, and other appliances using plastic as a major component. The production method for the conversion of plastic to liquid fuel is based on pyrolysis of plastic and the condensation of resulting hydrocarbon. On the other hand, plastic waste recycling can provide an opportunity to collect and dispose of plastic waste in the most environmental friendly way and it is converted into useful resource. Plastic waste recycling also has a great potential for resource conversation and reduce harmful emission.

Keyword: - Waste plastic, recycling processes, Petroleum product

1. INTRODUCTION

1.1 Problem statement

The purpose of our project is to get detailed knowledge about plastic waste and their reuse in well-being of the society. In which we are trying to get useful petroleum fuel by using of waste of plastic. By doing recycling process on waste low density polymer plastic by setting appropriate temperature and pressure so we can get the petroleum products by waste and make renewable energy as petroleum products.

1.2 Problem identification

The growth of the plastic consumption has been occurring rapidly due to its light weight and non-corrosive behavior / non-biodegradable. However the great number of consumption would increase the product of plastics waste which led to environmental problem. Landfilling is not suitable option for disposal plastic waste because of their slow degradation rates. Therefore recycling and recovering method have been used to minimize the environmental impact and to reduce damage of plastic waste. The production method for conversion of plastic waste in to the useful petroleum products is based on pyrolysis of plastic waste and condensation of the resulting hydrocarbon based petroleum fuel. Pyrolysis refers to the thermal decomposition of the matter under an inert gas like nitrogen, followed by cracking using suitable catalyst. Polyethylene, Polypropylene and Polystyrene plastic will be preferably used in this project as feedstock in the production of liquid Hydrocarbons.

1.3 Aims and objectives

In this scenario our project aims to solve the twin problem of environment, first is pollution due to plastic and second is the need for an alternative fuel source. The main aim of our project is to find a solution to the mounting problem of plastic disposal, for which the plastic are converted into useable fuel. This is like cashing on the pollution itself. This project if implement can turn the tides globally by providing a long term solution for these problems.

2. USE FULL PROCESSE

For the recycling the waste of plastic then we have to grinds it and burn it at some appropriate temperature and condensate at that level and getting fuel as an output.

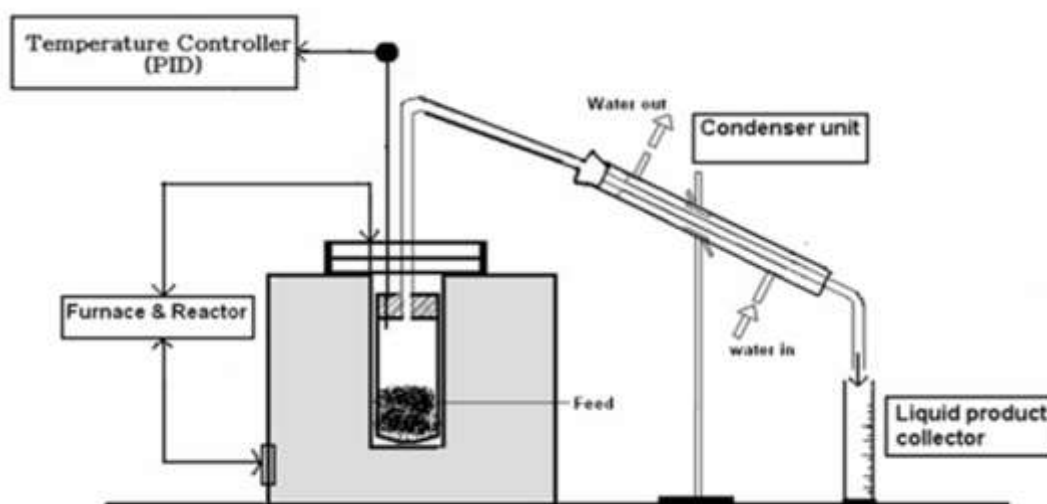


Figure: Setup

2.1 Pyrolysis

Pyrolysis process is thermo chemical decomposition of organic material elevated temperatures in the non-present of oxygen. It involves the simultaneous changes of chemical composition and physical phase, and it is irreversible. Pyrolysis word is coined from Greek-derived elements “pyro” is “fire and “lysis” is “separating”. Organic materials exposed at very high temperature are observed most commonly in pyrolysis which is a type of thermolysis. This is implicated processes charring wood at 200-300°C temperature. Solid fuel is burn or we can say vegetation comes into contact with lava volcanic an eruption where fire is occurs. Gas and liquid product generally produced from

pyrolysis and solid richer in carbon content and char are leaves. Carbonization we can say which leaves generally carbon as the residue in extreme pyrolysis.

3. EXPERIMENTAL PROCEDURE

The pyrolysis process is an advanced conversion technology that has the ability to produce a clean, high calorific value hydrocarbon from waste (polyethylene). The detailed procedure is given below:

- Take 1 kg of waste plastics of some kind [ldpe, hdpe] cut it into piece and dries it.
- The waste plastic is put inside the reactor after drying it.
- The reactor must design to withstand high temperature of about 350oc-400oc.
- It has an inlet at the top for collecting the vapor.
- Start the burner for heating the reactor and measure the temperature.
- When the temperature reaches 150oc the vapor start to come down to the Condenser.
- The heating is continued for about 1&1/2 hours till the vapor stop collecting.
- After 1 or 1&1/2 hrs. the plastics are decomposed.
- At the time larger carbon molecules are break into smaller molecules.
- There is no need of using catalyst for the process.
- The top of the reactor inlet is connected with the spiral condenser where the vapors are condensed.
- Finally the fuel from condensed vapors is collected.
- Approximately 700ml of thermo fuel will be collected from per kg of waste plastics.
- Thermocouple is used to measure high temperature.

3.1 Apparatus and Material

1) Reactor



Initial stage of reactor (First phase)



Final phase of reactor

The Reactor which we used in initial phase had some leakages in it and it was not enough strong to withstand against the pressure and temperature that will be created during the process, to avoid the above mentioned problems we used Mild Steel pipe of approx. 5mm thick and machined it from upper side we had used pressure and temperature gauges measure the temperature we had also used handles on the lid and outer surface of the reactor so to avoid the accident and for safety. In reactor the plastic waste is heated and the temp goes up to 500oC.

2) Condenser



Initial experimental phase



Final stage of condenser

It cools the entire heated vapor coming out of the reactor. It has an inlet and an outlet for Vapor to run through its outer area. This is used for cooling of the vapor. The gaseous hydrocarbons at a temperature of about 350c are condensed to about 30 – 35c. The initial condenser was made was not really a success case it has lots of leakages in it after deep thinking of another type of condenser which is like heat exchanger is made and it worked successfully. The successful working condenser we made is of aluminum of outer shell and the flow of vapor will be given through the spiral copper tube which is inside of the shell. The refrigerant used in condenser is cold water and ice cubes. We also managed to fit tap for removing hot water.

3) Pressure gauge

We Used pressure gauge for the safety as the chamber was air tight and only one outlet hole was given there could be a risk of excess pressure increase and blow of reactor.



4) Temperature gauge

We also provide temperature as to know the temp. The reaction usually starts after 300c. The Left side one is container that we used for collecting the output we get for testing.



5) Pipes and holder

6) Burner

7) Plastic waste as material

4. OUR EXPERIMENTAL SET-UPS

We have performed this model in two stages. First one is initial-first rough model and then we made finalized model on the basis of initial model.

- Initial phase model



Figure: initial stage model

- Final project model



Figure: Final model

5. ADVANTAGES

- Corrosion less
- Reduce plastic waste
- One of the better method to save the environment profitably
- One of the better method to produce fuel
- Anywhere & anytime produce thermo fuel
- Get easily raw material
- No need of engine modification
- Residue can be used as paraffin wax
- Less amount of residue and large amount of product

6. DISADVANTAGES

- Initial cost is high
- Production rate of fuel is less as compare to input of raw material
- Time consuming process
- Need very high temperature
- Fire hazards
- Safety is required

7. APPLICATIONS

- Transportation
- Industrial power
- Heating and lighting
- Lubricant
- Petro-chemical industry

8. SCOPE OF FUTURE WORK

- Here this project has wide view on the basis of whole world because of plastic conversion or its reuse way is world problem because of it's a non-bio-degradable element.
- So, if we are looking for future purpose then it's a big scenario as plantation of big plant in every country as well as every state and converts the plastic waste in to the most useable way as petroleum fuel. This is alternate way of production of fuel, so it's directly reducing the worry of decreasingly rate of crude oil.
- As the mention above we can also find the combine way of conversion of tyre tube, plastic wastes, also all carbon contain things which all are converting into the useful fuel or any useful things so we can reduce the pollution and crude oil demand in front of production.

9. CONCLUSIONS

After these whole things as research work, experimental work, we can conclude that, the production method for the conversion of plastic to liquid fuel is based on pyrolysis of plastic and the condensation of resulting hydrocarbon which is successfully achieving by our project title model method. On the other hand, plastic waste recycling can provide an opportunity to collect and dispose of plastic waste in the most environmental friendly way and it is converted into useful resource. Plastic waste recycling also has a great potential for resource conversation and reduce harmful emission.

10. REFERENCES

- [1] Dr. Samy Sadaka, P.E., P.Eng, Pyrolysis, Iowa State University 1521 West F. Ave. Nevada, IA 5020.
- [2] Lisardo Nunez, F. Fraga, M.R. Nunez, M. Villanueva, Thermogravimetric study of the decomposition process of the system, *Polymer* 41 (2000) 4635–4641
- [3] Yal_c_n TONBUL,kadir yurdakoc, Thermogravimetric Investigation of the Dehydration Kinetics of KSF, K10 and Turkish Bentonite, *Turk J Chem* 25 (2001) , 333 { 339., 13.10.2000
- [4] R. Ebrahimi-Kahrizangi1, 2, M. H. Abbasi, Evaluation of reliability of Coats-Redfern method for kinetic analysis of non-isothermal TGA, *Transaction of non ferrous metals society of china* , accepted 31 July 2007
- [5] Engr. C. O. Osueke, Conversion Of Waste Plastics (Polyethylene) To Fuel By Means Of Pyrolysis, *International Journal Of Advanced Engineering Sciences And Technologies*, Vol No. 4, Issue No. 1, 021 – 024
- [6] http://www.alternet.org/story/61607/the_great_plastic_bag_plague
- [7] Moinuddin Sarker*, Mohammad Mamunor Rashid & Mohammad Molla, Waste Plastic Converting into Hydrocarbon Fuel Materials, Department of Research and Development Natural State Research Inc. Brown House Rd. Stamford CT 06902
- [8] Weibing ding, Jing liang and Larry Anderson , hydro cracking of waste plastics TO CLEAN liquid fuels , department of Chemical and Fuels Engineering, University of Utah Salt Lake City, UT 841 12
- [9] Jerzy Walendzie, Institute of Chemistry and Technology of Coal, Poland, 25 july 2011.
- [10] Achyut K. Panda , R.K. Singh a, D.K. Mishra ,Thermolysis of waste plastics to liquid fuel, Department of Chemical Engineering, National Institute of Technology, Rourkela, Orissa, India, 2009 Elsevier Ltd
- [11] N. Miskolczia, L. Bartha, Thermal degradation of municipal plastic waste for production of fuel-like hydrocarbons, Department of Hydrocarbon and Coal Processing, University of Veszpre´m

