

Studies of Conversion of Plastic Waste into Fuel

¹Shehab Mohammed Rageh,¹ Md Zishan Nezami, ¹Mohammed Anas, ¹Ahmed Al hasani, ²V.N. Iyer,
³K. Srikanth Kumar

¹ Undergraduate Student, Petroleum Engineering, LORDS Institute of Engineering & Technology, Hyderabad, India.

²Assistant Professor, Petroleum Engineering, LORDS Institute of Engineering & Technology, Hyderabad, India.

³Professor & HOD, Petroleum Engineering, LORDS Institute of Engineering & Technology, Hyderabad, India

* Corresponding Author Email: rajeshkanna@lords.ac.in

ABSTRACT

The aim of this research was to study the pyrolysis oil production from municipal plastic waste in INDIA. A pyrolysis experiment is done on the municipal LDPE plastic waste of 150 grams. A series of tests were carried out at a temperature range of 300- 350 OC with all other parameters being same. Under pyrolysis conditions plastic waste was decomposed into three types: producer gas, oil and solid residue. The obtained result shows that the properties of the pyrolysis oil are closely similar to that of Liquid fuel. hence it can be used as alternative fuel which friendly to the environment.

Keywords: Pyrolysis Unit, Catalyst, alternative fuel, LDPE, Plastic waste

I. INTRODUCTION

Conversion of waste to energy is one of the recent trends in minimizing not only the waste disposal but also could be used as an alternate fuel for internal combustion engines. Waste plastics are non-biodegradable materials and its application in the domestic as well as industrial field is continually increasing. As the disposal of plastic will take more than 500 years in natural way. Hence, the plastic waste disposal is the biggest concern of the city. In kolhapur city, around 165 tonnes of solid waste is generated every day, out of which nearly 11% i.e. 18 tonnes is contributed by only plastic waste. The aim of this experiment is to convert this non biodegradable plastic into useful components.

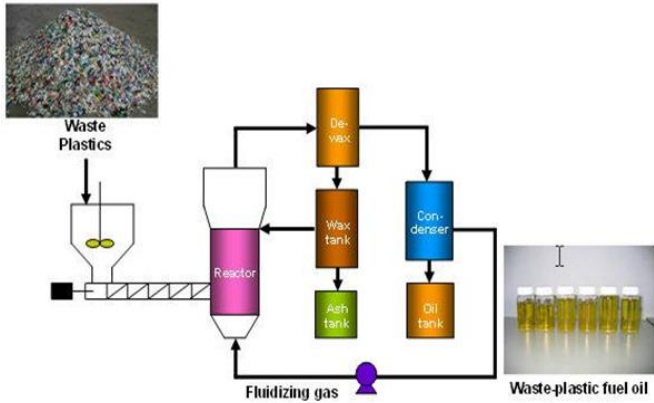
A plastic material is a wide range of synthetic or semi-synthetic organic solids that are malleable. Plastics are typically organic polymers of high

molecular mass, but they often contain other substances. They are usually synthetic, most commonly derived from petrochemicals, but many are partially natural. Plastics can be converted into hydrocarbon fuels since it contains hydrogen and carbon. Ldpe (low density polyethylene) is defined by a density range of 0.910–0.940 g/cm³. It is widely used for domestic as well as industrial applications. pyrolysis is the thermo chemical decomposition of organic substances at elevated temperatures in absence of oxygen. Plastic waste is treated in a cylindrical reactor at temperature of 300 oc – 350 oc. The gases are condensed to give a low density oil. A solid carbon Residue gets generated at the bottom of the reactor.

II. PROCEDURE

The process flow chart

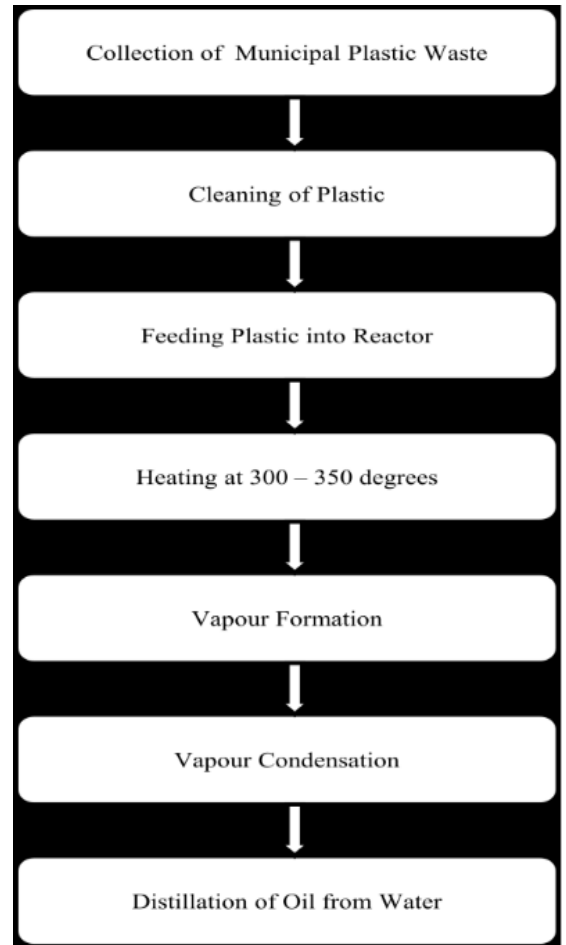
process. 100ml oil was formed with 150 grams of plastic waste.



Process of Pyrolysis of Waste Plastics Technology

Fig 1: process of pyrolysis

1. Waste plastic is collected from municipal solid waste. A sample of 150 grams of waste plastic (LDPE) is taken and cleaned. The sample is fed into the reactor and heated at a temperature of 300-350 oC for about 35 minutes using induction heater. The plastic is evaporated at this temperature and the vapours are condensed by direct mixing it with water at atmospheric temperature. The layer of oil is formed at the surface of water due the difference in their densities. This oil is separated by using distillation



Output	% of output
Fuel oil	80% - 90%
Producer Gas	8% - 10%
Coke Residue	2% - 13%

III. RESULTS AND DISCUSSION

Sr. No.	Parameter	Unit	Pyrolysis Oil	Diesel
01	Specific Gravity	-	0.7894	0.81
02	Viscosity at 25oC	cSt	5056	3.80
03	Flash Point	oC	41	50
04	Fire Point	oC	46	56
05	Sulphur	%	0.028	>0.035
06	Carbon Residue	%	0.05	0.20
07	Calorific value	KCal/Kg	9434	11031.5
08	Cetane Number	-	49	55
09	Density	Kg/m3	780	850

The breakdown of the output from pyrolysis process is given below:

From above comparative analysis, it is clear that the properties of pyrolysis oil are similar o that of diesel. Also, it is found that the carbon residue, sulphur content of plastic pyrolysis oil is much lesser than the diesel, hence its use will result in lesser air pollution. Hence plastic pyrolysis oil can be used as an alternative fuel for diesel engines and oil fired furnaces. Char is the material that is left once the pyrolysis process is complete and the fuel recovered.

The total amount of plastic waste collected from Kolhapur city is 18 tonnes/day. This can be converted into 12000 litres of pyrolysis oil per day. The running cost of pyrolysis plant ranges from Rs. 14 to Rs. 18 per litre while the market price of oil is Rs. 40 per liter.

IV. CONCLUSION

According to the current statistics, there is continuous rise of consumption and thus cost of petroleum oil, International Energy Outlook 2008 reports the world consumption of petroleum oil as 84 million barrels per day. The conversion of waste plastics to liquid hydrocarbon fuel was carried out in thermal pyrolysis unit.

This method is superior in all respects (ecological and economical).By adopting this technology, efficiently convert weight of waste plastics into 75% of useful liquid hydrocarbon fuels without emitting any pollutants. It would also take care of hazardous plastic waste and reduce the import of crude oil. Depletion of non-renewable source of energy such as fossil fuels at this stage demands the improvements of this technique.

Based on the properties of the Plastic fuel and Diesel fuel the all properties are nearer hence concluded that Waste plastic fuel represents a good alternative fuel for diesel engine and therefore it can be used for diesel engine vehicles for the transportation purpose.

V. REFERENCES

- [1]. http://www.kolhapurcorporation.gov.in/English/PH_Solid/20waste%20management.html
- [2]. <http://www.kolhapurcorporation.gov.in/pdf/ESReport201314.pdf>
- [3]. Senthil kumar Tamil kolundu and Chandrasekar Murugesan, The Evaluation of blend of Waste Plastic Oil- Diesel fuel for use as alternate fuel for transportation, 2nd

International Conference on Chemical, Ecology and Environmental Sciences, (ICCEES'2012) Singapore April 28-29, (2012)
International Journal of Engineering Research and General Science Volume 3, Issue 1, January-February, 2015 ISSN 2091-2730

- [4]. Mani M., Nagarajan G. and Sampath S., An experimental investigation on a DI diesel engine using waste plastic oil with exhaust gas recirculation, *Fuel*, 89, 1826–1832 (2010)
- [5]. Walendziewski Jerzy, Engine fuel derived from waste plastics by thermal treatment, *Journal of Fuel*, 81 473-481 (2002).
- [6]. Lee SW, Park S, Daisho Y. An experimental study of the effects of combustion systems and fuel properties on the performance of a diesel engine. *Proc Inst Mech Eng D-J Auto Eng* 2004;218:1317-23
- [7]. www.pyrolysisplant.com/wpcontent/uploads/2011/02/FAQ/pyrolysis-plant.pdf
- [8]. Fuentes MJ, Font R, Gómez-Rico MF, Martín-Gullón I (2007). Pyrolysis and combustion of waste lubricant oil from diesel cars: Decomposition and pollutants. *J. Anal. Appl. Pyrol.* 79:215-226.
- [9]. Williams PT, Williams EA (1990). Interaction of plastics in mixed plastics pyrolysis. *J. Energy Fuels.* 13:188-196



3. **Ahmed Al Hasani** studying in final year in LIET, hyd in petroleum dept.



4. **Shehab Mohammed Rageh** studying in final year in LIET, hyd in petroleum

AUTHORS



1. **Md Zishan Nezami** studying in final year in LIET, hyd in petroleum dept. He has gone through one month of industrial training in **ONGC** Gujrat .



2. **Mohammed Anas** studying in final year in LIET, hyd in petroleum dept. He has gone through one month of industrial training in **ESSAR** Ahmedabad.