Waste plastic to fuel-Petrol, Diesel, Kerosene

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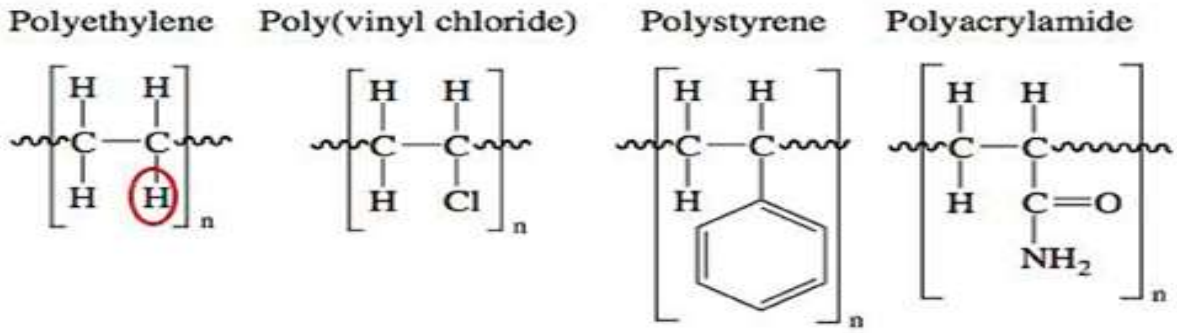
***Abstract*: The waste plastic is generated in India 15000 tons per day (as per government survey) .The waste plastic affects the humans, animals, birds' earth and environment. For dissolving (breakdown) plastic may require around 500 years in the earth. Every year 65% waste plastic is land filled or in the natural environment (River system and ocean). The technology is used to dissolve these all type waste plastic is pyrolysis. The pyrolysis is the heating substance in the absence of oxygen. In this study 430^0 Celsius temperature need. The all type of waste plastic is converting to fuel. It works like Petrol, diesel, kerosene and LPG. By implementing this concept can be reduced 80-90% of waste plastic and can be provide 60% oil for diesel vehicles. The fuel does not emit sulfur dioxide.(SO_2). It increases machine efficiency. The 5% residue is obtained which is carbon block.**

I.INTRODUCTION

In chemistry, plastics are large molecules, called polymers, composed of repeated segments, called monomers, with carbon backbones. A polymer is simply a very large molecule made up of many smaller units joined together, generally end to end, to create a long chain. The smallest building block of a polymer is called a monomer. Polymers are divided into two distinct groups: thermoplastics (moldable) and thermo sets (not). The word "plastics" generally applies to the synthetic products of chemistry. More than 15,000 tones of plastic waste are generated in India everyday, of which 6,000 tones remain uncollected and littered, the government today said. However, as per the CPCB report in 2014-15, 51.4 million tones of solid waste were generated in the country, of which 91 per cent was collected, and 27 per cent was treated and remaining 73 per cent disposed of at dump sites. "Central Pollution Control Board has estimated the generation of 15,342 tones of plastic waste in the country, out of which, 9,205 tones were reported to be recycled and leaving 6,137 tones uncollected and littered". The technology is used to dissolve these all type waste plastic is pyrolysis. The pyrolysis is the heating substance in the absence of oxygen. In this study 430^0 Celsius temperature need. The all type of waste plastic is converting to fuel. It works like Petrol, diesel, kerosene and LPG. By implementing this concept can be reduced 80-90% of waste plastic and can be provide 60% oil for diesel vehicles. The fuel does not emit sulfur dioxide.(SO_2). It increases machine efficiency. The 5% residue is obtained which is carbon block.

II.PLASTIC BACKGROUND

Plastic is a high molecular weight material that was invented by Alexander Parkes in1862. Plastics are also called polymers. The term polymer means a molecule madeup by repetition of simple unit. For example, the structure of polystyrene can be written in a form as shown in figure (polystyrene structure).



III.TYPES OF PLASTIC

1)***Thermoplastics*** which are softened by heat and can be moulded. (Injection moulded, blow moulded or vacuum formed). Good examples are acrylic, polypropylene, polystyrene, polythene and PVC.

2)***Thermo sets*** which are formed by ha heat process but are then set (like concrete) and cannot change shape by reheating. Good examples are melamine (kitchen worktops), Bakelite (black saucepan handles), polyester and epoxy resins.

Type I	Recyclable	Polyethylene Terephthalate	Beverages.
Type II	Recyclable	High density polyethylene	Milk, detergent,oil bottles, toys, containers used outside parts and plastic bags.
Type III	Recyclable(uncommon)	Polyvinyl chloride	Food wrap, vegetable oil,bottles,automotive parts

Type IV	Recyclable	Low density polyethylene	Plastic bags, shrink wraps, garment bags, bottles.
Type V	Recyclable	Poly-propylene	Refrigerated containers, some bags, most bottle tops, some carpets.

VI.LITERATURE SURVEY

In order to have a proper background study on technologies available for conversion of waste plastics to fuel, literature survey is carried out to know its various applied method throughout the globe, they are summarized below. From this crude oil various products petrol, diesel and kerosene etc. can be obtained by distillation. This process can convert all HDPE waste plastic to different grade fuels and specially jet grade fuel. After reviewing these various literatures, we can see that different forms of Pyrolysis processes have been employed for the conversion of plastic wastes to efficient fuels and also successfully tested as well.

A. Production of Plastics

The production of plastic begins with a distillation process in an oil refinery. The distillation process involves the separation of heavy crude oil into lighter

groups called fractions. Each fraction is a mixture of hydrocarbon chains (chemical compounds made up of carbon and hydrogen), which differ in terms of the size and structure of their molecules. One of these fractions naphtha, is the crucial element for the production of plastics. Plastics are also produced from natural gas.

B. Production of Naphtha

Naphtha is an intermediate hydrocarbon liquid stream derived from the refining of crude oil. It is the lightest liquid distillate product of crude distillation consisting of C5 to C10 hydrocarbons boiling in the 100 to 310°F range. It is produced from the atmospheric distillation of crude oil and from many secondary processing units in the refinery. Unlike other petroleum fuels such as kerosene, diesel, or fuel oil, naphtha is not a direct petroleum fuel but is used as a feedstock for the manufacture of plastics. The first unit process in a petroleum refinery is the crude oil distillation unit. The overhead liquid distillate from that unit is called virgin or straight-run naphtha and that distillate is the largest source of naphtha in most petroleum refineries. The naphtha is a mixture of very many different hydrocarbon compounds. It has an initial boiling point of about 35 °C and a final boiling point of about 200 °C, and it contains paraffin, naphthenic (cyclic paraffin's) and aromatic hydrocarbons ranging from those containing 4 carbon atoms to those containing about 10 or 11 carbon atoms. The virgin naphtha is often further distilled into two streams: a virgin light naphtha with an IFP of about 30°C and a FBP of about 145 °C containing most (but not all) of the hydrocarbons with 6 or less carbon atoms. A virgin heavy naphtha containing most (but not all) of the hydrocarbons with more than 6 carbon atoms. The heavy naphtha has an IFP of about 140 °C and a FBP of about 205 °C [2]. It is the virgin heavy naphtha that is usually processed in a catalytic reformer because the light naphtha has molecules with 6 or less carbon atoms which, when reformed, tend to crack into butane and lower molecular weight hydrocarbons which are not useful as high-octane gasoline blending components. Also, the virgin light naphtha molecules with 6 carbon atoms tend to form aromatics which are high-octane components but which are undesirable because they are carcinogens (most particularly benzene) and governmental environmental regulations in a many countries limit the amount of aromatics that gasoline may contain.

V.METHEDOLOGY

A. Pyrolysis Pyrolysis is generally defined as the controlled heating of a material in the absence of oxygen. In plastics Pyrolysis, the macromolecular structures of polymers are broken down into smaller molecules or oligomers and sometimes monomer units. Further degradation of these subsequent molecules depends on a number of different conditions including (and not limited to) temperature, residence time, presence of catalysts and other process conditions. The Pyrolysis reaction can be carried out with or without the presence of catalyst Accordingly, the reaction will be thermal and catalytic Pyrolysis. Since majority of plastic used are polyolefin, so extensive research has been done on this polymer which is summarized as below.

B. Thermal Pyrolysis of Polyolefin

The non-catalytic or thermal Pyrolysis of polyolefin is a high energy, endothermic process requiring temperatures of at least 350–500 °C.

Materials and apparatus

⇩

Set up

⇩

Feeding system

⇩

Heating process

⇩

Condensation

⇩

Liquid oil

Model used for extract fuel

In the pyrolysis the oil will be collected at different temperature. At the 130^0 C 20% oil, at 210^0 C 30% oil, at 250^0 40% oil, at 300^0 60% and at 430^0C 90% oil will be collected.

VI.RESULT

In the Pyrolysis reaction different type of oil will be extracted from different type of waste plastic. Such oil acts as petrol, diesel and kerosene. The same pyrolysis reaction produce 10% gas it acts as LPG .

Three different types oil

Gas acts as LPG

Oil composition with diesel

Properties	Diesel	Plastic fuel
Density(gm/cc)	0.735-0.755	0.68
Flash point(°C)	52	29
Ash(%)	.01	No ash
Carbon content(%)	10	5

For overall pyrolysis reaction using vacuum pump and catalyst oil production will be faster. For 1Kg of waste plastic will get 900ml oil can be extracted and 100gm of gas can be extracted and the remaining thing is carbon block.

VII.ADVANTAGES

1. Problem of disposal waste plastic can be solved.
2. Waste plastic is converted into the high value of fuels.
3. Industrial and automobile fuel requirement shall be fulfilled to some extent at lower price.

4. No pollutants during cracking of plastic.
5. The crude oil can be used for generation of electricity.
6. Volume of waste is significantly reduced.
7. Storable/transportable fuel or chemical feed stock is obtained.
8. Desirable process as energy is obtained from renewable sources like municipal solid waste or sewage sludge.
9. Reduce environment effects .
10. Reduce importing of petroleum products.
11. Good helpful for 'Swach Bharat'
12. Helpful for Make in India.
13. Carbon block is used in blast furnace.
14. Echo friendly.

VIII.CONCLUSION

Plastics present a major threat to today's society and environment. Over 14 million tons of plastics are dumped into the oceans annually, killing about 1,000,000 species of oceanic life. Though mankind has awoken to this threat and responded with developments in creating degradable bio-plastics, there is still no conclusive effort done to repair the damage already caused. In this regard, the catalytic Pyrolysis studied here presents an efficient, clean and very effective means of removing the debris that we have left behind over the last several decades. By converting plastics to fuel, we solve two issues, one of the large plastic seas, and the other of the fuel shortage. This dual benefit, though will exist only as long as the waste plastics last, but will surely provide a strong platform for us to build on a sustainable, clean and green future. By taking into account the financial benefits of such a project, it would be a great boon to our economy. So, from the studies conducted we can conclude that the properties of the fuel obtained from plastics are similar to that of petrol and further studies on this field can yield better results.

REFERENCES

[1] Feedstock refining and pyrolysis of waste plastics by John Scheirs and Waller Kaminski.
[2]http://www.inspirationgreen.com/plastic-waste-as-fuel.html
[3]http://biomassmagazine.com/articles/2067/power-and-fuelfrom- plastic-wastes
[4] Worner, Timothy. 2011. "Why and How to Baseline Your Extruder." Plastic Technology, August 2011.
[5] Onu P. Vasile C. Ciocilteu S. Iojoiu S. Darie H. thermal and catalytic decomposition of polyethylene and polypropylene Journal of analytic and applied pyrolysis 1999.
[6]. Lee KH. Shin DH. Thermal degradation of waste polyolefin polymers using spent FCC catalysts with various experimental variables. Korean journal of chemical engineering 2003.
[7].Thermal and catalytic conversion of waste polyolefin's by jerzymieczyslawsteiningerwalendziewski and mieczyslawsteininger institute of chemistry and technology of petroleum and coal, Wroclaw university of technology.
[8].Engine fuel derived from waste plastics by thermal treatment jerzy walend ziewski institute of chemistry and technology of petroleum and coal, technical university of Wroclaw Poland.
[9].continuous flow cracking of waste plastics by jerzywalendziewski institute of chemistry and technology of petroleum and coal.
[10].Alkazadgaonker "waste plastic to hydrocarbon fuels projects" final report published in Envis aug-04 issue.
[11].website: www.wastecare.com//plastic/waste/oil production
[12].public domain:en.wikipedia.ord/wiki/plastic materials in India.
[13].Book: Author Dr.samirsarkar fuels and combustion, second edition, chapter 5 liquid fuels.