International Conference On Emerging Trends in Engineering and Management Research
NGSPM's Brahma Valley College of Engineering & Research Institute, Anjaneri, Nashik(MS) (ICETEMR-16)
23rd March 2016, www.conferenceworld.in ISBN: 978-81-932074-7-5

FUEL FROM WASTE PLASTIC

Dipak Ahire[1], Dnyneshwar Shinde[2], Ankush Thombre[3], Vishal Wagh[4], Ankit Kumar[5]

[1,2,3,4]BVCOE & RI Nashik B.E.Mechanical Pune University,(India)

[5]Assistant Professor, Mechanical Dept. BVCOE& RI Nashik (India)

ABSTRACT

Waste plastic from municipal solid waste were collected it was stored based on the types like HDPE, LDPE, PVC, etc. They were graded into nearly uniform size by crusher, cutter and shredder. The graded feed was heated just to melt it so that irrelevant impurities such as hard metal, clay, sand, glass, etc. settles in the bottom of the melter, which was removed sometimes. The gaseous product during melting can be either dissolved in suitable solvent or incinerate to produced heat. The modern plastic along with catalyst it sent to a reactor which is maintained at temperature between 350-600 degree celcius and impressive pressure. The vapour which come out of the reactor can be distilled to obtain different fraction of petroleum product. The different fraction dependent upon type of feed, catalyst /feed ratio, temperature and time of heating. Catalyst and different products are characterized for these usefulness.The various properties of the product obtained were then tested and compared with the actual values for the petroleum range product.

Keywords: Plastics, Distillation, Pyrolysis, Catalyst, Heating, Testing

I. INTRODUCTION

In current years, as a result of changes in people's consumption patterns, large amounts of waste plastic are available in municipal solid waste (MSW). In 2000, the production of plastic in the world had reached 150 million tons. According to the formula that the yield of waste plastic is about 70% of the plastic product in the corresponding period, the yield of waste plastic is 105 million tons. In our country, 70% of the MSW is disposed of as landfill use land filling not only wastes the resources but also engrosses land with pollution with macromolecules of plastic that are not decomposable, it is important to find an efficient strategy to treat them. Our present study of thermal degradation is concerned with polypropylene (PP) as a representative of plastic waste. PP is a hydrocarbon polymer made from petrochemicals it has a large amount of volatile matter with high heating value and low ash content these factors may favour a better product yield from thermal degradation. Thermal and first of all catalytic cracking process of waste polymers are economically and environmentally accepted methods of their utilization. The last 30 years have seen an explosive growth of the plastic industry. The production of synthetic polymers characterized by polyethylene (PE), polypropylene (PP), polystyrene (PS), and polyvinyl chloride (PVC) worldwide has increased further than 100 times in the last three decades. These plastics are widely used in many important day to day applications such as clothing, domestic appliances and in automotive products and aerospace. While we enjoy the conveniences that plastics can provide, the treatment of waste plastics becomes an unavoidable and imminent issue. In this regard, it can be safely specified that we are in urgent need and effective ways to recover waste plastics. Recently new ways of environmentally-friendly waste plastic recovering have been of notice, and among them, the use of waste plastics as a supplemental fuel with coal in the steel making industry has concerned interest. Plastics are non-biodegradable polymers mostly containing carbon, hydrogen and few other elements.

1.1 DEMAND OF FUEL

The present rate of commercial growth is unmanageable without saving of fossil energy like crude oil, natural gas or coal. International Energy Position 2010 reports the world consumption of liquid and petroleum products grows from 86.1 million barrels per day in 2007 to 92.1 million barrels per day in 2020 and 110.6 million barrels per day in 2035 and natural gas consumption rises from 108 trillion cubic feet in 2007 to 156 trillion cubic feet in 2035. This way, the oil and gas reserve available can meet only 43 and 167 years further. Thus mankind has to rely on the alternate/renewable energy sources like biomass, hydropower, geothermal energy, wind energy, solar energy, nuclear energy, etc. Waste plastic to liquid fuel is also an different energy source path, which can contribute to depletion of fossil fuel as in this process liquid. Fuel with like properties as that of petrol fuels is obtained.

II. LITERATURE REVIEW

In order to have a appropriaterelated study on technologies available for conversion of waste plastics to fuel, literature review is carried out to know its various applied method throughout the globe, they are summarized below. The study was shown by Tiwari et al. (2009) on catalytic cracking process in which waste plastic is melted and cracked in the absence of oxygen and at very high temperature, the resulting gases were cooled by condensation and resulting crude oil was recovered. From this crude oil various products petrol, diesel and kerosene etc. can be obtained by distillation. This process generally consists of four units (1) reacting vessel or reaction chamber (2) condensation unit (3) receiving unit (4) distillation unit. The study was carried out by Nikolett Borsodiet et al. (2011) on Pyrolysis of clear and unclean waste plastics in a tubular reactor, applying 500°C temperature. Y-zeolite catalyst was applied to reduce the chemical level in the products and the effect of pre-treatment of raw materials was also studied. Thermal degradation of unclean plastic wastes resulted in higher yields of volatile products than the Pyrolysis of pre-treated or innovative raw material. The study was carried out by Deshpande et al. (2012) on thermal degradation of waste plastic into gasoline range hydrocarbon i.e. petrol, diesel and kerosene etc. Thermal cracking is a process in which waste plastic remained melted and cracked in the absence of oxygen and at very high temperature, the resulting gases were cooled by condensation and resulting crude oil was recovered. From this crude oil various products petrol,diesel and kerosene etc. can be achieved by distillation. The study was accompanied by Moinuddin 2012 reviewed on thermal cracking and fractional refinement process conducted with single types of HDPE waste plastic to get jet grade fuel production. This process can convert all HDPE waste plastic to dissimilar grade fuels and specially jet grade fuel. After reviewing these various literatures, we can see that dissimilar forms of Pyrolysis processes have been employed for the conversion of plastic wastes to well-organized fuels and also successfully tested as well.

III. METHODOLOGY

Waste plastic collected form grocery store in Norwalk and Stamford. Collected waste plastic sample were low density polyethylene (LDPE), polypropylene (PP) and polystyrene (PS). Low density polyethylene was milk container red colour lid with ink printed, polypropylene waste plastic was transparent food container cap and finally polystyrene waste plastic was red colour drinking glass. Waste plastics collected contained foreign materials such as milk, food and liquid product. Raw waste plastic are cleaned with liquid detergent and water. During waste plastics cleaning period a waste water by product is created. This waste water cleaning and treating with coagulations process for reuse. This treatment is a cyclic process.Washed out waste plastics is dried using fan air. Dry waste plastic are cut into small pieces by using scissor for grinder machine. This waste plastic size is 3-4 inch. Waste plastic put into grinder machine at the end collected mixture of grounded waste plastic and size is 3-4 mm. Table 1 and table 2 showing waste plastic mixture percentage ratio for investigational process and carbon (C%), hydrogen (H%) and nitrogen (N%) percentage by Elemental analyser - 2400 equipment and ASTM test method was apply for CHN mode detection ASTM D5291.a. Table-2 EA-2400 results shown C, H and N percentage is less than 100% each underdone material. Because of waste plastics has other impurity when plastics making time manufacturing company are use as 4-5 % different types of additives.

Materials	Wt. %
Polystyrene (PS)	33.33
Low density polyethylene (LDPE)	33.33
Polypropylene (PP)	33.34

Table 1: Composition of the waste plastic mixture

Name of Materials	Carbon %	Hydrogen %	Nitrogen %
PS	78.60	07.21	<0.30
LDPE	85.33	14.31	<0.30
PP	79.83	14.17	<0.30

Table 2: Raw Materials Carbon, Hydrogen and Nitrogen percentage

A grounded waste plastics mixture was transfer into reactor chamber. A waste plastic to fuel production process thermal degradation process was applied and temperature range was 25 ºC to 390 ºC. During fuel production process vacuum system did not apply and catalyst or extra chemical did not added. Condensation unit was setup with reactor and no water circulation system was added. Reactor temperature capability range from 25 ºC to 500 ºC and experimental temperature controller was wat low system .LDPE waste plastic melting point temperature is 120 ºC, PP waste plastic melting point temperature is 160 ºC and PS waste plastic melting point temperature is 240 ºC. Based on three types of waste plastics melting point temperature experimental temperature profile was setup. Initial raw sample was start heat from 25 ºC and temperature increased gradually up to 390 ºC for fuel production. Waste plastics starts to melt when temperature is increased and turn into liquid slurry after that liquid slurry turn into vapour, volatile vapour passed through condenser unit, at the end collection liquid hydrocarbon fuel. Waste plastics sample melting point temperatures are different range temperature for that reason was used temperature from 25 ºC to 390 ºC. Temperature when goes up from 150 ºC to 260 ºC was notice that fuel was coming droopily and when temperature goes up to 300 ºC fuel production rate was increased and until finished experiment was monitored step by stepDuring manufacture period vacuum system was not apply to take out moisture for that reason carbon and water is generating carbon dioxide and it's come out with light gas and passed through alkali cleaning system. Also production period are creating some alcoholic group compounds. Ones start experiment heat moisture is come out with some light gas which is present methane, ethane, propane and butane mixture. These types of light gas is not condensing due to negative boiling point are present in this light gas compounds. These light gases pass through collection tank to alkali cleaning process then transfer into storage system for upcoming use or identification by using small pump. Whole production process finished time was 5-5.30 hours. Raw materials were used 3 types of waste plastics (LDPE/PP/PS) to fuel production process equal ratio wise. After finished testing process produced fuel was cleaned by using RCI technology provided RCI fuel purification system with 35 psi force and micron filter to remove all kind of fuel sediment. At the end liquid fuel was collected as final fuel and fuel density is 0.80 g/ml.

IV.THE BENEFITS OF PLASTIC FUEL

- To establish the basis for the development and implementation of waste plastics recycling with the application of Environmentally sound technologies (EST) to stimulate resource conservation and greenhouse gases (GHG)
- The aim of this continuous tackle was to convert LDPE and mixture of PE, PP and PS into gas and liquid fuels with maximizing the diesel range product.
- Reduce dependence on fossil fuel and conserve natural resources.
- Promote reuse of waste plastic thus providing alternative solutions to waste plastic disposal and simultaneous reduction in GHG emissions.
- Fuel cost control and saving is competitive advantage
- Improved site and labourutilisation.

4.1 Limitations

- Highly skilled manpower required.
- High initial investment.

4.2application& Scope

- **Furnace fuel (Furnace oil)**

• Wider applicability
• Lower production cost
• Less inflexible quality norms
• Easy storage regulations / norms
• Bulk Use
• Industry spread throughout the country

- **Sell as fuel (Like Diesel)**

• Larger, well established and fast growing market
• Better Margins as compared to boiler oil applications

• Good existing Distribution Network

- **Convert & sell as Electrical Energy**

• Easy or no marketing efforts of product

• Well controlled business

• Fuel quality control and engine tuning in owner's control

- **Captive Power plant with Converted Fuel**

• Smaller operations at individual levels, so lower investments, scatteredinvestment.

• Easy to controls

• Built & Operate model can work

V.CONCLUSION

Based on the revised paper for the performance and emissions of waste plastic Pyrolysis oil , it is concluded that the waste plastic Pyrolysis oil signifies a good alternative fuel for diesel and therefore must be taken into consideration in the future for transport purpose. plastics present-day a major hazard to today's society and environment. Over 14 million tons of plastics are dumped into the oceans annually, slaying about 1,000,000 species of marine life. Though mankind has awoken to this threat and replied with developments in generating degradable bio-plastics, there is still no decisiveexertion done to repair the damage already caused. In this respect, the catalytic Pyrolysis studied here grants an efficient, clean and very effective means of eliminating the foreign particles that we have left behind over the last several decades. By converting plastics to fuel, we solve two issues, one of the great plastic seas, and the other of the fuel deficiency. This dual benefit, though will occur only as long as the waste plastics last, but will assuredly provide a strong platform for us to build on a acceptable, clean and green future. By taking into account the economic benefits of such a project, it would be a great benefit to our economy. Consequently, 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 produce better results.

REFERANCE

[1] John William Bordynuik JBI, Inc.–Plastic2Oil ® 20 Iroquois, Niagara Falls Niagara Falls, New York , USA 14303

[2] Environmental Defense Agency. Common Wastes & Materials. Retrieved from, http://www.epa.gov/osw/conserve/materials/plastics.htm .Murugan S., Ramaswamy M.C. and Nagarajan G.,The use of tyre Pyrolysis oil in diesel engines, Waste Management, 28,(12),2743-2749 (2008)

[3] Senthilkumar Tamilkolundu 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)

[4] Walendzieuwski Jerzy, Engine fuel derived from waste plastics by thermal treatment, Journal of Fuel,81473-481 (2002)

[5] Williams P.T. and Williams E.A., Interaction of plastics in mixed plastics Pyrolysis, Journal of Energy and Fuels,13188-196 (1990)

 ISBN: 978-81-932074-7-5

[6] Mani M., Nagarajan G. and Sampath S., Characterisation and effect of using waste plastic oil and diesel fuel mixtures in compression ignition engine, Energy,36,212-219 (2011)

[7] Mani M. and Nagarajan G., Influence of injection timing on performance, emission and combustion characteristics of a DI diesel engine running on waste plastic oil, Energy, 34,1617–1623