PRODUCTION OF BIO FUEL COMPOUNDS FROM WASTE PLASTICS BY USING CATALYTIC PYROLYSIS PROCESS

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Abstract - — *As we know that world getting modernizing and industrializing day by day. Because of this vehicles and engines has been increasing rapidly from last 10 years and energy sources available to meet require demand get decreasing gradually in future days. Therefore this is the time to look at an alternative fuel for diesel engines and industries. In such consequence bio-diesel found that best source to replace situation and meet the require demand. In mean time, plastic production rate is also increasing. According to 2015 survey global production of plastics reached 333million metric ton and the plastic are non biodegradable and consist of long chain of molecules called polymers .Therefore, in this paper the waste plastics converted into bio-diesel compounds by using different method and properties are evaluated.*

***Key Words*: : Biofuel, Diesel fuel , Central Pollution Control Board (CPCB), Low density polyethylene (LDPE)**

1. INTRODUCTION

As world is growing, transport becomes essential part of life. The biggest problem is the growing population & depletion of fossil fuel. About 100 years ago, the major source of energy shifted from recent solar to fossil fuels. This necessitates the search for alternative of oil as energy source. Biodiesel is an alternative fuel for diesel engine. Worldwide plastics production increases 80 million tons every year. Global production and consumption of plastics have increased, from less than 5 million tons in the year 1950 to 260 million tons in the year 2007 [2]. Of those over one third is being used for packaging, while rest is used for other sectors. Plastic production has increased by more than 500% over the past 30 years. Per capita consumption of plastics will increase by more than 50% during the next decades. Plastic production requires large amounts of resources, primarily fossil fuels and 8% of the world's annual oil production is used in the production of plastics. Potentially harmful chemicals are added as stabilizers or colorants. Many of these have not undergone environmental risk assessment and their impact on human health and environment is currently uncertain. Worldwide municipal sites like shops or malls had the largest proportion of plastic rubbish items. Ocean soup swirling the debris of plastics trash in the Pacific Ocean has now grown to a size that is twice as large as the continental US. In 2006, 11.5 million of tons of plastics were wasted in the landfill [3].

Most plastics are non-biodegradable and they take long time to break down in landfill, estimated to be more than a century. Plastic waste also has a detrimental impact on wild life; plastic waste in the oceans is estimated to cause the death of more than a million seabirds and more than 100,000 marine mammals every year (US Environmental Program Estimate). Along with this hundreds of thousands of sea turtles, whalesand other marine mammals die every year eating discarded waste plastic bags mistaken for food. Setting up intermediate treatment plants for waste plastic, such as, plastic incineration, recycle, or obtaining the landfill for reclamation is difficult [3].Therefore it is necessary to use a wastes plastic to avoid such problems and conevernt onto useful bio diesel compounds by different methods.

1.1 Survey On Plastics Wastes

As per the estimate by Central Pollution Control Board (CPCB) the plastic consumption in India, is 8 million tons per annum and about 5.7 million tons of plastic is converted into waste annually (Rathi, 2006).The increase in production and consumption of plastic materials results in a constant plastic waste increase (UNEP, 2009). As a consequence in 2007, more than 250 million tons of plastic waste was produced (Jovanovic et al. 2009). Plastic materials are predominantly not biodegradable and having a low density makes them unfit for disposal in landfills (Aguado et al., 2007). Norway and Switzerland produced about 24.9 megatonnes of plastic waste (Mudgal et al., 2011). In 2009, around 230 million tonnes of plastic were produced and about 25% of these plastics were used in the European Union (EU) (Mudgal et al., 2011). This global figure has been increasing by an average rate of 9% since 1950 to a peak of 245 million tones in 2008. Polybags and other plastics items except PET in particular have been a focus, because it has contributed to host of problems in India such as choked sewers, animal death and clogged soils.

Globally, by 2050, plastic packaging production will be more than the overall plastic volumes today, according to a report by the World Economic Forum (WEF). Plastics' share of

global oil consumption is expected to more than treble to 20% between 2014 and 2050, and plastics' share of the global carbon budget will see an even steeper rise, from 1% to 15%. (Carbon budget is the amount of carbon emissions that can be allowed while maintaining a reasonable chance of limiting the temperature increase this century to 2 degree Celsius above pre-industrial levels.) An increase in recycling means a reduction in the dependence on virgin feedstock.

One of the worst consequences of plastic waste is a lot of it ends up in the ocean. Around 8 million tonnes of plastic waste enter the ocean every year, with Asian countries responsible for four-fifths of it, and at present there are 150 million tonnes in seas. The WEF report says in 2014 there was 1 kg of plastic in the ocean for every 5 kg of fish; by 2025 the ratio will worsen to one to three; and by 2050 plastic will exceed fish by weight.

From the estimation of CBCP in year 2010 to 2011around 3 hundred tonnes of plastic waste generated in every day. Figure 1 shows a Delhi alone produces 40% more plastic waste than other cities in a country.

1.2. Survey On Plastic Wastes In Bangalore City

CPCB has conducted a study in the year 2015 in Bangalore city . Total MSW that are generated in Bangalore city was about 3700 MT/Day. The survey was conducted at Mavallipura Dumpsite which has the average PW generation of 84.83Kg/MT Shown in Table 1. Around 93% of total plastics waste generated from HDPE/LDPE/LLDPE materials with the minimum plastic waste generation of 72.54 Kg/MT and Maximum of 97.12 Kg/MT

Table -1: Study of Bangalore City: PW(Kg/MT)

SL NO OF DAYS	PET	HDPE /LDPE	PVC	PP	PS	OTHER	Total
Day 1	2.1	90.8	1	0.64	0.88.	1.7	97.12
Day2	0.94	67.8	0.74	0.9	0.64	1.52	72.54
Average	1.52	79.3	0.87	0.77	0.76	1.61	84.83

2. METHOD AND METHODOLOGY

Following two major methods are used to converting plastic wastes into useful products such as a fuels

A. Thermal pyrolysis
B. Catalytic pyrolysis

A. Thermal pyrolysis

The non-catalytic or thermal pyrolysis of plastic is a high energy, endothermic process requiring temperatures of at least 350° C–500° C.Thermal cracking or Pyrolysis, involves the degradation of the polymeric materials by heating in the absence of oxygen [1]. The process is usually conducted at temperatures between 350° C and 500° C and results in the formation of a carbonized char (solid residues) and a volatile

B. Catalytic pyrolysis

Addition of catalyst enhances the conversion and fuel quality. As compared to the purely thermal pyrolysis, the addition of catalyst in pyrolysis. Significantly lowers pyrolysis temperatures and time. A significant reduction in the degradation temperature and reaction time [1] under catalytic conditions results in an increase in the conversion rates for a wide range of polymers at much lower temperatures than with thermal pyrolysis. Narrows and provides better control over the hydrocarbon products distribution in Low density polyethylene (LDPE), High density polyethylene (HDPE), polypropylene [5] and polystyrene pyrolysis. While thermal pyrolysis, results in a broad range of hydrocarbons ranging from C5 to C28, the selectivity of products in the gasoline range (C5, C12) are much more enhanced by the presence of catalysts. Again, oils obtained by catalytic pyrolysis contain less olefins and more branched hydrocarbon and aromatic content. Increases the gaseous product yields. Under similar temperatures and reaction times, a much higher gaseous product yield is observed in the presence of a catalyst for plastic wastes [3].

In this papers going use catalytic pyrolysis method to convert waste plastic into bio fuel . mainly two catalyst are used such as dry ash powder and dry wood powder. Dry ash powder mainly consists of carbon content that accelerate the chemical reaction and dry powder helps to catch the fire easily and enhance the conversion of plastic waste into bio fuel compounds.

2.1. Biodiesel production unit

Pyrolysis unit developed from MS materials with 5mm thickness. By using arc and gas welding technology, we are fabricating the above pyrolysis unit. The experiments carry out with high temperature and atmospheric pressure so unit must be withstanding to high temperature. Professional

Thermocouples, pressure gauge and safety valves are provided to reactor. Reactor welded by using gas welding to prevent the leakage of vapours. The safe and efficient pyrolysis unit is shown in the above Fig.3

Fig 1: Pyrolysis unit to produce biodiesel

Fig 2: Waste Plastics

Fig 3: Waste Carbon Residue

2.2 Steps involved in process

1. **Feeding-** Feed the feedstock's to reactor through feeder and closes the feeder inlet.

2. **Heating-** To increase the temperature of reactor, heat the product of reactor inside by using heating source.

3. **Condensing-** The plastic get evaporated at high temperature, this vapor is condensed to atmospheric temperature by using straight and spiral tube condensers.

4. **Liquid collection-**Out coming product from the condenser is collected at liquid collector. At the end of condenser provide a cyclone separator to separate the plastic liquid fuel and noncondensible gases. These noncondensible gases are reuses to heat the pyrolysis unit.

5. **Water wash, Purification and pH test**- This involves many purification processes. In this method we take equal proportion of plastic fuel and water in a container and shake well, allow it for 5-7 hours to settle down. Now water alongwith some crystals is collected at bottom and pure plastic fuel is collected at the top container.

6. **Purification-** Purify the plastic fuel by using filter papers and vacuum machine.

7. **pH Test-** After purification measure the pH value of plastic fuel by using pH meter. If the pH is less than 7, the fuel is acidic in nature. It is needed to wash with dilution of potassium hydroxide or sodium hydroxide to bring pH value at 7.

2.4 RESULTS AND DISCUSSION

Following bio fuel yields are obtained for waste plastic by using a catalytic paralysis process
table: Liquid fuel yields by using catalytic pyrolysis process

Table -2: Liquid fuel yields by using catalytic pyrolysis process

Type of condenser	Types of feedstock	Yield of liquid product	Residue
Straight Tube condenser	Plastic covers	45% – 58%	4.5% – 5%
	Medicine bottles	36% - 45%	4.5% - 6%
	Edible oil cover	66% - 70%	5.6% -6 %

Table -3: Properties of the different plastic fuel blends

PARAMETERS	DF100	PF100
Flash point (°C)	57	73
Fire point (°C)	59	82
Kinematic viscosity at 40°C (mm^2/s)	2.83	7.29
Density at 40°c (kg/m^3)	812	821.32
Calorific value (MJ/kg)	44.81	41.112

3. CONCLUSIONS

By adopting this technology, efficiently convert weight of waste plastics into 65% 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.

1. The biodiesel obtained from different plastics will clear and satisfactory.

2. The pyrolysis process is use to convert plastics into useful liquid fuel compounds such as biodiesel.

3. Plastic fuel and their different blends produce about lesser carbon monoxide and unburnt hydrocarbon emissions than diesel fuel, while nitrogen oxide emissions are higher than diesel fuel.

4. Produced biofuel compounds can use for use various application.

5. The production of plastic fuel from different plastics on a large scale can be beneficial economically.

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