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Energy from Waste Plastic

Saurabh Pande[1], Rahul Argelwar[2], Dharmendra Gandhi[3]

[123]*Assitant Professor*
[12]*Dept. of Electrical Engineering and* [3]*Dept. of Civil Engineering, DMIETR, Wardha-442001*

Abstract- *Solid waste management is a major challenging issue causing health hazards to all living beings and pollutes environment .Huge amount of plastic waste are one of the dominant and non biodegradable content of solid waste. Conventional methods of disposal of plastic waste includes sanitary land filling degrades the environment. Thus recycling of waste plastic is one of the remedy. This paper elaborates thermal and catalytic decomposition of plastic waste by using pyrolysis process. The reaction is carried out in the combustion chamber. The residue obtained from the above, further synthesized can be used as a byproduct and as alternative source of energy thereby resolving fuel problem along with environmental issue.*

Keywords-*Solid Waste Management, Pyrolysis*

I-INTRODUCTION

Plastic was invented in the 1936 and many researches after that were made to obtain its different types. It has become the essential element in our day to day life because of its magnificent property moulding, Due to which it can be moulded in any shape. Average Plastic Production has been increased by 10% globally and in India rate of Production increased by 17% than the other country due to the fact that consumption of plastic products are more due to less cost of production than the other available items like glass, rubber so middle class Family rely on Plastic products for satisfying their needs. To meet our nation's economic and environmental goals, We needs a comprehensive energy policy that draws on our nation's diverse energy supplies, including renewable and alternative sources such as energy recovery from plastics. Technologies today are able to recover the energy contained in plastics. Plastics have a high energy content that can be converted to electricity, synthetic gas, fuels and recycled feedstock for new plastics and other products of chemistry. Recovering this abundant energy also reduces waste sent to landfills and complements plastics recycling. Energy recovery is rapidly becoming viewed as another source of clean or renewable energy. Plastics have become a major threat due to their no biodegradability and high visibility in the waste stream. Littering causes clogging of drains and serious health issues. Plastic waste has attracted. Wide spread attention in India, particularly in the last five years, due to the widespread littering of plastics on the landscape of India. The environmental issues due to plastic waste arise predominantly due to the throwaway culture that plastics propagate, and also the lack of an efficient waste management system.

II-LITERATURE REVIEW

Antony Raja (2011) explains the utilisation of plastic waste by recycling it and using by product as a fuel thereby solving the problem of overflowing bins and land filling problems.

Rima Ingle (2014) Elaborates the process of conversion of plastic waste to energy since it comprises of majority of organic polymers made up of carbon and other elements.

Prajakta Sontakke (2014) Plastic composed of small hydrocarbon chain molecules along with other chain that posses different properties so decomposition i.e gasification and catalytic pyrolysis decomposes the plastic into small chain of hydrocarbon i.e naphtha, diesel etc which is widely used in automobiles.

Ravi D Bumtariya (2014) Categorised the waste plastic based on their types from municipal solid waste collected and graded into uniform size by machines i.e cutter & shredder.

Mohamed M.Garib Alla (2014) Elaborates health and environmental hazards faced by authorities in the Khartoum State (Sudan).

G.kirubakaran (2015) Focused on alternative fuel for vehicles due to depletion of oil reservoirs and present fuel used were violating emission norms.

Nitul Limbasiya (2015) Civilization and Development led to increasing plastic waste generation.

Vikas Mukhraiya (2015) In this decomposition of plastic waste High and low density polythene is decomposed in the combustion chamber, at 110 to 300 degree Celsius for 1hour.The byproduct obtained posses similar properties like petrol after investigation such as viscosity, density,

specific gravity, flash point, fire point, cloud point, or pour point .

Sunbong Lee (2015) Waste plastic can be transformed to oil by the pyrolysis and it may be applicable as a fuel for diesel engines. The pyrolysis oil property varies depending on the raw waste plastic and the pyrolysis condition, which is different from that of diesel and gasoline.

Dhawal Soni (2015) Decomposition of Waste plastic converts organic compounds into useful liquid hydrocarbon Product that can be utilized as energy source for many purposes such as in diesel engines, generators, vehicles and etc.

Raj Kumar Yadav (2016) 100million tones of plastics are produced annually have become a common feature at overflowing bins and landfills.

Presently plastic waste is used to get the fuel and electricity. But to obtain the electricity from the plastic the waste is burnt in furnace to obtain heat like the coal power plant, this will generate some toxic gases and increase the global temperatures too. This both plants are bulky and require their own space which is another problem. The Plastic has the organic origin. So, it can be converted back to its original form by certain procedure. According to the study the process called Pyrolysis can be used for this conversion. Our project is on this we have done some work over plastic to get the best efficiency. And the best process to get maximum from the waste. As the world is facing the huge problem regarding to plastic thus, there is much need to find out the effective and convenient way to recycle or reuse this plastic. The main motive of our project is to protect the environment from this "giant plastic waste". Another objective of our project is to deal with the drawbacks in the conventional working plant and providing mankind the efficient and cheap way to utilize this plastic waste. To design and fabricate the plant in order to reduce the size and increase the efficiency of the plastic to energy plant.

III. METHODOLOGY

In the traditional process of obtaining electricity the harmful gases are liberated due to process of combustion. The conversion of plastic to the vapor form is smartly done by the process named as Pyrolysis. In which the exhaust of toxic fumes is nearly zero. This makes the thing eco-friendly, the converted plastic is going to be utilized for both the purposes electricity as well as fuel.

Condensation polymers which include materials such as polyamides, polyesters, nylons and polyethylene erephthalate can be depolymerised via reversible synthesis reactions to initial diacids and diols or diamines. Typical depolymerisation reactions such as alcoholysis, glycolysis and hydrolysis yield high conversion to their raw monomers. However, addition polymers which include materials such as polyolefins, typically making up 60–70% of municipal solid waste plastics, cannot be easily depolymerised into the original monomers by reverse synthesis reaction.

PYROLYSIS PROCESS

Pyrolysis is generally defined as the controlled burning or 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 monomeric units.Further degradation of these subsequent molecules depends on a number of different conditions including (and not limited to) temperature, residence time, and the 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 polyolefins, so extensive research has been done on this polymer which is summarised as Below. Thermal pyrolysis of polyolefins The non-catalytic or thermal pyrolysis of polyolefins is a high energy, endothermic process requiring temperatures of at least 350–500 8C [10-12]. In some studies, temperatures as high as 700–900 8C are essential in achieving decent product yields [13–15].Thermal pyrolysis of both virgin and waste plastics as well as other hydro-arbonaceous sources has been studied extensively in the past. A good number of these thermal cracking studies are on polyethylene [16–20], polystyrene and polypropylene [21-23]. On the other hand, only a few have worked on the thermal ecomposition of other common plastics such as polyvinylchloride [26,27], polymethyl methacrylate, polyurethane [28] and polyethylene terephthalate [27].Generally, thermal cracking results in liquids with low octane value and higher residue contents at moderate temperatures, thus an inefficient process for producing gasoline range fuels [28,22]. The gaseous products obtained by thermal pyrolysis are not suitable for use as fuel products, requiring further refining to be upgraded to useable fuel products [29,30]. A few researchers have sought to improve thermal pyrolysis of waste polyolefins without employing the use of catalysts; however these changes either yielded insignificant improvements or added another level of complexity and costs to the system [22-23].Catalytic cracking of polyolefins

Addition of catalyst enhances the conversion and fuel quality.As compared to the purely thermal pyrolysis, the addition of catalyst in polyolefin pyrolysis.

(1) Significantly lowers pyrolysis temperatures and time. A significant reduction in the degradation temperature and reaction time [32] 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 [21-25].

(2) Narrows and provides better control over the hydrocarbon products distribution in Low density polyethylene (LDPE) [26,27], High density polyethylene (HDPE), polypropylene [28,29] and polystyrene [31] pyrolysis. While thermal pyrolysis, results in a broad range of hydrocarbons ranging from C5 to C28 [28], 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 [32,33].(3) Increases the gaseous product yields. Under similar temperatures and reaction times, a much higher gaseous product yieldis observed in the presence of a catalyst for polyethylene.

[64,74]. CH_2 O(dry plant matter) +Heat → black carbon$H_2 + CO + CH_{4+}$ + hydrocarbons

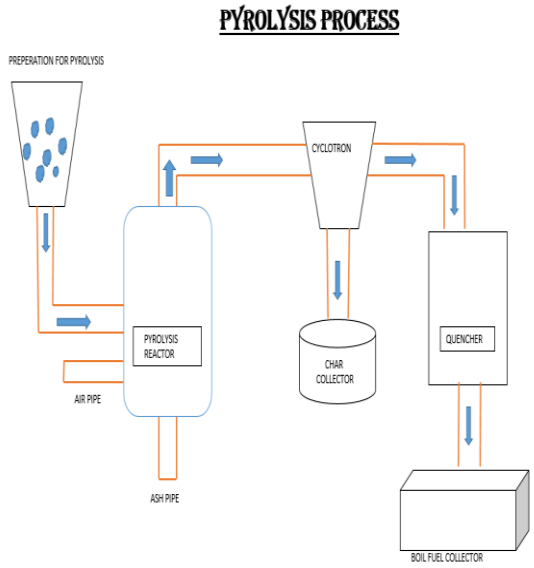

Fig.3: Experiment setup of Pyrolysis Process

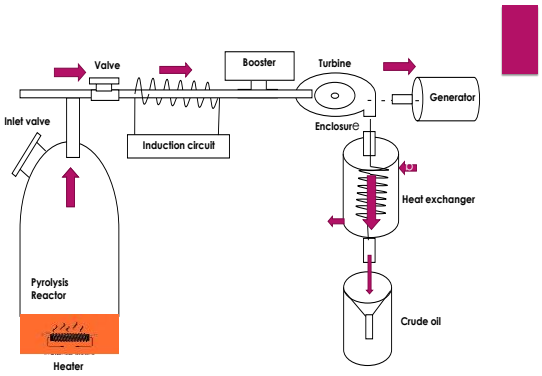

Fig.2: Work layout of Pyrolysis Process

The major impact of our project is on the environment it help the environment in following way:-

a) It reduces the non-biodegradable plastic waste on the earth which is present on earth from decades.

b) Helps the power grids to supply every person on the earth.

c) Provide fuel with almost zero pollution.

d) It helps the industries and the nation to develop economically.

e) It can be implemented by any private or government industry for the global health.

Sr. No.	Equipment	Material	Dimension(approx.)
1	Reactor	Iron	31*61 Cm
2.	Induction Circuit	Electrical component	NA
3.	Heat Exchanger	Copper	0.7*31 Cm

IV. RESULT AND FUTURE SCOPE DISCUSSION

The experiment is performed for 1000gm plastic.

Effect of temperature on product yield. The product are separated into gas, oil and char residue by pyrolysis of waste plastic.

After performing the experiment we can obtain following quantity of fuel.

Sr. No.	Without Catalyst*	With Zeolite *	With* Al_2O_3 + SiO_2	With* Al_2O_3
Test 1	63.5 ml	95.3 ml	98.5 ml	70 ml
Test 2	61.2 ml	96 ml	98 ml	73 ml

Results are obtained by performing the experiment on the setup:-

Properties	Fuel Obtained
Viscosity at 40^0C (cST)	1.980
Density at 40^0C (g/cc)	0.7477
Carbon residue (wt%0	0.5
Ash contain%	0.036
Flash Point (C)	15
Fire Point (C)	20
Calorific Value (kcal/kg)	9829.35

Effect of temperature on yield of fuel:-

There was on output at low temperature range and the process was carried out between the temperature range of 330 and 490 Degree Celsius in the reactor for about two hours and forty minutes. The vapour product of pyrolysis was carried out through two condensers. The condensers were cooled by water and the condensed oil was collected into two collectors. Therefore, the temperature mention may have appeared small in amount as compare to convenient system.

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