Design Analysis and Manufacturing of Plastic Fuel Pyrolysis

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Abstract— Plastic has woven its way in our daily life and is now a tremendous threat to the environment. more than one. Worldwide, 100 million tons of plastic are produced annually, and the use of the product has become a common feature. Overflow has been made to make futuristic biodegradable plastics through work, on cans, and landfills. There have not been many decisive steps towards cleaning the existing problem. The process of converting waste. In value-added fuel, the plastic is explained as a viable solution for the recycling of plastic, thus two universal. Problems like the problem of waste plastic and the problem of fuel deficiency are being linked to it. This can be solved by the Plastic Fuel Pyrolysis plant. Pyrolysis was used to obtain fuel oil to study plastic wastes, which have the same physical properties as fuel Petrol, diesel, etc. The pyrolysis is the heating substance in the absence of oxygen. In this study 4300 Celsius temperature needs. 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 provide 60% oil for diesel vehicles. The fuel does not emit sulfur dioxide. (SO2). It increases machine efficiency. The 5% residue is obtained which is carbon block.

Keywords: Pyrolysis, Plastic Waste, Fuel and Environmental Problems

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 thermosets (not). The word "plastics" generally applies to the synthetic products of chemistry. More than 15,000 tones of plastic waste are generated in India every day, 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 percent was collected, and 27 percent was treated, and the remaining 73 percent disposed of at dumpsites. "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 of waste plastic is pyrolysis. The pyrolysis is the heating substance in the absence of oxygen. In this study 4300 Celsius temperature needs. 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 provide 60% oil for diesel vehicles. The fuel does not emit sulfur dioxide. (SO2).

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 made-up by the repetition of a simple unit. For example, the structure of polystyrene can be written in a form as shown in figure (polystyrene structure).

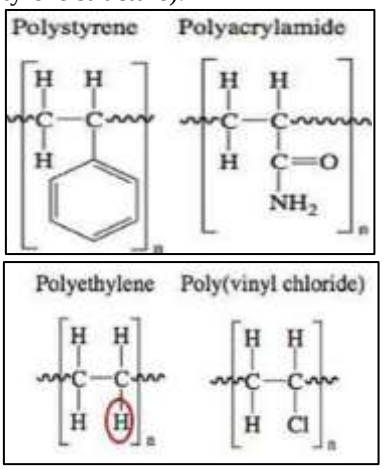

Fig. 1: polystyrene structure

II. SCENARIOS OF PLASTIC WASTE MANAGEMENT

Due to the population increase, the demand for plastic products has steadily increased over the last 40 years. Since plastics are non-biodegradable, they cannot be easily returned to the natural carbon cycle; hence the life cycle of plastic materials ends at waste disposal facilities [4]. There are several methods for disposal of municipal and industrial plastic waste, i.e. landfill, incineration (energy recovery), true material recycling (similar recycled product or monomer recovery), and chemical recovery [5]. The suitable treatment of plastic wastes is one of the. This figure varies from country to country, however, they are approximately nearer to it with some exception. In Japan, the percentage of municipal plastic wastes, as a fraction of MSW, that was landfilled in the early 1980s was estimated to be 45%, incineration was 50%, and the other 5% was subjected to separation and recycling. In the USA, more than 15% of the total MSW was incinerated in 1990; only about 1% of post-consumer plastics were recycled. In India, during 1998 around 800,000 tonnes representing 60% of plastic wastes generated in India were recycled involving 2000 units. This level of recycling is the highest in the world. The corresponding figure for Europe is 7%, Japan 12%, China 10%, and South Africa 16%. In Europe, 2006 marks a milestone as the first year when recovery and disposal rates of used plastic were equal. The recovery rate of post-consumer end of life plastics now stands at 50% and disposal stands at 50%. The recycling rate for post-consumer plastics has increased to 19.7% up from 18% in 2005 and energy recovery has increased to 30.3% up from 29% in 2005. Of the 11.5 million tonnes recovered 4.5 million tonnes were recycled as material and feedstock and

7.0 million tonnes were recovered as energy. The overall material recycling rate of post-consumer plastics in 2006 was 19.7%, with mechanical recycling at 19.1% (up 2.5% point over 2005) and feedstock recycling at 0.6% (down 1% from 2005). The energy recovery rate was up by 1.5% from 2005 to 30.3%, reflecting the stricter legislation on a landfill in the several Member States [8]. From the above recent data, it is clear that there is an increase in the recycling operation (material and energy) compared to landfilling due to strict regulations and growing awareness.

III. PYROLYSIS OF PLASTIC

Pyrolysis is the process of thermal degradation of plastics in the absence of oxygen.

Principle Of Pyrolysis

- All plastics are polymers mostly containing carbon and hydrogen and few other elements like chlorine, nitrogen, etc.
- When this long chain of polymers breaks at certain points, or when lower molecular weight fractions are formed, this is termed as degradation of polymers. This is the reverse of polymerization.
- If such breaking of long polymeric chain occurs randomly, it is called Random depolymerization.
- In the process of conversion of waste plastics into fuels, random depolymerization is carried out in a specially designed reactor in the absence of oxygen and the presence of coal and certain catalytic additives. The maximum reaction temperature is 350°C. There is a total conversion of waste plastics into value-added fuel products.

IV. METHODOLOGY

Pyrolysis process for conversion of waste plastic into fuel Pyrolysis is the chemical decomposition of organic substances by heating the word is originally coined from the Greek-derived elements pyro "fire" and lysis "decomposition". Pyrolysis is usually the first chemical reaction that occurs in the burning of many solid organic fuels, cloth, like wood, and paper, and also of some kinds of plastic. The anhydrous Pyrolysis process can also be used to produce liquid fuel similar to diesel from plastic waste. Pyrolysis technology is the thermal degradation process in the absence of oxygen. Plastic waste is treated in a cylindrical reactor at a temperature of 300ºC – 350ºC. Nowadays plastics waste is very harmful to our nature also to human beings .plastic is not easily decomposable its effect in fertilization, atmosphere mainly affects on ozone layer so it is necessary to recycle these waste plastic into useful things .so we recycle this waste plastic into a useful fuel.

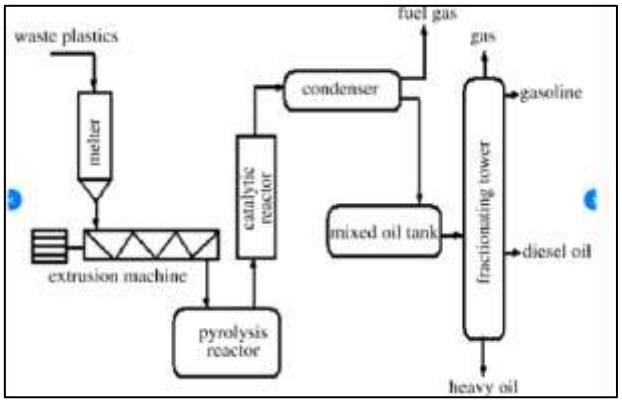

Fig. 2: Pyrolysis Plant

V. WASTE PLASTIC PYROLYSIS

Pyrolysis is the chemical decomposition of organic substances by heating the word is originally coined from the Greek-derived elements pyro "fire" and lysis "decomposition". Pyrolysis is usually the first chemical reaction that occurs in the burning of many solid organic fuels, cloth, like wood, and paper, and also of some kinds of plastic. The anhydrous Pyrolysis process can also be used to produce liquid fuel similar to diesel from plastic waste. Pyrolysis technology is the thermal degradation process in the absence of oxygen. Plastic waste is treated in a cylindrical reactor at a temperature of 300ºC – 350ºC. The plastic waste is gently cracked by adding a catalyst and the gases are condensed in a series of condensers to give a low sulfur content distillate. All this happens continuously to convert the waste plastics into fuel that can be used for generators. The catalyst used in this system will prevent the formation of all the dioxins and Furans (Benzene ring). All the gases from this process are treated before it is let out in the atmosphere. The flue gas is treated through scrubbers and water/ chemical treatment for neutralization. The non-condensable gas goes through water before it is used for burning. Since the Plastics waste is processed about 300ºC - 350ºC and there is no oxygen in the processing reactor, most of the toxics are burnt. However, the gas can be used in a dual-fuel diesel generator set for the generation of electricity. This process applied for petrol and diesel grade fuel production processes. Waste plastic to fuel was used for further distillation process and making petrol and diesel grade fuel. The distillation column is used for the distillation process. The distillation process set up different columns with different temperature profiles like low boiling point fuel to high boiling point fuel. Petrol grade fuel collected from 1st fractional column and temperature range was 90°C to 130°C. Diesel grade fuel collected from the 2nd fractional column and temperature range was 250°C to 285°C. In the distillation process, 2nd-grade fuel was diesel fuel and diesel fuel density 0.80 g/ml. This fuel hydrocarbon compound also heavier and this fuel is not igniting. The collected diesel grade fuel percentage was 30%, petrol grade fuel percentage was 60% and the rest of all light gas percentage was 10% including light gas also. The fractional distillation process was also generating some light gases. Light gas cleaning procedure also the same above procedure. Plastic pyrolysis fuel to different fuel by using fractional distillation column

used for heat applied with different column temperature-wise and fuel break down into shorter into longer chain wise and come out into different fraction column then collected.

VI. ADVANTAGES

- Waste plastic is converted into high-value fuels. Environmental pollution is controlled.
- Industrial and automobile fuel requirements shall be fulfilled to some extent at a lower price.
- No pollutants are created during cracking it.

VII. PHYSICAL PROPERTIES OF FUEL DERIVED FROM WASTE PLASTIC

The city-based Sustainable Technologies & Environmental Projects (STEPS) plans to set up a plant to convert plastic waste into light diesel, petrol, calorific value combustible gas, and carbon pellets. Pune Municipal Corporation, India is planning on running a pilot project that will convert plastic into fuel for generators.

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.

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