# Development of Prototype Plant for Generating Viable Energy from Waste: A Review

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***Abstract*** **- The need for viable fuel is growing day by day, be it for the power plants, use in automobiles, grain dryers, generators or any other application. But the continuous dependence and use of these fossil fuels has increased the load on the reserves. It has been predicted that by the year 2050 the shell reserves would reach a critical low and when they get exhausted it may hinder the daily way of life. To tackle this problem alternative fuel such as bio-diesel is being tested for sustainability but there still is a need for more and more fuel looking at the way we are developing ahead. The other problem we are currently facing is Plastic Pollution. Since the advent of plastic it has found an inseparable part in human life but due to its properties I has been problematic for some time. Plastic cannot degrade as it is a non-organic product and due to this reason it has accumulated over the years. The rate at which we use plastics and dispose them in an unhealthy way, the future streets may be covered with layers of plastic. Plastic is also harming the fauna as many animals tend to consume polythene bags or solid plastics which results in choking and death. Hence it is necessary to find a way to safely dispose plastic waste while also looking for a way to create alternative fuels. The process of Plastic Pyrolysis comes handy when we need to satisfy these aims. In this study a review of Plastic Pyrolysis processes has been carried out which can be used to generate fuel to satisfy human needs.**

***Keywords*** **- Plastic, Pyrolysis, LDPE (Low Density Polyethylene), Alternative Fuel, Compression Ignition Engines, Diesel Fuel.**

## I. INTRODUCTION

Compression Ignition engines or Diesel engines are an important aspect of the modern world. Since their inception in 1892 by Rudolph Diesel, they have found a variety of uses. Diesel engines are used in automobiles, generators, trains and development of Diesel engine for motorbikes has also started. This is a mere example of how much our life has revolved around fossil fuels. As the shell reserves keep on decreasing daily in the Gulf and other fuel rich countries, they have started looking for an alternative to support their economy. The same way there is a need to look for alternative fuels to feed the need for constant use of these applications. There are various types of alternative fuels such as alcohols, bio-diesel and pyrolysis fuel which is finding a growing share in the diesel fuel market. Alcohol such as methanol is being used in Indy Car racing, bio-diesel obtained from plants has proved its worth in engines by giving results close to contemporary fuels. Pyrolysis oil can be obtained from rubber, paper, wood and plastic. Plastic fuel obtained by pyrolysis of waste plastic is currently being tested for use in diesel engines and its sustainability is an important aspect for future generations.

Plastic has become an increasing menace since its inception. It has been found that only 8% of waste plastic is recycled by the United States, around 15% in the Europe and even less in developing countries. Studies show that 500 billion pounds of brand new plastic is manufactured on a yearly basis and on an average only 33% of that plastic is single use and throw. Due to technical drawbacks or inconvenience of recycling, extra-ordinary amounts of plastic is being dumped in landfills and since plastic is non bio-degradable it may lie there for thousands of years. The data sourced from National Institute of Environmental Research around 3.44 million tons of plastic waste was generated in Korea in the year 2002. Regarding the methodology of recycling around 50% weight by weight was by incineration, 30% weight by weight was by landfills and the rest 20% weight by weight was by recycling. Pyrolysis was one such method of recycling.

## II. PROCEDURE

The word pyrolysis is obtained from Greek words Pyro meaning ‘Fire’ and Lysis meaning ‘Separation’. It is a thermochemical process in which plastic waste is heated in a chamber which causes changes in chemical composition and physical phase and it is an irreversible process. The process can be carried out in presence of oxygen i.e. aerobically or in absence of oxygen i.e. anaerobically. The process which has been reviewed in this paper is carried out on LDPE (Low Density Polyethylene) plastics. This process can be carried out on different kinds of plastics and the yield obtained differs for each type of plastic. The waste plastic is first shredded and then added to the heating chamber. The chamber is then closed and heated from the bottom. The working temperature range for LDPE plastics is 150-420 degree Celsius. The melting point of LDPE plastics is around 120 degree Celsius and at around 150 degree Celsius the fumes start emerging from the waste plastic which then gets condensed in a condenser. This condensed liquid oil obtained is in the crude form thus it cannot be directly used in engines or generators, it needed to be purified. This crude oil consists of various hydrocarbons which have different complexities. These hydrocarbons

have different condensation point according to their complexities. For fractionation process fractionating column is used. The different temperatures at which different types of yields are obtained are given below:

Table 1: Temperatures at which yields are obtained.

| Yield Obtained | Temperature |
|---|---|
| Gasoline Grade | 40 – 65 |
| Naptha Chemical Grade | 110 – 135 |
| Kerosene Grade | 180 – 205 |
| Diesel Fuel | 260 – 285 |
| Fuel Oil | 340 – 365 |

According to one study it has been found that for 500 grams of LDPE plastic undergoing pyrolysis gives the following yields[1] :

Table 2: Quantity of yield obtained.

| Yield | Quantity (Grams) |
|---|---|
| Gasoline Grade | 50 |
| Naptha Grade | 100 |
| Kerosene Grade | 150 |
| Diesel Grade Fuel | 100 |
| Fuel Oil | 50 |
| Light Sample | 30 |
| Leftover Residue | 20 |

The collected kerosene fuel was purified by RCI technology provided RCI purification system and from this fuel unnecessary elements such as water, ash and sediment part.

## III. CONCLUSION

Many European countries have been using this recycling technique to produce diesel type fuel from plastic because of this the problem of plastic dumping is reduced and alternative fuel is obtained. This is the only alternative to the fossil fuels which can be used directly in the internal combustion engines. The ash and emissions from the fuel produced is also under the permitted emission levels. The quality of the fuel obtained from this process is much better than the conventional fuel in the boilers used in industries. The difference of its quality is shown in the table below[1]:

Table 3: Emission of waste gases.

| Chemicals | Boiler Fuels | Fuel from plastic |
|---|---|---|
| Sulphur | 4% | 0%(<4 ppm) |
| Sediment and water | 1% | 0% |
| Carbon residue | High | Low |

The sulphur content of this fuel is very low thus it is cleaner than conventional fuels. Because of low sulphur contents in the fuel the emission is low thus the advanced emission control unit in the engine or boiler can be removed reducing its bulk in the assembly.

## IV. ACKNOWLEDGMENT

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