A REVIEW ON THE PYROLYSIS OF PLASTICS IN DIFFERENT CONDITIONS USING DIFFERENT CATALYSTS

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ABSTRACT: The use of plastic products caused by sudden growth in living standards had a remarkable impact on the environment. Plastics have now become indispensable materials, and the demand is continually increasing due to their diverse and attractive applications in household and industries. Economic growth and changing consumption and production patterns are resulting into rapid increase in generation of waste plastics in the world. Plastic waste recycling can provide an opportunity to collect and dispose of plastic waste in the most environmental friendly way and it can be converted into a resource. The Pyrolysis is most economical method of recycling the plastic in which thermo chemical decomposition of organic material at elevated temperatures in the absence of oxygen (or any halogen).
Keyword: Environment, thermoplastic, polymer, cost, health.

I. INTRODUCTION

The increase in use of plastic products caused by sudden growth in living standards had a remarkable impact on the environment. Plastics have now become indispensable materials, and the demand is continually increasing due to their diverse and attractive applications in household and industries. Mostly, thermoplastics polymers make up a high proportion of waste, and this amount is continuously increasing around the globe. Hence, waste plastics pose a very serious environmental challenge because of their huge quantity and disposal problem as thermoplastics do not biodegrade for a very long time. The term "plastic" covers a wide range of synthetic polymer materials. What they have in common is that they are all made by joining together or "polymerizing" a bunch of molecules (monomers). There are two main families of plastics, thermosetting and thermoplastics. The consumption of plastic materials is vast and has been growing steadily in view of the advantages derived from their versatility, relatively low cost, and durability (due to their high chemical stability and low degradability). Some of the most used plastics are such as polyethylene and polypropylene, which have a massive production and consumption in many applications such as packaging, building, electricity and electronics, agriculture, and health care .In turn, the property of high durability makes the disposal of waste plastics a very serious environmental problem, land filling being the most used disposal route. Plastic wastes can be classified as industrial and municipal plastic wastes according to their origins; these groups have different qualities and properties and are subjected to different management strategies.

Plastic materials production has reached global maximum capacities leveling at 260 million tons in 2007, where in 1990 the global production capacity was estimated at 80 million tons. Plastic production is estimated to grow worldwide at a rate of about 5% per year . Polymer waste can be used as a potentially cheap source of chemicals and energy. Due to release of harmful gases like dioxins, hydrogen chloride, airborne particles, and carbon dioxide, incineration of polymer possesses serious air pollution problems. Due to high cost and poor biodegradability, it is also undesirable to dispose by landfill. Recycling is the best possible solution to the environmental challenges facing the plastic industry. These are categorized into primary, secondary, tertiary, and quaternary recycling. Chemical recycling, that is, conversion of waste plastics into feedstock or fuel has been recognized as an ideal approach and could significantly reduce the net cost of disposal. The production of liquid hydrocarbons from plastic degradation would be beneficial in that liquids are easily stored, handled, and transported. Various methodologies have been tried and tested to process waste plastics for many years, with recycling becoming the most common method reflecting today's environmental requirements. Liquefaction of plastic is a superior method of reusing this resource. The distillate product is an excellent fuel and makes ThermoFuel one of the best, economically feasible and environmentally sensitive recycling systems in the world today.

II. THERMOFUEL SYSTEM SUTABILITY

Polyethylene(PE) Very good.
Polypropylene (PP) Very good.
Polystyrene (PS) Very good.
ABS resin (ABS) Good.
Fiber Reinforced Plastics (FRP) Fair.
PET Not suitable.
Polyvinylchloride (PVC) Not suitable

A. Typical Examples of Waste Plastics for the Thermo Fuel Process:-

Thermo Fuel can process commingled and miscellaneous waste plastics such as:
1.Plastic packaging scrap from material recovery/sorting facilities.
2.Oil and detergent bottles.
3.Off-cuts/trimming from nappy production.
4.Mulch film and silage wrap.
5.Mixed post-consumer plastics.
6.Caps/labels/rejected bottles from bottle recycling

operations.
7.Commercial stretch and shrink wrap.

III. PROBLEM IDENTIFICATION

Economic growth and changing consumption and production patterns are resulting into rapid increase in generation of waste plastics in the world. In Asia and the Pacific, as well as many other developing regions, plastic consumption has increased much more than the world average due to rapid urbanization and economic development. The world's annual consumption of plastic materials has increased from around 5 million tonnes in the 1950s to nearly 100 million tonnes; thus, 20 times more plastic is produced today than 50 years ago. This implies that on the one hand, more resources are being used to meet the increased demand of plastic, and on the other hand, more plastic waste is being generated. Due to the increase in generation, waste plastics are becoming a major stream in solid waste. After food waste and paper waste, plastic waste is the major constitute of municipal and industrial waste in cities. Even the cities with low economic growth have started producing more plastic waste due to plastic packaging, plastic shopping bags, PET bottles and other goods/appliances using plastics the major component. This increase has turned into a major challenge for local authorities, responsible for solid waste management and sanitation. Due to lack of integrated solid waste management, most of the plastic waste is neither collected properly nor disposed of in appropriate manner to avoid its negative impacts on environment and public health and waste plastics are causing littering and chocking of sewerage system. On the other hand, plastic waste recycling can provide an opportunity to collect and dispose of plastic waste in the most environmental friendly way and it can be converted into a resource. In most of the situations, plastic waste recycling could also be economically viable, as it generates resources, which are in high demand. Plastic waste recycling also has a great potential for resource conservation and GHG (greenhouse gases) emissions reduction, such as producing diesel fuel from plastic waste. This resource conservation goal is very important for most of the national and local governments, where rapid industrialization and economic development is putting a lot of pressure on natural resources. Some of the developed countries have already established commercial level resource recovery from waste plastics. Therefore, having a "latecomer's advantage," developing countries can learn from these experiences and technologies available to them. To raise the awareness and to build the capacity of local stakeholders, UNEP has started to promote Integrated Solid Waste Management (ISWM) system based on 3R (reduce, reuse and recycle) principle. This covers all the waste streams and all the stages of waste management chain, viz.: source segregation, collection and transportation, treatment and material/energy recovery and final disposal. It has been shown that with appropriate segregation and recycling system significant quantity of waste can be diverted from landfills and converted into resource. Developing and implementing ISWM requires comprehensive data on present and anticipated waste situations, supportive policy frameworks, knowledge and capacity to develop plans/systems, proper use of environmentally sound technologies, and appropriate financial instruments to support its implementation.

IV. METHODOLOGY

The main process that we use in this experiment is Pyrolysis and Catalytic Cracking.
Pyrolysis is a thermochemical decomposition of organic material at elevated temperatures in the absence of oxygen (or any halogen). It involves the simultaneous change of chemical composition and physical phase, and is irreversible. The word is coined from the Greek-derived elements pyro means "fire" and lysismeans "separating". Fluid catalytic cracking (FCC) is one of the most important conversion processes used in petroleum refineries. It is widely used to convert the high-boiling, high-molecular weight hydrocarbon fractions of petroleum crude oils to more valuable gasoline, olefinic gases, and other products. Cracking of petroleum hydrocarbons was originally done by thermal cracking, which has been almost completely replaced by catalytic cracking because it produces more gasoline with a higher octane rating. It also produces byproduct gases that are more olefinic, and hence more valuable, than those produced by thermal cracking. The feedstock to an FCC is usually that portion of the crude oil that has an initial boiling point of 340 °C or higher at atmospheric pressure and an average molecular weight ranging from about 200 to 600 or higher. This portion of crude oil is often referred to as heavy gas oil or vacuum gas oil (HVGO). The FCC process vaporizes and breaks the long-chain molecules of the high-boiling hydrocarbon liquids into much shorter molecules by contacting the feedstock, at high temperature and moderate pressure, with a fluidized powdered catalyst.

A. RAW MATERIALS:

Waste Plastic (HDPE, LDPE, Polystyrene, Polypropylene)

B. APPARATUS

- Reactor Tank
- Collector Tank
- GI Pipes
- 90 deg Elbow joints
- Coke

C. PROCESS DISCRIPTION

- Take 4 kg of waste plastics of some kind [ldpe,hdpe] cut it into piece and dry it .
- The waste plastic is put inside the reactor after drying it.
- The reactor must designed to withstand high temperature of about 450-500 deg.
- It has an inlet at the top for collecting the vapour.
- Start burning the coke for heating the reactor and measure the temperature.
- When the temperature reaches 150degree c the vapour start to come down to the Condenser.
- The heating is continued for about 7/2 hours till the vapour stop collecting.

- After 7 or 7/2 hrs the plastics are decomposed.
- At the time larger carbon molecules are break into smaller molecules.
- There is no need of using catalyst for the process.
- The top of the reactor inlet is connected with the collecting tank where thevapours are condensed.
- Finally the fuel from condensed vapours are collected .
- Approximately 300-375 ml of thermo fuel will be collected from per kg of waste plastics.

Thermocouple is used to measure high temperature .

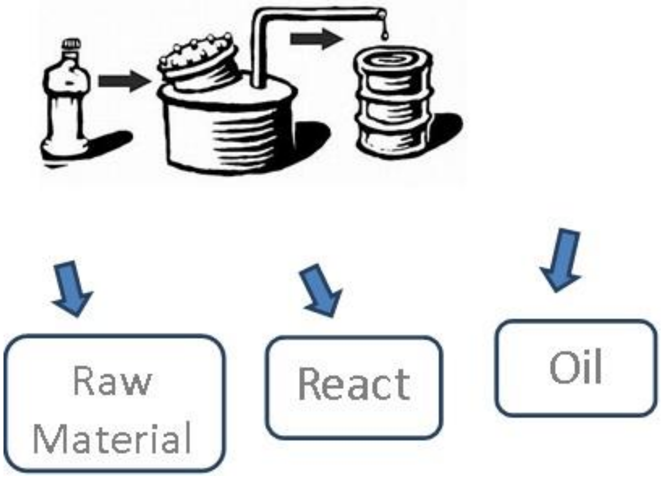

Fig.4.1. Pyrolysis Tank

V. EXPERIMENTAL DATA

Following are the data of our Experiment:-

A. APPRATUS USED

Reactor Tank	Vol- 200ltr
Collector Tank	Vol-22ltr
GI Pipes	Dia-0.5inch
90 deg Elbow joint	Qty-2, Dia.-0.5inch
Coke	5Kg approx.

We use 4 kg of Waste Plastic mainly Mineral Water Bottle's, etc and some other kinds of LDPE and HDPE.

Due to some leakage problems in reactor tank first time when performing the Experiment we got nearly about 150-175 ml of Thermofuel collected from per kg of Plastic. But after solving the problem of leakage by applying some methods though it is not solved completely and performing it 2 to 3 times more we get a maximum of 300 to 325 ml of Thermofuel collected from per kg of plastic.

VI. CONCLUSION

Plastics are “one of the greatest innovations of the millennium” and have certainly proved their reputation to be true. Plastic is lightweight, does not rust or rot, is of low cost, reusable, and conserves natural resources and for these reasons, plastic has gained this much popularity. The literature reveals that research efforts on the pyrolysis of plastics in different conditions using different catalysts and the process have been initiated. However, there are many subsequent problems to be solved in the near future. The present issues are the necessary scale up, minimization of waste handling costs and production cost, and optimization of gasoline range products for a wide range of plastic mixtures or waste. Huge amount of plastic wastes produced may be treated with suitably designed method to produce fossil fuel substitutes. The method is superior in all respects (ecological and economical) if proper infrastructure and financial support is provided. So, a suitable process which can convert waste plastic to hydrocarbon fuel is designed and if implemented then that would be a cheaper partial substitute of the petroleum without emitting any pollutants. It would also take care of hazardous plastic waste and reduce the import of crude oil. Challenge is to develop the standards for process and products of postconsumer recycled plastics and to adopt the more advanced pyrolysis technologies for waste plastics, referring to the observations of research and development in this field. The pyrolysis reactor must be designed to suit the mixed waste plastics and small-scaled and middle-scaled production. Also, analysis would help reducing the capital investment and also the operating cost and thus would enhance the economic viability of the process.

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