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Review Paper on Fuel from Waste Plastic Using Pyrolysis Method

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Abstract-Plastics have become in indispensable part in today's world. Due to their light-weight durability, energy efficiency, coupled with a faster rate of production and design flexibility, these plastics are employed in entire gamut of industrial and domestic areas. Plastic are non-degradable polymers of mostly containing carbon, hydrogen and few others elements such as chlorine, nitrogen etc.…Due to its non-biodegradable nature. The plastic waste contributes significantly to the problem of municipal waste management. Plastic are natural / synthetic materials. They are produced by chemically modifying natural substances or are synthesized from inorganic and organic raw material. On the basis of their physical characteristics, plastics are usually divided into thermosets, elastomers and thermoplastics. These groups differ primarily with regard to molecular structure, which is what determines their differing thermal behavior. The following table lists the characteristics of the various types of plastics. So here we will convert waste plastic into diesel, plastics are shredded and then heated in an oxygen-free chamber (known as pyrolysis) to about 400 degrees Celsius. As the plastics boil, gas is separated out and often reused to fuel the machine itself. The fuel is then distilled and filtered. Because the entire process takes place inside a vacuum and the plastic is melted - not burned, minimal to no resultant toxins are released into the air, as all the gases and or sludge are reused to fuel the machine.

Keywords- Waste Plastic; energy efficiency; diesel; fuel; pyrolysis.

I. INTRODUCTION

Most of the big cities in country produce waste at a rate that outpaces its capacity to collect and dispose it of in a safe and environmentally sound manner. Its current approaches to waste management are neither effective nor sustainable. This necessitates a paradigm shift in thinking. Traditional end-of-pipe solutions to waste management problems only deal with symptoms of poor management and not the root causes.

However, Plastics have opened the way for new inventions and have replaced other materials in existing products. They are light, durable and versatile, as well as resistant to moisture, chemicals and decay.

Yet these are the same properties that present environmental challenges. High-quality products that are sustainable in production and us we are rethinking mobility so that we no longer have to ask ourselves why a single person in a 5-seater SUV drives to work alone every day.

Plastic is a high molecular weight material that was invented by Alexander Parkes in1862.Plastics is also called polymers. The term polymer means a molecule made up by repetition of simple unit.

II. DESIGN

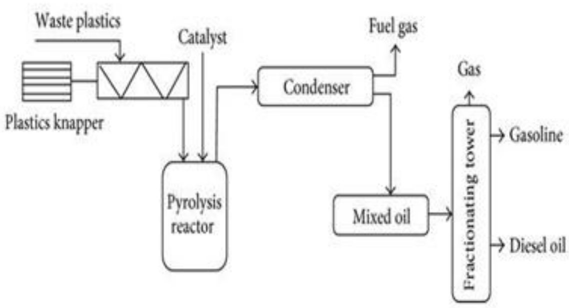

Fig 1. A.G. Buekens etal 1998.

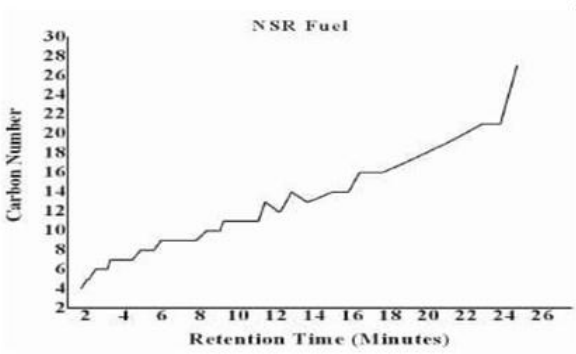

Fig 2. Moinuddin Sarker etal 2013.

III. LITERATURE REVIEW

All around the globe companies and individuals are starting to produce fuel from waste plastic. As only 8% of waste plastic is recycled in the U.S., 15% in Western Europe, and much less in developing countries, this reuse of plastic could potentially keep enormous amounts of plastic out of landfills and out of the oceans. Over 500 billion pounds of new plastic is manufactured each year and roughly 33% of that is single use and thrown away.

As so little plastic is recycled, we need to reframe plastic waste as an underused resource vs landfill destined. If all plastic waste made it into the landfill, it would surely be mined in the future, but currently all plastic waste does not make it into our landfills. The United Nations estimates plastic accounts for four-fifths of the accumulated garbage in the world's oceans. We need to stop polluting our oceans with plastic before it is too late, and start collecting all plastics suitable for this new fairly simple technology, a technology that is available now.

The technology is not overly complicated; plastics are shredded and then heated in an oxygen-free chamber (known as pyrolysis) to about 400 degrees Celsius. As the plastics boil, gas is separated out and often reused to fuel the machine itself. The fuel is then distilled and filtered. Because the entire process takes place inside a vacuum and the plastic is melted - not burned, minimal to no resultant toxins are released into the air, as all the gases and or sludge are reused to fuel the machine.

For this technology, the type of plastic you convert to fuel is important. If you burn pure hydrocarbons, such as polyethylene (PE) and polypropylene (PP), you will produce a fuel that burns fairly clean. But burn PVC, and large amounts of chlorine will corrode the reactor and pollute the environment. Burning PETE releases oxygen into the oxygen deprived chamber thereby slowing the processing, and PETE recycles efficiently at recycling centers, so it is best to recycle PETE traditionally. HDPE (jugs) and LDPE (bags and films) are basically polyethylene so usable as fuel as well, just slightly more polluting as a thicker heavier fuel is created. But additional processing can turn even HDPE into a clean diesel.

IV. AUTHORS AND THEIR WORK

S.M. Al-Salem (2009) In Recycling and recovery routes of plastic solid waste (PSW): A review stated recent progress in the recycling and recovery of PSW is reviewed. A special emphasis is paid on waste generated from polyolefin sources, which makes up a great percentage of our daily single-life cycle plastic products. The four routes of PSW treatment are detailed and discussed covering primary (re-extrusion), secondary (mechanical), tertiary(chemical) and quaternary (energy recovery) schemes and technologies.

S.V.S. Rao (2010) in Treatment of Plastic Waste by Melt Densification- Operational Experience at CWMF described the operational experience of melting of different plastic wastes namely polythene sheets & bottles, HDPE pipes and cans, PVC shoe covers and neoprene gloves. About 47M3 of β-γ and 18 M3 of α contaminated plastic wastes were melted using the above MDU. The volume reduction factors varied from 2.5 to 30 depending on the initial bulk density of the material. The radioactivity in the off-gases was found to be always below detectable limits.

Mochamad Samsara (2013) in Fuel Oil Production from Municipal Plastic Wastes in Sequential Pyrolysis and Catalytic Reforming Reactorsstudied fuel oil production from municipal plastic wastes by sequential pyrolysis and catalytic reforming processes. The results show that the feedstock types strongly affect the product yields and the quality of liquid and solid products. Municipal Plastic Waste pyrolysis produced higher heating value solid products than those of biomass and low rank coal, so that they can be used either for blending with biomass and coal or for single fuel.

M. Punčochářa (2012) in Development of process for disposal of plastic waste using plasma pyrolysis technology and option for energy recovery had explained a drastic non-incineration thermal process, which uses extremely high temperature in an oxygen- starved environment to completely decompose input plastic waste into syngas, composed of very simple molecules: CO, H2 and small amount of higher hydrocarbons. The above paper has explained a very good way of plastic waste treatment for energy recovery.

Wiwin Sriningsih (2014) in Fuel Production from LDPE Plastic Waste over Natural Zeolite Supported Ni, Ni-Mo, Co and Co-Mo Metalsstudied Hydro cracking of LDPE plastics into fuel over bi-functional catalysts systematically. Study found that natural zeolite obtained from Sukabumi which consists of the mordenite type crystalline. By using this technology, the conversion of plastic waste into fuel is expected to reduce the environmental pollution, support the use of soil, and increase the energy storage.

Onwughara Innocent Nkwachukwu (2007) in Issues of Roadside Disposal Habit of Municipal Solid Waste, Environmental Impacts and Implementation of Sound Management Practices in Developing Country "Nigeria "explained various waste management options, which integrated waste management disclosed the hierarchy of waste management options, environmental impacts of those options where studied under health and social effects, and the legislation of Extended Producer

Responsibility were suggested where by product take back by manufacturers, especially when remanufacturing and reuse is available to ensure sound management practice in developing country Nigeria.

Young Koo Park (2013) in Release of Harmful Air Pollutants from Open Burning of Domestic Municipal Solid Wastes in a Metropolitan Area of Korea estimated the effects of irregular open burning on local air quality; we evaluated the emission levels of harmful substances from test combustion of individual types of domestic municipal solid waste (MSW), including paper, wood, and plastics. In this paper a brief survey of residents and local government officials had done showing that more than 10.6% of homes in the metropolitan area have eliminated waste by irregular burning.

M.P. Joshi (2013) in Solid Waste Management on Dumping Ground in Mumbai Region – a Study had provided the present status of solid waste management on dumping ground in Mumbai region and also suggests some methods to control the same. Urgent steps in this direction will reduce the water, air, soil pollutions and health hazards.

Jefferson Hopewell (2009) in Plastics recycling: challenges and opportunities briefly set recycling into context against other waste-reduction strategies, namely reduction in material use through down gauging or product reuse, the use of alternative biodegradable materials and energy recovery as fuel. Recycling is one of the most important actions currently available to reduce these impacts and represents one of the most dynamic areas in the plastics industry today. Recycling provides opportunities to reduce oil usage, carbon dioxide emissions and the quantities of waste requiring disposal.

Elena Friedrich and Cristina Trois (2011) in Quantification of greenhouse gas emissions from waste management processes for municipalities – A comparative review focusing on Africa summarized and compared GHG emissions from individual waste management processes which make up a municipal waste management system, with an emphasis on developing countries and, in particular, Africa. The review shows that the highest GHG savings are achieved through recycling, and these savings would be even higher in developing countries which rely on coal for energy production.

A. López (2014) in Pyrolysis of municipal plastic wastes II: Influence of raw material composition under catalytic conditions elaborated the recent technologies for recycling and recovery of Plastic Waste Management. A special emphasis is paid on waste generated from polyolefin sources, which makes up a great percentage of our daily single-life cycle plastic products. Energy recovery was found to be an attainable solution to PSW in general and municipal solid waste (MSW) in particular.

Dezhen Chen (2015) in Pyrolysis technologies for municipal solid waste: A review addressed the state-of-the-art of MSW pyrolysis in regards to its technologies and reactors, products and environmental impacts. In this review, first, the influence of important operating parameters such as final temperature, heating rate (HR) and residence time in the reaction zone on the pyrolysis behaviors and products is reviewed; then the pyrolysis technologies and reactors adopted in literatures and scale-up plants are evaluated.

Kemal Ozkan (2015) in new classification scheme of plastic wastes based upon recycling labels proposed classification scheme provides high accuracy rate, and also it is able to run in real-time applications. It can automatically classify the plastic bottle types with approximately 90% recognition accuracy. Besides this, the proposed methodology yields approximately 96% classification rate for the separation of PET or non-PET plastic types. It also gives 92% accuracy for the categorization of non-PET plastic types into HPDE or PP.
P.M. Subramanian (2000) in Plastics recycling and waste management in the US has briefly discussed their efforts in the United States in addressing the issue of solid wastes and in particular, plastic wastes. The more importance is given to environmental compatibility and recyclability is being considered during the designing of new parts. Life cycle analyses and management are also being studied as tools for decision making.

S.M. Al-Salem (2009) in the valorization of plastic solid waste (PSW) by primary to quaternary routes: From re-use to energy and chemicals are aimed to provide information and analysis regarding the recovery, treatment and recycling routes of plastic solid waste (PSW), as well as the main advantages and disadvantages associated with every route. Recovery and recycling of PSW can be categorized by four main routes, i.e., re- extrusion, mechanical, chemical and energy recovery. It also presents a number of application and technologies currently being used to incinerate plastics. It is concluded that, tertiary (chemical methods) and quaternary (energy recovery) are robust enough to be investigated and researched in the near future, for they provide a very sustainable solution to the PSW cycle.

A.G. Buekens and H. Huang (1998) in Catalytic plastics cracking for recovery of gasoline-range hydrocarbons from municipal plastic wastes reviewed recent developments in plastics cracking, a process developed to recycle plastic wastes into useful petrochemical materials. Plastics cracking are only an elementary conversion technology; its application has to be combined with other technologies such as municipal solid waste collection, classification and pretreatment at the front end, as well as hydrocarbon distillation and purification at the back end. Social, environmental and economic factors are also important in industrial implementation of the technology.

R. Vasudevanet (2012) in A technique to dispose waste plastics in an ecofriendly way – Application in construction of flexible pavements explained Waste plastics, littered both by domestic and industrial sectors was found to be a source of raw material for the flexible pavement. PCA + bitumen mix showed improved binding property and poor wetting property.

Achyut K. Panda (2010) in Thermolysis of waste plastics to liquid fuel A suitable method for plastic waste management and manufacture of value-added products—A world prospective reviewed the available literature in the field of production of fuel from waste plastics of active research and identifies the gaps that need further attention. Production of liquid fuel would be a better alternative as the calorific value of the plastics is comparable to that of fuels, around 40 MJ/kg. Each of these options potentially reduces waste and conserves natural resources.

M. Sajdak and R. Muzyka (2014) in Use of plastic waste as a fuel in the co-pyrolysis of biomass. Part I: The effect of the addition of plastic waste on the process and products investigate the effects of using polypropylene, a common polymer used in the polymer industry, in the co-pyrolysis of two types of biomasses. In this paper, the effects of using polymer material as an additional co-fuel on the thermal conversion process are discussed. The addition of polypropylene reduces the amount of heat energy needed in the thermal conversion of biomass.

Chika Muhammad (2015) in Catalytic pyrolysis of waste plastic from electrical and electronic equipment collected plastic waste from waste electrical and electronic equipment (WEEE) was pyrolyzed in the presence of zeolite catalysts to produce gasoline range aromatic oil. The plastic was from equipment containing cathode ray tubes (CRTs) and also plastic waste from refrigeration equipment. The research reported shows that pyrolysis of plastics produced from commercial waste electrical and electronic equipment produces a mainly oil product containing mostly styrene

V. CONCLUSION

Inference on plastic waste management from researchers work as below: Recycling is best method than reuse and reduce; because plastic had become integral part of life and cannot be avoided. Plastic waste segregation from mixed municipal and industrial waste is the key issue for research.

Incineration is fast and fetch ample amount of energy, but very harmful environmental impact causing serious problems. Pyrolysis is best and promising method in deep research for better results. Pyrolysis will be a necessary need of tomorrow as an alternative source of fuel. This project will help to decrease the pollution caused due to waste plastic.

It will be an initiative & a step towards Clean India. It is an alternative source of fuel. By using waste plastic as a raw material, itself disposal of waste plastic. Very less amount of process loss. No need of engine modification. Less amount of residue and large amount of product.

By segregating plastic from waste, we can use remaining waste for make of compost fertilizers. This is like cashing on pollution itself because if this project is implemented can turn tides globally by providing long-term solution for increasing waste plastic.

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