LIQUID HYDROCARBON FUEL COLLECTED FROM WASTE PLASTIC BY USING $CuCO_3$ CATALYST

Manvir Singh and Sudesh Kumar
Department of Chemistry, Banasthali University, Rajasthan India
E-mail: manvir25365@gmail.com

Moinuddin Sarker
Waste Technologies LLC Department of R & D, 1376 Chopsey Hill Road
Bridgeport CT-06606, USA

Plastics have many properties like light weight, high durability, so demands increase in every sector. Plastics include carbon, hydrogen, nitrogen, oxygen, sulfur and halogen atoms. The main thing which makes plastics waste valuable is longer carbon chains than those in gasoline and diesel fuels. Therefore, it is possible to convert waste plastic into liquid hydrocarbon fuels. This research paper aims to solve the twin problem of environment pollution due to plastics and the need for an alternative liquid hydrocarbon fuel source. Pyrolysis of the waste plastic bag (hdpe) was carried out with catalysts. The collected liquid hydrocarbon fuels were characterised by FT-IR spectroscope, NMR spectroscope and conversion was very good.

Key words: *Pyrolysis, liquid hydrocarbons green fuel, catalysts, conversion, glass reactor*

Introduction

In daily life, polymer products are used for different plastics which consist of low density polyethylene (ldpe), high density polyethylene (hdpe), polyvinyl chloride (pvc), polypropylene (pp), polystyrene (ps), polyamides (pa), polyethylene terephthalate (ptet), bakelite, dacron, and natural rubbers. Similarly, synthetic rubbers consist of neoprene rubber, styrene rubber, nitrile rubber, butyl rubber, polysulphide rubber, polyurethane rubber, etc. Due to its lightweight, high durability, sustainability and a faster rate of production and design flexibility demands for plastics have increased in every sector[1–2]. Since 1950, the plastic production also increased on an average to 10 per cent every year around the globe[3]. Plastic production growth of 2006, 2007 was around 1.3-245 million tonnes[4–5]. In India, during 1998 around 800,000 tonnes representing 60 per cent of plastics wastes generated in India were recycled involving 2000 units. This recycle rate is the highest in the world[6]. The plastic consumption worldwide was around 150 million tonnes in the year 2000. It is estimated to be around 258 million tonnes in 2010[7]. The plastic industries are making a significant contribution to the economic development and the growth of various key sectors in the country, such as automotive, construction, electronics, healthcare, textiles, and FMCG, etc. Its demand is rapidly growing at ~10 per cent CAGR to reach 10 MnTPA by FY13. Further India observes a significant regional diversity of the consumption of plastics, in western India its consumption is 47 per cent, in Northern India, it is 23 per cent, and in Southern India it is 21 per cent. The bulk of the consumption of Northern India is from end-use industries of auto, electronic appliances packaging (including bulk packaging), plasticulture applications, etc., which are concentrated mostly in UP and Delhi-NCR →50 per cent[8]. Increase in the economic growth rate is unsustainable without the saving of fuel energy like hydrocarbons[9]. High durability causes great threat to the environment system and it results from landfill release of toxic gasses like CO, CO_2, SO_2, NOx and contributes to the global warming, acidic rain, and depletion of ozone layer. Leaching of chemicals cause the emission of CO, CO_2 and pollutes the environment. Polymers release flue gases after burning[10-19]. Further, the dumped polymers also cause risk of the environment, human health and public amenities[20]. The research paper exhibits concentrating on polymer practical, its formation and conversion into hydrocarbon as it will serve to present chemistry in a way which is both entertaining and educational to the students.

Materials and Method

Waste plastic bags were collected from the local markets. Collected waste plastic bags were washed with liquid soap and then dried in the sunlight. Dried waste plastic bags were cut into small pieces using grinder machine. These grounded wastes were placed into the glass reactor.

The dried waste plastic bags with $CuCO_3$ catalyst material were placed into a round shaped glass reactor. Then the round shaped glass reactor was put into an insulated furnace which protected the loss of heat and gave heat. Then the glass reactor was put inside the furnace. Further, a condenser unit was set up with the reactor and the other end with the fuel collection device. The furnace also had a temperature controller. Then the temperature was increased slowly. Inside the glass reactor, the solid waste plastic was converted into vapors and then passed through a glass pipe to a condenser and distillate and then liquid hydrocarbon is collected.

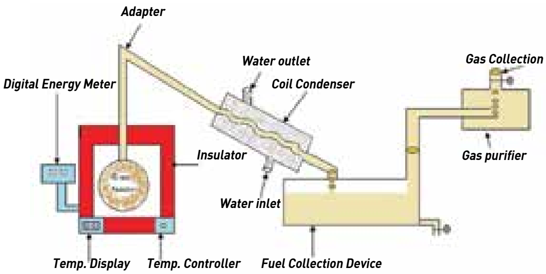

Fig. 1. Waste plastic bag into liquid hydrocarbons production process diagram

Result and Discussions

Liquid hydrocarbon fuel analysis: FT-IR analysis of liquid hydrocarbon fuel (Figure 2 and Table 1) according to their wave numbers and spectrum band following types of functional groups were appeared in the analysis. We noticed that in the spectrum field wave numbers 2921.91 cm^{-1} and 2855.42 cm^{-1} functional group is C-CH^3, wave number 1642.50 cm^{-1} functional group is conjugated, wave numbers 1458.21 cm^{-1} and 1374.87 cm^{-1} functional group is CH_3, wave number 992.41 cm^{-1} and 908.21 cm^{-1} functional group is -CH=CH, wave number 724.55 cm^{-1} functional group is -CH=CH-(cis).

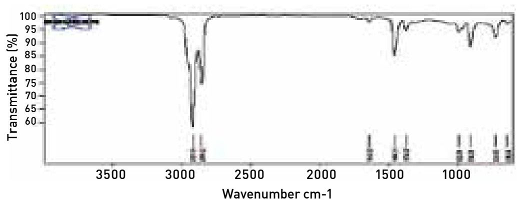

Fig. 2. FT-IR Spectrum of waste plastic bag into liquid hydrocarbons

Table 1

FT-IR spectrums waste plastic bags into liquid hydrocarbons functional group name

Number of Peak	Wave Numbers (cm^{-1})	Functional Group Name
1	2921.91	$C\text{-}CH_3$
2	2855.42	$C\text{-}CH_3$
3	1642.50	Conjugated
4	1458.21	CH_3
5	1374.87	CH_3
6	992.41	-CH=CH
7	908.21	-CH=CH
8	724.55	-CH=CH-(cis)
9	638.04	

TGA shows that the waste plastic bag was placed in quartz crucible for thermo-gravimetric analysis. The waste plastic bag degrades to 500 °C temperatures without any catalyst but in the presence of $CuCO_3$ catalyst it degrades to 390 °C temperatures. 13CNMR shows that more peaks due to mixture of different types of hydrocarbons.

Fig. 1. Collected liquid hydrocarbon fuel from waste plastic

Conclusion

In the present investigation the successful catalytic pyrolysis conversion of waste plastic bag was studied. Under this experimental condition, a waste plastic bag was degraded in the presence of $CuCO_3$ catalyst which resulted in fraction. The collected liquid hydrocarbon fuel was analysed by FT-IR, 13CNMR and 1HNMR. Analysis result indicates that mainly lots of hydrocarbons, long straight chains break down into shorter hydrocarbon chain by using pyrolysis conversion process. Applications of gaseous and solid residue for use as fuel or as a source of chemical were also obtained. Liquid hydrocarbon fuel has a high flammable capacity and its contents are highly combustible.

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