High value aromatic compounds & syngas from waste plastics pyrolysis-catalysis

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1 Introduction

- Plastics are mostly synthetic materials made from hydrocarbons.
- Waste generated by plastics are enormous, there constitute environmental and health hazards due to the non-biodegradability of plastics.
- Recycling of these plastic waste provide avenue for reduction of waste generated, disposal in landfill, hydrocarbon usage and carbondioxide emission reduction.
- Chemical recycling provide most efficient method of waste plastics recycling and also have capability to form the raw materials from which it is made leading to sustainable resources.
- In this work, pyrolysis-catalytic of high density polyethylene plastics (HDPE) was carried out in a two stage reactor for production of aromatics and syngas.

Waste plastics

Fuel

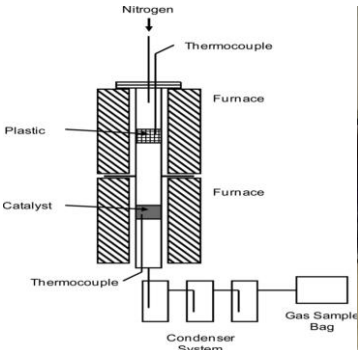
Aromatic

2 Aim and objectives

- To convert waste plastics to valuable hydrocarbon fuel and chemicals feedstock.
- To produce aromatics and syngas from waste plastics using pyrolysis-catalysis in a fixed bed two-stage reactor.
- To customize a further third stage reactor for about 100% conversion of hydrocarbon gases from the two stage reactor into high value aromatic chemicals.

3 Method and materials

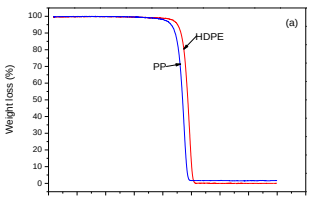
High density polyethylene (HDPE) was pyrolysed in a two stage fixed bed reactor using Y-zeolite catalyst.



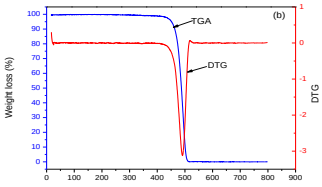
Two stage fixed bed reactor (sketch & photograph)

4 Results

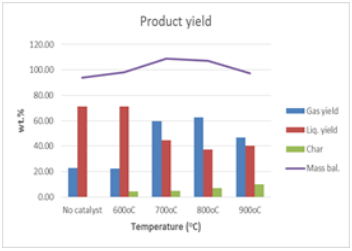
Effect of catalyst and temperature from 600-900°C was evident on product yield.



Thermo-gravimetric analysis (TGA)



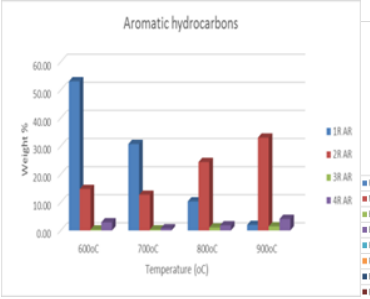
TGA & DTG curve for HDPE



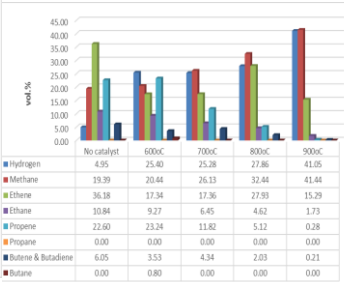
Product yield and mass balance plot

At increasing temperature

- Aromatics yield increased
- Syngas yield increased
- Total gas yield increased up to 800°C.
- Liquid yield decreased up to 800°C.
- At 900°C, total gas yield decreased while liquid yield increase.



Aromatic composition at increasing temperature



Gas yield composition at increasing temperature

5 Conclusion

- Aromatics and syngas production continually increased as temperature increases from 600-900°C.
- Total gas yield decreased at 900°C while liquid yield start to increase.

Future work

- Usage of customized third stage fixed bed reactor.
- Focus on catalyst preparation with different metals support.
- Usage of different waste plastic samples such as polypropylene, mixture of plastics, etc.

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