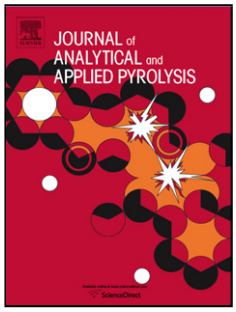
Accepted Manuscript




Title: Reverse engineering of plastic waste into useful fuel products

Authors: Prosper Achaw Owusu, Noble Banadda, Ahamada Zziwa, Jeffrey Seay, Nicholas Kiggundu

PII: S0165-2370(17)30862-8
DOI: https://doi.org/10.1016/j.jaap.2017.12.020
Reference: JAAP 4219

To appear in: *J. Anal. Appl. Pyrolysis*

Received date: 22-9-2017
Revised date: 14-12-2017
Accepted date: 31-12-2017

Please cite this article as: Prosper Achaw Owusu, Noble Banadda, Ahamada Zziwa, Jeffrey Seay, Nicholas Kiggundu, Reverse engineering of plastic waste into useful fuel products, Journal of Analytical and Applied Pyrolysis https://doi.org/10.1016/j.jaap.2017.12.020

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

ACCEPTED MANUSCRIPT

# Reverse engineering of plastic waste into useful fuel products

Prosper Achaw Owusu[a], Noble Banadda[a,b*], Ahamada Zziwa[a], Jeffrey Seay[a,c] and Nicholas Kiggundu[a]

[a]Department of Agricultural and Biosystems Engineering, Makerere University, P.O. Box 7062, Kampala, Uganda

[b]Department of Agricultural and Biosystems Engineering, Iowa State University, 1340 Elings Hall, Ames, Iowa 50011 – 3270, USA

[c]Department of Chemical Engineering, University of Kentucky College of Engineering, Paducah Extended Campus Program, 211 Counsel Hall, 4810 Alben Barkley Drive, Paducah, Kentucky 42002

***Corresponding author:** Tel.: +256774046689**,** Email address: banadda@caes.mak.ac.ug (Noble Banadda)

## Highlights

- Fast vaporization of the pyrolysis process lasted for about five minutes which was detected between the 35th and 40th minutes.
- Thermal pyrolysis enhances the yield of liquid oil at high degradation temperatures.
- Silica alumina catalyst favours the formation gaseous fractions at low temperatures.
- Pyrolytic liquid oil from high density polyethylene and polypropylene are of high quality and can be used individually or blended with conventional fuel as an energy source.

## Abstract

This paper's twofold aims are: to assess the potential of converting plastic waste into useful fuels in both continuous and batch pyrolysis reactors using an appropriate technology and to investigate the effect of silica-alumina catalyst on the yield and quality of pyrolytic liquid oil. The plastic waste used (HDPE, PP and PS) were obtained from Kiteezi landfill site, Kampala (Uganda). In a further step, the properties of the liquid fuel obtained from pyrolysis were also compared with commercial transportation fuel to ascertain its suitability on diesel engines.The fuel qualities were analysed using ASTM standard test methods. At a degradation temperature of 450$^{o}$C, thermal pyrolysis in a batch reactor resulted in the highest yield of liquid fractions. The liquid yield of HDPE, PP and PS was found to be 80%, 82.6% and 80% by mass, respectively. In contrast, silica-alumina catalyst to feedstock ratio of 1:10 was the most effective in terms of gaseous fraction production. The gaseous fractions were: 60 wt% for the mixture, followed by HDPE (59.63 wt%), PS (59.07 wt%) and PP (49.33 wt%). A catalyst/polymer ratio of 1:10 greatly reduced the degradation temperature. The degradation temperature for HDPE, PP and PS was reduced by about 33%, 23% and 17%, respectively. The liquid oils from HDPE and PP had densities of 0.796 g/cm$^3$ and 0.786 g/cm$^3$; kinematic viscosities of 2.373 mm$^2$/s and 2.115 mm$^2$/s, dynamic viscosities of 1.889 mPas and 1.856 mPas; boiling point ranges of 119-364$^{o}$C and 148-355$^{o}$C; and cetane indices of 46 and 63, respectively. The characteristics of HDPE and PP pyrolytic sample oils are similar to conventional transportation fuel.

Download English Version:

https://daneshyari.com/en/article/7606497

Download Persian Version:

https://daneshyari.com/article/7606497

Daneshyari.com