Accepted Manuscript

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F.I. Nwabue, U. Unah, E.J. Itumoh

PII: S2352-1864(16)30072-4
DOI: http://dx.doi.org/10.1016/j.eti.2017.02.008
Reference: ETI 129

To appear in: *Environmental Technology & Innovation*

Received date : 15 September 2016
Revised date : 29 December 2016
Accepted date : 26 February 2017

Please cite this article as: Nwabue, F.I., Unah, U., Itumoh, E.J., Production and characterisation of smokeless bio-coal briquettes incorporating plastic waste materials. *Environmental Technology & Innovation* (2017), http://dx.doi.org/10.1016/j.eti.2017.02.008

Production and Characterisation of Smokeless Bio-coal Briquettes Incorporating Plastic Waste Materials

F. I. Nwabue*, U. Unah and E. J. Itumoh
Department of Industrial Chemistry, Ebonyi State University Abakaliki, Nigeria
*e-mail: ikennanwabue@gmail.com

Abstract

Sub-bituminous coal from Okaba mine in Kogi State, Nigeria and locally available plastic and bio-waste materials (used sachet water bags, polythene bags, saw dust and maize husk) were partially carbonized, pulverized and used in varying proportions with limestone dust, cassava flour and laterite as binders for the production of solid fuel briquettes. The briquettes were characterized by testing for porosity index, briquette density, compressive strength, ignition and heating efficiency, volatile matter, calorific value, moisture and ash contents using ASTM and DIN standards. The gross calorific values of the briquettes were determined and their fuel properties of burning rate, power output and specific fuel consumption were as well measured. The briquette ash was analysed by X-ray florescence spectrometry (XRF). However, all the briquette ash samples were found to remain intact as a block without collapse after burning. Results of the briquette characterization showed that the briquettes produced with the compositions: 20-70% coal, 2-8% limestone, 10% plastic waste, 2.5-10% cassava flour and 10-60% biomass were of medium to high quality in terms of burning and cooking characteristics, smokelessness, environmental friendliness, binding and mechanical strength. These characteristics suggest that the briquettes produced are good alternative to fuel wood for out-door and in-door cooking and for mitigation of deforestation, desertification and environmental pollution and degradation. Recycling of the plastic wastes into refuse derived fuel by incorporation in the production of these bio-coal briquettes shows great promise and could be considered as part of waste management options especially in the developing countries.

Keywords: biomass, bio-coal briquettes, plastic waste recycling

1. Introduction

One of the major challenges encountered in most parts of the world today, especially in the developing countries, is the scarcity of clean and affordable fuel for domestic cooking and