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DEPARTMENT OF CHEMICAL AND PROCESSING ENGINEERING

AGRO PROCESSING ENGINEERING PROGRAMME

FINAL YEAR PROJECT REPORT

SUITABILITY OF SELECTED AGRO-WASTES FOR BRIQUETTE PRODUCTION, PALLISA DISTRICT

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DECLARATION

I, Tukei Timothy, hereby declare to the best of my knowledge that this research report is an outcome of my own work and that it has not been presented for any academic award in any university, college or higher institution of learning. Throughout the work I have acknowledged all sources in its compilation.

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APPROVAL

This research report has been submitted to Faculty of Engineering for examination with approval from the following supervisors:

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DEDICATION

I dedicate this research report to my uncle Mr. Okurut Moses and my mother Mrs. Okurut Anne Loyce for the love, care, support and encouragement.

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I am so grateful to God the Almighty who has seen me through the years and who by His grace I keep shining.

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Then to my comrades in Christ

ACRONYMS

ASAE	American Society of Agricultural Engineers
CEN	European Committee for Standardization
CEN/TS	European Committee for Standardization/Technical Standards
DEEP	Developing Energy Enterprises Programme
FAO	Food and Agriculture Organisation of the United Nations
GCV	Gross Calorific Value
GDP	Gross Domestic Product
GVEP	Global Village Energy Partnership
LPG	Liquefied Petroleum Gas
MEMD	Uganda Ministry of Energy and Mineral Development
NCV	Net Calorific Value
UBOS	Uganda Bureau of Statistics
UNDP	United Nations Development Program

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EXECUTIVE SUMMARY

Groundnut husks, cotton stalk and sorghum stalk are abundant agro-waste in Pallisa district. In their loose form however, they are not preferred as bio-fuels. Densification of these agro-wastes to form briquettes will allow their use as substitute to firewood and charcoal.

This research involved the investigation of the thermo chemical properties of the different samples of briquettes prepared from varying material composition. The three selected agro-waste were mixed with varying ratios and briquetted with 40grams of cassava binder. A bomb calorimeter was used to determine the calorific values of the samples while their burning temperature was estimated by the use of a Temperature Flame Chart.

The findings showed that single material briquettes had comparably higher calorific value as compared to composite material briquettes. Non-carbonized groundnut husk briquette had the highest calorific value of 19585J/g and it burnt with a yellowish-red flame in the furnace whose flame temperature is estimated to fall within the range of 2500-2700K. The calorific value of carbonized sorghum briquette was higher than that of carbonized cotton.

Key words: Densification, carbonization, calorific value, flame temperature.

CHAPTER ONE: INTRODUCTION

1.0 INTRODUCTION

This chapter explains the background of the study that leads to the problem statement. It also contains the main and specific objectives of the project.

1.1 Background of study

An estimate of 99% of Pallisa's population relies on wood fuel and charcoal to meet daily energy needs, resulting in rapid woodland depletion. Hydro-electricity supplies less than 1.1% (UBOS, November 2005) of the population in the area while the cost of petroleum fuel is rising rapidly (Barsky and Kilian, 2004). It is therefore expected that the district will continue to rely on biomass fuel for the unforeseeable future. The challenge of conserving the woodland resources by using the available biomass material in a sustainable manner can be overcome through the process of biomass densification. Biomass densification is the process of reducing the bulk volume of the material by mechanical means for easy handling, transportation and storage. (Sudhagar Mani, 2008).

Groundnut husks, cotton stalk and sorghum stalk are major abundant agro-waste in Pallisa; moreover, both groundnuts and sorghum enjoy a double growing period annually which makes them abundant and quite reliable all year through according to key informant in the area. Briquetting this selected agro-waste would reduce reliance on wood fuel. However, prior to the design or selection of machines for the briquetting of a given biomass material, it is important to determine the optimum condition required to make products of a desirable quality (Wamukonya and Jenkinss, 1995).This is because every agro-waste has a unique set of conditions for its densification (Chin and Siddiqui, 2000). Furthermore, thermo-chemical composition is also unique for every biomass material. However, information on optimum briquetting conditions and thermo-chemical properties of selected agro-wastes are not known, therefore, limiting biomass use as an energy source.

1.2 Problem Statement

Pallisa has got a variety of unutilized agro-waste like groundnut husks; cotton stalk and sorghum stalk which are dumped back to the field after utilizing the crop. However, after a long time, the agriculture fields do not need plenty of this agro-waste for mulch; hence dumping this agro-waste back to the field is in one way wasting a useful resource. The

REFERENCES

American Standard: ASAE269.3 (1989). Wafers, pellets, crumbles definitions and methods for determining density durability and moisture content pp346F348

Andrejko, D. & Grochowicz, J. (2006). Effect of the moisture content on compression energy and strength characteristic of lupine briquettes. Journal of Food Engineering Vol.18, pp116F120

Barsky, R.B & Kilian, L.,(2004). Oil and macro economy since the 1970s. Journal of Economic Perspectives. Vol 18, pp 115-134

Bhattacharya, S.C. Sett, S. & Shrestha, R. M., (1989). State of the art for biomass briquetting. Energy for sustainable development,Vol.6,pp

Birn Jeremy (2003) Digital Lighting and Rendering chart and colors. Accessed in November 2014 http://www.3dRender.com

CEN/TS14774F2:2004.Solid biofuels–Methods for the determination of moisture content–

Chin, O.C. & Siddiqui, K.M., (2000). Characteristics of some biomass briquettes prepared under modest die pressures. Biomass and Bioenergy Vol. 18, pp 223-228 densification. Energy Sources.Vol.11,pp161F182

NFA (2011). NFA STATISTICAL YEARBOOK. Country profiles, Uganda. Accessed in March 2008 http://www.fao.org/forestry/site/18308/en/uga/

Hamish Ferguson, (2012) Briquette Businesses in Uganda, GVEP International.

Jessup, R.S (1996) Precise measurement of heat combustion with a bomb calorimeter. U.S Bureau of Standards, USI government printing

Mani, S. Tabil, L. G. & Sokhansanj, S. (2006) . Specific energy requirement for compacting corn Stover . Bio-resource Technology Vol.97, pp1420F1426 industry. Critical Reviews in Plant Sciences, Vol.24, pp461F495

MEMD (2004). Uganda energy balance for 2004. Ministry of Energy and Mineral

MEMD (2007), Uganda Renewable Energy Policy 2005

MEMD (2008), Uganda energy balance for 2006

Parr Instrument Company (1980) operating instruction for 1241 oxygen bomb calorimeter, technical manual 203.

Parr Instrument Company (2000) Introduction to calorimetry Technical manual 2000.

Samson R., Mani, S. Boddey, R, Sokhansanj, S., Quesda, D., Urquiaga, S., Reis, V. & Lem, C.H.,(2005). The potential of C4 perennial grasses for developing a global BIOHEAT

Sudhagar Mani, (2008) Recent Development in Biomass Densification Technology, Agricultural Engineering Department, University of Georgia.

UBOS, (November, 2005) 2002 Uganda Population and Housing Census; Pallisa District Report.

Wamukonya, L. & Jenkins, B., (1995). Durability and relaxation of sawdust and wheat-straw briquettes as possible fuels for Kenya. Biomass and Bioenergy Vol. 8, pp 175-179