BUSITEMA UNIVERSITY
Pursuing Excellence

FACULTY OF ENGINEERING

DEPARTMENT OF CHEMICAL AND PROCESSING ENGINEERING

INVESTIGATING THE POTENTIAL OF CARBONIZED BAGASSE BRIQUETTES AS AN ALTERNATIVE BIOMASS FUEL IN UGANDA

By

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DECLARATION

I **Mugumya Crispus** declare to the best of my knowledge that this final year project report is as a result of my research and effort. It has never been presented or submitted to any institution or university for the award of the B.Sc. Agro processing engineering.

Signature...

Date......19/5/2017..............................

DEDICATION

This report is dedicated to my most loved parent the late Mrs. Kabajungu Sabina, I miss you.

ABSTRACT

Despite huge amount of agricultural waste generated in Uganda, most people continue to use charcoal and wood fuel, which leads to deforestation. In particular sugar factories produces large volumes of bagasse beyond requirements for cogeneration which is not directly suitable for use as a household cooking fuel. The limitations are mostly attributed to low bulk densities of bagasse. This excess bagasse congest sugar factories and poses numerous risks including fire out breaks. This research has identified utilization potential of bagasse through briquetting. In this research, bagasse was carbonized and briquetted into alternative fuel to supplement conventional charcoal and firewood. The objectives were to develop briquettes from bagasse, loam soil and molasses, to evaluate the moisture content, volatile matter content, ash content and calorific value of the briquettes, to determine the water resistance and fuel shatter resistance of briquettes and carry out an economic evaluation.

The raw bagasse was obtained from GM sugar ltd and dried to 5.13% moisture content. Molasses and loam soil were used as binders to develop three formulations of briquettes. The results of proximate analysis revealed the main constituents of the briquettes. The percentage of volatile matter and calorific values varied directly with the percentage composition of molasses of the briquette. A briquette blend with 20% SCB, 40% loam soil and 40% water had the least moisture content and the fastest drying rate of the three blend of briquettes. However the major drawback was the low calorific value of 2.13 Kcal/g and absorbed the highest amount of water during a water resistance test. All blends were comparable to most cooking fuels in developing countries and performed well with respect specifications and recommendations by US765 and FAO. Blend I briquettes had the highest calorific value and the result of economic analysis shown a 16.5 cost-benefit ratio for briquette project. However future research should increase the range of properties and number of samples tested to establish the effect of loam soil quality on the final ash content of briquettes.

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APPROVAL

This final year project report has been submitted to the department of agro-processing engineering for examination with approval from the following supervisors:

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LIST OF ACRONYMS

SCOUL	-	Sugar Corporation Of Uganda
MEMD	-	Ministry of Energy and Mineral Development
FAO	-	Food and Agriculture Organization
UBOS	-	Uganda Bureau Of Statistics
ASTMD	-	American Society for Testing and Materials
°C	-	Degrees Celsius
GJ	-	Gigajoule
kcal	-	Kilocalorie
UN	-	United Nations
SCB	-	Sugar cane bagasse
LS	-	Loam soil
SCM	-	Sugar cane molasses
GOU	-	Government Of Uganda

DEFINITION OF TERMS

Sugarcane	-	Type of grass with peripheral fibers enclosing a soft central pith (Hugo, 2010).
Bagasse	-	Cane stalk left after crushing and extraction of the sugar cane juice (United Nations, 2012).
Charcoal	-	The solid residue from the carbonization of wood or other vegetal matter through slow pyrolysis.
Briquetting	-	Compaction of pulverized biomass materials (FAO, 2010).
Calorific Value	-	Amount of heat liberated by the complete combustion of unit mass of a fuel briquette.
Ash	-	The grayish-white to black, soft solid residue of combustion.

CHAPTER ONE: INTRODUCTION

1.0 Background

Biomass energy accounts for about 14 % of the total world energy compared to coal (12 %), natural gas (15 %) and electric energy (14 %) (Onchieku *et al*, 2012). In East Africa 84 % of the total energy is derived from biomass sources including charcoal, firewood and agricultural residues such as bagasse (Onchieku *et al*, 2012). In Uganda, 93% of the energy consumption is in form of either firewood or charcoal (MEMD, 2010). As the demand for energy continues to rise, it's imperative to identify and develop energy technologies that have a much lower environmental impact by utilizing agricultural wastes. However despite huge amount of agricultural waste generated in the world today, most people in developing countries like Uganda continue to use lump charcoal and wood fuel, which leads to deforestation.

In Uganda manufacturing of sugar from sugar cane produces large volumes of sugar cane wastes (bagasse), much of which remains unutilized (Barbara, 2006). One ton of sugarcane generates 280 kg of bagasse (Suhardy, 2007) and Uganda produced 11,506 TJ equivalent of *1,490 metric tons* of bagasse by 2012 (United Nations, 2012). However, the utilization of this type of waste is still low as only a small proportion of it is used for cogeneration. Bagasse composition, consistency, and heating value vary depending on the climate, type of soil upon which the cane is grown, variety of cane, harvesting method, amount of cane washing, and the efficiency of the milling plant (Shabbir Gheewala, 2006). Also bagasse is not directly suitable for use as a household cooking fuel (Judd *et al*, 2003). The main limitation to utilization of bagasse a cooking fuel is mostly attributed to low bulk densities.

Bagasse can be transformed into a clean-burning fuel through briquetting to supplement conventional charcoal (produced from natural and plantation forests) whose consumption rate in Uganda increases by 6% per year (Basu *et al*, 2012). Before briquetting, bagasse is carbonized to char in a thermo-chemical conversion process that takes place in absence of oxygen. It always occurs before combustion and gasification where complete or partial oxidation is allowed to proceed (Hugo, 2010). The char yields are enhanced by low temperatures and low heating rates (Jahirul *et al*, 2012).

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