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FACULTY OF ENGINEERING

DEPARTMENT OF CHEMICAL AND PROCESSING ENGINEERING

FINAL YEAR PROJECT REPORT

DESIGN AND CONSTRUCTION OF A SOLAR-BIOMASS ENERGY SYSTEM FOR GRAIN DRYING

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ABSTRACT

Maize is one of Uganda's staple foods contributing about 35% of the daily dietary energy consumption rates and about 80% of the rural households are involved in maize production. After harvesting, the greatest enemy of grain is moisture that has to be reduced by drying to increase grains' shelf life.

Solar drying of grains is commonly used in Uganda. Most used system of solar drying is the use of flat plate collectors which has drawbacks of requiring more space and having low concentration efficiency. Bad weather and inability to store sufficient solar energy reduces the effectiveness of drying that calls for integration of a biomass stove to enhance drying at night and during bad weather. This report therefore provides the methods for availing sufficient and cheap renewable energy that can be used by the famers to enhance profitability of agriculture by reducing the post-harvest losses. A solar-biomass energy system in this study was developed and achieved through the methodology, mainly studying the matrix air heater. In order to achieve the above purpose, data was collected which involved literature surveys and reviews and internet surfing, designing the system components, constructing the prototype which was tested and the results analyzed.

In this project, the matrix air heater gave temperature increments of 5^0C, 7^0C and the maximum was 10^0C which was achieved by noon on a collector with a length of 0.6m and a width of 0.5m. In comparison with a flat plate collector of the same size, it's found to produce maximum temperature increments of 5^0C which therefore shows that a matrix air heater can be adopted in place of the flat plate collector. The further increase in temperature to a range of 40 to 45^0C as required for maize drying for seed grain was attained by using a biomass stove which was lighted using firewood as the biomass fuel because it's locally readily available. However, testing the solar collector was not effective due to unfavourable weather conditions.

Further work such as measuring the air temperature at the fan exit, increasing the collector size to that of an area of 1.286m^2 and increasing visibility of energy in Operation Wealthy Creation, the country's poverty reduction strategy can be done to enhance the effectiveness and performance of the energy system.

DECLARATION

I **WANSOLO BRIAN** declare that the work presented in this project report is as a result of my own research and has never been submitted to any institution of higher learning for any award whatsoever.

Signature:………………………………

Date:………30/05/2017……

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APPROVAL

This report about the design and construction of a solar-biomass energy system for grain drying has been written under the supervision of;

Main supervisor

Mrs. KABASA MARY SALLY

Signature ....

Date..

Co-supervisor

Mr. DUMBA JOSEPH LWANYAGA

Signature ....

Date..

DEDICATION

I dedicate this report to my parents, my brothers, sisters and friends and my supervisors for you are the reason I have come this far.

ACKNOWLEDGEMENT

I thank the Almighty God for the far that He has brought me, the gift of life, protection and his provision to me during and throughout the writing of this project report.

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Lastly, I thank all those who were involved directly or indirectly during my project report writing.

May the good Lord reward you all!

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1 CHAPTER ONE

1.1 INTRODUCTION

This chapter contains the background of the study, problem statement, objectives, purpose, justification and the scope including the limitation to the study.

1.2 BACKGROUND

In many parts of the world there is a growing awareness that renewable energy have an important role to play in extending technology to the farmer in developing countries to increase their productivity ***(Waewsak, et al., 2006).*** The Ugandan Government's Policy Vision for Renewable Energy is to make modern renewable energy a substantial part of the national energy consumption, ***(Liu, Masera & Esser, 2013).*** Uganda's per capita energy consumption of 62KWh/year is very low compared to its neighboring countries. This is because of high electricity tariffs—US $ 24 cents per KWh—brought about by high distribution costs. Because of a highly centralized supply system from the main hydro power dam in Jinja, distributing power across the country is very expensive. Because of these exorbitant costs, poor people in rural areas cannot afford to pay for the power with a result that only 3.0% have access. The majority of the communities both urban and rural largely depend on fuel wood and charcoal for their energy need ***(Timothy Byakola, 2007).*** In the world, solar energy is the most abundant energy resource and it is available for use in its direct (solar radiation) and indirect (wind, biomass, hydro, ocean etc.) forms. Solar thermal technology is rapidly gaining acceptance as an energy saving measure in agriculture application. It is preferred to other alternative sources of energy such as wind and shale, because it is abundant, inexhaustible, and non-polluting ***(Akinola 1999; Fapetu 2006; Akinola, et al., 2006).*** This can exhaustively be used to enhance the productivity of grains as this facilitates easy drying of the grains.

Grains are harvested at a higher unsafe moisture content and therefore require safe handling and reduction of their moisture content in order to reduce the post-harvest losses that are estimated to be 40% but they can, under very adverse conditions, increased to as high as 80% ***(Bassey 1989; Togrul and Pehlivan 2004).*** Drying is the major post-harvest operation that prevents further deterioration of grains before processing and storage. Economic analysis so far indicates that Uganda does not have an international comparative advantage in maize production and marketing. Ugandan producers usually sell maize in an unprocessed form and in small quantities. No farm level drying facilities exist and the moisture content of sun dried maize varies considerably depending upon local weather conditions and the period of storage. This lack of uniformity is a problem both for storage and for meeting the strict requirements of international markets. Most of Ugandan maize is exported to Kenya and has high moisture content which

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