FACULTY OF ENGINEERING

DEPARTMENT OF CHEMICAL AND PROCESSING ENGINEERING

DESIGN AND CONSTRUCTION OF A SMALL SCALE MAIZE HAMMER MILL

By

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A final year project report submitted to the department of chemical and processing engineering in partial fulfillment of the requirement for the award of a Bachelor of Science in Agro-Processing Engineering of Busitema University.

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ABSTRACT

Maize (*Zea mays L*) is one of the world's important cereal crops and a major staple food in East Africa. In addition to it being an important animal feed, it's also a source of income. Milling of maize grain into flour and other bi-products such as bran is an important process in increasing food security as well as increasing the shelf life. Maize flour is used to prepare porridge and a paste called posho, highly consumed in institutions, prisons and food vending businesses. Maize flour also supports the local brewery industry, where flour is fermented to produce local brews.

However the maize milling technologies especially the maize hammer mills that exist have not been efficient enough to cope up with such increasing demands of maize flour. Parameters that affect their efficiency include: thickness of the hammers, the mill clearance, and moisture content of the grains, drum rotational speed and capacity of the mill. Poor design of such parameters leads to high power consumption during the milling process. The aim of this study is to design a maize hammer mill operating at an optimum speed with a mill clearance and hammer weight that will reduce power consumption and increase the efficiency of the mill.

Designing and constructing of the various components of the maize hammer mill involved determining the appropriate angle of repose of maize grits, a suitable gate size for the hopper, determining the pneumatic pressure developed by the blower to convey the flour to the cyclone and analyzing forces acting on the components to prevent failure of the mill during operation. Force analysis led to selection of proper materials to withstand the forces to avoid failure. Engineering drawings of the various components of the hammer mill were designed before the hammer mill was constructed and assembled. The performance of the hammer mill after construction was evaluated taking into consideration hammer mill capacity, efficiency and power requirement. The obtained results reveal that it is recommended to operate the hammer mill at a rotational speed of about 3500 rpm, grain moisture content of 13%, mill clearance of 5mm and hammer thickness of 3mm to produce fine milled corn and decrease coarse milled corn. Therefore, it is recommended that, this maize hammer mill should be manufactured and popularized for adoption in Uganda and will help reduce power consumption as well as increase profits to the maize millers.

DECLARATION

I *Kirunda Emmanuel, BU/UG/2013/14* declare to the best of my knowledge that the work presented in this final year project report is my own and has never been presented to any University or higher institute of learning for any academic award.

Signature...

Date.......30th | 05 | 2017.......................................

APPROVAL

This final year project report has been submitted to the Department of chemical and Processing Engineering for examination with approval from the following supervisors:

Mr. Sserumaga Paul

Signature..................................

Date..

Dr. Wandera Catherine

Signature..................................

Date.......... 15/6/2017 ....

Mr. Ashabahebwa Ambrose

Signature..................................

Date..

DEDICATION

This report is dedicated to my beloved parents Mr. Kirunda Tigastwa and Mrs. Namatende Monic in appreciation for their selfless care and unflinching support provided to me since childhood, and for the spirit of hard work, courage and determination instilled into me, which attributes I have cherished with firmness and which have indeed made me what I am today, To my brothers and sisters and all my church mates LRC Iganga. I also dedicate it to my pastors, David kyakulaga and Muwereza James for the guidance that they have given me in all aspects of life, May the Almighty God reward you abundantly for such good work.

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May the Almighty God reward you abundantly.

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ABBREVATIONS AND ACRONYMS

UBOS - Uganda National Bureau of Standards

FAO - Food and Agricultural Organization

UNIDO - United Nations Industrial Development Organization

WEMA - Water Efficient Maize for Africa

FPMC- Food price management committee

CHAPTER ONE

This chapter presents the general information about the research design giving its background, problem statement, significance, objectives, justification and scope of the study.

1.1 Background

Maize (*Zea mays* L) (Rooney and Serna-Saldivar, 1987) is one of the world's important cereal crops. In East Africa, the crop is a major staple food for a large proportion of the population in addition to being an important animal feed (FPMC, 2003). While home consumption remains the main reason for maize production, farmers depend upon maize among other crops as a source of income (Venegas & Ngambeki, July 2010). About 60 percent of the maize produced in Uganda is white, used primarily for human diets, and the rest is yellow, used mostly for animal feed. (Orefi Abu & Johann F Kirsten, 2009).

Milling of maize grain into flour and other bi-products such as bran is an important process in increasing food security as well as increasing the shelf life (Kent and Evers, 2005, Anon, 2007).

Maize flour is used to prepare porridge and a paste called posho, demand for which is on an increase. Posho is highly consumed in institutions, prisons and food vending businesses in several urban centers including Kampala City. (Ambrose Agona and Jane Nabawanuka H. 2010). Maize flour, in addition to being prepared directly as food, supports the local brewery industry, where flour is fermented to produce local brews.

However the maize milling technologies especially the maize hammer mills that exist have not been efficient enough to cope up with such increasing demands of maize flour (Orefi Abu & Johann F Kirsten, 2009). A number of design parameters affect their performance and grinding efficiency and these include: hammer thickness (Vigneault et al, 2008), the mill clearance, if large causes coarse maize flour particles and if smaller leads to clogging of the material, the moisture content of the grain, drum rotational speed, motor size and capacity of the mill (EL- Gayar and Bahnas, 2002). Poor design of such parameters leads to high power consumption during the milling process. This has made about 60% of the maize mills close up due to high electricity bills (Ali Twaha observers 19 October 2015).

The day to day metal to metal wear of the frictional faces, loose machine parts and broken parts of grinding mills contaminate the flour with metal filings (Normanyo et al., 2010). Iron filings produced

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