



**BUSITEMA  
UNIVERSITY**  
*Pursuing Excellence*

**FACULTY OF ENGINEERING**

**DEPARTMENT OF WATER RESOURCES AND MINING  
ENGINEERING**

**DESIGN AND CONSTRUCTION OF GLASS WASTE  
CRUSHING MACHINE**

**BY**

**SSENGABI MOSES**

**BU/UG/2017/1819**

**SUPERVISOR**

**Mr. LUBAALE AZARIUS SOLOMON**

*This final year project report is presented to the Department of Water Resources and Mining Engineering in partial fulfillment of the requirements for the Award of a Bachelor's of Science in Water Resources Engineering of Busitema University*

**January, 2022**

## DECLARATION

I **SSENGABI MOSES** solemnly declare that this final year project report is a result of my own efforts and tremendous work done during the research period and it has never been submitted to Busitema University or any other institution of higher learning for any academic award.

NAME: SSENGABI MOSES



REG NO: BU/UG/2017/1819

DATE: 30 January 2022

## APPROVAL

This is to certify that this project report was written under the guidance of my supervisors on the topic “*Design and Construction of Glass Waste Crushing Machine*” and is now ready for submission to the department of Water Resources and Mining Engineering Busitema University.

SUPERVISOR

Mr. LUBAALE AZARIUS SOLOMON

DATE: .....

Signature: .....

## ABSTRACT

The management of waste glass is one of the major problems faced by many cities around the world especially in densely populated cities like Hong Kong. Government data has shown that about 300tonnes of glass waste is generated daily in Hong Kong, however, the recovery rate is only about 1-2%. Solid waste includes organic waste (food waste) and inorganic waste (glass waste, plastic waste, etc.) unlike the inorganic waste, the organic waste is biodegradable and easy decompose. Glass is found in municipal solid waste (MSW), primarily in the form of containers such as beer and soft drink bottles, wine and liquor bottles, and bottles and jars for food, cosmetics and other products. The uses of glass products have increased tremendously resulting in large amount of glass waste. In Uganda, Solid waste (glass waste) collection is currently one of the most critical services, whose quality and coverage has caused serious public outcry in slum areas of Kampala. Kampala Capital City Authority acknowledges that the amount of solid waste generated overwhelms the capacity of the Authority to collect and dispose it given the fact that cost of solid waste is enormous. The aim of this proposed research work is to design and construct a glass waste crushing machine that will reduce on the amount glass waste deposited in the landfills.

## Table of Contents

DECLARATION .....	i
APPROVAL .....	ii
ABSTRACT.....	iii
TABLE OF FIGURES .....	vii
1.0 CHAPTER ONE: INTRODUCTION .....	1
<b>1.1 Back ground.</b> .....	1
1.2 PROBLEM STATEMENT .....	2
1.3 OBJECTIVES .....	2
1.3.1 Main objective .....	2
1.3.2 Specific objectives .....	2
1.4 JUSTIFICATION OF THE STUDY. ....	3
1.5 SCOPE .....	3
1.6 DELIMINATION .....	3
CHAPTER TWO: LITERETURE REVIEW .....	4
2.1 INTRODUCTION .....	4
2.2 PROPERTIES OF GLASS WASTE.....	5
2.2.1 Physical properties .....	5
2.2.2 Chemical composition.....	6
2.3 TYPES OF GLASS WASTE CRUSHING MACHINES.....	6
2.3.1 Hammer mills.....	6
<b>2.3.2 Vertical Shaft Impactor</b> .....	7
2.3.3 Rotating Drum and Breaker .....	7
2.3.4 Hammer mill .....	7
2.3.4.1Principle of operation of a hammer mill.....	8
2.4. Specification for natural and crushed fine aggregate.....	8
3.0 METHODOLOGY .....	9
3.1INTRODUCTION .....	9

3.2 Design Considerations .....	9
. 3.3 MACHINE DESCRIPTION .....	9
3.4 Specific Objective one. ....	10
3.4.2 Design of the crushing Chamber.....	10
3.4.1 Hopper: .....	11
3.4.2 Design of shaft .....	11
3.4.3 The shaft diameter .....	11
3.4.4 Design of hammers .....	11
3.4.5 Design of the sieve.....	12
3.4.6 SIEVE ANALYSIS.....	12
3.5 SPECIFIC OBJECTIVE TWO .....	13
3.5.1 FABRICATION AND ASSEMBLEMENT OF THE PROTOTYPE .....	13
3.5.2 Selection of materials.....	13
3.5.3 Fabrication methods.....	13
3.5.4 Tools and equipment.....	14
3.6 SPECIFIC OBJECTIVE THREE .....	15
<b>3.7</b> Specific objective four.....	17
4.0 CHAPTER 4(Specific Objective 5) .....	18
4.1 RESULTS AND DISCUSSION .....	18
4.1.1 Design of the crushing chamber.....	18
4.1.2 Hopper: .....	18
4.1.3 Force exerted by the cylinder where hammers are welded .....	19
4.1.4 DESIGN OF HAMMER BLOWS .....	20
Design of the shaft. ....	22
4.1.5 TORSIONAL AND BENDING MOMENT ON THE SHAFT.....	22
4.1.6 Determining the design stress and factor of safety. ....	23
4.1.7 <i>Design of the sieve</i> .....	23
4.1.8 FABRICATION AND ASSEMBLY OF MACHINE COMPONENTS. ....	26

4.1.9 PERFORMANCE EVALUATION OF THE GLASS CRUSHING MACHINE.....	27
4.1.10 Cost benefit Analysis .....	28
5.0 CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS. ....	31
5.1 Conclusion. ....	31
5.2 Recommendation. ....	31
Appendix.....	32
References.....	42

## TABLE OF FIGURES

Table 1 shows sieve analysis for fine aggregates.....	24
Table 2 shows sieve analysis for coarse aggregates.....	<b>Error! Bookmark not defined.</b>
Table 3 results for different designed components .....	25
Table 4 machine assembly and fabrication procedure .....	26
Table 5 shows fuel consumption of the machine .....	27
Table 6 shows the costs incurred .....	28
Table 7 shows NPV of the machine.....	<b>Error! Bookmark not defined.</b>
Table 8 shows depreciation of the machine .....	<b>Error! Bookmark not defined.</b>