

BUSITEMA UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF TEXTILE AND GINNING ENGINEERING
MAKING PAVERS FROM POLYETHYLENE
TEREPHTHALATE WASTE AND SAND REINFORCED WITH
COTTON WASTE

BY



NGOMA CHARLES

SUPERVISORS: M/S TUSIIMIRE YVONNE

AND

MR. TUMUSIIME GODIAS

*A final year project proposal submitted to the Department of Textile and Ginning Engineering as
a partial fulfillment for the award of Bachelor of Science in Textile Engineering*

ABSTRACT

Plastics, especially polyethylene terephthalate (PET bottles) are rapidly growing segment of the solid waste in Kampala city and Uganda as a whole. Disposal of waste materials including waste plastic bags and cotton wastes has become a serious problem. In order to overcome this issue, they should be reused in an effective way. Pavement blocks are perfect materials on the pathways and streets for simple laying and finishing. The PET waste was mixed with sand at a ratio of 1:1 and cotton waste was added as a reinforcement was added in bits of 0%, 0.5%, 1%, 1.5% and 2% of the weight of the mixture. The pavers were produced by compression molding and compressive strength, flexural strength and water absorption properties were tested. A testometric materials testing machine was used to test compressive strength and flexural strength. An analytical balance was used to measure the weights of the pavers and water absorption was calculated. The effect of cotton waste addition on the physical and mechanical properties of the pavers was analyzed using ANOVA software. The paver containing 2% cotton showed the highest compressive strength (5.4891 N/mm^2) and it also showed the highest flexural strength (8.330 N/mm^2) compared to the sample without cotton waste (0%) which showed compressive strength (3.78898 N/mm^2) and flexural strength of 0.584 N/mm^2 . Data analysis using ANOVA showed a significant effect of increasing cotton waste on compressive and flexural strength but showed less effect on water absorption.



DECLARATION

I **NGOMA CHARLES** declare to the best of my knowledge that this project report is as a result of my research and effort, except where explicit citations have been made and it has never been presented or submitted to any institution or university for any academic award.

DATE 21/05/2019

SIGNATURE 



APPROVAL

This project report has been submitted to the department of Textile and ginning Engineering for examination with approval from the following supervisors:

MAIN SUPERVISOR

M/S. TUSIIMIRE YVONNE

SIGNATURE..... DATE

CO-SUPERVISOR

MR. TUMUSIIME GODIAS

SIGNATURE DATE



ACKNOWLEDGEMENT

First and foremost, I thank the Almighty God who has enabled me to do this project and granted me healthy life.

Secondly, in a special way I thank my parents, relatives for their continued support and I extend my sincere gratitude to M/s. Tusiimire Yvonne and Mr. Tumusiime Godius my supervisors for the guidance, advice, encouragement and reading through my project. Lastly, I would like to extend my appreciation to my friends and the Textile class of 2015 for their continued support and encouragement during the period of report writing.

LIST OF ACCRONYMS

PET.....	Polyethylene terephthalate
PP.....	Polypropylene
HDPE.....	High density polyethylene
LDPE.....	Low density polyethylene
ASTM.....	American standard of testing materials
ISO.....	International standards organization
FPR.....	Fiber reinforced polymer
NEMA.....	National environment management authority
Kg.....	Kilograms
ICBP.....	Interlocking Concrete Block Pavers

LIST OF TABLES

Table 1;showing properties of PET(Luwalaga, 2016).....	8
Table 2 showing comparison of properties of bricks reinforced with different agro waste	12
Table 3;showing standards to be followed while testing the properties of the pavers	17
Table 4: showing forces at peak for compressive strength.....	21
Table 5; showing the results for compressive strength.....	22
Table 6; showing summary for the for the forces at peak for flexural strength.....	24
Table 7;showing data for flexural strength results.....	25
Table 8;showing Summary of results for water absorption	27

LIST OF FIGURES

Figure 1; showing the process flow chart of the methodology	15
Figure 2; showing a paver mold.....	16
Figure 3;Graph showing relationship between cotton addition and compressive strength	23
Figure 4; showing a bar graph of compressive strength against cotton waste addition.....	24
Figure 5; showing a graph of the relationship between cotton waste inclusion and flexural strength.....	26
Figure 6Showing a bar graph of average flexural strength against cotton waste	27
Figure 7Showing a bar graph showing average water absorption at against cotton waste.....	28
Figure 8; showing a graph of the effect of cotton on water absorption	28
Figure 9;Showing a testometric materials testing machine performing compressive strength test.	36
Figure 10; showing a testometric materials testing machine performing flexural strength test. ..	36
Figure 11 ;Showing mechanical workshop Makerere university	37
Figure 12; Showing analytical weighing balance	37
Figure 13; showing PET plastic bottles blocking water streams	38
Figure 14;showing PET bottles clogging water bodies	38
Figure 15;Showing paver sample produced.....	38

Table of Contents

ABSTRACT	i
DECLARATION	ii
APPROVAL	iii
ACKNOWLEDGEMENT	iv
LIST OF ACCRONYMS	v
LIST OF TABLES	vi
CHAPTER ONE: INTRODUCTION	1
1.1 Back ground.....	1
1.2 Problem statement.....	2
1.3 Objectives.....	3
1.3.1 Main objectives.....	3
1.3.2 Specific objective.....	3
1.4 Purpose/significance of the study.....	3
1.5 Scope and limitations of the study.....	3
1.6 Justification of the study.....	4
CHAPTER TWO: LITERATURE REVIEW	5
2.1 Plastics.....	5
2.1.2 Types of plastics.....	5
2.1.3 Categories of plastics.....	5
2.1.4 Desirable intrinsic properties of plastics.....	6
2.2 An overview on polyethylene terephthalate (PET).....	6
2.2.1 Reasons for using PET.....	7
2.2.2 PET waste.....	8
2.2.3 Re use of PET plastic waste in construction industry.....	8
2.3 Cotton waste.....	11
2.3.1 Utilizing cotton waste in construction.....	11
CHAPTER THREE: METHODOLOGY	14
3.1 Introduction.....	14
3.2 Materials.....	14

3.3.1 Fabrication of the mold	16
3.3.2 Collecting, cleaning and sorting PET waste.....	16
3.3.3 Collecting cotton waste	16
3.3.4 Fabrication/ production of the paver	16
3.4 Determining the selected physical and mechanical properties of the paver produced.....	17
3.4.2 Compressive strength test	17
3.4.3 Water absorption test.....	18
3.4.4 Flexural strength test	18
3.5. Analyzing the effect of cotton waste inclusion on the properties of the paver	19
4.1 Production of the pavers.....	20
4.1.1 Dimensions used	20
4.1.2 Mixture ratios	20
4.2.1 Compressive strength.....	21
4.3 Analyzing the effect of cotton addition.....	29
4.3.1 ANOVA on compressive strength	29
4.3.2 ANOVA on flexural strength	30
4.3.3 ANOVA on water absorption.....	31
CHAPTER FIVE: CHALLENGES, RECOMMENDATIONS AND CONCLUSION.....	32
5.1 Challenges	32
5.2. Recommendations	32
5.3. Conclusion.....	32
APPENDICES	36

CHAPTER ONE: INTRODUCTION

1.1 Back ground

The use of Polyethylene terephthalate also known as PET is increasingly becoming paramount among manufacturers in Uganda, as they use these PET bottles to package their products because it (PET) is an excellent barrier material with high strength, thermal stability and transparency. Consumer also prefer or choose PET because it is inexpensive, light weight and recyclable among other reasons(David, 2010). PET is strong, recyclable and available making it fit for use for this research. PET is the common name for a unique plastic belonging to the polyester family. PET polyester is formed from ethylene glycol (EG) and terephthalic acid (TPA), sometimes called "purified terephthalic acid" or PTA(O'Callaghan, 2017). It is estimated that about 13-14 million tons of PET are being produced as waste annually. PET belongs to thermoplastics with excellent physical properties. It constitutes around 18% of the total polymers produced worldwide and over 60% of its production is used for synthetic fibers and bottles, which consume approximately 30% of global PET demand .Efforts are put forward to see that all these plastic wastes are recycled or reused into useful materials to protect the environment from pollution for example, through reinforcing them with fibers into composites(Palakurthi, 2016).

The interest and development of composites making use of natural fibers for example cotton, aimed for structural applications, is growing from a long-term to sustainable perspective. Fiber-reinforced polymers (FRP) are relatively new materials in the construction of structural members and parts to provide alternatives to natural minerals which are used today in order to save the environment. Advantages such as low weight, resistance to corrosion and low maintenance costs make this type of materials an attractive alternative to traditional materials such as wood, steel and concrete(Raftoyiannis, 2012).

Cotton is a strong natural vegetable fiber and the most important vegetable fiber, it is grown on large scale globally and in Uganda in particular. Cotton was introduced in Uganda in 1903. Cotton in Uganda is cultivated at altitudes varying from 3,500 feet to 4,500 feet above sea level and is entirely rain fed(Faso, Eastern and Africa, 2013). Cotton ginning involves separating cotton fibers from its seeds. 1 bale (560 Kgs) of seed cotton gives you 1 bale (185 Kgs) of cotton lint, 350 Kgs of cotton seeds and the balance is un cleaned cotton which consists of seeds and trash which can also be called cotton waste(Raftoyiannis, 2012). An initiative of utilize the cotton waste with PET plastics which are all over the place leading to land pollution to make a new construction material comes in to play. In 2005, Binci



REFERENCES

- Achitra, M. *et al.* (2018) 'Recycled Plastic and Coconut Fibre used in Concrete Paver Block', 8(4), pp. 16827–16830.
- Ashour (2016) 'utilising straw as a reinforcement fibre in plaster material for wall plaster'.
- David, M. (2010) 'Waste plastic Disposal: A grave problem'.
- Faso, B., Eastern, I. and Africa, S. (2013) 'Cotton sector', (October).
- Ismail, B., Sc, F. B. and Yassin, E. E. (2010) 'Management of PET Plastic Bottles Waste Through Recycling In Khartoum State', *Sudan Academy of Science*, p. 90.
- Kanawade, B. D. (2018) 'Strength and Durability of Concrete Paver Block', *Advances in Civil & Structural Engineering*, 2(3), pp. 0–11.
- Kimura, T. and Hanamitsu, H. (no date) 'Recycle of Polyester / Cotton Mixed Yarn as Reinforcement of Hybrid Composite Material'.
- Later, T., Figure, P. E. T. and Pet, A. (1970) 'The Facts about PET What is PET ? PET as a packaging material', pp. 1–7.
- Luwalaga, John Groover (2016) 'Analysing the Behaviour of Soil Reinforced with Polyethylene', (March).
- Mohan, D. M. S. *et al.* (2018) 'Utilization of plastic bags in pavement blocks', 119(15), pp. 1407–1415.
- NEMA (2018) 'plastic waste disposal'.
- Newvision (2018) 'plastic waste is choking kampala'.
- O'Callaghan, F. J. (2017) 'Autism - What is it and where does it come from?', *Qjm.Mon.J Assoc.Phys.*, QJM-Monthl, pp. 5–265.
- Ohemeng, E. A., Adjei, K. O. and Asamoah-duodu, A. (2015) 'Equations for Predicting Flexural Strength and Compressive Strength of Plastic Concrete Pavement Blocks', 7(2), pp. 140–149.
- Palakurthi, M. (2016) 'Development of Composites from Waste PET - Cotton Textiles'.
- Pawar, S. and Bujone, S. A. (2017) 'Use of Fly ash and Plastic in Paver Block', pp. 1542–1547.
- Raftoyiannis, I. G. (2012) 'Experimental Testing of Composite Panels Reinforced with Cotton Fibers', *Open Journal of Composite Materials*, 02(02), pp. 31–39. doi: 10.4236/ojcm.2012.22005.
- Rahman, W. M. N. W. A. and Wahab, A. F. A. (2013) 'Green pavement using recycled Polyethylene Terephthalate (PET) as partial fine aggregate replacement in modified asphalt', *Procedia Engineering*. Elsevier B.V., 53, pp. 124–128. doi: 10.1016/j.proeng.2013.02.018.
- Ramakrishna, S. (2017) 'variation in chemical composition of coir, sisal, jute and hibiscus fibres'.

Safiuddin, M. *et al.* (2010) 'Utilization of Solid Wastes in Construction Materials', *International Journal of Physical Sciences*, 5(13), pp. 1952–1963. doi: 10.3844/ajessp.2013.14.24.

Sellakutty, D. (2016) 'UTILISATION OF WASTE PLASTIC IN MANUFACTURING OF BRICKS AND PAVER UTILISATION OF WASTE PLASTIC IN MANUFACTURING OF BRICKS AND PAVER', (May).

Shanmugavalli, B. (2017) 'Reuse of Plastic Waste in Paver Blocks', 6(02), pp. 313–316.

Tapkire, G. *et al.* (2014) 'Recycled Plastic Used in Concrete Paver Block', *IJRET: International Journal of Research in Engineering and Technology*, eISSN pISS, pp. 2319–1163.