

THE EFFECTIVENESS OF PALM OIL
CLINKER (POC) IN GABION WALL FOR
SLOPE PROTECTION

LIM LI YANG

B. ENG (HONS.) CIVIL ENGINEERING

UNIVERSITI MALAYSIA PAHANG

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FOR SLOPE PROTECTION

LIM LI YANG

Thesis submitted in partial fulfillment of the requirements
for the award of the
B. Eng (Hons.) Civil Engineering

Faculty of Civil Engineering and Earth Resources

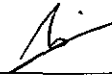
UNIVERSITI MALAYSIA PAHANG

MAY 2019

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.



(Student's Signature)

Full Name : LIM LI YANG

ID Number : AA15154

Date : 31 MAY 2019

ACKNOWLEDGEMENTS

Firstly, I would like to express my sincere gratitude to my advisor Dr. Amizatulhani for her patience, motivation, enthusiasm, and immense knowledge. Her guidance helped me in all the time of research and writing of this thesis. I could not have imagined having a better advisor and mentor for my degree study.

Next, thank to my fellow technician assistants of Soil & Geotechnical Engineering Laboratory, Faculty of Civil Engineering and Earth Resources, Universiti Malaysia Pahang (UMP) for their fully support and assistance. I would like to thanks my good buddies, Hafiz, Izzat and Asyraf for their help all along the time. I would never forget all the chats and beautiful moments I shared with them.

I am grateful to my parents, who have provided me through moral and emotional support in my life. I am also grateful to my other family members and girlfriend Mun Lin who have supported me along the way.

Lastly, thanks to everyone that help me along this university life! Good luck!

ABSTRAK

Klinker kelapa sawit (POC) adalah produk sampingan dalam industri kelapa sawit yang biasanya digolongkan sebagai sisa yang menyebabkan masalah alam sekitar. Kerikil adalah bahan utama dinding gabion. Walau bagaimanapun, kerikil merupakan sumber yang tidak boleh diperbaharui di muka bumi, jadi bahan alternatif perlu dicadangkan untuk mengurangkan penggunaan kerikil. Kajian ini mengkaji keberkesanan klinker kelapa sawit untuk digunakan sebagai bahan dinding gabion untuk perlindungan cerun. Objektif utama kajian ini adalah untuk mengkaji keberkesanan POC dalam menggantikan kerikil di dinding gabion dengan nisbah 0%, 20%, 50%, 80%, dan 100% dari segi jumlah. Dinding gabion digunakan untuk mengekalkan model cerun yang terdiri daripada tanah dengan sudut yang paling kritikal iaitu 60 °. Keamatan hujan berterusan diaplikasikan ke atas cerun dan bacaan transduser yang mencatatkan pergerakan dinding gabion telah diambil. Perbandingan dibuat berdasarkan bacaan yang diperolehi. Kajian didapati bahawa dinding gabion dengan 20% klinker minyak sawit mempunyai anjakan tambahan sebanyak 25% berbanding dengan gabion konvensional. Hasilnya menunjukkan klinker kelapa sawit kurang berkesan untuk digunakan sebagai bahan alternatif untuk kerikil dalam pembinaan dinding gabion. Walau bagaimanapun, bahan tersebut masih mempunyai potensi untuk mengurangkan penggunaan sumber semula jadi.

ABSTRACT

Palm oil clinker (POC) is a waste by-product of palm oil industry that usually treated as waste which may cause problem to the environment sustainability. Gravel is the main material of gabion wall. However, gravel is non-renewable resources on earth, so alternative material has to be suggested to reduce the usage of gravel. This research studied about the effectiveness of palm oil clinker to use as raw material of gabion wall for slope protection. The primary objective of this study is to study the effectiveness of POC in replacing the gravel in gabion wall with 0%, 20%, 50%, 80%, and 100% in term of volume. Gabion wall was used to sustain the slope model consisting of soil sample with critical angle of 60° . Constant rain intensity was added on the slope and transducer reading that recorded the movement of gabion wall was taken. Comparison was made based on the reading obtained. It was found that the gabion wall with 20% of palm oil clinker has 25% extra displacement when compared with conventional gabion. The result shows that palm oil clinker is less effective to use as alternative material for gravel in constructing of gabion wall. However, there are still have potential to reduce the usage natural resources.

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LIST OF SYMBOLS

c	Cohesion
G_s	Specific gravity
kN	Kilo Newton
kPa	Kilo Pascal
mm	Millimetre
mm/h	Millimetre per hour
μm	Micrometre
w_{opt}	Optimum moisture content
γ	Unit weight
γ_{max}	Maximum unit weight
ρ_d	Dry density
R^2	Correlation cohesion
$\%$	Percent
$^\circ$	Degree
ϕ	Angle of friction

LIST OF ABBREVIATIONS

ASTM	American Society for Testing and Materials
LL	Liquid Limit
PL	Plastic Limit
POC	Palm Oil Clinker

CHAPTER 1

INTRODUCTION

1.1 Introduction

Every year, slope failure causing huge impact due to amount of losses to the people and country of Malaysia (Abd Rahim et al , 2017). For example, in 2008, July 2013, November 2013 and June 2015, slope failure have repeated occurred in Kampung Mesilou and caused trillions of Ringgit Malaysia for reconstruction and repairs. Therefore, slope protection has become an urgent issue to take attention. The suitable material used for the slope protection reinforcement need to be considered instead of slope condition because the material properties will affect the strength and durability of the retaining structure.

Gabion wall is one of the methods to overcome the problem of slope failure (Yuen, 2012). Gabions filled up with rock or other heavy material which provide stability to the slope. The interlocking effect of the packed stone and their mass functioned to support the slope (Hrvatska, 2018). However, gravel is non-renewable resources that may finish up one day in future. Therefore, alternative material is needed to be study to reduce the dependency on gravel.

Malaysia is one of the largest producers and exporters of palm oil in the world, which contributing to 11% of the world's oils and fats production and 27% of export trade of oils & fats (MPOB, 2011). During the extraction process, there is large number of waste by product produce at the same time, which is palm oil clinker (POC). The study is purposely using this waste material to use in construction industry in order to reduce to usage and dependency on natural aggregate.

According to researcher (Abutaha et al, 2016), POC shows its potential to replace aggregate in manufacturing of fresh concrete. It indicates that POC is very useful due to its properties and sustainability. The properties of POC is suitable to use as lightweight material that can save up 40% of aggregate during the batching process. This may reduce the cost of construction (Ahmad and Noor, 2009).

1.2 Problem Statement

Nowadays, palm oil was widely used as cooking oil and manufacturing of margarine and non-dairy creamers. Besides that, it is also used as raw material for soap and detergent. In 2016, Malaysia has 4.49 million hectares of land that was under oil palm cultivation due to its hot climate. Malaysia is one of the largest producers and exporters of palm oil in the world, which contributing to 11% of the world's oils and fats production and 27% of export trade of oils & fats (MPOC, 2016). The palm oil industry is looking forward for keep growing and developing.

During palm oil processing phases, there are plenty of waste by-products are produced. One of them is palm oil clinker (POC), which is obtained in large amount during the oil palm shell and fibre incineration process. POC has no economic value and consider as solid waste.

1.3 Objective

The main objectives of this research study are stated as follows,

- i. To determine the basic properties of testing material (Soil, Gravel and Palm Oil Clinker)
- ii. To identify the critical angle of the slope.
- iii. To determine the effectiveness of palm oil clinker in replacing gravel as material to make gabion wall.

1.4 Scope of Research

The main focus in this study is to identify the effectiveness of palm oil clinker in gabion wall. A model that simulate the slope is build up. The slope is formed in various angle which are 30° , 45° and 60° using soil sample that collected from same location and its critical angle is determined. In order to get the comparison result between gravel and palm oil clinker, several laboratory test such as particle size distribution test, specific gravity test and Atterberg limit test were conducted on the soil sample collected, palm oil clinker, gravel to obtain the value required (sieve analysis, specific gravity, unit weight of soil and more). After the critical angle was determined, the slope had been reinforced using gabion wall that made up using different proportion of gravel and POC. The results obtained were compared to identify the performance of each combination of material. The performance was evaluated based on the time taken for the slope to fail and collapse under same rain intensity.

1.5 Significance of Research

Since gravel is non-renewable material that may use up in one day, this research may contribute to the reduction of dependency of gravel in manufacturing of gabion wall. By combining palm oil clinker into the manufacturing material of the gabion wall, the quantity of raw material used to build up gabion wall which is gravel can be reduced. Meanwhile, the strength of the gabion wall with combination of gravel and POC is expected to have same strength or even greater strength than gabion wall that made up of 100% of gravel. Utilising the waste material is promoting the sustainable material to replace conventional material, which by this can preserve environment and save up construction cost.

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