LATERITIC SOIL STABILIZATION BY USING ROADPACKER PLUS

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To my beloved family

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ABSTRACT

In Malaysia, more than half the area in Peninsular Malaysia is covered with lateritic soil. Improvement method is needed to provide a strong subgrade construction during construction process. Currently, there are a lot of popular improvement methods and stabilization methods are used in the field. In study, 7% and 13% of RoadPacker Plus were used as a mean of stabilization treatment of soil while 0% act as control sample. Soil stabilization is the alteration of one or more soil properties, by mechanical or chemical means, to improve soil material possessing the desired engineering properties. The main purpose of soil stabilization is to increase soil strength, bearing capacity and resistance to deteriorative forces of nature and manmade environment. Laboratory tests were conducted to determine the engineering properties of soil sample such as classification, Standard Proctor Compaction Test, and Unconfined Compressive Test (UCT). For compaction test, 7% RoadPacker Plus content has the highest MDD value which is 1.54 with 25.47% of moisture content. As for the UCS testing, soil mixture with 7% RoadPacker Plus content have gain higher strength improvement as compare to 13% content. The results indicated that RoadPacker Plus is able to significantly improve the unconfined compression strength of Laterite soil. The soil strength increased with the duration of curing period. As a result, RoadPacker Plus is suitable to use for some practical project such as increasing road bearing capacity.

ABSTRAK

Di Malaysia, lebih daripada separuh kawasan di Semenanjung Malaysia diliputi dengan tanah laterit. Kaedah peningkatan kestabilan tanah diperlukan untuk menyediakan pembinaan subgrade yang kuat semasa proses pembinaan. Pada masa ini, terdapat banyak kaedah penambahbaikan dan kaedah penstabilan telah digunakan di pasaran. Dalam kajian ini, 7% dan 13% daripada RoadPacker Plus telah digunakan sebagai kaedah rawatan penstabilan tanah sementara 0% bertindak sebagai sampel kawalan. Penstabilan tanah adalah pengubahan ciri-ciri tanah, dengan cara mekanikal atau kimia untuk meningkatkan kestabilan tanah yang mempunyai sifat-sifat kejuruteraan dikehendaki. Tujuan utama penstabilan tanah adalah untuk meningkatkan kekuatan tanah, keupayaan dan kekuatan ricih untuk mengatasi kuasa yang meyebabkan kegagalan yang disebabkan alam semula jadi dan alam sekitar buatan manusia. Ujian makmal telah dijalankan untuk menentukan sifat-sifat kejuruteraan sampel tanah seperti analisis saiz partikel, Ujian Pemadatan Proktor Piawai, dan Ujian Kekuatan Mampatan Tidak Terkurung (UCT). Untuk ujian pemadatan, tanah dengan 7% kandungan RoadPacker Plus mempunyai nilai ketumpatan kering maksimum (MDD) tertinggi iaitu 1.54 dengan 25.47 % kandungan kelembapan. Bagi ujian Kekuatan Mampatan Tidak Terkurung (UCT), campuran tanah dengan 7 % kandungan RoadPacker Plus telah mendapat peningkatan kekuatan yang lebih tinggi berbanding dengan kandungan 13%. Keputusan menunjukkan bahawa RoadPacker Plus dapat meningkatkan kekuatan mampatan tanah Laterit. Kekuatan tanah meningkat dengan peningkatan jangka masa tempoh pengawetan. Hasilnya, RoadPacker Plus sesuai digunakan untuk beberapa projek praktikal seperti peningkatkan keupayaan galas jalan .

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LIST OF ABBREVIATIONS

BS	-	British Standard
CBR	-	California Bearing Ratio
JKR	-	Jabatan Kerja Raya
LI	-	Liquidity Index
LL	-	Liquid Limit
MDD	-	Maximum Dry Density
OMC	-	Optimum Moisture Content
OPC	-	Ordinary Portland Cement
PI	-	Plasticity Index
PL	-	Plastic Limit
PSD	-	Particle Size Distribution
PVC	-	Polyvinyl Chloride
UCS	-	Unconfined Compressive Strength

LIST OF SYMBOLS

°	-	Degree
°C	-	Degree Celsius
Ca+	-	Calcium Ion
Na+	-	Sodium Ion
K+	-	Potassium Ion
Mg+	-	Magnesium Ion
H+	-	Hydrogen Ion
qu	-	Unconfined Compressive Strength
w	-	Moisture Content
σ	-	Shear Stress

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CHAPTER 1

INTRODUCTION

1.1 Background

Lateritic soils are generally found in tropical and sub-tropical countries. In Malaysia, more than half the area in Peninsular Malaysia is covered with residual sedimentary rock soil rich in iron and alumina content which give its lateritic nature (Aun. OT., 1982). Their geotechnical properties are influenced by the climate, parent rock and the degree of laterisation. During laterisation, iron oxide and aluminium oxide coat and bind the clay particles leading to change in the micro-structure of the soil. The mineralogy and micro-structure influence the geotechnical properties of lateritic soil (Mahalinga-Iyer and Williams, 1991).

Therefore, the characteristic of lateritic soil is hard to predict during construction. Lateritic soil are not conducive to road construction thus, if the techniques of road design and construction is not in accordance with the soil conditions, then failure will prevail before its design life. To ease the work of construction pavement, stabilization works have been introduced to improve characteristics of soil such as compressive strength, compressibility and permeability of the soil.

There are various method are adapted to improve the engineering characteristic of soil to ensure stability of soil. The problematic of soil either removed and replaced by good or better quality material or stabilized by using

physical or chemical stabilization. Chemical stabilization includes cement, lime, fly ash, bitumen and asphalt emulsion. These are the most common soil stabilization method used in the construction industry. However, in recent years, commercial sector has a variety of non-traditional soil stabilization such as enzymes, liquid polymers, resins, acids, silicates, and lignin derivatives which are considered not common (Marto et al., 2013).

In this study, a liquid chemical was used as soil stabilizer which is known as RoadPacker Plus. RoadPacker Plus is a corrosive liquid, N.O.S. (Phosphoric Acid, Sulphuric Acid) Class 8; UN 1760; PGII which acts as a highly effective soil stabilizer and has a branched molecular structure comprised of millions of molecules linked and cross linked together to create an unbreakable bonding adhesion matrix tat increase the strength of the in-situ soil significantly.

1.2 Problem Statement

Malaysia is a rapidly developing country. As the result, there has been a considerable amount of development in all major cities. To cope with the developing and strong economic performance, there has been lots of urbanization project done by the government.

Problem laterites are laterite soils that have the reputation of being problematic in road and airfield pavement construction. Highway and airfield pavements that have this soil as bases and sub-bases are characterized by pavements swelling, depression, and lateral movement in the presence of water, even under moderate wheel loads. Problem laterites are generally identified as residually weathered soils formed in regions of recent volcanic activity and/ or continuous wet climate with an average rainfall generally above 1,500mm. They are characterized by high natural water contents and liquid limits, low natural densities, and are friable and/ or have a crumbly structure (Terzaghi 1958, Millard 1962).

Alternative ways to deal with lateritic soil included attempts to dry and compact the soil, adding geosynthetic material into the soil or adding chemical stabilizer such as lime, cement, polymer. Chemical stabilizer such as cement, lime, or bitumen treatment is effective in soil treatment, but this research focus on the efficiency and performance of RoadPacker Plus soil stabilizer to treat the lateritic soil by conducting laboratory tests.

1.3 Objectives

The objectives of the research as below:

1. To determine the engineering properties of laterite soil.

2. To determine the strength of the soil after stabilization by using RoadPacker Plus with different emulsion content and curing period.

3. To determine the optimum composition of RoadPacker Plus emulsion for soil stabilization.

4. To determine the relationship of soil strength and the Liquidity Index (LI) under varies percentage of RoadPacker Plus content and curing period.

5. To compare the soil strength, maximum dry density, optimum moisture content and the relationship of soil strength and liquidity index after stabilized using RoadPacker Plus and Ordinary Portland Cement (OPC) for 7 days curing period.

1.4 Scope of study

The main purpose of this research is to determine optimum chemical emulsion to be used in soil stabilization lateritic soil. The scope of this research includes:

1. The soil selected is laterite soil and the soil stabilizer is RoadPacker Plus.

2. The physical properties and classification tests of laterite soil according to BS 1377 part 2 to identify physical properties of soil such as Atterberg limits, particle size distribution of laterite soil and moisture content.

3. The Optimum Moisture Content (OPC) for the most efficient compaction that is at which the maximum dry density is achieved under that compaction effort, which is accordance to BS 1377: 1990: Part 4 (2.5 kg rammer method).

4. The Maximum Dry Density (MDD) and Optimum Moisture Content (OMC) of the RoadPacker Plus soil stabilizer is used in preparation on the remolded samples and the samples are cured for 1, 7, 14 and 28 days at room temperature.

5. 7% and 13% of Stabilizer are added in different sample in order to stabilize the laterite soil.

6. Obtaining the shear strength of the laterite soil which stabilized with 0%, 7% and 13% RoadPacker Plus soil stabilizer content by using unconfined compression test according to BS 1924.

7. The relationship between the soil strength and Liquidity Index (LI) is to shows the soil sensitivity according to the amount of soil stabilizer and curing period. The relationship will help in determine the optimum amount of RoadPacker Plus to be used during road construction.

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