COMPARISON BETWEEN CANLITE STABILIZED LATERITE AND PROBASE STABILIZED LATERITE

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This project report is dedicated to my late father and beloved mother

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ABSTRACT

In the previous studies, the unconfined compressive strength (UCS) of Laterite soil was improved significantly by adding polymer soil stabilizers like Canlite and Probase. Although this is the important finding of the research, there is still no comparison study done between the two polymer soil stabilizers. The aim of this paper is to investigate the effectiveness of the Laterite soil stabilization treated by Canlite-liquid and Probase-liquid soil stabilizer. A testing programme, scheduled to achieve the overall objectives of this study was to determine the basic properties of Laterite soil, establish the relationship between the compaction characteristics (maximum dry density and optimum moisture content) with the amount of polymer emulsion and last but not least compare the strength of the Canlite-treated and Probase-treated Laterite soil. The effects of both polymer soil stabilizer – Canlite and Probase were examined. The optimum moisture content of the mixtures was used as a reference to determine the water content for preparing all the specimens and later used in unconfined compressive strength (UCS) test. The laboratory test results showed that the additional amount of Canlite and Probase improved the physical properties, liquid limit and unconfined compressive strength (UCS) of Laterite soil. The compressive strength of the treated Laterite was varied and depends on the type of stabilizers, quantity of additives and curing time. From the UCS tests, it was found that the Probase improve the greater strength of the Laterite as compared to the Canlite.

ABSTRAK

Dalam kajian sebelum ini, ujian kekuatan mampatan tak terkurung (UCS) tanah laterit telah bertambah baik dengan ketara dengan menambah penstabil tanah polimer seperti Canlite dan Probase. Walaupun ini merupakan penemuan penting dalam penyelidikan, masih tiada kajian perbandingan dilakukan antara kedua-dua penstabil tanah polimer. Tujuan kertas ini adalah untuk melihat keberkesanan penstabilan tanah Laterit dirawat oleh Canlite-cecair dan Probase-cecair penstabil tanah. Satu program ujian, yang dijadualkan untuk mencapai objektif keseluruhan kajian ini adalah untuk menentukan sifat-sifat asas tanah laterit, menentukan hubungan antara ciri-ciri pemadatan (ketumpatan kering maksimum dan kandungan lembapan optimum) dengan jumlah emulsi polimer dan akhir sekali bandingkan kekuatan tanah Canlite dirawat dan Probase dirawat Laterit. Kesan kedua-dua penstabil tanah polimer - Canlite dan Probase telah diperiksa. Kandungan lembapan optimum campuran telah digunakan sebagai rujukan untuk menentukan kandungan air untuk menyediakan semua spesimen dan kemudian digunakan dalam kekuatan mampatan tak terkurung (UCS) ujian. Keputusan ujian makmal menunjukkan bahawa tambahan Canlite dan Probase meningkatkan sifat-sifat fizikal, had cecair dan kekuatan mampatan tak terkurung (UCS) tanah laterit . Kekuatan mampatan Laterit yang dirawat bergantung kepada jenis penstabil, kuantiti bahan tambahan dan masa sembuhan. Daripada ujian UCS, didapati bahawa Probase meningkatkan kekuatan yang lebih besar kepada Laterit berbanding dengan Canlite.

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LIST OF ABBREVIATIONS

UCS	=	Unconfined Compressive Strength
CBR	=	California Bearing Ratio
SPC	=	Standard Proctor Compaction
MDD	=	Maximum Dry Density
OMC	=	Optimum Moisture Content
CMS	=	Cement-Modified Base
CTB	=	Cement-Treated Base
GGBFS	=	Ground Granulated Blast Furnace Slag
PVC	=	Polyvinyl Chloride
SS299	=	Canlite
TX-85	=	Probase
US	=	Untreated Sample
PL	=	Plastic Limit
LL	=	Liquid Limit
PI	=	Plasticity Index
UU	=	Unconsolidated, Undrained

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CHAPTER 1

INTRODUCTION

1.1 Research Background

The use of soil is an inevitable element in the construction process, especially for developing countries. It is used extensively as construction materials in the building of roads, dams, embankments and airfields. According to Whitlow (2001), the properties of the materials need to be measured and evaluated before use and introduce some quality control measures to ensure a quality product. In this sense, it is worth to realize that the strength of the soils varies from different types of soils. Indeed, there are a wide variety of soils in Malaysia; one of the special soils is called Laterite soils.

Laterite soils are found abundantly in the Tropicana country such as Malaysia. The colours can differ from ochre through red, brown, violet to black, depending largely on the concentration of iron oxides (Amu et al., 2011a). Laterite soil is well known in Asian countries as a building material for more than 1000 years and the temples at Angkor are famous examples for this early use. Basically, Laterite soils are regarded as good foundation materials as they are virtually non-swelling (Alhassan, 2008). However, it contains amount of clay minerals that its strength and

stability could not be guaranteed under loads, especially under presence of water (Oluremi et al., 2012). When Laterite soil consists of highly plastic clay, the plasticity of soil may cause cracks and damage on building foundations, pavement, highway or any other construction projects. It is therefore important, to understand the behaviour of Laterite soil and thus figure out the method of soil stabilization.

The soil stabilization can be either mechanical or chemical stabilization. The former refers to either compaction or the introduction of fibrous and other non-biodegradable reinforcement to the soil while the latter is the method of improving the engineering properties of soil by adding some chemical to improve the existing soil. The used of stabilized soils in construction like road construction has been introduced since Roman times (Krebs and Walker, 1971) and used in construction of adobe buildings in Cyprus and Arizona (Fitzmaurice, 1958). It has a very long history and common practice around the world. When the mechanical stability of a soil cannot be obtained and considered, it is always an alternative by adding of the chemical additives. For instance, addition of traditional chemical stabilizer such as lime, cement, bituminous materials and fly ash were done by many researchers (Oluremi et al., 2012; Alhassan, 2008; Little et al., 2000; Rogers et al., 1993; Sherwood, 1993; Ola, 1975).

Despite of traditional chemical stabilizer, polymer emulsion which is considered non-traditional chemical stabilizer has introduced recently like PolyPavement, Soil Sement, TerraBond, Canlite, Probase, etc. Principally, the function of polymers is to enhance the strength of the soil and it is especially suitable to increase the strength of silty-sand soil under wet and dry condition (Yong, 2013). Among the polymer emulsions, Canlite and Probase was studied by many researchers recently such as Latifi et al., (2013); Marto et al., (2013) and Yong, (2013) in respect of Laterite stabilization.

In this study, both polymer soil stabilizer entitled Canlite and Probase were tested to the Laterite soil. Both Canlite and Probase exist in two forms which are liquid and powder form; however, only liquid form was used in this research. The results obtained from the UCS test for both polymer soil stabilizers were then compared and discussed.

1.2 Problem Statement

Laterite soil is found to be good construction materials and can be easily available in the Malaysia. For instance, it can be used as building materials for moulding blocks and plastering. Beyond that, it can be utilized in a variety of construction purposes such as highway construction and pavement construction. However, the Laterite soil in the natural has low bearing capacity and low strength due to high content of clay. Many research found that the construction failure are owing to poor Geotechnical properties of the underlying soils (Laterite soil). For example, several highway pavements on Nigeria roads are failing due to the inadequate of soil strength (Amu et al., 2011b). This soil stabilization is practiced when it is more economical to improve its engineering properties rather than bring in the one that fully complies with the requirement of the specification for the soil (Ola, 1975).

Different additives have different functions and can bring different effect to the same materials. The addition of cement will increase the compressive strength of the Laterite soil, but probably produce shrinkage cracks when the cement content is high; addition of coconut husk ash increase the California Bearing Ratio (CBR) value of the Laterite soil but reduces the plasticity index of the Laterite soil.

For the non-traditional stabilizers, polymer emulsions can be used on most soils; however, certain products are more effective for specific soil types. For instance, when synthetic polymer emulsions applied at low application rates (sprayed-on or mixed-in) to the surface of the unbound roads, they perform well for dust suppression. They bond soil particles together and so reduce dust generation. Another example is synthetic polymer emulsions can be used to stabilize soils at higher application rates (Kestler, 2009). In the previous studies, the Laterite soil was treated with both Canlite and Probase and the research found that the unconfined compressive strength (UCS) of Laterite soil was improved significantly. Although this is the important finding of the research, there is still no comparison study done between the two polymer soil stabilizers. It is always advisable that does not rely only on one material and should go for alternatives. This is because the comparison study can search for the best solution. Thus, comparison study between the Canlite-treated soil and Probase-treated soil is vital for the construction industry.

1.3 Aim and Objectives

The aim of this paper is to investigate the effectiveness of the Laterite soil stabilization treated by Canlite-liquid and Probase-liquid soil stabilizer. In this paper, three objectives were identified to attain the above aim:

a. To determine the basic properties of Laterite soil.
b. To establish the relationship between the compaction characteristics (maximum dry density and optimum moisture content) with the amount of polymer emulsion.
c. To compare the strength of the Canlite-treated and Probase-treated Laterite soil.

1.4 Scope of Research

Generally, this research is a comparison study of the stabilization of Laterite soil between the use of Canlite and Probase soil stabilizer. Physical properties tests like Atterberg limits Test was carried out while mechanical properties tests were standard protocol compaction (SPC) test and unconfined compressive strength (UCS) test. All the tests were performed in accordance with the British Standard 1377 (1990) and Head (1992).

For the constant variables, there were settings as follow:

a) The soil sample was obtained around the Faculty of Electrical and Electronic, Universiti Teknologi Malaysia Skudai Johor;
b) Only the soil particles which passed through the 2mm sieve were considered in the laboratory test;
c) The amounts of Probase and Canlite soil stabilizer were added to the Laterite soil were 2%, 8% and 16%, besides, there were a condition which no soil stabilizer added to the sample soil as control samples;
d) All the treated soil samples were cured for 3, 7 and 28 days.

For the laboratory test procedure, there were carried out as follow:

a) All the soil specimens were dried out in the oven (approximately 110 ℃) for one day before laboratory work were carried out.
b) A standard proctor compaction test was carried out to achieve the maximum dry density (MDD) and optimum moisture content (OMC).
c) The soil samples for unconfined compressive strength (UCS) test were prepared by referring to the MDD and OMC of the untreated soil.
d) UCS tests were carried out after curing period of 0, 3, 7 and 28 days with different emulsion content.

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