STABILISATION OF ORGANIC CLAY USING LIME-ADDED SALT

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ABSTRACT

The main objective of this research is to investigate effectiveness of salts used as an additive in lime-stabilized organic clay. Lime is known to be an effective stabilization method for clayey soil. However, for organic clay it becomes less effective due to low increase in strength. Therefore, salts are used to accelerate lime-organic clay reactions. Salts are introduced to remove the barrier in order to accelerate as well as help lime to increase the strength of soil. Two types of salts used are sodium chloride (NaCl) and calcium chloride (CaCl₂). The unconfined compressive test (UCT) is conducted on 108 remolded samples (38mm x 80mm) for 0, 7, 14 and 28 days of curing period. The test results indicated that when NaCl or CaCl₂ is added to the lime-organic clay mixture, the strength of mixture increases with increasing salt concentration. The strength of clay stabilized with lime and sodium chloride is higher than clay stabilized with lime and calcium chloride at a 10% salt concentration. The highest unconfined compressive strength (UCS) achieved is 777kPa for clay stabilized with 10% lime and 10% NaCl cured at 28 days.

Keyword: Lime Stabilization, Salt Additive, Organic Clay
ABSTRAK

Tujuan utama kajian ini dijalankan adalah untuk menentukan dan mengenalpasti keberkesanan penggunaan garam sebagai salah satu bahan reagen tambahan terhadap kapur dalam menstabilkan tanah liat berorganik. Umum mengetahui bahawa penggunaan kapur dalam menstabilkan tanah merupakan satu kaedah yang efektif. Walau bagaimanpun, bagi tanah liat berorganik, pendekatan ini kurang efektif ekoran daripada kekuatan tanah yang rendah. Oleh itu, garam digunakan untuk mempercepatkan tindak balas antara tanah liat dan kapur sekaligus membantu meningkatkan kekuatan tanah tersebut. Dua jenis garam yang digunakan adalah Sodium Klorida (NaCl) dan Kalsium Klorida (CaCl₂). Ujian Mampatan tak Terkurung dijalankan ke atas 108 sampel (38mm x 80mm) untuk tempoh 0, 7, 14, dan 28 hari. Keputusan ujikaji menunjukkan bahawa apabila NaCl atau CaCl₂ ditambah ke atas campuran tanah liat dan kapur, kekuatan campuran tersebut meningkat dengan pertambahan kandungan garam. Kekuatan tanah liat yang distabilkan dengan kapur dan NaCl adalah lebih tinggi berbanding tanah liat yang distabilkan dengan CaCl₂ pada kepekatan garam 10%. Kekuatan mampatan tak terkurung yang tertinggi dicapai ialah sebanyak 777kPa apabila tanah liat distabilkan dengan 10% kapur dan 10% NaCl pada hari ke 28.

Katakunci: Penstabilan Kapur, Garam, Tanah Liat Berorganik
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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Most of the problem encountered by geotechnical engineers at construction site is the properties of material are unable to reach the required specification. These problems normally face by soft soil such as organic clay. As we know, soil are complex and has variable material and commonly soil is unsuited to the requirements of the construction either wholly or partially (Ingles, 1972). Generally, clays exhibit low strength and high compressibility. Many are sensitive, in the sense that their strength is reduced by mechanical disturbance (T.S Nagaraj & Norihiko Miuro, 2001). Hence, the construction over clay soil may experience bearing capacity failure induced by its low shear strength. Therefore clay soil has to be improved before any engineering works can commence.

The important of a basic decision must therefore to take into account whether to use the original site material and design to standard sufficient by its existing quality or; to replace the site material with the superior material or; create a new site material that suite to the standard requirement by alter the properties of existing material which known as soil stabilization (Ingles, 1972). Replacement of this poor soil by suitable imported fill materials is one of the conventional solutions. However this method is naturally very expensive especially when encountered with a thick layer. Stabilization of soil with lime is the most economical method and has been widely used for centuries.
Lime act as the balancer which will give a significant change in the soil’s engineering properties (Roger, Glendinning & Dixon, 1996). The stabilizing effect depends on the reaction between lime and the soil minerals. The main effect of this reaction is an increase in the shear strength and bearing capacity of the soil.

Although the use of lime stabilization of soil has been used extensively, but the effect of lime alone is not the most effective stabilizer for clay soil due to low increase in strength (Koslanant, Onitsuka & Negami, 2006). This is because, the organic matters have tendency to coat the soil particles causing the obstruction when lime is used as well as reducing the effectiveness of lime stabilization. Stabilization must therefore be considered as having both of salt used as an additive in lime-stabilized organic soils.

1.2 PROBLEM STATEMENT

The most critical problem of construction on organic clay is low undrained shear strength and low bearing capacity. This result influenced by the appearances of some organic matter which consist of humic acid more than 2%. Organic matter will act as ‘masking’ in which it will coat the primary source of organic clay minerals (silica and alumina) thus will effect the pozzolanic reaction in stabilization process. Even though many research done proves that lime can be used as a methods of ground improvement, but the significant increase of soil strength is still lower due to a reduction in compacted dry unit weight of clay soil (B.Dan Marks & T.Allen Haliburton, 1972). Indicates that by using salts as an additive in lime, the strength of clay soils will increase much better compared to the used of lime alone.
1.3 OBJECTIVES

The objectives of this study are to:

i. Evaluate the effectiveness of salt-lime for clay soil in comparison with lime-clay soil mixture.

ii. To determine the percentage of strength increment for clay soil obtained between two salts mixture at different concentration.

1.4 SCOPE OF STUDY

This study focused on the strength characteristic of the clay soil by using unconfined compression test. The soil samples from clay obtained at Masjid Tanah, Melaka. To extend this finding in an application, various proportions of lime with addition of various proportions sodium chloride (NaCl) and calcium chloride (CaCl₂) were examined for clay soil stabilization. Results given will be compared between the two different mixture lime-salts and different concentration of lime-salts with its strength gain. Hydrated lime will be used in this research since it is not too exothermic and harmful to the skin compared to quicklime. The concentration of salts used are 2.5%, 5%, and 10% performed on the samples at curing periods of 7, 14, and 28 days.