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 ($CaCl_2$). 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 $CaCl_2$ 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 ($CaCl_2$). 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 $CaCl_2$ ditambah ke atas campuran tanah liat dan kapur, kekuatan campuran tersebut meningkat dengan pertambhan kandungan garam. Kekuatan tanah liat yang distabilkan dengan kapur dan NaCl adalah lebih tinggi berbanding tanah liat yang distabilkan dengan $CaCl_2$ 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

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	THESIS STATUS VALIDATION	
	TITLE	**i**
	DECLARATION	**ii**
	ACKNOWLEDGEMENT	**iii**
	ABSTRACT	**iv**
	ABSTRAK	**v**
	TABLE OF CONTENTS	**vi**
	LIST OF TABLES	**ix**
	LIST OF FIGURES	**x**
	LIST OF APPENDICES	**xiii**
1	**INTRODUCTION**	
	1.1 Background Study	1
	1.2 Problem Statement	2
	1.3 Objectives	3
	1.4 Scope of Study	3
2	**LITERATURE REVIEW**	
	2.1 Clay Behaviour	4
	2.2 Ground / Soil Improvement	6
	2.3 Lime Stabilisation	8
	2.3.1 Lime Clay Reactions	11

	2.3.2 Mechanisms of Lime Stabilisation	11
	2.3.3 Factors that Control Hardening Characteristics of Lime Treated Clay	13
	2.3.4 Effect of Sulphate in Soil-Lime Reactions	14
	2.4 Additive Chemical Stabilizer	16
	2.5 Recommended Construction Procedure	18
3	**METHODOLOGY**	
	3.1 Laboratory Testing	23
	3.2 Soil Testing	25
	3.2.1 Specific Gravity	25
	3.2.2 Particle Size Distribution	26
	3.2.3 Atterberg Limit	28
	3.2.3.1 Plastic Limit	29
	3.2.3.2 Liquid Limit	29
	3.2.3.3 Plasticity Index	30
	3.2.4 Standard Proctor	31
	3.2.5 Loss of Ignition	33
	3.3 Lime Testing	34
	3.3.1 Initial Consumption Lime	34
	3.3.2 Lime Fixation Capacity	35
	3.3.3 Available Lime Content	35
	3.4 Lime-Additive Salt Stabilize Soil Testing	36
	3.4.1 Unconfined Compression Test	36
4	**RESULT AND DISCUSSION**	
	4.1 Soil Classification	38
	4.1.1 Atteberg Limit	38
	4.1.2 Specific Gravity	40
	4.1.3 Particle Size Distribution	40

	4.2 Initial Lime Consumption (ICL)	42
	4.3 Available Lime Content (ALC)	42
	4.4 Loss of Ignition	43
	4.5 Standard Proctor Compaction Test	43
	4.6 Unconfined Compressive Strength (UCS)	44
5	**CONCLUSION**	**50**
REFERENCES		**52**
APPENDIX A	Result of Soil Classification Test	55
APPENDIX B	Result of Loss on Ignition Test	61
APPENDIX C	Result of Compaction Test	62
APPENDIX D	Result of Unconfined Compressive Test	71

LIST OF TABLES

TABLE NO.	TITLE	PAGE
2.1	Applicability of Ground Improvement for Different Soil Types (After Kamon and Bergado, 1991)	7
4.1	Summary of data for Specific Gravity Test	40
4.2	Compaction Test Result	44
4.3	Summary Result of Unconfined Compressive Strength	45

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
2.1	Schematic Diagram of the Clay Structure (After Lambe,1953)	5
2.2	The Influence of Temperature on Unconfined Compression Strength (After Bell, 1996)	9
2.3	Effect on Lime Addition on the Plasticity (After Sherwood, 1967)	10
2.4	Reaction Mechanisms Involved in the Hardening Effect of Improved Soil (After Rajasekaran, 2005)	15
2.5	Clay Stabilized with 10% Lime and Various Contents of $CaCl_2$ and NaCl at a 28 day Curing Period (After Koslanant, Onitsuka & Negami, 2006)	16
2.6	Comparison of Strength of Clay Stabilized with 10% lime and $CaCl_2$ and NaCl (After Koslanant, Onitsuka & Negami, 2006)	17
2.7	Clay Particles Before and after Adding Salt (After Koslanant, Onitsuka & Negami, 2006)	18

2.8	Spreader used to Distribute Lime (After National Lime Association, 2004)	19
2.9	Bulk Air Tanker Used to Fill spreader (After National Lime Association, 2004)	20
2.10	Wirtgen Recycler WR2500 Rotovator	20
2.11	Addition of Water through the Hood of a Rotovator during mixing	21
2.12	Compaction of Lime Stabilized clay Using a Smooth Wheeled Roller (After National Lime Association, 2004)	22
3.1	Flow Chart for Laboratory Testing	24
3.2	Specific Gravity Vacuum	25
3.3	A set of Sieves	26
3.4	Mechanical Shaker	27
3.5	Hydrometer Reading	27
3.6	Parameters of Atterberg Limit	28
3.7	Plastic Limit Test	29
3.8	Liquid Limit Test	30

3.9	Consistency States of Fine Grained Soils	31
3.10	Mould for Compaction	32
3.11	Typical Compaction Curves	33
3.12	Samples Preparation	37
3.13	Unconfined Compression Test Equipment	37
4.1	Cone Penetration vs Moisture Content	38
4.2	Plasticity Chart	39
4.3	Soil Particle Distribution Chart	41
4.4	UCS of clay and lime treated clay at different curing period	46
4.5	UCS on clay stabilized with 10% lime and various contents of NaCl and $CaCl_{2.}$	47
4.6	Result of unconfined compressive strength on clay stabilized with 10% lime and various of NaCl at different curing period	47
4.6	Result of unconfined compressive strength on clay stabilized with 10% lime and varius of $CaCl_2$ at different curing period	48
4.8	Rate of increase in strength	49

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A1	Atterberg Limit Test	55
A2	Specific Gravity Test	56
A3	Particle Size Distribution	57
B1	Loss on Ignition Test	61
C1	Compaction Test (Untreated Clay)	62
C2	Compaction Test (Clay + 5%lime)	63
C3	Compaction Test (Clay + 10%lime)	64
C4	Compaction Test (Clay + 10%lime + 2.5%$CaCl_2$)	65
C5	Compaction Test (Clay + 10%lime + 5%$CaCl_2$)	66
C6	Compaction Test (Clay + 10%lime + 10%$CaCl_2$)	67
C7	Compaction Test (Clay + 10%lime + 2.5%NaCl)	68
C8	Compaction Test (Clay + 10%lime + 5%NaCl)	69
C9	Compaction Test (Clay + 10%lime + 10%NaCl)	70
D1	Unconfined Compressive Test (0 DAY)	71
D2	Unconfined Compressive Test (7 DAYS)	80
D3	Unconfined Compressive Test (14 DAYS)	89
D4	Unconfined Compressive Test (28 DAYS)	98

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 ($CaCl_2$) 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.