

STABILIZATION OF ORGANIC SOIL USING LIME ADDED SALT (NaCl)

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ABSTRACT

Lime stabilization is known to be an effective stabilization method for soil. However for organic soil it becomes less effective due to low increment in strength. Therefore salt is used to accelerate lime-organic soil reactions. Salt is introduced to remove the barrier in order to accelerate as well as help lime to increase the strength of organic soil. Hydrated lime & salt of Sodium (NaCl) is used here for the stabilization of organic soil. This study focused on the strength characteristic of the organic soil by using unconfined compression test. The soil samples have been collected from Koiya Bazar, Botiaghata, Khulna near Abul Kasem Degree College, Bangladesh. Various proportions of lime with addition of various proportions of sodium chloride (NaCl) are examined for organic soil stabilization. Results obtained are compared among the three different mixtures of organic soil, lime & salt. Hydrated lime is used in this research since it is not too exothermic and harmful to the skin compared to quicklime. On 36 remolded samples (38mm x 80mm), the percentage of lime used are 3%, 6% and 12% & variable concentration of sodium chloride (NaCl) as 2.5%, 5% and 10% at the curing period of 0, 7, 14, and 28 days have been used to observe the strength increment of organic soil. Here proportion of 10% NaCl & 3% lime shows best result among these three combinations.

Keywords: Lime stabilization; organic soil; sodium chloride (nacl); hydrated lime; unconfined compression test; strength increment

INTRODUCTION

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 which has low un-drained shear strength and low bearing capacity. This result influenced by some organic matter which consists of Humic acid more than 2%. Organic matter acts as 'masking' in which it coats the primary source of organic clay minerals (silica and alumina) causing the obstruction when lime is used as well as reducing the effectiveness of lime stabilization & also affects the pozzolanic reaction in stabilization process. Even though many research done proves that lime can be used as a method of ground improvement, but the significant increase in soil strength is still lower due to a reduction in compacted dry unit weight of clay soil (B. Dan Marks & T. Allen Halliburton, 1972). Which indicates that by using salts as an additive in lime, the strength of organic soils may be increased much better compared to the use of lime alone. The main objective of this research is to investigate the effectiveness of lime – salt mixture in stabilization of organic soil & to determine the percentage of strength increment in organic soil obtained from different proportions of lime (Hydrated lime) & salt (NaCl).

METHODOLOGY

To determine the physical & engineering properties of organic soil different laboratory tests have been performed like as Natural water content, Specific gravity, Particle size distribution, Atterberg limit, Standard proctor test, Consolidation test, Compaction Test etc. Different salt percentages (2.5%, 5%, and 10%) mix with different percentages of lime (3%, 6%, and 12%) and unconfined compression test was performed for these soil samples at the curing period 0, 7, 14, 28 days respectively.

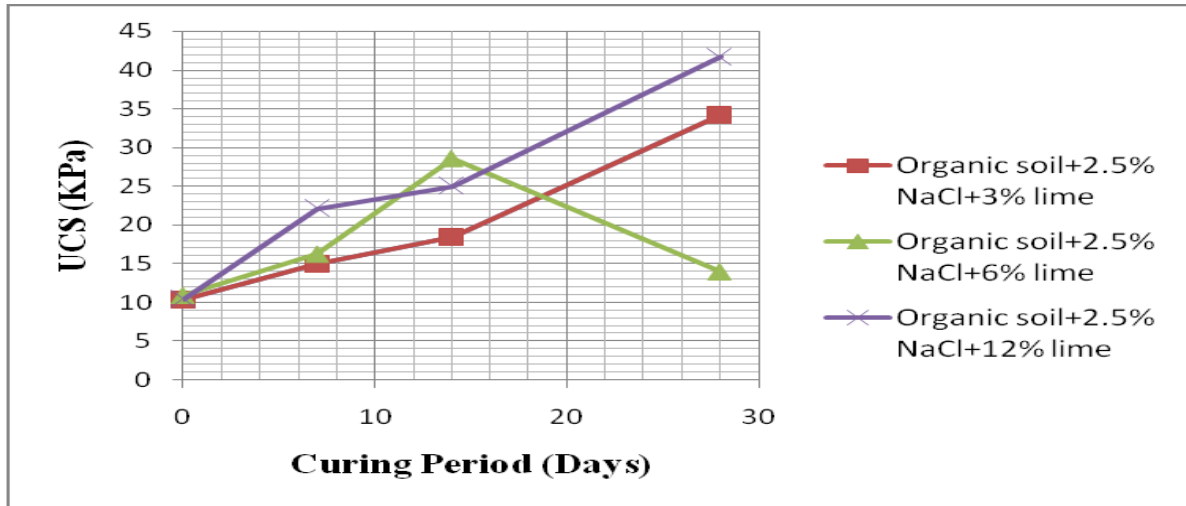


Fig. 1: Curing period vs. Unconfined Compressive Strength Curve for Organic Soil with 2.5% NaCl + (3, 6, 12%) lime

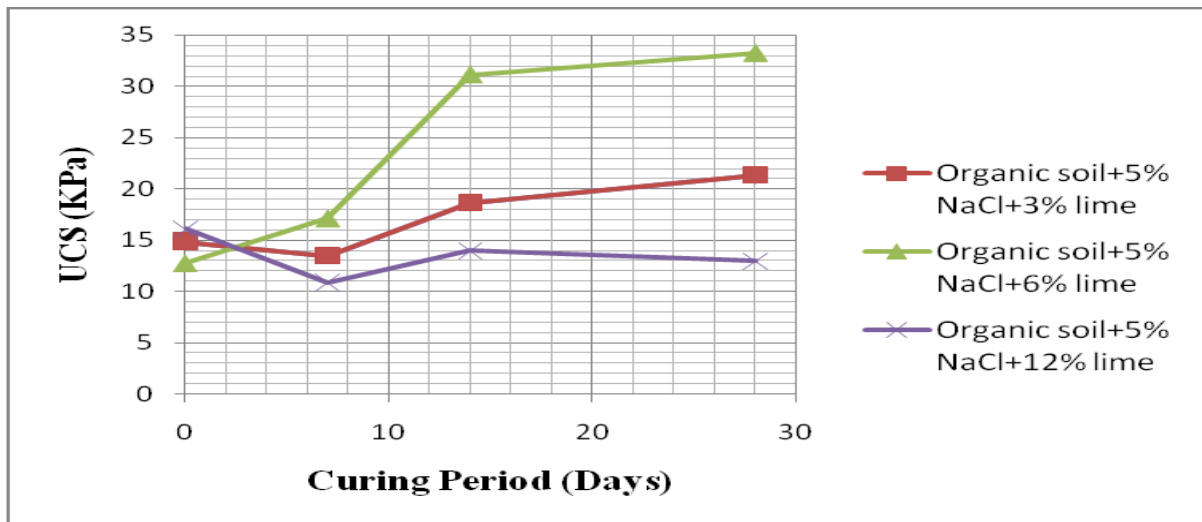


Fig. 2: Curing period vs. Unconfined Compressive Strength Curve for Organic Soil with 5% NaCl + (3, 6, 12%) lime

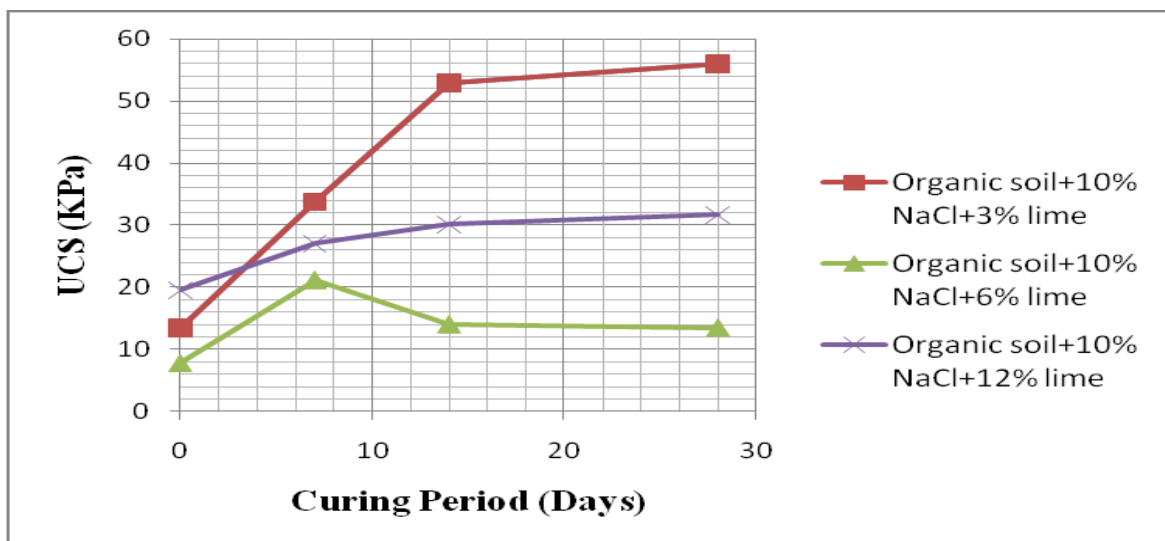


Fig. 3: Curing period vs. Unconfined Compressive Strength Curve for Organic Soil with 10% NaCl + (3, 6, 12%) lime

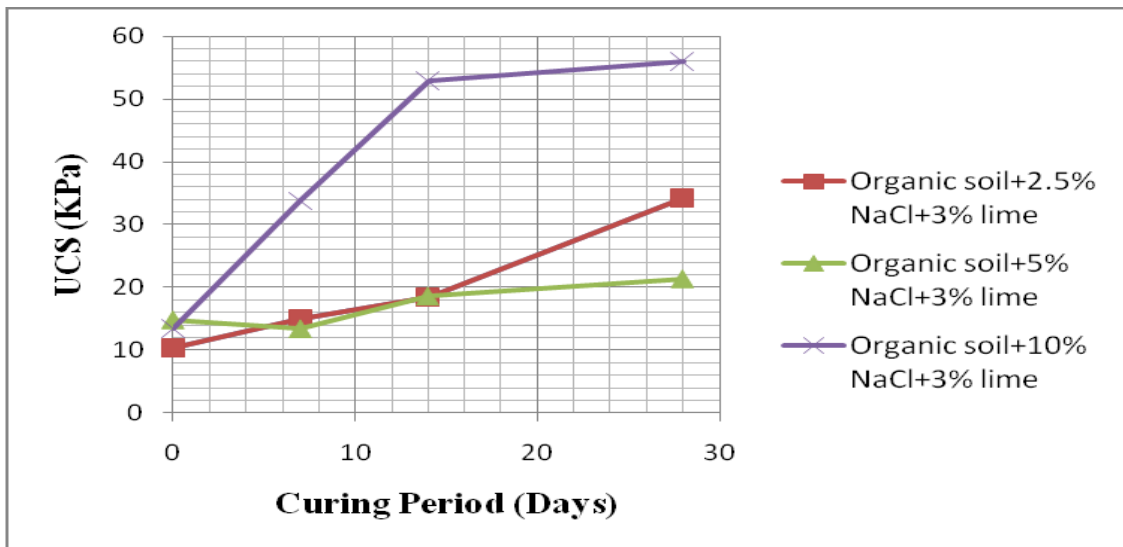


Fig. 4: Curing period vs. Unconfined Compressive Strength Curve for Organic Soil with (2.5, 5, 10%) NaCl + (3%) lime

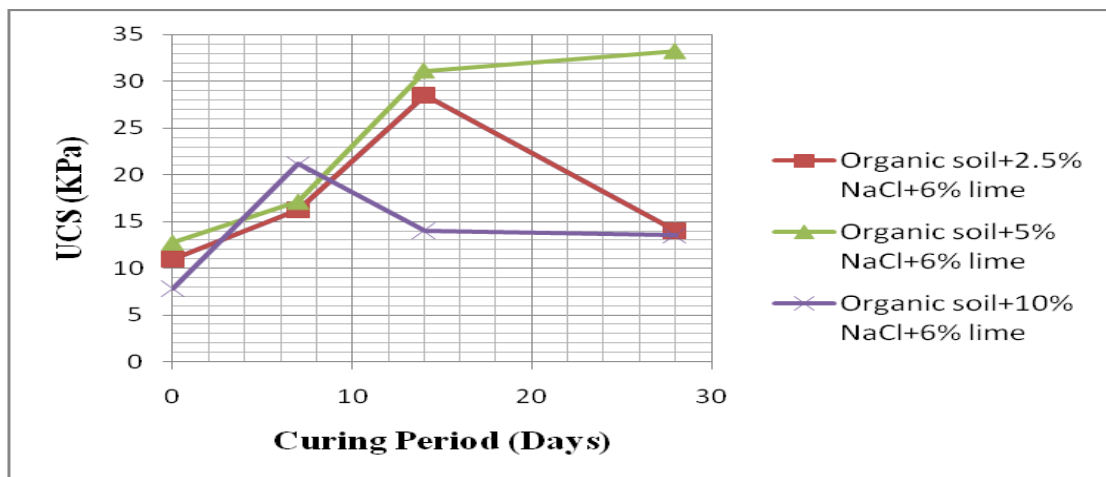


Fig. 5: Curing period vs. Unconfined Compressive Strength Curve for Organic Soil with (2.5, 5, 10%) NaCl + (6%) lime

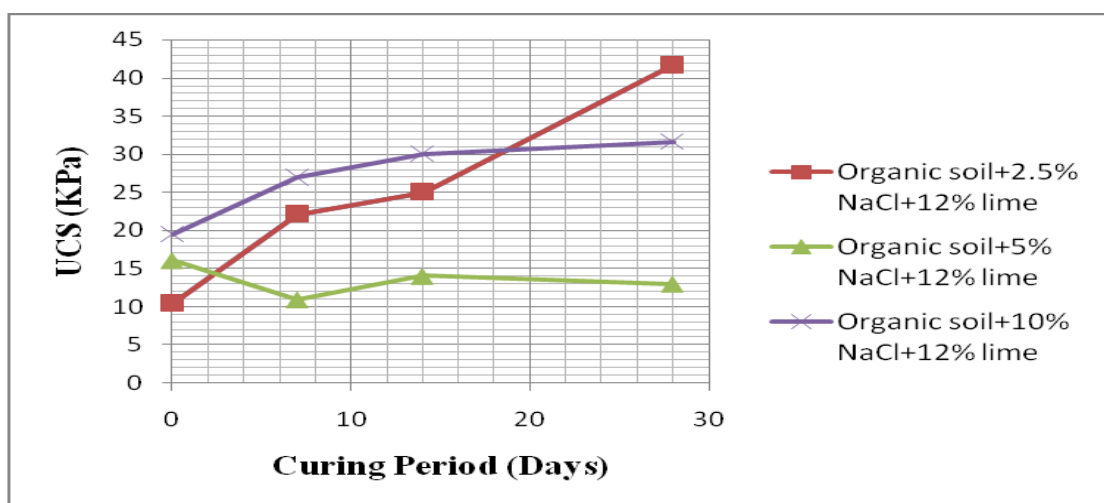


Fig. 6: Curing period vs. Unconfined Compressive Strength Curve for Organic Soil with (2.5, 5, 10%) NaCl + (12%) lime

Table 1: Summary Result of Unconfined Compressive Strength (UCS)

SAMPLE	UCS (psi) 0 day	UCS (psi) 7 days	UCS (psi) 14 days	UCS (psi) 28 days
Organic soil+2.5%NaCl+3%lime	10.38	15.05	18.47	34.26
Organic soil+2.5%NaCl+6%lime	10.97	16.27	28.55	14.02
Organic soil+2.5%NaCl+12%lime	10.44	22.16	25.06	41.75
Organic soil+5%NaCl+3%lime	14.89	13.49	18.65	21.37
Organic soil+5%NaCl+6%lime	12.77	17.13	31.14	33.22
Organic soil+5%NaCl+12%lime	16.1	10.89	14.02	12.98
Organic soil+10%NaCl+3%lime	13.35	33.74	52.94	56.05
Organic soil+10%NaCl+6%lime	7.79	21.16	14.02	13.49
Organic soil+10%NaCl+12%lime	19.51	26.99	30.1	31.66

RESULTS AND DISCUSSIONS

The present work studied the strength characteristics of organic soil using admixtures. The admixture used here lime & sodium chloride. The percentage of lime used are 3%,6% and 12% & variable concentration of sodium chloride (NaCl) as 2.5%,5% and 10% at the curing periods of 0,7,14 and 28 days have been used to observe the strength increment of organic soil. The soil has been collected from Koiya Bazar, Khulna from 10 feet depth. Its specific gravity & liquid limit are found to be 1.611 & 104% respectively. From the grain size distribution curve, the particle size of organic soil lies between (0.01- 0.4) mm.

For 2.5% NaCl concentration, initially the strength of soil is same for all the lime percentage used (Fig.1). Soil strength at 7 days is same for 3% & 6% lime but higher for 12% lime. At 14 days soil strength is found to be lowest for 3% lime & highest for 6% lime. At 28 days soil strength is higher for 12% lime & lower for 6% lime content. Here 2.5% NaCl & 12% lime combination shows higher values of strength among these three combinations considering curing period.

For 5% NaCl concentration, initially the strength of soil is same for all the lime percentage used (Fig.2). Soil strength at 7 days is found to be lowest for 12% lime but highest for 6% lime. At 14 days soil strength is lower for 12% lime & higher for 6% lime. At 28 days soil strength is higher for 6% lime & lower for 12% lime content. Here 5% NaCl & 6% lime combination shows higher values of strength among these three combinations considering curing period.

For 10% NaCl concentration, initially the strength of soil is higher for 12% than other percentages (Fig.3). Soil strength at 7 days is lower for 6% lime but higher for 3% lime. At 14 days soil strength is lower for 6% lime & higher for 3% lime. At 28 days soil strength is higher for 3% lime & lower for 6% lime content. Here 10% NaCl & 3% lime combination shows best result among these three combinations.

Among these combination when sodium chloride percentages are fixed then 10% NaCl & 3% lime combination shows higher values of soil strength. It is observed that with increase in percentage of NaCl causes reduce in percentage of lime to get higher strength.

For 3% lime concentration, initially the strength of soil is same for all the NaCl percentage used (Fig.4). Soil strength at 7 days is same for 2.5% & 5% NaCl but higher for 10% NaCl. At 14 days soil strength is same for 2.5%&5% NaCl & higher for 10% NaCl. At 28 days soil strength is higher for 10% NaCl & lower for 5% NaCl. Here 3% lime & 10%NaCl combination shows higher values of strength among these three combinations considering curing period.

For 6% lime concentration, initially the strength of soil is higher for 5% NaCl than other two percentages (Fig.5). Soil strength at 7 days is same for 2.5% & 5% NaCl but higher for 10% NaCl. At 14 days soil strength is lower for 10% NaCl & higher for 5% NaCl. At 28 days soil strength is same for 10% & 2.5% NaCl & higher for 5% NaCl. Here 6% lime & 5% NaCl combination shows higher values of strength among these three combinations considering curing period.

For 12% lime concentration, initially the strength of soil is higher for 10% NaCl than other two percentages (Fig.6). Soil strength at 7 days is lower for 5% NaCl but higher for 10% NaCl. At 14 days soil strength is lower for 5% NaCl & higher for 10% NaCl. At 28 days soil strength is lower for 5% NaCl & higher for 2.5% NaCl. Here 12% lime & 2.5% NaCl combination shows higher values of

strength considering curing period. Here also found that for higher percentage of lime reduces percentage of NaCl is required to get higher strength (Table 1).

CONCLUSIONS

Among these combinations when lime percentages are fixed then 10% NaCl & 3% lime combination shows higher values of soil strength. From the test result, it is observed that the strength is generally increases with curing period irrespective of the percentage of admixture used except for two cases (5% NaCl +12% lime +organic soil) & (10% NaCl +6% lime +organic soil).

The lowest strength is observed for 10 % NaCl+6% lime +soil & the highest value for 10%NaCl +12% lime at zero days of curing. For 7, 14, 28days curing , the corresponding strength shows minimum values for 5% NaCl +12% lime +soil which are 10.89 , 14.02 , 12.98 psi respectively. For the same curing period, 10% NaCl +3% lime soil shows the highest value of strength considering all the proportions. The increment of strength for 7, 14, 28 days are 209.83%, 277.61% &331.82% respectively. Higher percentage of NaCl with less percentage of lime mixed with organic soil gives higher strength than that of higher percentage of lime with less percentage of NaCl mixed with organic soil. Thus it can be concluded that NaCl may be used with lime to increase the strength of organic soil.

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