

Improve Swelling Soil Properties by Mixing With Lime for Road Projects

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Abstract: Lime is used in heavy clay soil stabilization and increases the resistance and improved plasticity also Whenever the soil has a clay content more whenever the use of lime more useless in any installation process Whenever the soil contains a higher proportion of aluminum silicate and Whenever we get later on soil with good specifications treatment. As a result, it is not recommended using the lime in the soil that have no content of clay and are advised to be not less than the amount of material passing through the sieve 0.075mm 25% treatment, and in order to install soil stabilization soil must plasticity index $IP > 30\%$ and the percentage of clay is greater than 10% have. When adding lime to the soil and after an investigation sufficient moisture lime reacts with water and calcium ions are spread around Mnralat soil. Using small proportions of lime note the difficulty in mixing and get the heterogeneity as a result of soil particles gathered around Lime show granule blocks, so I do not prefer to use low levels of lime less than 2% for the risk heterogeneity, for a few plasticity clay Kaolinite possible (4% - 6%) and for the high plasticity clay the ratio (5% -10%) and about 8% for montmorillonite. After adding lime to the sample used in the research show us some noticeable change in the properties of the sample. For example Liquid Limit was an end to the sample before adding lime and 70% after the addition of lime proportions determined by decreased liquidity limit to up to 60, so for the density, water content and the California bearing ratio.

Keywords: swelling soil, lime, stabilization, treatment, geotechnical problems.

1. Introduction

The problem of expansive soils is one of the most well known geotechnical problems that was studied and researched by a lot of geotechnical researchers. The main problem clay are changes in volume (swelling or Shrinkage) depending on the change in moisture, shown in Figures (1), Often requires the establishment of engineering projects in specified locations where the soil is in that process is suitable for construction sites and then be required to either replace or improve the soil and often resort to be improved because the replacement would be more expensive. generally improve soil is to improve the physical properties of the soil or mechanical, chemical, or all combined and consequently includes improving soil resistance to shear and to reduce settlement, swelling and Shrinkage and reduce soil

affected by external factors as ice and frost. The adoption of the best ways to improve the soil depends on soil type and include them particleboard and content of soft material and resist the initial objective of the optimization process. The use of lime in France to repair of the collapsed Dibble port city walls by the engineer (charles Beringng), and Lime uses of in California to stabilization the slopes for channel (FRJANT-KERN).and Lime use of in order to treatment roads in the US Louisiana.

The chemically clays are hydrated aluminum silicates, but due to change and adjustment in the alumina content clay may found in different minerals containing the same elements although varying in the crystal structure, three main clay mineral groups are well known these are under Photomicrograph, shown in Fig (2).

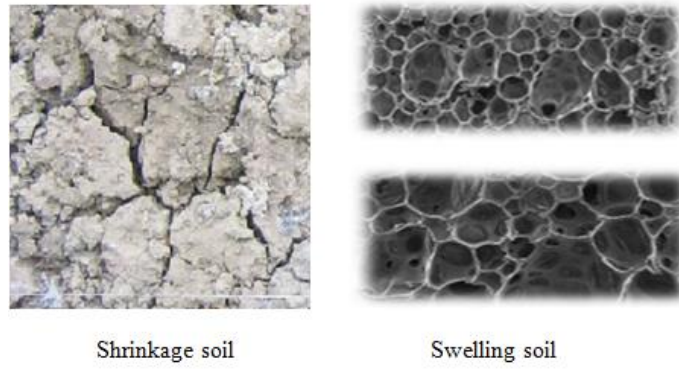


Fig (1): Swelling Soil and Shrinkage Soil due to Change in moisture

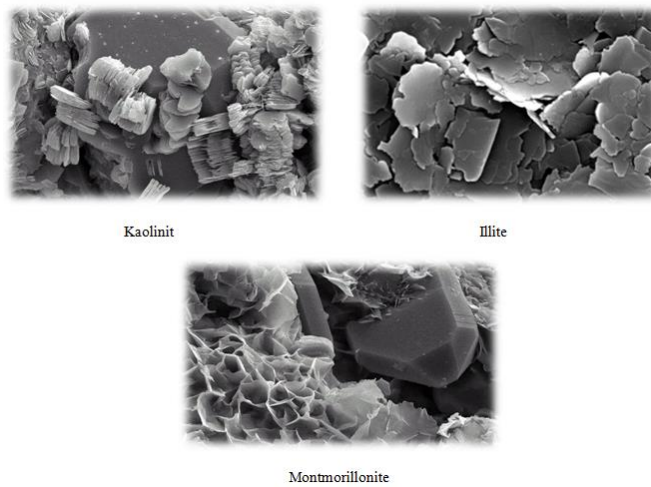


Fig (2): Photomicrograph of Kaolinite , Montmorillonite and Montmorillonite

2. Experimental Program and Materials

Laboratory tests of the research have in the soil mechanics laboratory and foundations - Faculty of Engineering - South Valley University, using clay soil before treatment with lime and passing from a sieve No. 200 and shown in

Fig (3). Done identify some of the properties of the soil used perform Testing sieve analysis , atteraberge limits , specific gravity , direct shear test and finally the compaction test, And then has added lime attributed to the sample mentioned so as to get the best results for the soil a good installation using lime, shown in Fig (4).

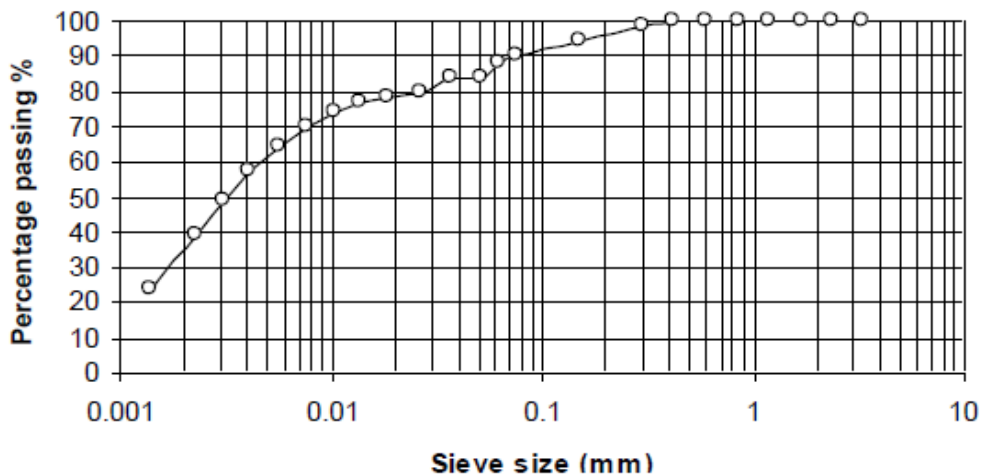


Fig (3): Grain Size Distribution of the Untreated Sample



Fig (4): Soil before Treatment

When you add lime to the soil complex chemical reactions between lime and soil minerals occur and the result is a new soil specifications differ from the original soil, table (1).

reactions result in improvement of the soil plasticity specifications (Lime Modification) and Interactions you need to a relatively large time lead to increased soil strength.

According to Chen (1975) - Brown (1996) can be divided lime soils interact with a mechanism to: Relatively quick
Table (1): Properties of Sample

properties	Quantity
Passing sieve No.200	95 %
Liquid Limit	70 %
Plasticity Index	43 %
Free Swelling	60 %
Water Content	19%
Specific Gravity	2.52
California Bearing Ratio	0.7 %

3. Results and Analysis

After completion of the installation of the soil with lime the result is new soil physical and chemical differ totally of their properties from the original soil is shown in Figure (5) comparison between the soil before treatment and after treatment:



Fig (5): Soil after Treatment

As a result of the interactions occurring between the soil and the proportion of lime soft material will become virtually non-existent and increasing the proportion of silt and sand. Liquid Limit: soft granules proportion largely less and therefore less specific surface and thus the amount of water needed to encapsulate granules less so the liquidity is decreasing Limit. Limit plasticity: we need

more water to the work rolls the smallest amount of moisture without the crack as a result of increased soil resulting hardness and strength and therefore the Limit plasticity increases. The result is that at least any evidence plasticity least plastically area of the soil reflecting in it for improving the properties of plasticity, and Specific weight of the soil resulting decreases with increasing the proportion of lime due to low specific gravity Lime. Reduced ability installed soil with lime to swell and shrink and become the relative value of the Bulge almost non-existent because the free lime will work on connecting soil beads with each other bonds similar to concrete connections and thus increases the bonding durability of the soil and this in turn reduces Swell, also note that the flexibility factor increases with increasing the proportion of lime and the collapse of the sample experiences a pressure free brittle and is similar to the collapse of the fossilized soils, shown as Fig (6).



Of direct shear test it with lime to increase the proportion increasing friction angle of the soil increased soil coarser, as well as increasing cohesion as a result of interactions so certain percentage then possible to decrease cohesion because of excess lime granules possible that the spacing between the soil particles. Increasing the value of CBR soil reflects increase soil resistance, Pressure force is confined greater than 10 kg / cm², shown in Fig (7) and table (2).

Fig (6): strength required for durability, unconfined compressive strength Greater than 100 – 150 psi

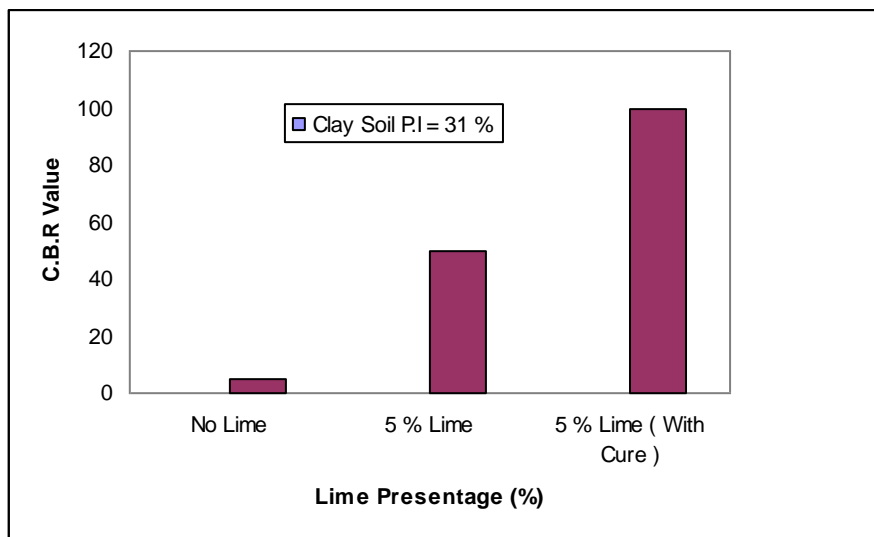


Fig (7): Correlation between California Bearing Ratio and Percentage of Lime

Table (2): California bearing ration values with Plasticity Index

	(LL)	(PI)	CBR
Fills soil	<43	< 18	
Sub - base	<43	< 13	37 %
base	< 32	< 7	74 %

It notes that the compaction curve becomes more curvature after the addition of lime and therefore there becomes wider to complete the optimum of the soil moisture field and moving closer to the behavior of

sand and is the optimum moisture content can be easier to control soil compaction in high humidity conditions and in a satisfactory, as shown in Fig (8).

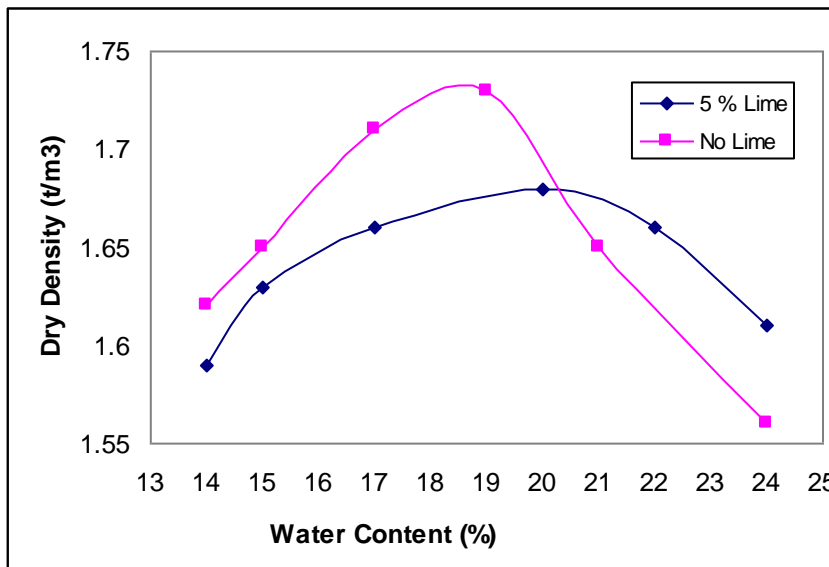


Fig (8): Correlation between Dry Density and Water Content

When soil treatment with lime show:

- Low liquidity of the Limit (0% lime) 72% to (14% lime) 60% , The high Limit of plasticity (0% lime) 27% to (14% lime) 41% , evidence of low plasticity (0% lime) 45% to (14% lime) 19% . And decreasing the dry density majority of 1.51 g / cm³ to 1.35 g / cm³ when the proportion of lime 14% and the interpretation of it by Lees

et al (1982) due to agglomeration processes and the transition to the dispersant structure and thus the same molecules will occupy larger and this will lead to a reduction in dry density Great The ideal humidity of the mixture to rise from 22% to 26.8% because of hydration reactions require more water. CBR value has risen to 37% when the ratio of Lime 8%, shown in Fig (9).

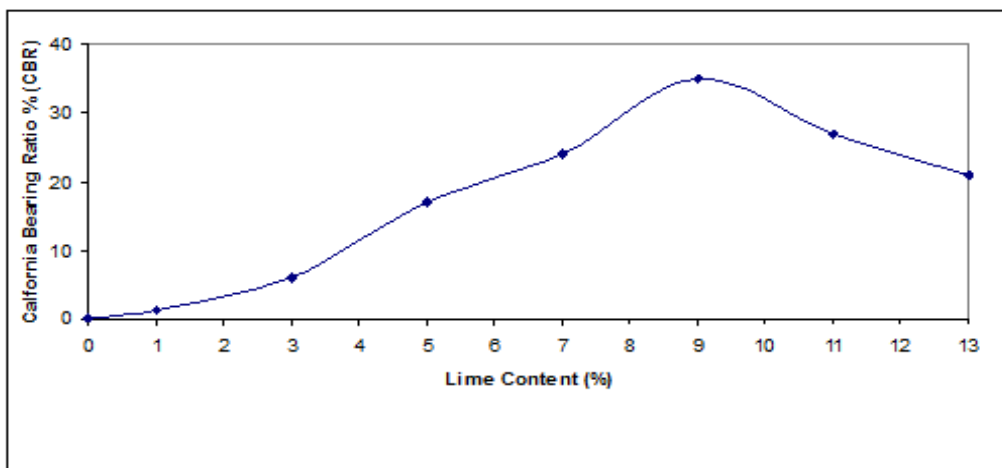


Fig (9): California Bearing Ratio with Lime Content Variation.

4. Conclusion

The use of lime to improve soil specifications not be random, but according to specific proportions of follow the on the type of soil and must specify these percentages by experiments in the laboratory and that similarities with any treatment of human uses for his health, any medication

must be taken by a set amount, otherwise it will affect adverse and so is soil with lime Flajha a very important topic and accuracy. When using lime in soil stabilization should not exceed soil organic material content of about 2% as well as the soil must not contain sulphates exceed

the rate of 0.2%. Lime is used to improve the soil specifications and increased ability to resist and bear, and that all possible uses of the soil for improve the plasticity specifications. Lime is used with the heavy clay soil in order to reduce the swelling and shrinkage properties. Lime is used for the subsequent installation of cement in order to facilitate mixing soil with cement as the Lime makes it brittle and easy to handle soil and reduce the conglomerate soil with each other.

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