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# Stabilizing of Expansive Soil with Lime Material for Improving Sub-Grade of Road, Case Study of Wozeka-Gidole Road Project, Arbaminch, Ethiopia

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***Abstract:***
*The performance of paved and unpaved road pavements constructed over expansive soil sub grades is often poor and shows cracking, rutting, differential settlements and heaving at various locations. The quality and durability of a pavement is greatly affected by the type of sub grade soil over which such pavements are to be constructed. There are different areas in Ethiopia where the soils are so expansive and the pavements became susceptible to such failures due to expansive soils are characterized by volumetric change during drying and wetting season. To resolve failures related to expansive soils or improve the strength of sub grade soils, stabilizing such problematic soil with lime is one solution. But in Ethiopia the usual practice is undercutting and replacing, attribute to the scarcity and is not always cost effective where there are no materials for replacement within economic hauling distance and the associated difficulty during construction particularly causes environmental impact where material for replacement is utilized. So, this study focuses on Stabilizing of expansive soil with lime material for improving sub-grade of road (Case study of Wozeka-Gidole road project, Arbaminch, Ethiopia). This study and laboratory results shows that the lime provides better index properties in term of liquid limit, plastic limit, plasticity index and improve swell shrink properties and outline that the CBR and unconfined compression value were increase as lime content increase with adding 2%, 4%, 6% and 8% of lime respectively for different curing periods of 7, 14, and 28 days. Generally, the most notable increases in strength occur within the first 7 days when 8% of lime used as stabilizer, 90.707% increment of strength was gained from treated specimen. Also, the lime decreases swelling and shrinkage of subgrade soil properties during dry and wet season condition which makes subgrade of pavement not durable and unable to sustain heavy traffic loading. Therefore, it can be concluded that lime can improve the engineering properties of expansive soils. Practically, the effective lime content should be blended with 8% lime which provides high strength, decrease swell shrinkage, optimize optimum moisture content and provides high quality of subgrade pavement rating.*

***Keywords:*** *Stabilization, lime, subgrade, improve, expansive soil, CBR, failures and engineering properties*

## 1. Introduction

The development of a country can be closely monitored by the improvement in infrastructural facilities in which transportation plays a key role in economic development of country. To this regard, construction of sustainable and economical roads with durable pavement is one of the key factors that need higher priority in resolving transportation problems. The quality and durability of a pavement is greatly affected by the type of sub grade soil over which such pavements are to be constructed. Pavement structure response is very sensitive to the characteristics of the sub grade, which provides support for such pavement structure. Problems associated with pavement construction further become far more critical, particularly in regions where the sub grade consists of expansive soils.

The problematic soil is removed and replaced by a good quality material or treated using mechanical and/or chemical stabilization. Different methods can be used to improve and treat the geotechnical properties of the problematic soils (such as strength and the stiffness) by treating it in situ. These methods include densifying treatments (such as compaction or preloading), pour water pressure reduction techniques (such as dewatering or electro-osmosis), the bonding of soil particles (by ground freezing, grouting, and chemical stabilization), and use of reinforcing elements (such as geotextiles and stone columns) (William Powrie, 1997). The chemical stabilization of the problematic soils (soft fine-grained and expansive soils) is an alternate solution for many of the geotechnical engineering applications such as pavement structures, roadways, building foundations, channel and reservoir linings, irrigation systems, water lines, and sewer lines to avoid the damage due to the settlement of the soft soil or to the swelling action (heave) of the expansive soils. Problematic soils such as expansive clay cause major problems in the design, construction and maintenance of pavements and in civil work infrastructures. The process by which the properties of the soil are improved so as to meet the construction requirement is chemical stabilization. In its broadest sense, soil stabilization may also be defined as a method used to change one or more properties of soil so as to improve the desired performance of the soil. Soil stabilization may be broadly classified in fig. 1 as follows.

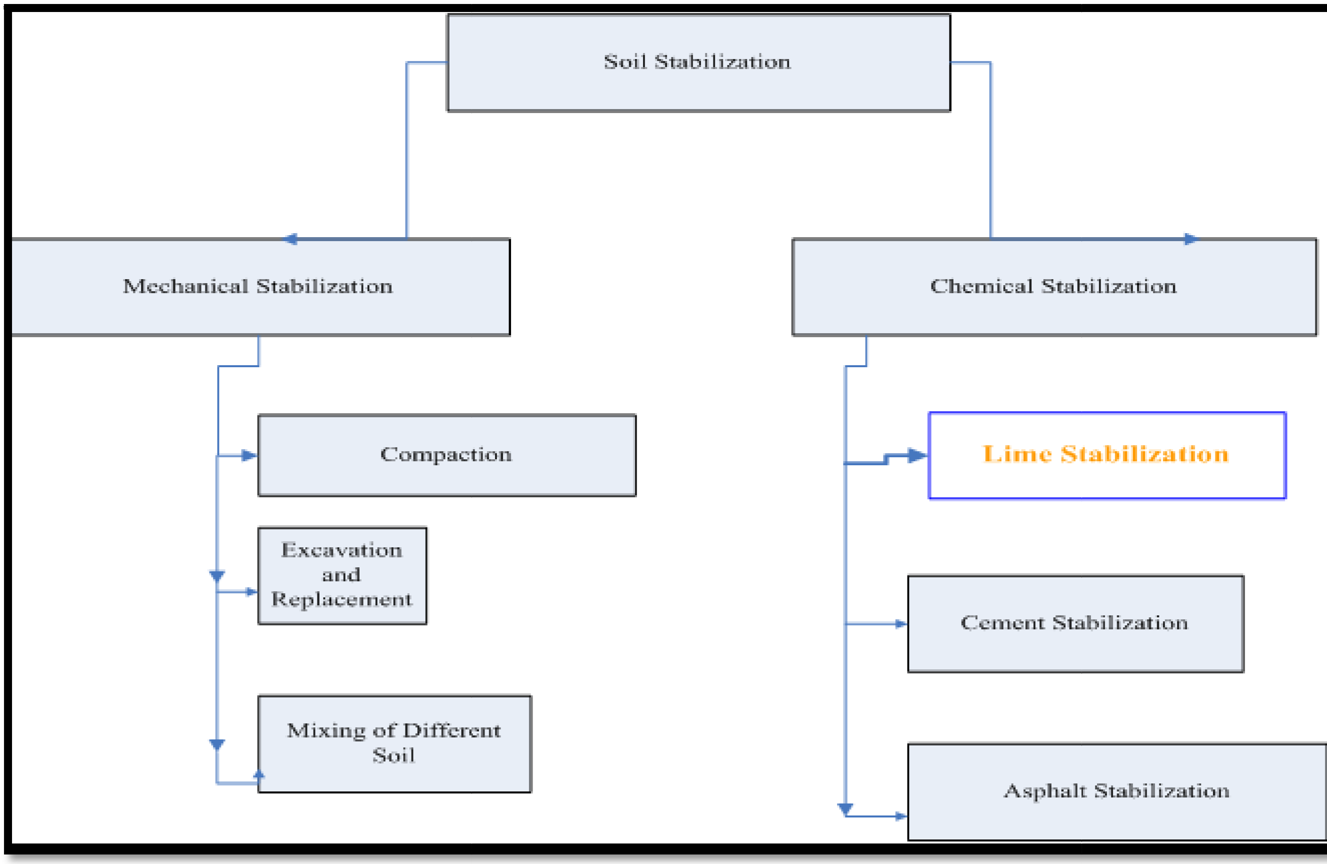


*Figure* ***Error! No text of specified style in document.****: Flow Chart of Soil Stabilization Methods*

Soil stabilization using lime has long been used to improve the handling and mechanical characteristics of soils for civil engineering purposes (Sherwood, 1993). This thesis work gives further investigation on lime stabilization for subgrade of Wozeka Gidole road project. The stabilizing effect depends on the reaction between lime and soil minerals. The main effects of this reaction are an increasing of shear strength, bearing capacity of the soils and as whole improve engineering properties of expansive soils.

The engineering properties of sub-grade soils including plasticity characteristics, compaction properties, volume stability and strength may be enhanced by adding materials such as lime. The changes in properties of the soils primarily depend upon the type and amount of binder, curing conditions and time, organic matter content and the percentage of clay. This thesis work was come out with stabilizing soil by the addition of small percentages of lime (2% -8% by weight), thereby enhancing many of the engineering properties of the soil and producing an improved construction material for Wozeka Gidole road project instead of blending selecting materials with in situ soil materials or removing poor soil by replacing selected materials from other place of excavated materials used currently by engineers of Wozeka Gidole road project.

## 2. Description of Project Area

The Wozeka-Gidole road project is situated in the south west of Arba Minch town and far from Addis Abeba capital city of Ethiopia 539Km to south and crosses a sharp faulted escarpment of Gidole Mountain. And the profile of the road is located at $5^0$39’00.97’’N and $37^0$22'03.29''E and the elevation of 2081m amsl and it is part of the Arba Minch-Jinka surface treatment road project which is located in the Southern Nations, Nationalities and Peoples Regional State (SNNPRS) in Arba Minch area and Derashe Woreda.

Wozeka-Gidole road project has a total length of 33.9km and the pavement is Double Bituminous Surface Treatment (DBST) standard. And the carriageway is 6.7m and 1.5m shoulder width in both sides in flat to rolling terrain, but only 0.5m shoulder width in both sides in mountainous terrain and also the cut slope of the area is made in successive steps and the whole cut slope has six benches. (ERA, Preliminary Landslide investigation report, 2010)

The present study is planned to be carried out the subgrade stabilizing of expansive soils in Wozeka-Gidole road project around Gidole Area about 34km from southwest of Arbaminch town. The wozeka-gidole road project is part of the Arbaminch-Jinka surface treatment road project which is located on western escarpment of the central rift southern segment where the two of the rift valley lakes, namely Abaya and chamo are found. Wozeka-gidole Road Project is a realignment of the existing Arbaminch to Delbena road, which is realigned in order to passes the road through Gidole town. The project starts at 34km from Arbaminch town & ends after traversing 33.4km through Gidole town at Gato village. This road plays a vital role in supporting the tourism industry as it is found on one of the major tourist attraction corridor of the country

## 3. Methodology

The following methods will be employed to achieve the objectives of the research.
Summarized list of methodologies to be followed are;

- Reviewing different literatures regarding the use of lime materials in improving expansive sub grade soil
- Taking soil sample
- Lime material
- Laboratory testing of the sampled soils with and without lime material.
- Analyzing the laboratory test results on the engineering properties of stabilized subgrade and conclusion

The flow diagram in Fig.2 is the summary of the methodology for this thesis work.

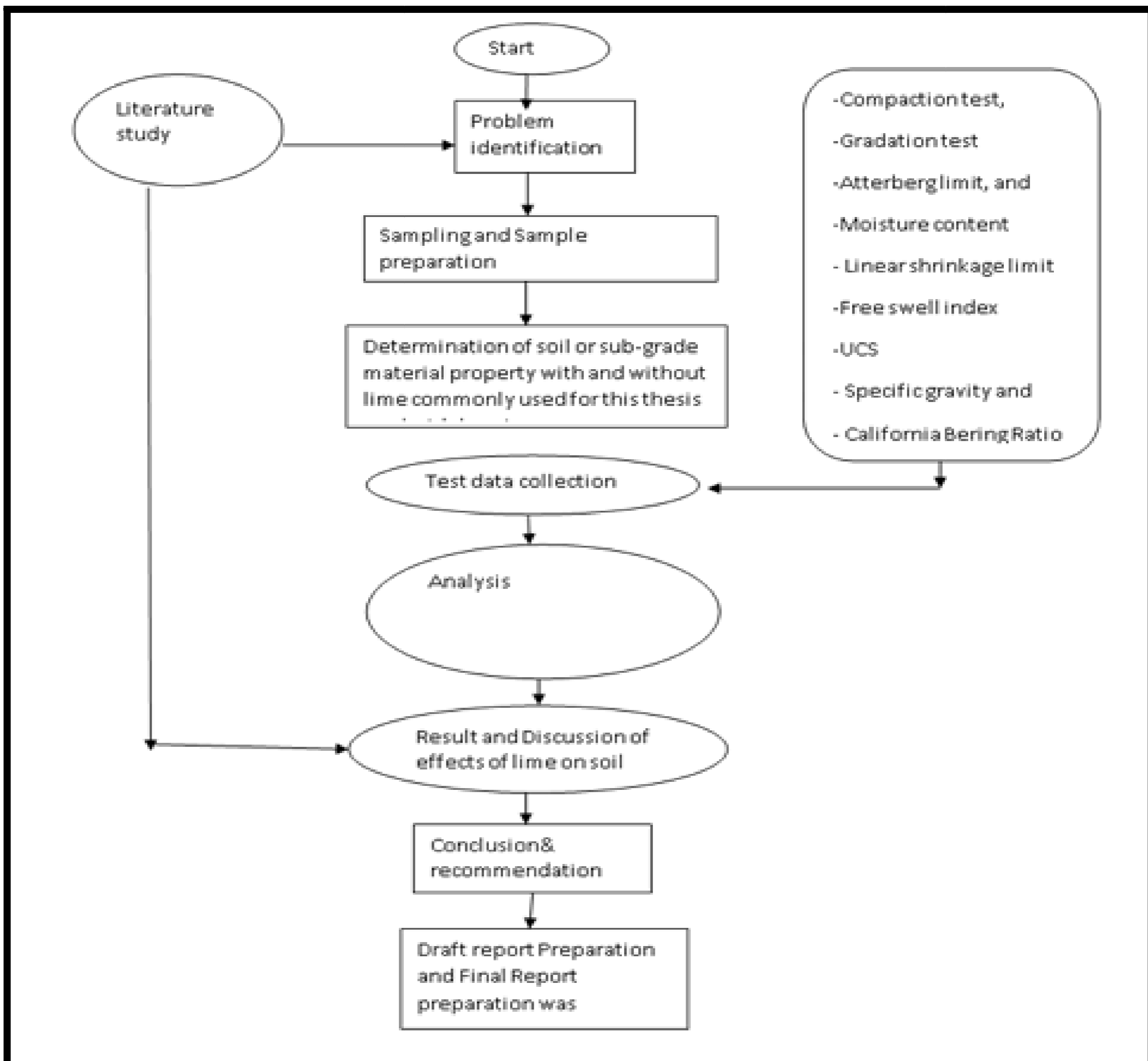


*Figure 2: Summary Flow Chart for Methodology*

## 4. Result and Discussion

The present study is a geotechnical laboratory program to estimate how the use of lime could improve the geotechnical properties [including consistency limits, compaction properties, unconfined compressive strength, swell–shrinkage properties, durability, California bearing ratio (CBR) and grain size distributions properties] of different soft fine-grained soils [expansive subgrade soil] collected from Wozeka Gidole road project at different percentage of lime was presented in literature review and objective part of this thesis work.

The results of the laboratory tests that were performed at each testing pit sample are presented and discussed in this chapter. From the test results, the material and mechanical properties (soil characterization, swell-shrinkage and strength properties) of the lime-treated subgrade soil layer are compared with those of the natural (untreated) subgrade soil layer. With the results of the comparison, the long-term performance of the lime-treated subgrade soil is evaluated for each pit. The purpose of the laboratory testing program is to classify subgrade material and evaluate support properties and moisture sensitivity (heave, collapse, softening) that can affect long-term pavement performance. Testing programs consist of classification testing (gradation analysis Atterberg limits) and engineering properties testing (i.e., unconfined compressive strength, California Bearing Ratio, compaction tests) and the other tests such as free swell index and linear shrinkage are performed.

### *4.1. Subgrade Soil Properties of Wozeka-Gidole and Its Classification*

The basic properties and soil classification of the different pit representative samples are summarized in give table 1 for untreated subgrade of Wozeka-gidole road. All representative soil samples collected from different each pits along the road contain more than 67% - 76% of fine grained soil passing through sieve No. 200 (0.075mm opening) as obtained from wet sieve grain size analysis and hydrometer analysis was performed to identify the amount of silt and clay pass sieve No.200 (0.075mm opening) which implies the subgrade rating class categorized as S1 according to Ethiopia Road Authority pavement manual (ERA) and TRRL manual for developing countries. Therefore, based on AASHTO and USCS soil classification systems, all representative sample falls under two classes of soil material types which is very high plasticity soil of clayey materials and high plastic silty soil under group index of A-7-6(31.45) and A-7-5(25.62) respectively.

| **Sample pit Representative No.** | **P-1** | **P-2** | **P-3** | **P-4** | **P-5** |
|---|---|---|---|---|---|
| percentage of passing 2mm sieve size(No.10) | 97.22 | 96.716 | 98.32 | 96.728 | 97.024 |
| Percentage of passing 4.75mm sieve size(No.4) | 99.732 | 99.584 | 99.796 | 100 | 99.596 |
| Percentage of passing 0.075mm(No.200) | 78.066 | 67.29 | 73.534 | 75.966 | 75.474 |
| Gravel | 0 | 0 | 0 | 0 | 0.404 |
| Sand | 21.66 | 32.71 | 26.262 | 24.034 | 24.12 |
| Silt | 25.616 | 20.76 | 23.534 | 26.466 | 32.974 |
| Clay | 52.718 | 46.531 | 50.204 | 49.5 | 42.5 |
| Characteristics of Soil Pass Sieve No.40 | | | | | |
| Liquid Limit | 77.476 | 93.7026 | 75.066 | 76.2115 | 76.36 |
| Plasticity Index | 33.41 | 38.28 | 35.709 | 30.22 | 26.8145 |
| Classification According AASHTO systems | A-7-6 | A-7-6 | A-7-6 | A-7-6 | A-7-5 |
| Group Index | 31.45 | 29.92 | 29.51 | 27.94 | 25.62 |
| According to USCS System | CH | CH | CH | CH | MH |

*Table 1: Classification Table of Untreated Subgrade of Wozeka Gidole Road*

### *4.2. Effects of the Lime on Atterberg Limit Tests of Soil-Lime Mixed*

The effects of lime on soil plasticity was studied by performing Atterberg limits tests and presented in Figure 3 and 4. Figure 3 shows the liquid limit decrease while plastic limit increases with addition of lime in soil samples.

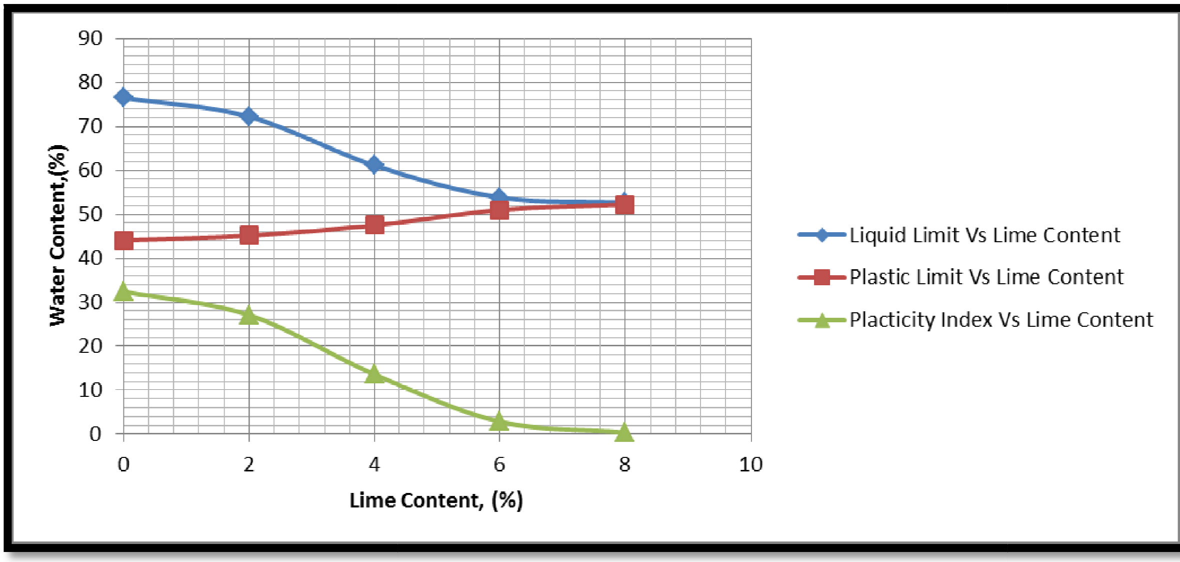


*Figure 3: Effects Lime Content on Atterberg Limit at the First 7 Days Curing Periods*

As the concentration of lime is increased, there is a reduction in clay content and a corresponding increase in the percentage of coarse particles. This results in a reduction of Plasticity Index at a lime content of 4%, a maximum reduction in Plasticity Index to 13.587% was obtained. When the lime content was increased beyond 6%, there was no further change in Plasticity Index, even for 7 days curing periods. The results shown in figure 5. 2 and 5.5) for the soil samples show that the addition of lime to the natural samples decreased their liquid limit, increased their plastic limit and consequently reduced their plasticity index. The optimum lime content (OLC) is the lime content at which the soil is non-plastic or at which the moisture content of treated soil sample crumbled before reaching 3mm diameter thread on addition of lime to the soil or the lime content for which Plasticity index is equal to or less than 10 (British Lime Association, 1990)

*Figure 4: Plastic Limit of Lime-Treated Soil at 4% after 28 Days Curing Periods*

According the performed laboratory result the plasticity index of soil-lime treated sample at 8% of lime content for curing periods of the first 7days was changed to non-plastic behavior. And after curing periods of 28 days plasticity index of soil-lime treated sample was completely changed to non-plastic at 4% of lime content since it is changed into silt sandy soil.

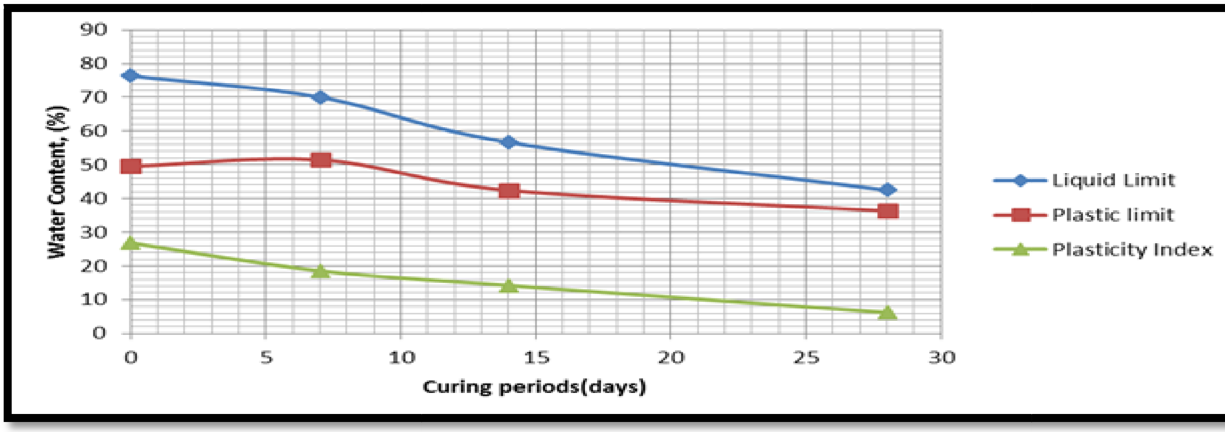


*Figure 5: Effect of Curing Periods on Atterberg Limit of Soil-Lime Treated at 2% of Lime Content*

Generally, the liquid limit of untreated soil sample was 79.75% which is decreased after lime mixture by 44.37% for the first 28 days and also plasticity index was decrease by 78.87% after curing periods of first 28 days at 2 % of lime content, this indicated that evaluation of plasticity index is one of the important criteria for selection of soil as construction material of Wozeka Gidole road project. Therefore, the reduction in plasticity index is desirable as it increases the workability. From the finding of performed laboratory result of lime stabilized expansive subgrade of Wozeka Gidole road 6% of lime content is optimum lime content to reduce the plasticity index of subgrade significantly.

*4.3. The Effect of Lime on Swell and Shrinkage Properties of Treated Soils*

The swell-shrinkage characteristics of expansive clayey soils are improved significantly by the addition of lime as shown in (Fig 6). The addition of lime to such clay soils also reduces, or indeed removes, their potential for swelling. The reduction in swelling is believed to be mainly due to substitution of other cations by calcium for lime content. The reduction in swelling also means that there is a decrease in moisture absorption in lime-treated soils in agreement with (Bhasin et al., 1978).

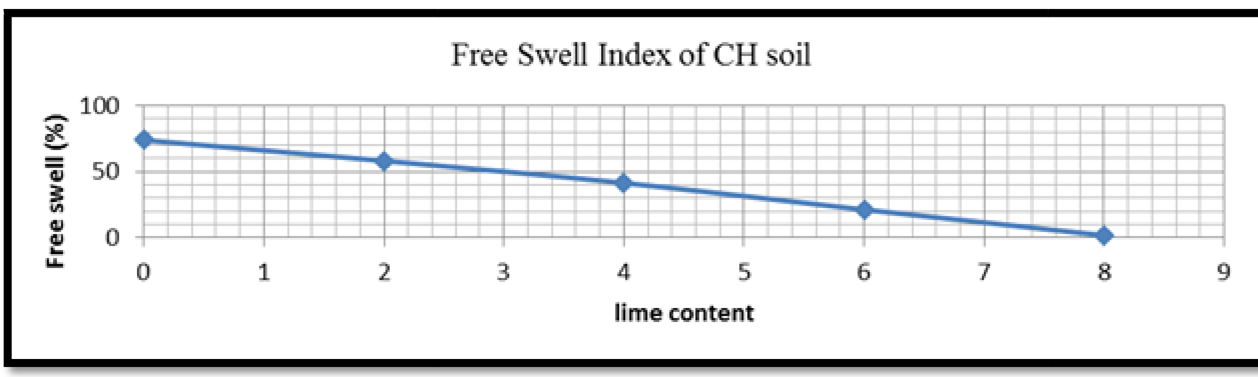


*Figure 6: Effect of Lime on Free Swells Index Behaviors of Soil-Lime Treated*

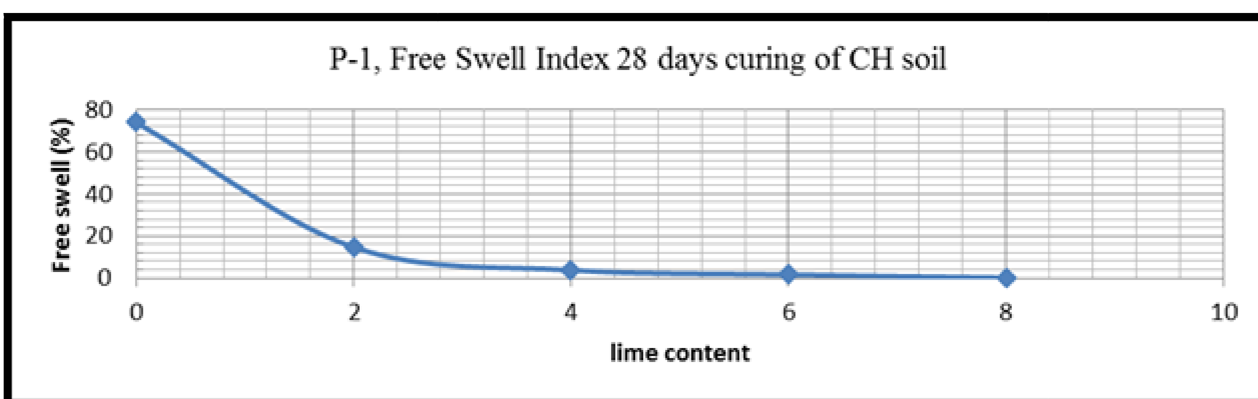


*Figure 7: Effect of Lime on Free Swell Index after 28 Days*

From the above fig.5.6 presented the swelling of soil-lime treated after 28 curing periods indicate no volume change at 4%- 8% of lime content. With addition of 2%, 4%, 6% and 8% lime, the linear shrinkage decreases significantly as presented in figure 5.7 and 5.8 below for the first 7 and 28 days curing respectively. The biggest reduction was noticeable at addition of only 2% and 4% of lime for 28 days and 7days of curing period respectively.

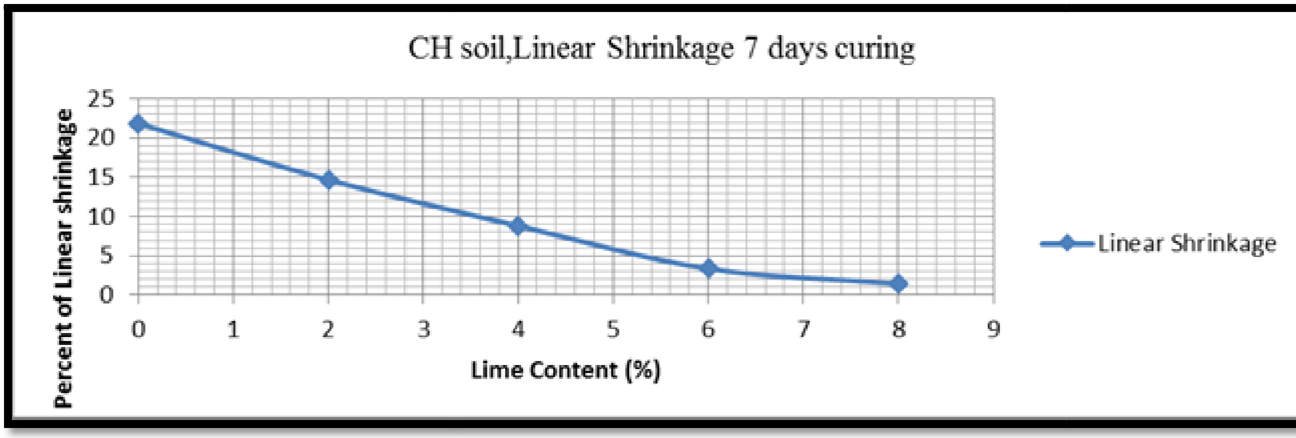


*Figure 8: Effect of Lime on Linear Shrinkage after 7days Curing*

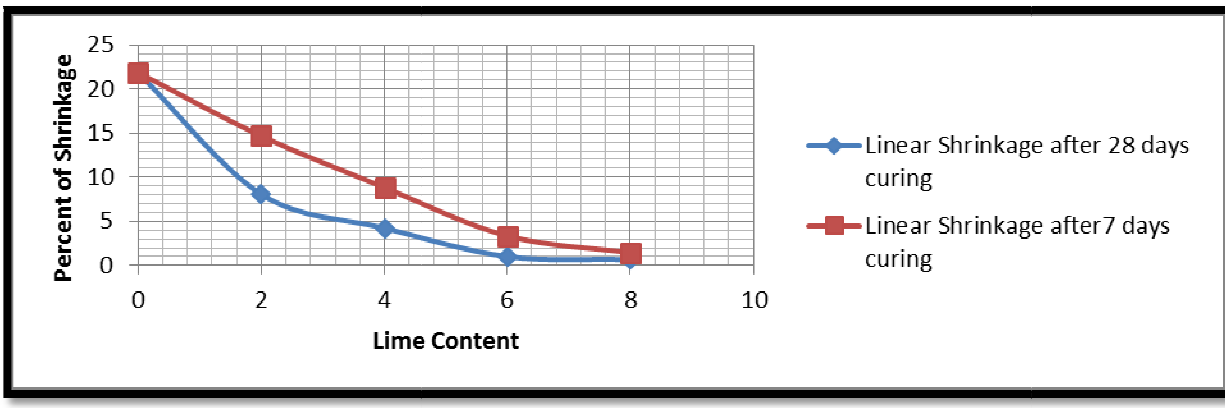


*Figure 9: Effect of Lime on Bar Linear Shrinkage Limit after 28 Days and 7 Days*

*4.4. Effect of Lime on Compaction of Treated Soils*

The addition of lime to expansive subgrade materials (CH soil) increases their optimum moisture content from 14.94% water content of 0% lime to 24.85% water content of 8% lime and reduces their maximum dry density from 0% lime 1.99g/cm³ to 0.805g/cm³ for the same compact effort (figure 10) with increase lime content.

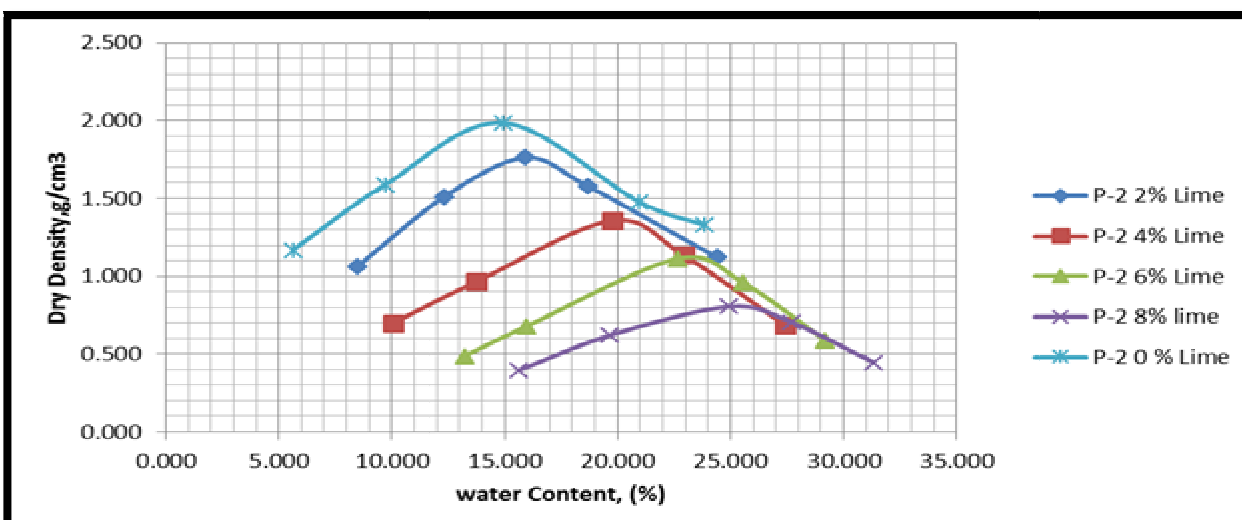


*Figure 10: Compaction Properties of Treated and Untreated Soils by Different Percentage of Lime*

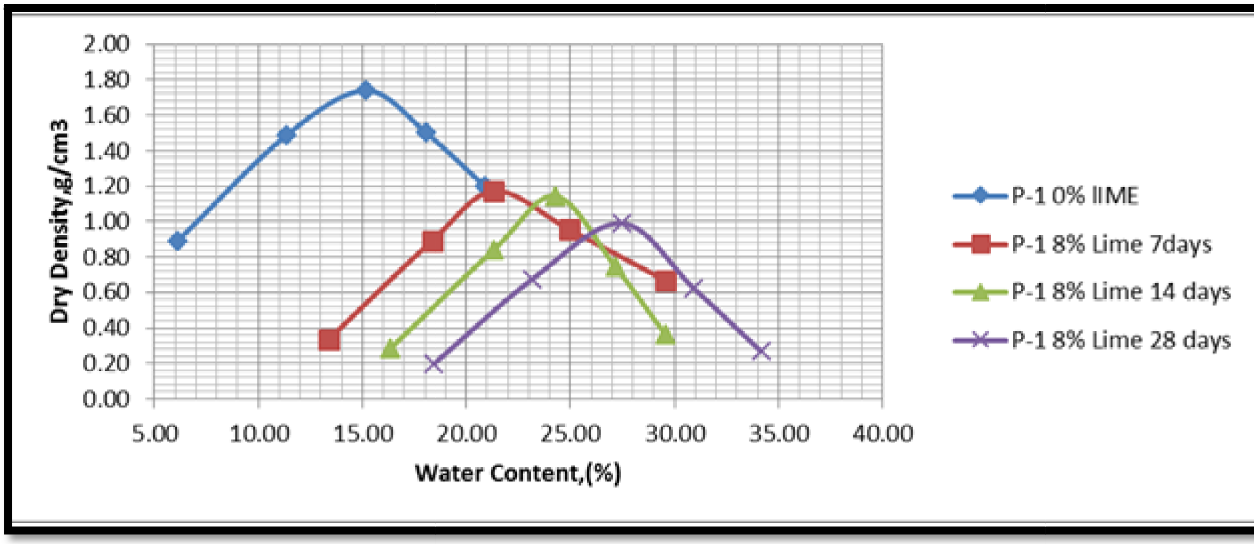


*Figure 11: Compaction Properties Soil-Lime Treated Based on Curing Periods of CH Soil*

Therefore, the maximum dry density of treated based on curing of 28 days was decreased by 43.1% whereas optimum moisture content was increased by 81.3% for this performed laboratory results Wozeka-gidole road project.

*4.5. Effect of Lime on Grain Size Distributions of Subgrade Materials*

Based on laboratory results mention in figure 12 and table 1, all the samples both treated and untreated soils were classified according to the Unified Soil Classification and AASHTO classification system by conducting wet sieving tests and hydrometer analysis following ASTM D 422-63.

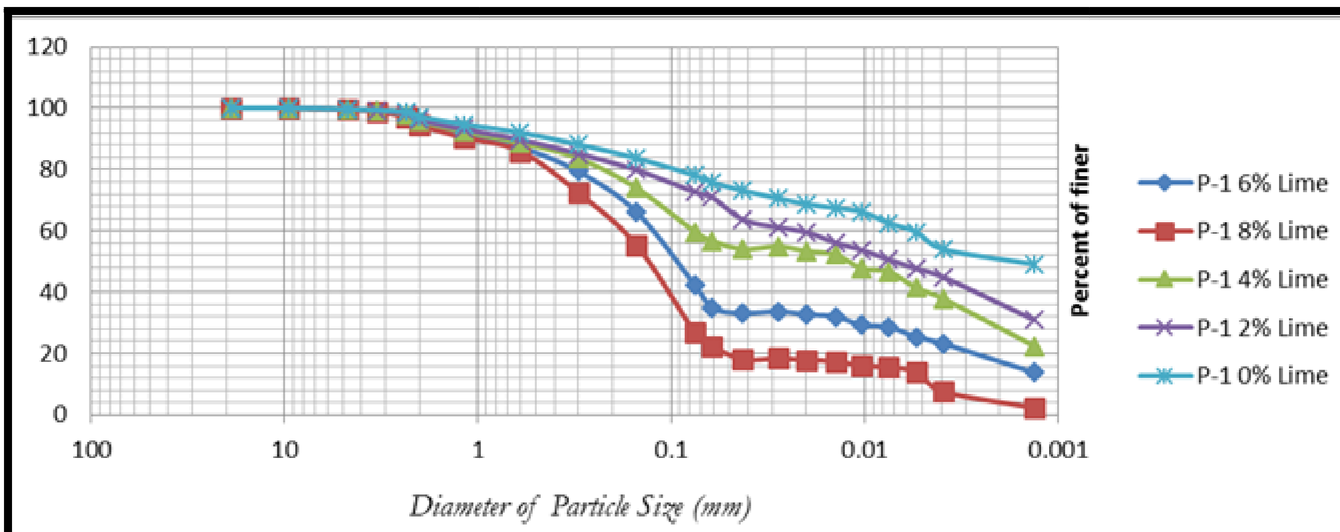


*Figure 12: Effect of Lime Hydration on the Grain Size Distribution of Subgrade Soil for the First 7days Curing Period with Different Percentage of Lime*

Figure 12. Shows particle size distribution curves of soil and lime mixtures. Results present reductions on the clay fraction (Table 2 and figure 5-12) and increases on the silt and fine sand fractions (Fig. 12); probably resulting was from flocculation reactions. Additionally, the clay fractions reduced from 52.718% to 5.44% after addition of different percentage of lime 2%, 4%, 6% and 8% of lime even using 10g of sodium hexametaphosphate dispersant agent in the sedimentation analysis.

| | Grain size distribution | | | | Atter Limit | | | Grain size distribution | Classification | | Materials Type |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pit-1 | Gravel | Sand | Silt | Clay | Liquid Limit | Plastic Limit | Plastic Index | | According To AASHTO | According To USCS | |
| | (%) | (%) | (%) | (%) | LL (%) | PL (%) | PL (%) | No. 200 pass | | | |
| 0% Lime | 0 | 21.66 | 25.616 | 52.718 | 77.48 | 44.07 | 33.41 | 78.07 | A-7-5 | MH | Mostly clay soils |
| 2% Lime | 0.44 | 27.052 | 34.632 | 38.316 | 72.22 | 45.14 | 27.08 | 72.63 | A-7-5 | MH | Mostly clay soils |
| 4% Lime | 0 | 36.026 | 39.658 | 24.316 | 61.07 | 47.48 | 13.59 | 59.66 | A-5 | ML | Low plastic silty clay |
| 6% Lime | 0 | 39.348 | 47.212 | 14.44 | 53.86 | 51.01 | 2.84 | 42.21 | A-5 | ML | Mostly Silty Soil |
| 8% Lime | 0 | 42.77 | 50.76 | 5.44 | 52.68 | 52.58 | 0.39 | 26.76 | A-2-5 | ML | Silty or clay gravel Sand |

*Table 2: Soil Lime Treated Classification Table*

| Curing Period | | Sleve Analysis | Atterberg Limit | | | Classification | | | Free Swell Index | Maximam Dry Density ($g/cm^3$) | Optimum Moisture content (%) | CBR with 4 day Soaking | Unconifed Compression Strength (Kpa) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lime Content | Sieve No. 200 Pass (%) | Liquid Limit (LL)% | Plastic Limit (PL)% | Plastici Index (PI)% | According to AASHTO | Group Index | According to USCS | | | | | |
| 7 Days | 0% | 75.474 | 76.36 | 49.54 | 26.82 | A-7-5 | 25.62 | OH | 74.78 | 1.445 | 13.609 | 4 | 47.7822 |
| | 2% | 63.356 | 70.03 | 51.46 | 18.57 | A-7-5 | 14.07 | OI | 63.11 | 1.327 | 15.233 | 6 | 80.68 |
| | 4% | 54.998 | 65.49 | 53.36 | 12.13 | A-7-5 | 7.40 | ML | 45.274 | 1.1 | 18.06 | 12.34 | 148.59 |
| | 6% | 33.452 | 59.54 | 54.78 | 4.76 | A-2-5 | 0.00 | OL | 12.54 | 0.929 | 20.85 | 18.9 | 276.54 |
| | 8% | 23.766 | 56.82 | NP | NP | A-3 | 0.00 | GC | 0.373 | 0.76 | 24.353 | 24.65 | 385.66 |
| 28 Days | 0% | 75.474 | 76.36 | 49.54 | 26.82 | A-7-5 | 25.62 | OH | 70.65 | 1.44 | 13.7 | 4.5 | 48.08 |
| | 2% | 53.356 | 62.56 | 45 | 17.56 | A-7-5 | 8.64 | ML | 14.62 | 1.12 | 21.405 | 10.5 | 102.4 |
| | 4% | 36.74 | 55.87 | 49.76 | 6.11 | A-5 | 0.00 | GC-GM | 3.744 | 0.9 | 24 | 19 | 234.5 |
| | 6% | 24.43 | 52.09 | NP | NP | A-3 | 0.00 | GC | 1.625 | 0.6 | 26.23 | 27.8 | 397.43 |
| | 8% | 19.65 | | NP | NP | A-3 | 0.00 | GM | 0.125 | 0.52 | 27.5 | 35 | 487.89 |

*Table 2: Soil Lime Treated MH Soil Classification Table*

*4.6. Effect of Lime on Unconfined Compression Strength of Subgrade Materials*

Unconfined compressive strength testing was performed on all extracted specimens using a strain rate of approximately 1.27 percent per minute. A data acquisition system was used to record the applied load and deformation. Corrections to the cross-sectional area were applied prior to calculating the compressive stress on the specimen. Each specimen was loaded until peak stress was obtained, or until an axial strain of approximately 15% was obtained. The unconfined compressive strengths of the natural soils of Wozeka-Gidole sample soil performed in the laboratory result was varied from 22 to 50kpa which indicates poor rating subgrade quality as outlined in the finding of laboratory result of this thesis. Lime-soil mixture strengths varied widely, depending on the soil, lime percentage, and curing period. The strength of a lime-soil mixture is not a constant value but varies in response to changes in the above factors.

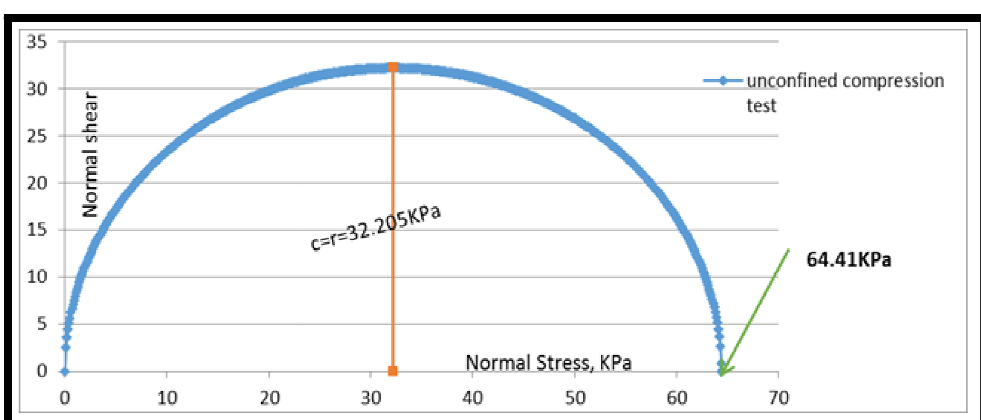


*Figure 13: MH Soil of 0% Lime Treated of Unconfined Compression Strength Test*

Unconfined compressive strengths of untreated compacted soils are interpreted in the context of the general relationship between the unconfined compressive strength and the consistency (quality) of the soils used in pavement applications according to Das, 1994. Unconfined compressive strength ranging from 20 to 50 Kpa and 50-100 Kpa is considered as a soft subgrade and medium subgrade respectively. This means that the finding of this thesis of tested untreated compacted soils are soft to medium subgrade due to compaction process at the optimum water content and without chemical additives (lime) which is similarly with Das, 1994.

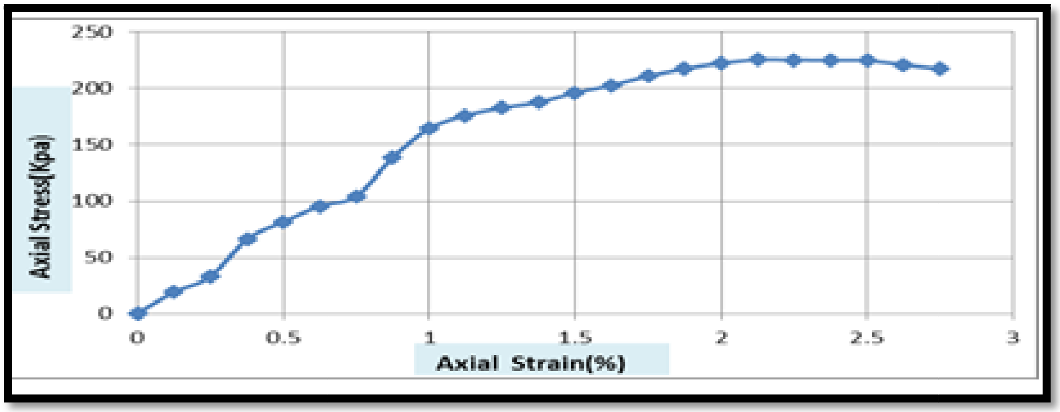


*Figure 14*

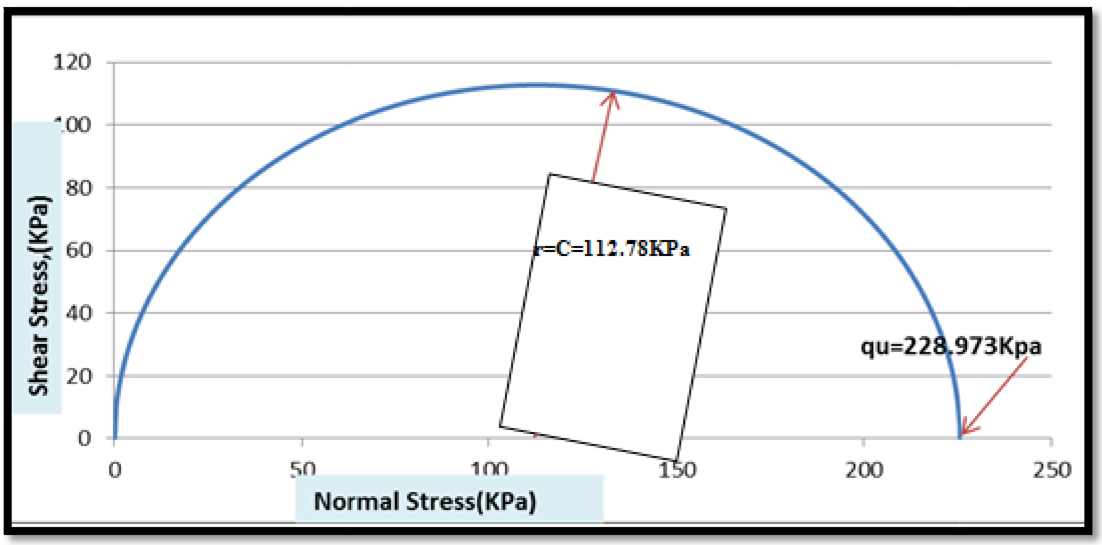


*Figure 15: CH Soil of 8% Lime UCS Test Result after 7 Days Curing*

*4.7. Effect of Curing Periods Lime Treated Soil on Unconfined Compression Strength Test*

When a lime-reactive soil was treated, increased curing period generally produces a stronger mixture. However, the magnitudes of the strength increases obtained are quite variable. Data from this investigation were analyzed to determine the influence of lime percentage (2%, 4%, 6% and 8%) on strength increase and an analysis was made to determine how lime-soil properties effect the magnitude of this strength increase. The values of unconfined compressive strength of soil-lime are shown in figure 15 and table 4.

| | **Curing Periods** | **7 Days** | **14 days** | **28 Days** |
|---|---|---|---|---|
| Pit-1 | 0% | 21.2776 | 22.34 | 21.05 |
| | 2% | 80.684 | 154.176 | 201.437 |
| | 4% | 158.3 | 201.003 | 255.36 |
| | 6% | 182.831 | 233.5 | 270.076 |
| | 8% | 228.973 | 249.22 | 377.4578 |

*Table 4: Summary Unconfined Compressive Strength Test Result of Different Lime Content and Curing Periods*

Findings of this study imply that hydrated lime is a suitable additive to stabilize expansive soils. Expansive clay treated with lime showed approximately swelling and gained high strength compared to untreated sample of Wozeka Gidole road at 8% optimum lime content.

*4.8. Effect of Lime on CBR of Treated and Untreated Subgrade of Wozeka Gidole Road*

Figures 16 below shows the variations of CBR for the soil lime combination at different percentages. The CBR values obtained for lime and soil mixture were remarkably higher than the values for untreated samples. Specimens prepared with different percentage of lime content and compacted at the optimum water content show the best improvement, with CBR ranging from 12% to 59%.

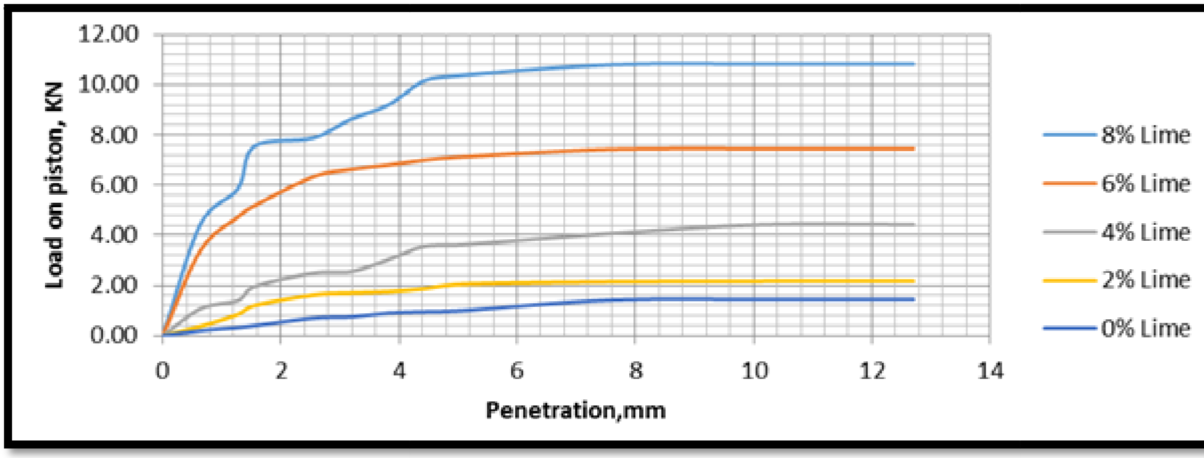


*Figure 16: Variation of CBR Result of Penetration Vs Load after 28 Days at Different Lime Percentage Content*

The observed value of CBR after 28 days of curing periods and at 8% of lime was 58.33% which are increased by 92% with 8% lime increment and 28 days curing. With this result the subgrade quality was referred good to excellent range of 40-60% as discussed in ERA manual 2002.

| | **7 Days Curing** | | **28 days curing** | |
|---|---|---|---|---|
| Lime Content | CBR | Swelling | CBR | Swelling |
| 0% | 5.19 | 39.86 | 5.2 | 38.6 |
| 2% | 8.15 | 26.09 | 12.04 | 7.84 |
| 4% | 10.19 | 10.12 | 18.43 | 4.83 |
| 6% | 17.41 | 5.57 | 46.85 | 2.59 |
| 8% | 42.78 | 3.46 | 58.33 | 1.34 |

*Table 5: Variations of CBR Result at Different Lime Content and Curing Periods*

Generally, the CBR value of soil-lime treated was increased significantly at 6% lime and after curing periods 28 days, with 8% Lime content the cbr value was increase extremely and indicate excellent subgrade quality proposed by ERA manual of the country. So, 8% of Lime content for 7 days curing periods was optimum lime content.

## 5. Conclusion

Expansive sub-grade soils pose severe problems to pavements which are constructed over them. Because of the high swelling, shrinkage characteristics and low load bearing capacity during wetting, and the expansive soils have been a challenge to the road construction sector in Ethiopia in general and Arba Minch Wozeka Gidole in particular, since these soils occupy major portion in the western, central and southwestern part of the country. As pointed out in literature review of this thesis, the cyclic wetting and drying processes due to seasonal climatic changes may lead to vertical movements which take place in expansive sub-grade soils and such vertical movements may result into failure of pavements. Such failures are manifested in the form of settlement, heavy depression, cracking and unevenness of road surfacing. Thus, the problem of expansive sub-grade soils exists and scarcity of suitable fill material within economic hauling distances and excavation cost in force to initiate the use of chemicals to stabilize sub-grade and sub base materials. The present study, hence, has the objective of evaluating the performance of a locally manufactured hydrated lime on highly expansive sub-grade soil samples collected from Arba Minch

Wozeka Gidole road project. The following conclusions can be drawn from the results of the study/investigation carried out on the effect of hydrated lime on expansive subgrade soil of Wozeka Gidole road within the laboratory results, collected literature review and the scope of the study.

- The chemical additives; hydrated lime has provided promising results in improving the engineering properties of the sub-grade soil. 6% of the hydrated lime is enough to stabilize the expansive sub-grade soil pavement of Wozeka Gidole subgrade roadbed.

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