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Study on Impact of Soil Stabilization using Lime, Brick Powder and Tamarind Kernel Powder

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Abstract - *Soil stabilization can be explained as the change in the soil properties by physical or chemical means in order to enhance the engineering quality of the soil. The most important objective of the stabilization of soil is to increase the bearing capacity of the soil, its adherence to the weathering process and soil permeability. The life-long performance of any construction project depends on the compatibility and properties of the underlying soils. Stabilization of soil techniques are necessary to ensure the adequate stability of soil so that it can successfully sustain the load of the superstructure especially in case of soil which is expansive. This study focuses on the impacts of conventional ground improvement techniques on the environment, supporting the argument with documental evidence and alternatives to these techniques. The study aims at testing the effectiveness of natural materials like tamarind kernel powder as a soil stabilizer and comparing the results of these minimal invasive alternative stabilizers like lime and brick powder with the existing techniques, to see how effective are the new alternatives in serving their purpose and saving the environment. Lots of parameters have been selected for comparison, including index properties and consolidation characteristics. Out of the materials identified, Tamarind Kernel Powder, Lime, and Brick powder are being adopted for use in soil stabilization. Each material is tested for its capability in soil stabilization by testing the index and engineering properties of the soil after the addition of the material to achieve promising and eco-friendly results.*

***Key Words*: Soil Stabilization, Tamarind kernel powder, Lime, Brick powder.**

1. INTRODUCTION

For any land-based structure, the foundation is to play very vitally and has to be strong to support the entire structure. In order for the foundation to be strong, the soil around it plays a very vital role. So, to work with soil, we need to proper knowledge about their property and factor affecting the behavior of soil. The process of soil stabilization help to achieve the required property in the soil needed for the construction of a structure. from the literature, it was observed that so many stabilizers added in the soil for stabilization like lime, fly ash, brick dust, some organic material like Eggshell, Tamarind kernel powder, vegetable west, etc. as soil stabilizer.

Soil stabilization can be explained as the change of the soil properties by physical or chemical means in order to enhance the quality of the soil. The study aim at testing the effectiveness of natural material like tamarind kernel powder as a soil stabilizer and comparing the result of these minimal invasive alternative stabilizer like lime and brick powder to see how effective they are serving their purpose and saving the environment. Each material tested for its capability in soil stabilization by testing the index and engineering properties of the soil after the addition of the material to achieve promising and eco-friendly results.

2. MATERIALS

2.1. Black Cotton Soil

Black cotton soil used in the study is procured from Varachha area of GUJRAT, India. Extensive laboratory work is carried out to check the engineering property black cotton soil. plasticity index is calculated by determining Atterberg's limits. Compaction characteristics are determined by conducting IS light compaction test and strength characteristics by conducting California bearing ratio (CBR) test. Results obtained are presented in Table 1.

2.2 Brick Powder

The engineering properties of the brick powder, procured from a local brick kiln in Mogar, are determined by carrying out extensive laboratory tests, namely, grain size analysis, Atterberg's limit tests, IS light compaction test, and soaked CBR test and the results obtained are tabulated in Table 2.

2.3 Lime

Black cotton soil is mixed with lime in varying proportions of 2%, 4%, and 6%.lime-mixed soil is then cured for a duration of 3 days. The mixture is then oven-dried for24 hours. Results of various tests carried out on black cotton soil mixed with various percentages of lime are tabulated in Table 3.

2.4 Tamarind Kernel Powder

Tamarind Kernel Powder (TKP) has not been used in the construction industry but its function as an additive in the improvement of performance of materials like cement has

been recently recognized. TKP can be used as water retention agents, thickener, binder, suspending agent, lubricant and friction reducing agent, air entraining agent reducing the weight in cement and lime to improve their performances without sacrificing strength and eliminating the need of other additives.

TABLE 1 ENGINEERING PROPERTIES OF SOIL

Engineering property	VALUE
Specific gravity	2.52
Gravel size (%)	0
Sand size (%)	9%
Fines (%)	91%
Liquid limit (%)	66.3%
Plastic limit (%)	31.56%
Plasticity index (%)	34.7%
Maximum dry density (g/cc)	1.42
Optimum moisture content (%)	25.33%
Soaked CBR (%)	2.18

TABLE 2 ENGINEERING PROPERTY OF BRICK DUST

ENGINEERING PROPERTY	VALUE
Gravel size (%)	0
Sand size (%)	86
Fines (%)	14
Liquid limit (%)	NP
Plastic limit (%)	NP
Plasticity index (%)	NP
Maximum dry density (g/cc)	1.30
Optimum moisture content (%)	33
Soaked CBR (%)	21.17

TABLE 3 Properties of black cotton soil stabilized with varying Contents of lime.

Engineering property	2%lime	4%lime	8%lime
Liquid limit (%)	62.98%	59.64%	52.58%
Plastic limit (%)	29.53%	26.5%	21.5%
Plasticity index (%)	33.45%	33.14%	31.08%
Maximum dry density (g/cc)	1.512	1.581	1.613
Optimum moisture content (%)	23.3%	21.4%	19.8%
Soaked CBR (%)	1.9	11.2	15.2

3.0 METHODOLOGY

Black cotton soil has to be collected from Varachha, Surat at 0.5m depth free from organic matter. The sample was oven dried and then mixed with lime, brick powder, and tamarind kernel powder at different concentration. The followed tests were performed in the mix of soil. The lime concentration is added in the proportions of 0%, 4% and 6% further the tests of index properties as well as tests like standard Proctor test, and California bearing test is done to test on black cotton soil for stabilization. The brick powder was obtained from brick kiln which is provided extensively used in all building constructional activities similar to that of common burnt clay bricks. The brick powder is comparatively light in weight and stronger than other common clay bricks found in the market. Since brick ash is being accumulated as waste material in tremendous quantity near the brick kiln which is basically a waste product. The waste product removed from brick kiln which can be used as soil stabilizer but it has to be processed first. The appropriate use of waste product gives stability and also gives strength to the soil .Tamarind kernel powder is the powdered form of the tamarind seeds which are dried at first and then churned to form a powdery substance, here we mix the proportions of TKP powder as 2%, 4% and 8% with the soil sample. All the materials are of same particle size which is passed through 425-micron sieve and then mixed dry before performing all the tests.

4.0 RESULT

TABLE 4 RESULTOF BD+ LIME

CONTENT	BLACK COTTON SOIL	20% BD +10% LIME	25% BD + 5% LIME	35% BD + 5% LIME
MDD(g/cc)	1.42	1.63	1.66	1.68
OMC (%)	25.33	21.3	19.3	18.2

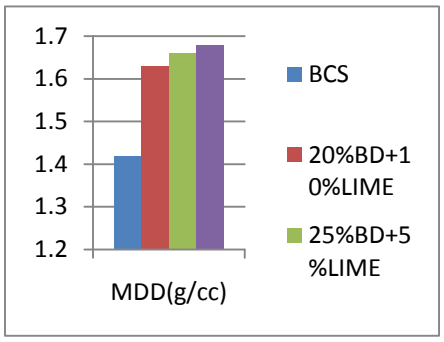

Figure 1

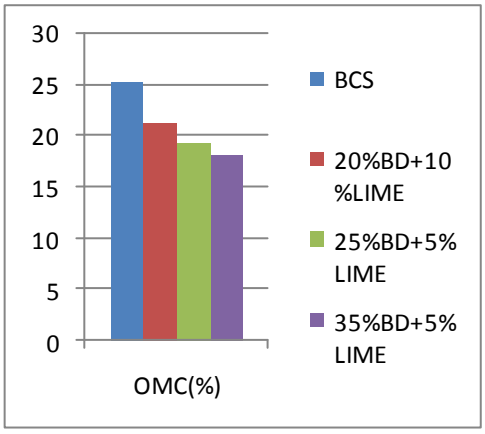

Figure 2

TABLE 4 RESULT OF TKP

CONTENT	2% TKP	4% TKP	8% TKP
MDD(g/cc)	1.442	1.483	1.531
OMC (%)	26.64	29.94	30.6

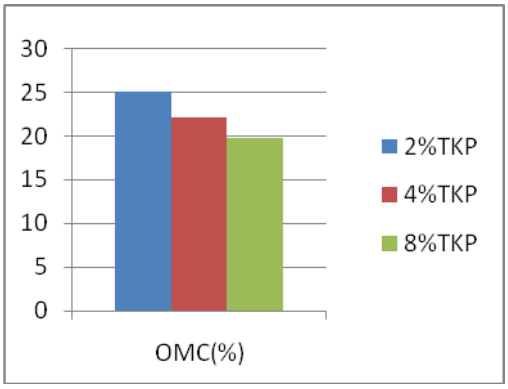

Figure 3

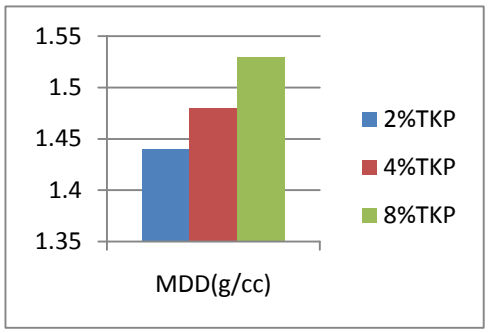

Figure 4

TABLE 6 RESULT OF TKP+ LIME

CONTENT	2%TKP+5%LIME	4%TKP+8%LIME	8%TKP+10%LIME
MDD(g/cc)	1.52	1.62	1.66
OMC (%)	19.4	18.1	17.7

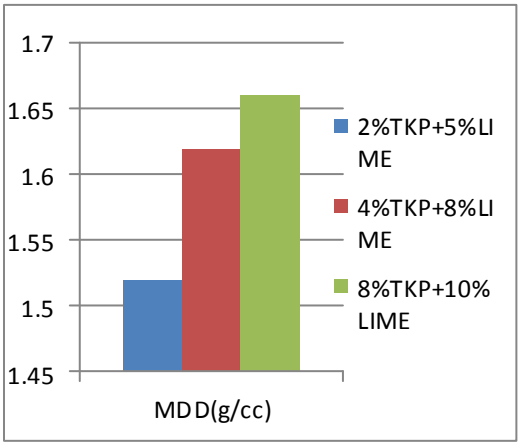

Figure 5

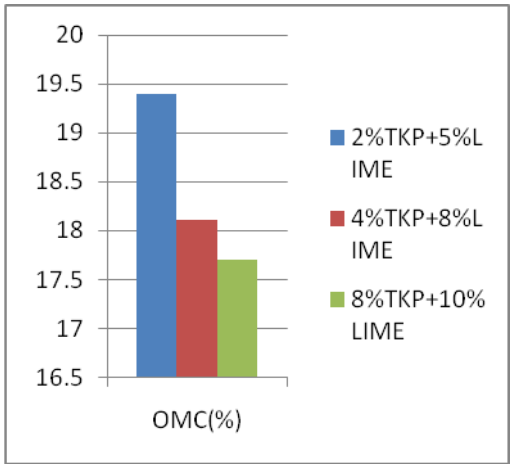

Figure 6

3. CONCLUSIONS

LIME AND BRICK POWDER COMPOSITION:

From the result, it concluded that the impact of the brick powder and lime on soil sample is positive. By replacing soil by 35% of brick powder and 5% of lime of its dry weight it gives a maximum improvement in the engineering properties of soil sample. So the use of brick powder and lime is preferable for soil stabilization Because it gives positive results as a stabilizer and also it is a waste utilization.

TAMARIND KERNEL POWDER:

From the result of adding just 2%,4%,8%of TKP in a sample, we conclude that OMC decreased and MDD increases so it is suitable for a soil stabilizer.

LIME AND TAMARIND KERNEL POWDER:

From the result of the combination of TKP and lime on the soil sample we have found that it is positive but in a minor way compared to the combination of brick powder and lime. By adding8% TKP and 10% lime in soil sample it is found that the soil engineering properties improved that the usual case of adding only TKP.

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