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Stabilization of Soil using Lime from Khambhat Region

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Abstract— *The role of soil in design and construction of any structure is very crucial. Since the soil is in direct contact with the structure, it is act as a medium of load transfer and hence for any analysis of force acting on the structure, one has to consider the aspects of stress distribution through the soil as ability of structure itself depends upon the soil properties. Geotechnically study of site is crucial at feasibility stage, taking place before the design in order to understand the characteristic of subsoil upon which the structure will stand.*

This study investigate the properties of soil sample taken from Khambhat region the practical study examine the change in properties of soil after adding chemical admixture (CaO) to increase and improve the stability of soil and to reduce the cost of construction by making best use of locally available material.

Keywords— Lime (CaO), Stabilization, Index properties, Engineering properties

1. INTRODUCTION

For any land based structure, the foundation is most important and has to be strong to support the entire structure. In order to the foundation to be strong the soil around it plays very critical role. So, to work with soil, we need to have proper knowledge about their properties and factors which affect their behaviour. The process of soil stabilization helps to achietve proper required properties in a soil needed for the construction work.

Soils are generally stabilized to increase their strength and durability or to prevent erosion and cavitation formation in soil. The main aim is the creation of a soil material or system that will hold under the design used condition and for design life of engineering project. The properties of soil vary a great deal at different places or at certain cases even at one place; the success of soil stabilization is depends upon a soil testing. Various methods are employed to stabilize soil and the method should be verified in laboratory with the soil material before applying it on the field.

Soil stabilization is generally as making major improvements to the engineering properties of the soil characteristic with an additive. These additives may include other soils or materials such as Portland cement, lime, fly ash, asphalt cement, polymers and fibres. Traditionally, additive such as bitumen, cement, and lime have achieved widespread used. Bitumen is typically used as a soil surface treatment to limit dust and losses of fineness. Cement is used to provide strength to soil. Lime is often used in clay soil to control plasticity. The effect of the additives and the optimum amount of additives to be used are dependent mainly on the mineralogical composition of the soils. The project focuses about the various stabilization techniques that are in practise for improving the poor grade soil for reducing its swelling potential and the limitation of the method of stabilization on .modification of soil by chemical admixture $cacl_2$ is a effective method for stabilizing the swell-shrink tendency of expansive soil

2. EXPERIMENTAL INVESTIGATION

I. Scope of Work:

1. Specific Gravity of soil using a pycnometer
2. Sieve Analysis
3. Determination of soil index properties (Atterberg Limits) Liquid limit by cassagrande's apparatus and Plastic Limit
4. Determination of the maximum dry density (MDD) and the corresponding optimum moisture content (OMC) of the soil by Proctor compaction test.
5. Determination of the shear strength by unconfined compressive strength test (UCS).
6. To determine the swelling properties of soil

7. To determine the Shrinkage Limit of a specimen of remoulded soil

8. Field Density Test By core cutter
9. Direct Shear Test: To determine the shearing strength of the soil using the direct shear apparatus.
10. UC test: To determine the shear parameter of the clay under unconfined conditions.

II. Materials Used

Soil sample location: bajrang ground (khambhat region)
Chemicals: Lime

III. Methodology

Using different proportion (5%,10%,15%) of lime chemical stabilizer to improve the stability of soil and to determine in which proportion best outcomes are there.

IV. Experiments Performed

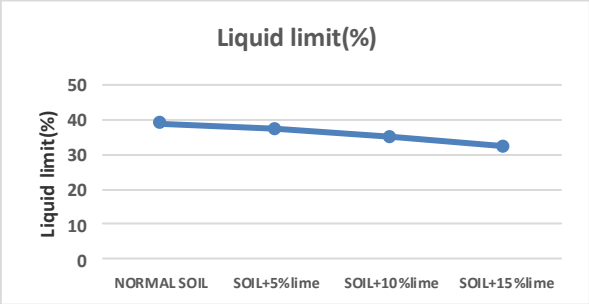
Field Density Test By Core Cutter Method, Sieve Analysis Test, Specific Gravity Test ,Liquid and plastic Limit Test, Shrinkage test, Swelling Index, Proctor Compaction Test

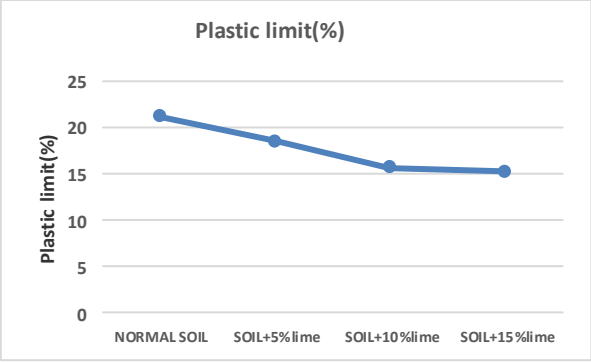
3. RESULTS AND DISCUSSION

Field bulk density of soil is 20.33kN/m³
Dry density of soil is 17.53kN/m³
Specific Gravity G = 2.27
Sieve Analysis: Cu = 12.5, Cc = 0.356 (For Poor Graded)

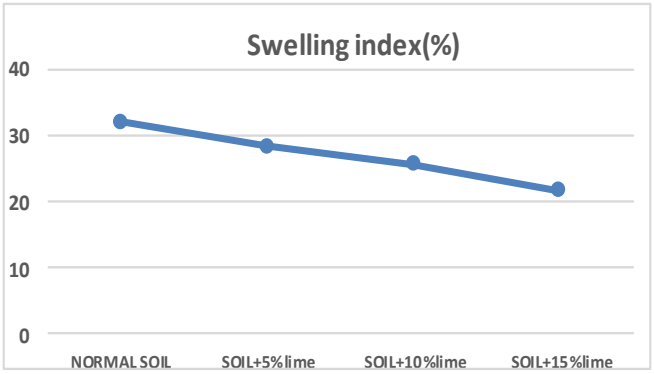
Atterberg's Limit

Soil	Liquid Limit(%)	Plastic Limit(%)
Normal Soil	39	21.18
Soil+5%Lime	37.23	18.5
Soil+10%Lime	35.15	15.72
Soil+15%Lime	32.25	15.23

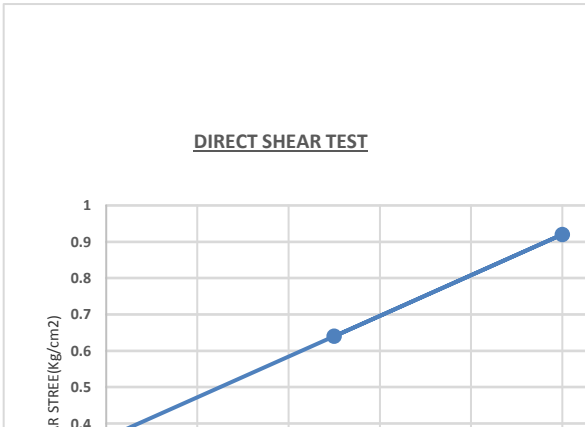




Soil	Swelling Index (%)
Normal Soil	32.1
SOIL+5%lime	28.32
SOIL+10%lime	25.6
SOIL+15%lime	21.7

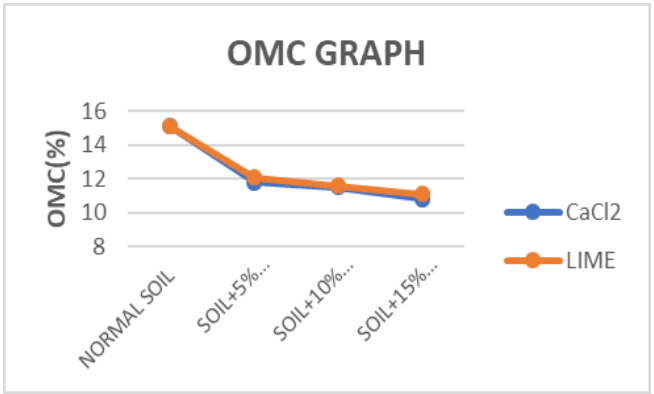


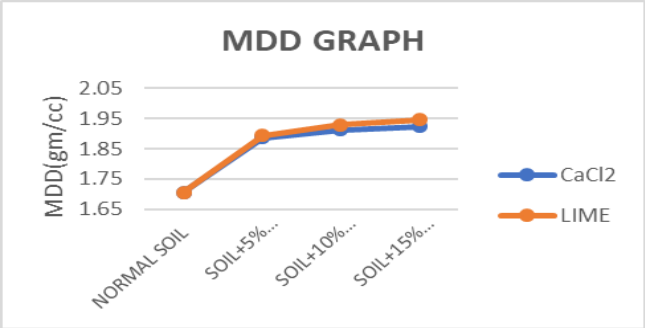
NORMAL STRESS	SHEAR TEST
0.5	0.64
1	0.92
0	0.36

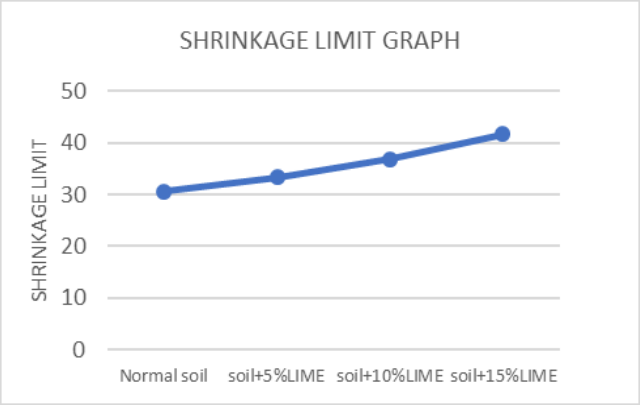


Proctor compaction test

SOIL	OMC (%)	MDD(gm/cm³)
NORMAL SOIL	15.1	1.7049
SOIL+5% CHEMICAL ADMIXTUTE	12.1	1.8933
SOIL+10% CHEMICAL ADMIXTUTE	11.6	1.9285
SOIL+15% CHEMICAL ADMIXTUTE	11.1	1.945







Normal Soil	30.65
Soil+5%LIME	33.26
Soil+10%LIME	36.82
Soil+15%LIME	41.63

4. CONCLUSIONS:

Graphical representation of the test results are presented above with varying percentage of calcium chloride. Based on the test result following conclusions are established.

- Adding CaO will increase the stability of soil and will enhance the index and engineering properties
- It is cheap and can be used as an alternative to piles and will reduce the cost of project.
- The required result is coming in adding 10% chemical stabilizer.
- Soil from Khambhat region (Bajrang ground) is of poor grade.
- CaO increase maximum dry density increase
- CaO increase optimum moisture content decrease
- CaO increase unconfined compression reading decrease
- CaO content increase and liquid limit decrease
- CaO content increase and plastic limit decrease)

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