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# Effect of stabilization in expansive soil from materials have rich source of calcium

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**ABSTRACT**

One of the common methods used to revise the concepts of road soil and black layer is soil improvement. This approach meets the nuances of development and involves improving the features of materials that are currently in the workplace. A final method of soil improvement is to replace loose dirt with more stable materials such as concrete, topsoil, geotextiles, and geo-grids to enhance the physical-mechanical qualities of such clays, conventional stabilizers, including hydrated lime, basic Portland concrete, sulphated oil, and dark top are frequently utilized. When used for soil improvement, substance stabilizers can reduce the negative ecological impact of the development industry and can be used as a soil stabilizer for kaolin clay soils. Due to the use of costly and sustainable ingredients like cement and lime, the expansion of kaolin is still difficult. The combination of SF and ESA stabilizes sensitive kaolin, as shown by the particle size distribution (PSD), specific gravity. Attberg limit, compression parameters, and pure shear strength (USS) properties are utilized in this work. In this study, the authors used materials like calcium-rich eggshells and lime to examine the stabilization effects of various soils. To establish hardness, ideal moisture content, maximum dry density, etc., several tests are carried out.

***Key words :*** *Soil stabilization, Chemical Stabilization, Hydrated Lime, Egg Shells, Kaolin Soil.*

## Introduction

The study of clay soil has been done, which happens to be an expansive soil. The properties of the same are discussed below. The soil stabilization methods, their types etc. have been mentioned below.

### Expansive Soil

Expansive soils such as montmorillonite or bentonite can experience expansion or contraction as a direct result of water changes. Expansive soil expands when exposed to high water and subsides when the water dries up. Structures built on this soil either sink or rise uniformly, often requiring foundation support as a result of the constant cycle of moisture into dry soil.

Expansive soil is very cohesive and difficult to irrigate, mainly due to the mineral content (fine particles) and low organic matter.

### Stabilization of Soil

Almost everywhere, road construction requires soil stabilization. All forms of soil stabilization can be categorized into two major categories: mechanical stabilization and chemical stabilization. Change the potting soils composition by combining it with different potting soils if it is mechanically stable. Soil can be compacted in this manner. Chemical stabilization, on the other hand, refers to the modification of soil characteristics by the addition of active (Jamri

*et al.*, 2021) chemicals. Understanding the pertinent post-blend combination features and their effects is crucial for soil stabilization. Determining how the substance will behave following stabilization is also crucial.

Types of Stabilization in Clay Soil (Rabab'ah *et al.*, 2021)

- Mechanical Stabilization
- Chemicals Stabilization
- Fly Ash Soil Stabilization
- Polymer use for Stabilization
- Geotextiles use for Stabilization
- Kaolin Clay use for Stabilization

### Objectives

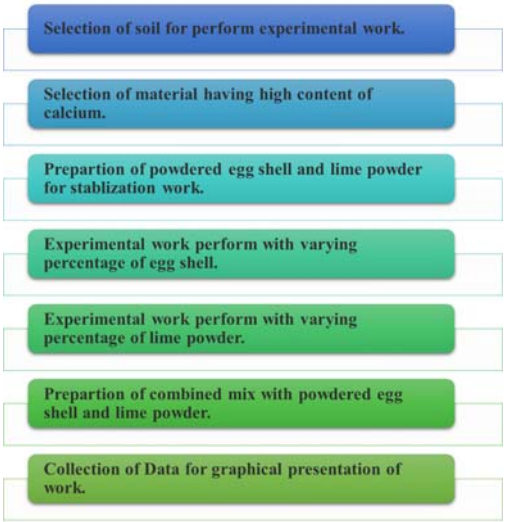
The objectives of the work are as follows-

- Study the expansive soils, specially kaolin soil, and clayey soil.
- Study about soil stabilization methods, techniques, usages, etc.
- Determine the consequence of the eggshells and lime on the expansion properties of the soil.
- Study the overall effect of soil stabilization in expansive soil when calcium like eggshells and lime are added to it.

## Methodology

For this research particular experimental work is discussed in this part of the study. Let's start by outlining how it works. Now that we are aware of the specifics of the technique, let's look at the experimental work performed on the sample.

### Execution steps of methodology



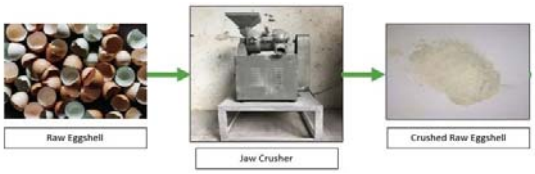




**Fig. 1.** Preparation of powdered egg shell

**Fig. 2.** Egg shells and its Powder

**Fig. 3**. Powdered Hydrated Lime powder

**Table 4.** Mix formulation of Soil stabilization with various % of PHL and PES

| Specimen Name | Soil % | Material (%) |
|---|---|---|
| Natural Specimen | 100% | 0.0% PHL |
| Specimen - 1 | 98.5% | 1.5% PHL |
| Specimen- 2 | 97.0% | 3.0% PHL |
| Specimen- 3 | 95.5% | 4.5% PHL |
| Specimen-4 | 94.0% | 6.0% PHL |
| Specimen- A | 95% | 5.0% PES |
| Specimen- B | 90% | 10.0% PES |
| Specimen- C | 85% | 15.0% PES |
| Specimen - A-1 | 89% | 6% PHL + 5% PES |
| Specimen- B-2 | 84% | 6% PHL + 10% PES |
| Specimen- C-3 | 79% | 6% PHL + 15% PES |

## Results and Discussion

Collect data from several experimental studies and plot graphs in this phase of the study. Compare the stabilization outcomes of lime powder with egg shell powder. Check the specific combination that contains lime and powdered egg shell to see what effects are present (Sathiparan, 2021) (Poorveekan *et al.*, 2021).

### Result of Soil Specific gravity

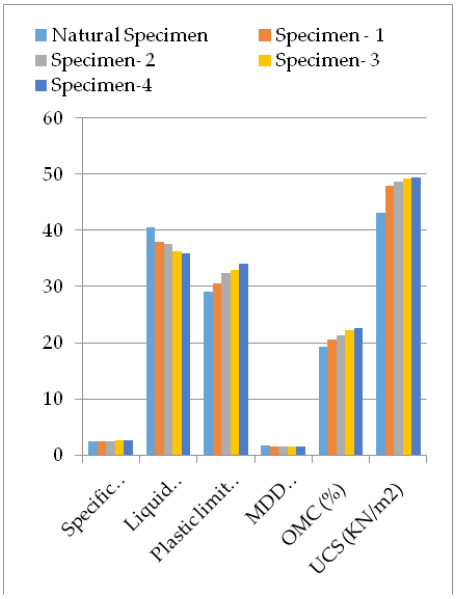



**Fig. 4.** Parameters of soil samples with various % of lime

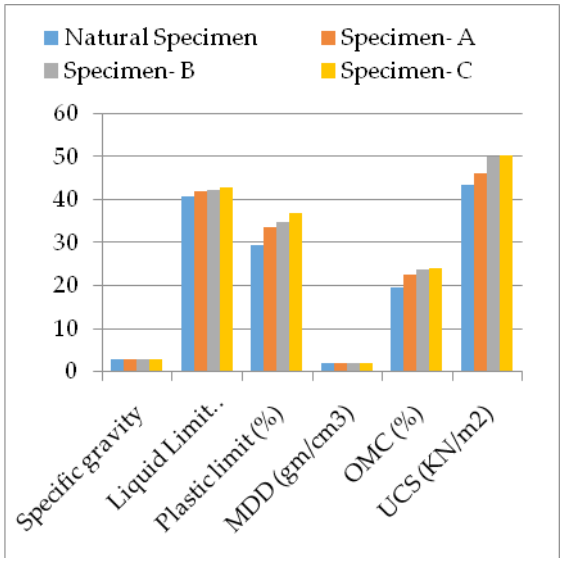



**Fig. 5**. Parameters of soil samples with various % of PES

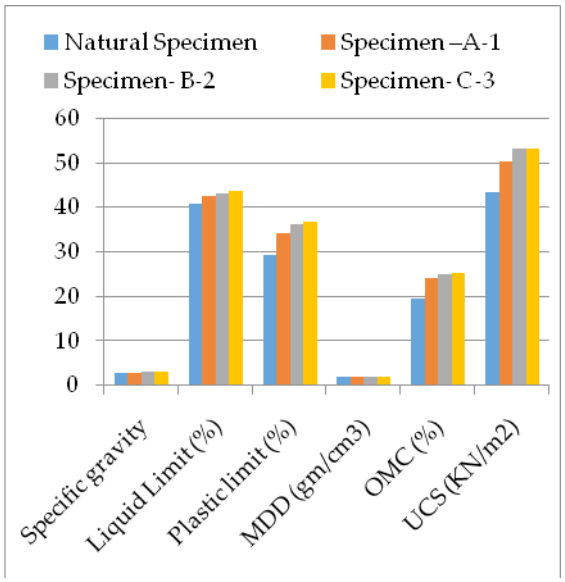



**Fig. 6**. Parameters of soil samples with 6% of Lime and various % of PES

## Conclusion

When a soil sample is treated with lime, the specific gravity of the sample increases until it contains 4.5% more lime, but as more lime is added, the specific gravity begins to decline. Maximum value of specific gravity due to lime mix is 2.70. The specific gravity of a soil sample increases linearly after PES treatment. Maximum value of specific gravity due to PES mix is 2.68. Maximum value of Specific gravity of soil samples with 6% optimum content lime and varying percentage of PES is 2.77.

The liquid limit of a soil sample lowers as the amount of lime in the sample increases. Maximum liquid limit is at minimum lime addition, and lowest liquid limit is at maximum lime addition. Maximum value of liquid limit is 42.81% at 15% addition of PES. As increase in PES content value of Liquid limit goes higher. Maximum value liquid Limit of soil samples is 43.48% at 15% addition of PES with optimum 6% lime.

The plastic limit of a soil sample higher as the amount of lime in the sample increases. Maximum plastic limit is at minimum lime addition, and highest plastic limit is at maximum lime addition. Maximum value of plastic limit is 36.77% at 15% addition of PES. As increase in PES content value of plastic limit goes higher. Maximum value plastic Limit of soil samples is 36.75% at 15% addition of PES with

optimum 6% lime.

The MDD of a soil sample lowers as the amount of lime in the sample increases. Maximum MDD is at minimum lime addition, and lowest MDD is at maximum lime addition. Maximum value of MDD occurs 1.722 gm/cm$^3$ at 5% addition of PES. As increase in PES content value of MDD goes lower. Maximum value MDD of soil samples is 1.696 g/cm$^3$ at 5% addition of PES with optimum 6% lime.

The OMC of a soil sample higher as the amount of lime in the sample increases. Maximum OMC is at maximum lime addition, and lowest OMC is at minimum lime addition. Maximum value of OMC occurs 23.87% at 15% addition of PES. As increase in PES content value of OMC goes higher. Maximum value OMC of soil samples is 25.15% at 15% addition of PES with optimum 6% lime.

The unconfined compressive strength of a soil sample higher as the amount of lime in the sample increases. Minimum unconfined compressive strength is at minimum lime addition, and highest unconfined compressive strength is at maximum lime addition.Maximum value of unconfined compressive strength occurs 50.17 KN/m$^2$ at 15% addition of PES. As increase in PES content value of OMC goes higher. Maximum value unconfined compressive strength of soil samples is 53.06 KN/m2 at 15% addition of PES with optimum 6% lime.

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