International Journal of Scientific Engineering and Research (IJSER)
www.ijser.in
ISSN (Online): 2347-3878, Impact Factor (2014): 3.05

Improvement of Lateritic Clay using Eggshell Powder & Marble Dust and its comparison with Lime Stabilized Clay

Elizabeth K Siby[1], Betsypaul K[2]

Toc H Institute of Science & Technology, Arakkunnam, Kerala, India

Abstract: ***Eggshell powder has not been commonly used as a stabilizing material in most parts of the world. Marble dust are the wastes/dust produced during cutting and polishing of marble. This project aims at determining the geotechnical properties of eggshell powder and marble dust stabilized clay with a view to determine its suitability as a substitute for conventional lime stabilized clay. The main aim of the project is to compare the stabilizing potential of eggshell powder and marble dust which is easily obtained as a waste material with that of artificially synthesized lime. Lime is produced by burning of lime stone in kilns, which is harmful to the environment. It needs more cost to burn lime stone so as to obtain lime used for stabilization. Thus eggshell powder and marble dust could be a good replacement for industrial lime since it contains lime content in it. The effect of eggshell powder and marble dust on the index and engineering properties of clay will be analyzed individually and in combination. The project is aimed at determining the optimum percentage of combination of eggshell powder and marble dust in clay which can effectively replace conventional lime.***

Keywords: Eggshell powder, marble dust , Lime, clay stabilization, geotechnical properties

1. Introduction

For any land-based structure, the foundation is very important 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 critical role. So, to work with soils, we need to have proper knowledge about their properties and factors which affect their behaviour. The process of soil stabilization helps to achieve the required properties in a soil needed for the construction work. By utilizing eggshell powder and marble dust commercially synthesized lime can be effectively replaced with waste products containing lime content. Environmental hazard due to burning of lime in kilns avoided and thus an economically efficient method of soil stabilization can be carried out.

This study is aimed at determining the geotechnical properties of eggshell and marble dust stabilized lateritic clay with a view to determine their suitability and potential as a stabilizing agent and also to compare its properties with that of lime stabilized clay.

1.1. Literature review

Studies on Improvement of Clayey Soil Using Egg Shell Powder and Quarry Dust: Anu, Anumol, Fathima, Jiksymol, Alka. In this study, eggshell powder and quarry dust were combined in various ratios to improve soil properties. It was concluded that the combination of quarry dust and egg shell powder is more effective than the addition of quarry dust/ egg shell powder alone for stabilization.

Effect of Eggshell Powder in the Index and Engineering Properties of Soil: Muthu, Tamilarasan. In this paper the effect of ESP in proportions of 0.5% to 5.5% at 0.5% interval by dry weight was analysed. The use of eggshell powder as an additive improved the strength of soils; however, using eggshell powder quantities in excess of 3% may not yield ample results.

Effect of Marble Dust on Index Properties of Black Cotton soil: Parte and Yadav: studied the effect of marble dust on index properties of Black Cotton soil. In this paper geotechnical property of varying proportions (0-40%) of marble dust was analysed on black cotton soils. Results showed that the expansive behaviour of clay was considerably reduced from “very high” to “low”.

Stabilization of Clayey Soil with Lime and Waste Stone Powder: Armin, Behzad. In this paper, the effectiveness of using waste stone powder and lime in stabilizing fine-grained clayey soil was investigated in the laboratory. The results show significant reduction in plasticity and changed the optimum moisture content and maximum dry density of clayey soil with increasing percentage content of waste stone powder and lime. The addition of waste stone powder and lime caused an increase in the value of UCS up to 6% waste stone powder content and 7% lime content, and increase in the value of CBR to 6% waste stone powder content and 9% lime content, thereafter, the values of UCS and CBR decreased.

2. Materials and Methodology

The eggshell powder and marble dust powder is mixed in different proportions with lateritic clayey soil and a series of laboratory tests were conducted on samples containing various percentages of eggshell powder, i.e., 0%,4%, 8%, 12% and 16% by weight of the dry soil and various percentages of lime, i.e., 1%,2%, 3%, 4% and 5% by weight of the dry soil . The following tests were conducted on eggshell powder and lime mixes as per relevantIS codes of practice.

The experiments conducted are:
- Specific gravity
- Hydrometer Analysis
- Liquid Limit

• Plastic Limit
• Standard Proctor test
• California Bearing Ratio test
•Unconfined Compressive Strength test

2.1 Soil

The Lateritic clay used for the study was collected from paddy fields in Vaikom region.

Table 1: Properties of Lateritic clay

Property	*Value*
Specific Gravity	2.71
Liquid limit,%	69.96
Plastic limit, %	23.33
Plasticity index	46.63
Optimum moisture content, %	19.65
Unconfined compressive strength, kN/m^2	11.79
California Bearing Ratio Value	2.20

2.2. Lime

When lime reacts with soil there is exchange of cations in the absorbed water layer and decrease in plasticity of the soil occurs. Lime that is used in this study is hydrated lime.

2.3 Eggshell Powder

The use of stabilization agents like lime and bitumen proves expensive and requires an economic replacement. The eggshell primarily contains lime, calcium and protein. It has being in use as a source of lime in agriculture, which confirms that lime is present in considerable amount in eggshell.

2.4 Marble dust

The production of fine particles (<2 mm) while cutting marble is one of the major problems for the marble industry. But, the fine particles can be easily dispersed after losing humidity, under atmospheric conditions, such as wind and rain. Thus, fine particles can cause more pollution than other forms of marble waste. Marble has very high lime (CaO) content up to 55 % by weight.

3. Experimental Investigations

The Various tests were conducted on lateritic clayey soil mixed with eggshell powder and lime in different proportions as per relevant IS Code of practice.

Table 2: Final observations when lime is added

%Lime	LL	PL	OMC	MDD
0	69.96	23.33	19.65	1.57
1	65.28	30.11	18.83	1.63
2	59.83	32.61	17.36	1.70
3	57.74	21.15	16.28	1.78
4	53.94	14.27	14.97	1.85
5	52.69	10.31	17.23	1.67

Table 3: Final observations when Eggshell Powder is added

% Eggshell Powder	*LL*	*PL*	*OMC*	*MDD*	*CBR*	*UCC*
0	69.96	23.33	19.65	1.57	2.20	11.79
1	67.62	21.41	18.91	1.67	3.03	16.4
2	61.97	18.06	18.73	1.75	3.85	25.2
3	58.36	15.51	15.88	1.82	5.23	36.9
4	59.48	14.69	17.89	1.52	4.40	27.62
5	69.96	23.33	19.65	1.57	2.20	12.38

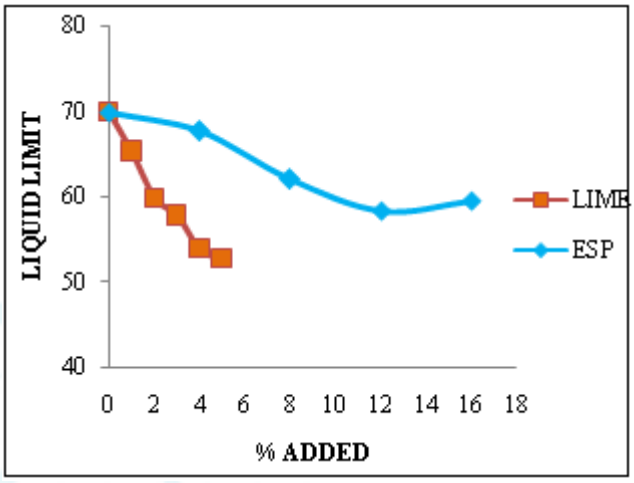

Figure 1: Variation of liquid limit on different percentage of Lime & ESP

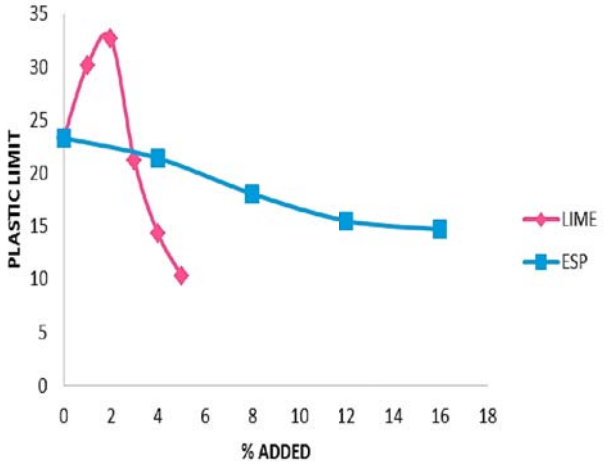

Figure 2: Variation of Plastic limit on different percentage of Lime & ESP

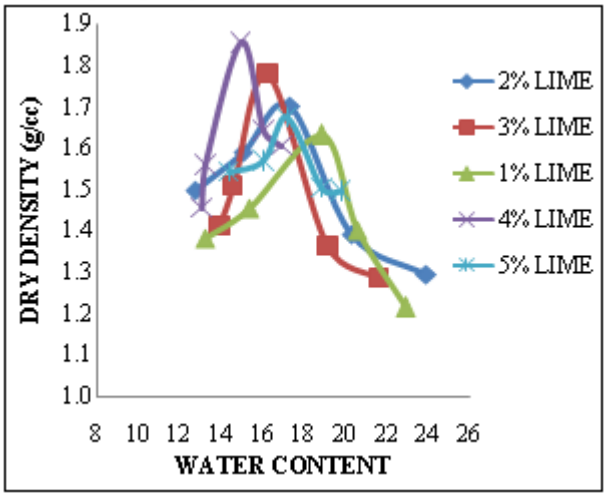

Figure 3: Dry density Vs OMC for different % of Lime

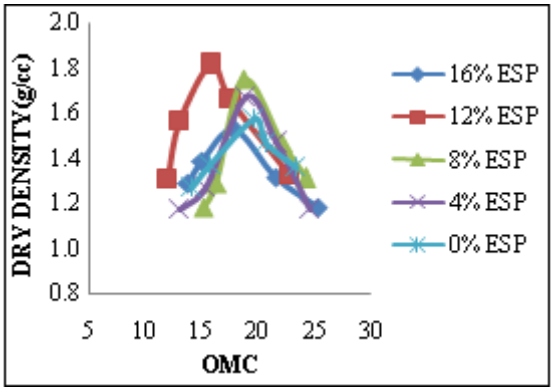

Figure 4: Dry density Vs OMC for different % of ESP

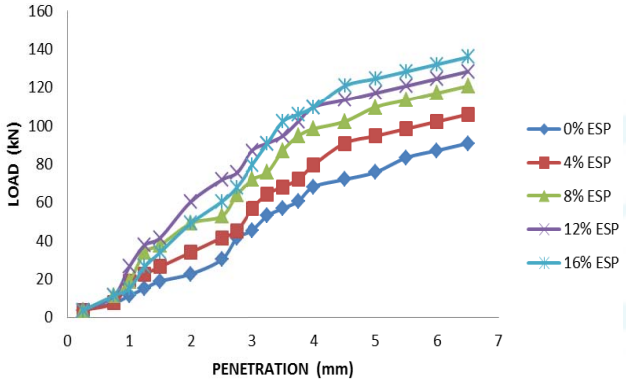

Figure 5: Load Vs Penetration graph for different % of ESP

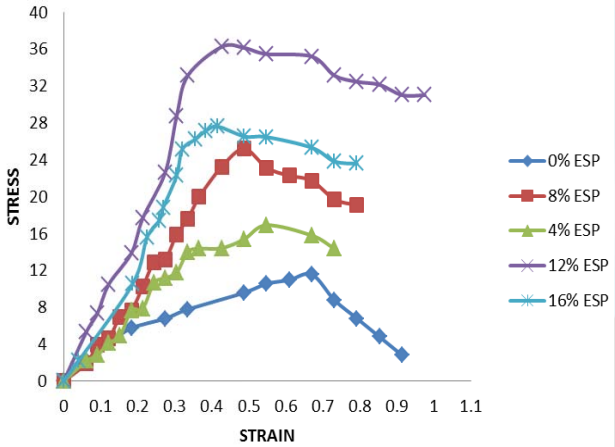

Figure 6: Stress Strain Graph for different % of ESP

4. Conclusion

It can be concluded that addition of Lime and ESP has improved the following soil properties considerably.

- Liquid limit and plastic limit decreased on addition of Lime and ESP when compared with normal clay.
- Maximum dry density increased with addition of Lime and ESP whereas the OMC showed a decreasing trend.
- Unconfined compressive strength of the soil also improved on addition of ESP when compared with normal clay.

References

Journal Articles

[1] Parte Shyam Singh and Yadav R K (2014), "Effect of marble dust on index properties of Black Cotton soil", International Journal of Civil and Structural Engineering, Vol.3, No.3, pp 158-163

[2] Muthu Kumar M, Tamilarasan V S (2014), "Effect of eggshell powder in the index and engineering properties of soil.", International Journal of Engineering Trends and Technology ,Vol.11, No.7,pp 319-323

[3] Mohamed Khemissa,AbdelkrimMahamedi (2014), "Cement and lime mixture stabilization of an expansive overconsoildated clay", Applied Clay Sciences, pp 1-7

[4] SireeshSaride, Anand J Puppala, Srujan R Chikyala (2013) "Swell-shrink and strength behaviors of lime and cement stabilized expansive organic clays", Applied Clay Sciences, pp 39-45

[5] J. Olarewaju, M. O.Balogunand S. O. Akinlolu (2011)."Suitability of Eggshell Stabilized Lateritic Soil as Subgrade Material for Road Construction." Civil Engineering Programme, Vol.16, pp 899-908.

[6] Akshaya Kumar Sabat, Radhikesh P Nanda (2011), "Effect of marble dust on strength and durability of Rice husk ash stabilized expansive soil", International Journal of Civil and Structural Engineering, Vol.1, No.4,pp 939-948

[7] Amu O. O. and Salami B. A. (2010) "Effect of common salt on the compaction and California Bearing Ratio (CBR) properties of eggshell stabilized lateritic soils", ARPN Journal of Engineering and Applied Sciences ,Vol.5, No.9,pp 64-73.