International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8 Issue-4, November 2019

Post Stabilization Performance of Lime Stabilized Soil Admixed with Press Mud

Parthiban.D, Srija Juluru, Sanjay Kumar.R, Bava shahad.TR, Unnimaya K Premachandran

Abstract: - In this study the investigational results obtained in the laboratory on expansive soils treated with low-cost materials i.e, lime and press mud are used. It is conducted to check the signs of progress in the properties of expansive soil with Press Mud and lime in varying percentages. The test results such as the Unconfined compression test, liquid limit, plastic limit, shrinkage limit, hydrometer analysis and pH obtained on expansive clays mixed with different proportions of lime and press mud are presented and discussed in this work. From the demonstrated result the addition of Press mud with lime in soil stabilization improves the Unconfined Compressive strength of the soil when compared to lime stabilization alone. The index properties of the soil have also been marginally improved due to the addition of Press mud as an admixture.

Keywords: Soil Stabilization, Admixture, Press mud, Lime, Pulverization, Atterberg Limit, Unconfined Compression, Hydrometer.

I. INTRODUCTION

Soil stabilization the word denotes the properties of weak soil by the way of introducing chemical or physical treatments to increase the engineering values of the soil, In the soil stabilization the system of increasing the bearing capacity of the soil, its resistance to weathering process and soil permeability. The long-term success of any construction activity depends on the health of underlying soils [3]. Unsound soils can make important problems for pavements or structures, therefore soil stabilization techniques are necessary to ensure the good stability of soil so that it can successfully sustain the weight of the superstructure particularly in case of soil which is highly vigorous, also it saves a lot of time and millions of money when compared to the method of cutting out and replacing the unstable soil. This study deals with the complete analysis of the improvement of soil properties and its stabilization using lime with partial replacement of industrial derivatives. This paper examines, the improvement of Engineering performance of Expansive soil by the addition of industrial waste Called Press mud. Press mud is spawned as by-product fiber after the Sugarcane Juice extraction in sugar industries, which is normally, consider as waste material.

Manuscript published on November 30, 2019.
* Correspondence Author
Parthiban .D*, is Assistant Professor in the Department of civil Engineering at Aarupadai Veedu Institute of Technology, Vinayaka mission research foundation, India . E-mail: Parthi92bhde@gmail.com
Srija Juluru is Assistant Professor in the Department of civil Engineering at Aarupadai Veedu Institute of Technology, Vinayaka mission research foundation, India E-mail: jsrija26@gmail.com
Sanjay Kumar R is Assistant Professor in the Department of civil Engineering at Aarupadai Veedu Institute of Technology, Vinayaka mission research foundation, India E-mail: sanjay.sk0412@gmail.com
Bava shahad TR is an UG student in the Department of civil Engineering at Aarupadai Veedu Institute of Technology, Vinayaka mission research foundation, India
Unnimaya K Premachandran is an UG student in the Department of civil Engineering at Aarupadai Veedu Institute of Technology, Vinayaka mission research foundation, India

II. MATERIALS AND METHODOLOGY

2.1 EXPANSIVE SOIL

The soil utilized in this experimental study was fine-grained expansive soil obtained from the village "Thattahmanji" in Thiruvallur district, Tamilnadu and the soil was tested before the stabilization process and find out the following properties as given in the Table-1 below

SOIL PROPERTY	VALUE
Liquid Limit	63.15%
Plastic Limit	25.5 %
Plasticity Index	41%
Shrinkage Limit	10%
Specific Gravity @ 270c	2.85
Optimum Moisture Content	21.10 %
Maximum Dry Density	1.59 g/cc
UCC Strength	344 kN/m^2
Initial Consumption of Lime	5.5%
Trial Lime content	3%
GRAIN SIZE OF SOIL PARTICLE	
Silt	65.24 %
Clay	32.16 %
Gravel	0%
Sand	2.6 %

Table-I: Properties of the soil before stabilization

2.2 LIME

It is a very reasonable material used in many construction projects. Lime is produced by the burning of calcium carbonate at elevated temperatures and is cooled up to obtain a homogeneous powder [2].

There is a variety of lime-based on its chemical mixture and fillings of calcium and magnesium.

There is so research which spoke the importance of using lime as a construction material and for soil stabilization in specific. Lime increases the strength of fine soil by three mechanisms: hydration, flocculation, and cementation [5]. For our project, we use the laboratory-grade lime, which has the following `constituents shown in Table-2 below.

S.NO	CONTENT	PERCENTAGE
1	Assay	95% min
2	Chloride (cl)	0.015% max
3	Sulphate (SO4)	0.25% max
4	Arsenic (As)	0.00045% max

Table- II: Properties of lime

2.3 Press Mud

Sugarcane press mud is the remainder of the purification of sugarcane juice [4]. The clearing up process splits the juice into a clear juice that increases to the top and goes to manufacture, and mud that collects at the bottom. The mud is then filtered to separate the suspended matter, which includes insoluble salts and fine bagasse. For this study was it is collected from "Thiruthani sugar mill- Thiruvalankadu" near Arakonam, Tamilnadu. The Chemical composition [1] of the filter press mud is given in Table 3 below.

S.NO	NUTRIENTS	PERCENTAGE
1	Nitrogen	0.20
2	Phosphorus	0.18
3	Potassium	1.28
5	Humic acids	20
6	Fiber	28
7	Crude wax	13

Table -III: Properties of pressmud

S.NO	LIME CONTENT (%)	PRESS MUD CONTENT (%)			
1	3%	0.25	0.5	1	2
2	5.5%	0.25	0.5	1	2

Table –IV: Percentage of lime and press mud for preparation of UCC soil specimen

III. RESULTS AND DISCUSSIONS

3.1 Influence of Press mud in UCC strength

Fig.1 below illustrates that the difference in UCC strength with % press mud for 3% lime stabilized the soil. It can be seen that the addition of press mud has resulted in only a marginal increase in strength with respect to various curing period. At 2 hours of curing increase of % press mud had resulted in a steady gain in strength. For curing period 3,7 & 14 days the trends of strength gained is more or less similar in the above cases there is a dip in strength for 0.25% addition of press mud followed by a steady in strength for further addition.

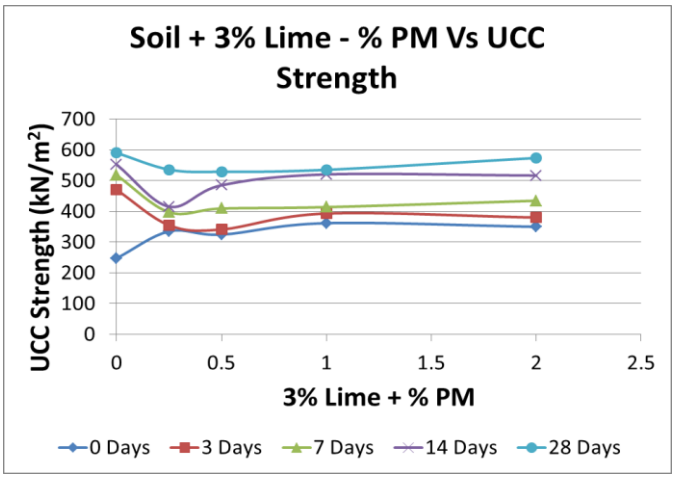

FIG.1 DIFFERENCE OF UCC STRENGTH WITH % PRESSMUD FOR 3% LIME AND STABILIZED SOIL

On 28 days of curing, there is a firm gain in strength after an initial depression in strength, but the loss in strength is not pronounced as seen from the curve. It can be seen that 3% lime stabilized soil admixed with press mud doesn't increase a significant amount of strength on the addition of press mud. It may be owing to the detail that there isn't enough lime for strength gain

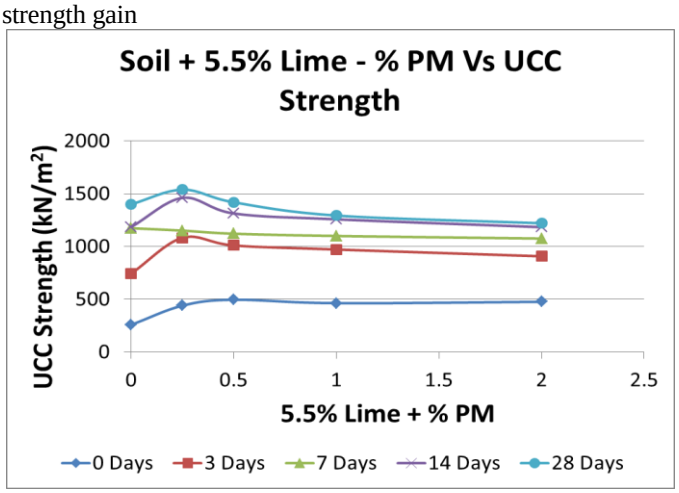

Fig.2 Difference of UCC strength with % pressmud for 5.5 % lime and stabilized soil

Fig.2 above illustrates the variation in UCC strength with % press mud for 5.5% lime stabilized the soil. At 5.5% lime addition it is clear that the trends are more or less similar for all curing period with exception of 7 days. The recent trend is that there is improvement in strength at 0.25% addition of press mud above which there is a depression in strength of lime stabilized soil. On zero-days curing,there is a stable gain in strength which is more or less than 0.5% addition of press mud [11].It can also be noticed there is significant strength at 3days of curing once likened to zero days beyond which the advance is nominal, In general at 5.5%additionof lime admixed with press mud produces significant strength gain when compared with virgin soil.

The addition of 0.25% pressmud with 5.5%lime produces the maximum value of 1538 kPa which is around 14o kPa more than the plane lime stabilized soil.

3.2 Influence of Curing Period on UCC Strength

Fig. 3 below illustrates the difference in UCC strength with % press mud and curing period for 3% lime stabilized the soil. The UCC strength of soil+3%lime+2% of press mud has exposed an increase nearly equivalent to soil+3% lime+0% of press mud, and for the soil+3% lime+0.25%PM, Soil+3% lime+0.5%PM and soil+3%lime+%PM, the strength values are almost equivalent but less than soil+3%lime+2% PM. Therefore it's contingent that the UCC strength increases with an increase in curing time & mixture of soil+3% lime+ higher % of Press mud.

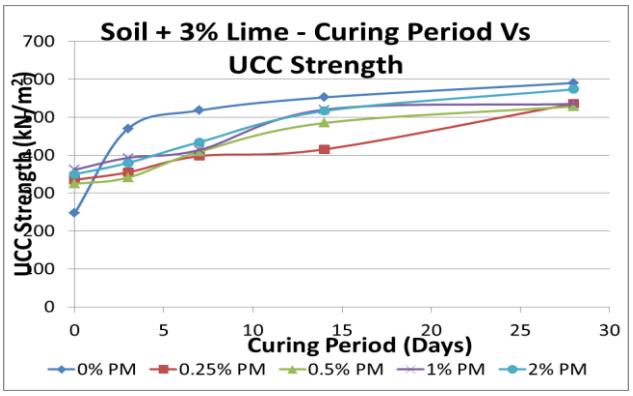

Fig.3 Difference in UCC strength with curing period for 3% lime stabilized soil

On zero days of curing, the strength of the lime stabilized soil increases with changing curing period, when related to the diverse days of curing period there is a general trend of depression in the strength of stabilized soil [10]. As the effect of curing does not bring a remarkable change in strength with increase in the percentage of press mud. These would occur due to inadequate fraction of lime

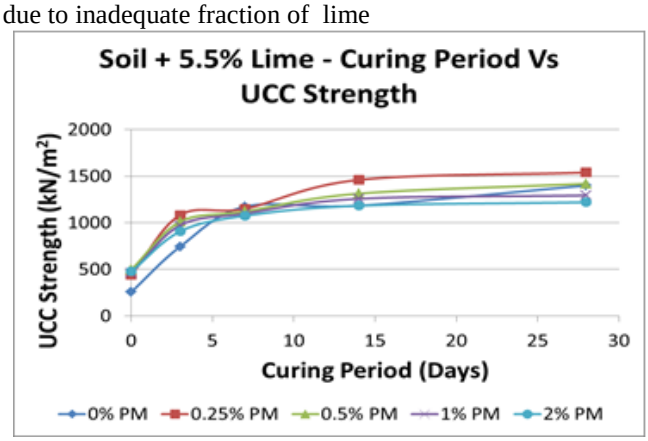

Fig.4 Difference in UCC strength with curing period for 5.5% lime stabilized soil

Fig. 4 above illustrates the difference in UCC strength with % press mud and curing period for 5.5% lime stabilized the soil. At 3 days of the curing period, it can be inferred that there is a significant increase in strength of lime stabilized soil when compared to the zero-day curing period [7]. The strength of soil doubles and there is also marginal increase in strength at 7 days of curing period, after which the strength of soil doesn't seem to increase much. Hence it can be seen that the variation in UCC strength of the lime stabilized soil increases with increases in curing period and soil gains its strength with a minimum period of curing.

3.3 Influence of Lime on UCC Strength

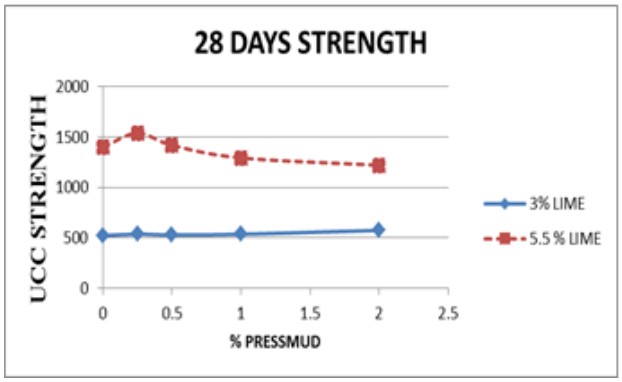

Fig:5 Difference in UCC strength with curing period for 3 and 5.5% lime stabilized soil

The fig 5 above illustrates the variation of UCC strength for 28 days curing at 3% lime, the strength is gradually increased and there is no depression in between the maximum content of press mud is added. But in 5.5% lime, there is a marginal increase in 0.25% when compared to the initial content, after that the strength decreases the amount of press mud is an increase [8].

3.4 Influence of Lime on Liquid Limit

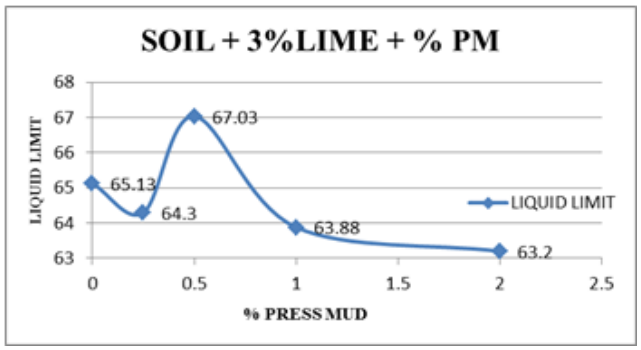

Fig.6 Difference of liquid limit with % pressmud for 3% lime stabilized soil

The fig 6 above illustrates the variation of a liquid limit of the 3% lime stabilized soil, the value of the liquid limit is increased only while adding 0.5% of press mud, except that the remaining percentage of press mud the value of the liquid limit is decreased below to the initial content of 0%.

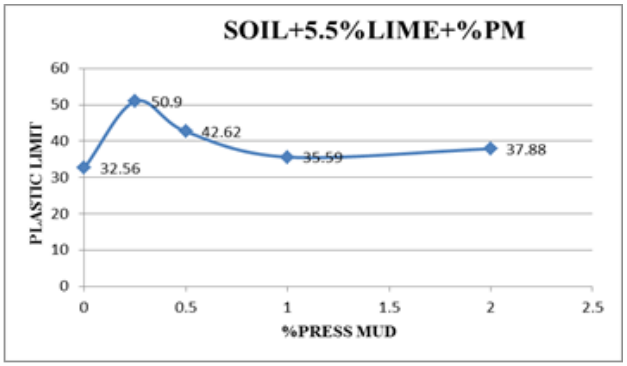

Fig.7 Difference of liquid limit with % press mud for 5.5% lime stabilized soil

The fig 7 above illustrate that the variation of a liquid limit of the 5.5% lime stabilized soil, the value of the liquid limit is decreased while the percentage of press mud is increased from the initial value of 0%

3.4 Influence of Press Mud on Plastic Limit

The fig 8 below illustrates that the Plastic limit of these stabilized soil with the addition of Press Mud [9]. For 3% lime, the value of the plastic limit is decreasing and increasing randomly when the percentage of press mud is increased but the value always lies below the initial value.

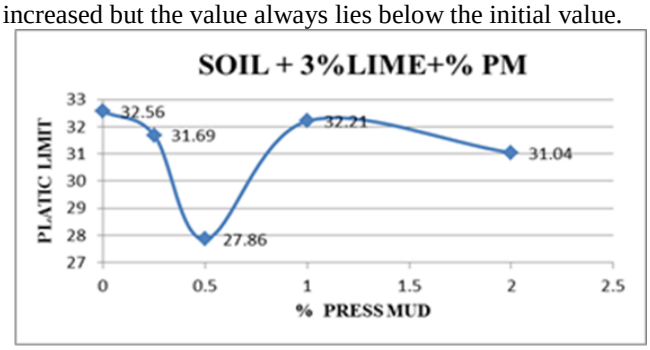

Fig.8 Difference of plastic limit with % press mud for 3% lime stabilized soil

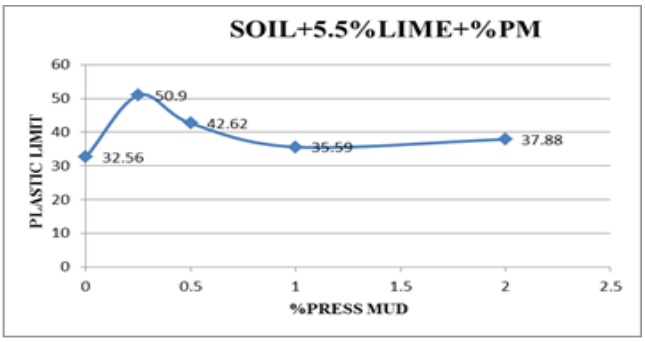

Fig. 9 Difference of plastic limit with % press mud for 5.5 % lime stabilized soil

In above fig 9 for 5.5% lime, the value of the plastic limit is increased at 0.25% and decreases gradually while the percentage of press mud is increasing, but the results are higher than the initial content of 0%.

3.5 Influence of Press Mud on Shrinkage Limit

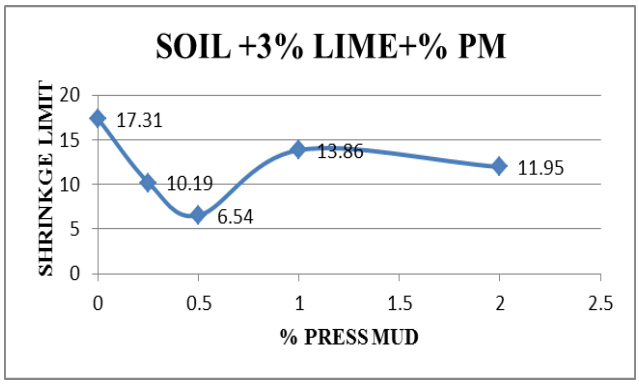

Fig.10 Difference of shrinkage limit with % press mud for 3% lime stabilized soil

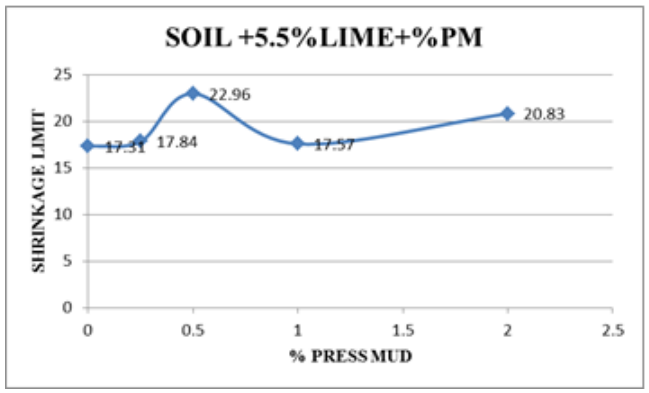

Fig.11 Difference of shrinkage limit with % press mud for 3% lime stabilized soil

The Fig 10 and Fig 11 above illustrates the variation of shrinkage limit of stabilized soils decreases at the 3% lime and increase at the 5.5% lime with the addition of Press mud, which facilitates in checking the volume change behavior of the soils over a large variation in the moisture content as the season changes.

3.6 Influence of Press Mud on the Plasticity Index

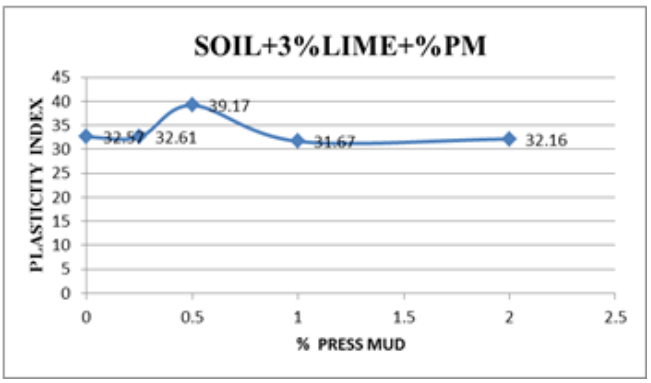

Fig.12 Difference of plasticity index with % of press mud for 3% lime stabilized soil

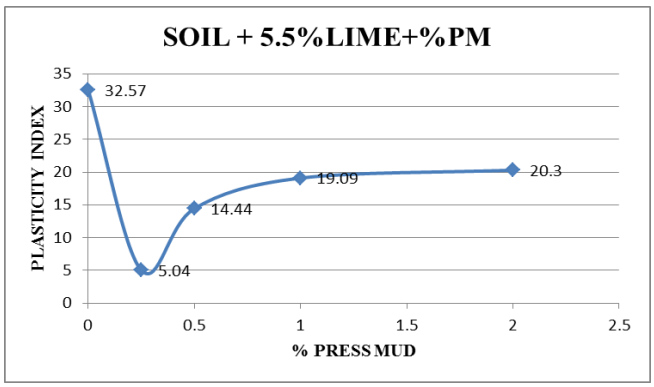

Fig.13 Difference of plasticity index with % press mud for 5.5 % lime stabilized soi

The fig 12 and fig 13 above illustrate that the difference of plasticity index of stabilized soil, which is comparatively declining at 3% Lime and increase at 5.5% lime in the plasticity index of the soils is another favorable change since it increases the workability of these soils.

3.7 INFLUENCE OF PRESS MUD ON pH

Fig 14 and Fig 15 below illustrate the graph, it is observed that the conductivity of 3% and 5.5% is increased with decreased pH values with the increase of oxide concentration in the specimens [6]. The graph below shows the variation of pH of stabilized soil.

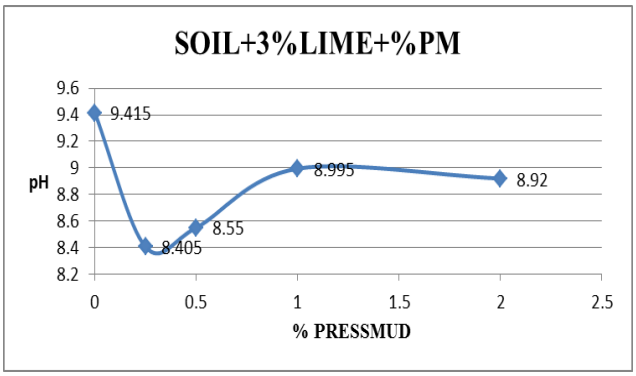

Fig.14 Difference of pH with % press mud for 3% lime stabilized soil

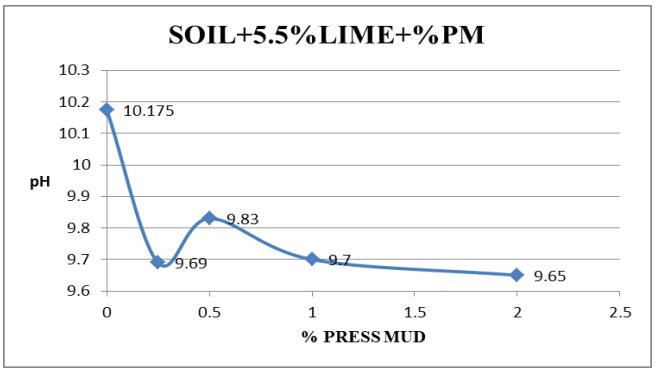

Fig.15 Difference of pH with % pressmud for 5.5 % lime stabilized soil

IV. CONCLUSIONS

Based on the test results on the soil stabilized with lime admixed with press mud the following conclusions can be drawn.

i. The Low consumption of lime value was not enough for stabilizing the soil as there wasn't enough gain in strength of the soil.

ii Lime content beneath the Low consumption lime value was also not significantly improve the index properties of the soil.

iii. Soil stabilized with Low consumption Lime content formed remarkable strength gain.

iv. Initial Consumption lime content was able to significantly improve the index properties of lime.

v. Accumulation of press mud as an admixture to lime stabilized soil below the Low consumption Lime content could not significantly boost limes stabilizing potential whereas when lime was present, press mud addition to lime resulted in enhanced strength gain.

vi. The addition of press mud has no effect on the particle size distribution of the soil as changes to particle size distribution were mainly due presence of lime.

vii. The pH value on the addition of press mud is lower than the plane stabilized soil, which may be an indication of the effective utilization of lime in soil-lime reaction.

REFERENCES

1. Recovery of Chemicals from Pressmud – A Sugar Industry Waste" by N. Partha and V. Sivasubramanian, Department of Chemical Engineering, Anna University, Chennai 600 025.
2. "Soil Stabilization Using Lime" by Ankit Singh Negi from International Journal of Innovative Research in Science, Engineering and Technology Vol. 2, Issue 2, February 2013.
3. "Stabilization of Black cotton soil using Fly-Ash" By Udayashankar D.Hakari, S.C.Puranik from Global Journal of Researches in Engineering Civil And Structural engineering- Volume 12, Issue 2, Version 1.0, February 2012.
4. "A Review on the Soil Stabilization Using Low-Cost Methods" By Amin Esmaeil Ramaji from Journal of Applied Sciences Research, 8(4): 2193-2196, 2012, ISSN 1819-544X.
5. "Effect of Stone Powder and Lime on Strength, Compaction and
6. CBR Properties of Fine Soils" by Nabil Al-Joulani from Jordan Journal of Civil Engineering, Volume 6, No. 1, 2012.
7. IS 2720-Part 26-1987" For the determination of Ph for the soil samples.
8. "The Potential of Using Rubberchips as a Soft Clay Stabilizer Enhancing Agent" by Meei-Hoan Ho (Corresponding author) from Modern Applied Science Journal, Vol. 4, No. 10; October 2010.
9. "Unconfined Compressive Strength of Clayey Soils Stabilized with Waterborne Polymer" by Seyed Abolhassan Naeini from KSCE Journal of Civil Engineering (2012) 16(6):943-949, DOI 10.1007/s12205-012-1388-9.
10. "Effect of Granite Dust on index properties of black cotton soil" by Jagmohan Mishra1, R K Yadav and A K Singhai, International Journal of Engineering research, science, and technology, ISSN 2319-5991, Vol. 3, No. 1, February 2014.
11. "Stabilisation of Black Cotton Soil Using Admixtures" by Pankaj R. Modak, Prakash B. Nangare, Sanjay D. Nagrale, Ravindra D. Nalawade, Vivek S. Chavhan, International Journal of Engineering and Innovative Technology (IJEIT) Volume 1, Issue 5, May 2012.
12. "Stabilization of Black Cotton Soil Using Groundnut Shell Ash" by T.S. Ijimdiyaa, A.L. Ashimiyu, D.K. Abubakar, International Journal of Engineering and Innovative Technology -Vol. 17 [2012].

AUTHORS PROFILE

Parthiban.D Working as Assistant Professor in the Department of Civil Engineering, Aarupadai Veedu Institute of Technology-VMRF.Chennai, Tamilnadu.

Srija Juluru Working as Assistant Professor in the Department of Civil Engineering, Aarupadai Veedu Institute of Technology-VMRF.Chennai, Tamilnadu.

Sanjay Kumar.R Working as Assistant Professor in the Department of Civil Engineering, Aarupadai Veedu Institute of Technology-VMRF.Chennai, Tamilnadu.