A Laboratory Investigation on The Efficacy of Sawdust Ash And Quick Lime on Improving Properties of Expansive Soil As Foundation Bed Under Static Pressure

Turubhatla Chaitanya[1], Dr.Ch.Bhavannarayana[2]
[1]Dept of Civil Engineering
[2]Professor, Dept of Civil Engineering
[1, 2] Kakinada Institute of Engineering & Technology-II College, Korangi, AP, India.

Abstract- *BC soil or extensive soil is otherwise called swelling soil. This kind of Black soils will found in Central states and a few areas of south India. The presence of this sort of soil is Black subsequently they are called as Black cotton soils. This BCS are particularly helpful for developing Cotton. Generally expansive soils have unacceptable engineering properties like low bearing capacity and high compressibility. Thus the improvement of soil at a site is needed. There are so many stabilizers to stabilize the strength of expansive soil like Jute, gypsum, fly ash, rise-husk ash, cement, lime, used rubber tyres etc. In this thesis the Saw Dust Ash inserted as a stabilizer and Quick Lime as additive to improve the properties of Expansive soil. The objectives of this study are to improve shear strength of the expansive soil by mixing Saw Dust Ash and Quick Lime. Addition stabilizer of Saw Dust Ash different percentages of 5%, 10%, 15%. Another stabilizer is Quick Lime varying percentage of 2%, 4%, 6%, 8% and 10%. It is noticed from the laboratory investigations that the liquid limit, plastic limit and plasticity index of the Expansive soil has been decreased and maximum dry density and CBR by on addition of 10% Saw Dust Ash and 8% Quick Lime as an optimum when compared with untreated Expansive Soil. In present investigation, the aim is to reduce swelling and shrinkage behavior of expansive soil by improving strength engineering properties of soil. Also the industrial solid waste sawdust ash is utilized for stabilization so as to solve the problem of indiscriminate disposal. The other additive used in this study is quick lime. Numerous tests are conducted with varying proportions and results are reported.*

Keywords- Expansive soil, Quick lime, Saw Dust Ash (SDA), CBR.

I. INTRODUCTION

A land based structure of any type is only as strong as its foundation. For that reason, soil is a perilous element persuading the success of a construction project. Soil is either part of the foundation or one of the raw materials used in the Construction process. Therefore, understanding the engineering properties of soil is perilous to obtain strength and economic performance. Soil stabilization is the process of maximizing the suitability of soil for a given construction purpose.

II. LITERATUREREVIEW

Dr. D. Koteswara Rao et al., (2012) studied the properties of expansive soil before and after treated with rice husk ash and potassium chloride.

GeethuSaji (2016) has studied the effect of Egg Shell Powder (ESP) and Quarry Dust (QD) on the properties of clayey soil.

Butt etal., (2016) conducted extensive experimental demonstrate the soil improvement prospective of saw dust ash (SDA) by performing California bearing ratio (CBR) and unconfined compression strength tests.

Dharmendrasahu has investigated the effects of NaoH on mixing with the black cotton soil as a stabilizing material.C. Neeladharan (2017) studied about the stabilization of expansive soil using tile waste with sodium hydroxide as a binder.

M. Vignesh (2019) studied about the stabilisation of clay soil using polypropylene and sawdust ash.

III. METHODOLOGY, EXPERIMENTAL STUDY ANDRESULT

The study is carried out on Expansive soil, Expansive soil blended with Saw Dust Ash and Expansive Soil with optimum percentage of Saw Dust Ash with Quick Lime in the

following percentages. Saw Dust Ash was varied in percentages of 5%,10%, and 15% by weight of Expansive soil throughout the experiments. To increase the CBR of Saw Dust Ash treated Expansive soil, Quick Lime was added in percentages of .2%, 4%, 6% ,8% and 10%.

3.1 Soil properties: The soil used for current study has been taken from Turpulanka village near Amalapuram area of East Godavari district, AP, India. It is collected from a depth of 1.50 m. Tests are conducted to determine the Index properties, Engineering properties as per Indian standard (IS 2720). The Soil properties are given in Table 1:

S.No	Property	Symbol	Untreated Expansivesoil
1	LiquidLimit(%)	W_L	75
2	PlasticLimit (%)	W_P	35.5
3	PlasticityIndex(%)	I_P	39.5
4	SoilClassification	--	CH
5	SpecificGravity	G	2.66
6	FreeSwell(%)	FS	130
7	OptimumMoisture Content(%)	OMC	27.20
8	Maximum Dry Density(g/cc)	MDD	1.54
9	CBR (%)	--	1.12

3.2 Sawdust Ash: The Sawdust Ash was collected from local saw mill, Kakinada, Andhra Pradesh which is an indiscriminate waste disposed in open areas and landfills. It can cause serious problems to the environment and humans; hence the utilization of saw dust ash in geotechnical applications is likely to provide a better solution.

Saw dust is a by-product of sawmills by sawing timber. It is the loose particles or wood chippings obtained by sawing wood into useable sizes. After collection, clean saw dust without much bark and much organic content was air dried and burnt at the room temperature. The SDA was then sieved through 600 micron sieve to remove the lumps, gravels, unburnt particles And other deleterious materials to soil and obtained SDA is used for the laboratory work

3.3 Quick Lime: Main constituent of lime is calcium carbonate (CaCO3), It is available in nature in the form of limestone. Limestone from stone hills is main source of lime and Shells of sea animals are its purest form.

Quick lime: When limestone is burnt CO2 is given out and quick lime is obtained.

Slaked lime: Water should be added on quick lime to turn it into calcium

Hydroxide, the process is known as slaked lime.

CaO+H2O ------>Ca (OH)2

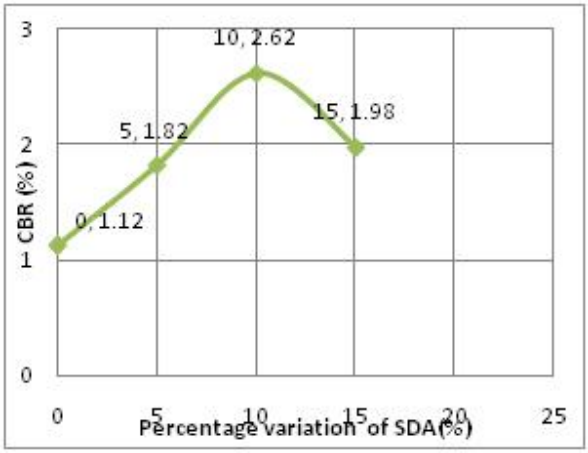
Table: 2 Compaction Characteristics of Expansive soil treated with percentage of Saw Dust Ash (SDA)

MixProportion	Water Content(%)	DryDensity(g/cc)
100%Expansivesoil	27.20	1.54
ES+5%SDA	25.63	1.591
ES+10%SDA	**25.82**	**1.71**
ES+15%SDA	25.18	1.68

Graph 1: Shows the Variation of MDD (g/cc) w.r.t various percentage of SDA

Table 3 CBR Values of Expansive soil treated with Percentage Variations of SDA

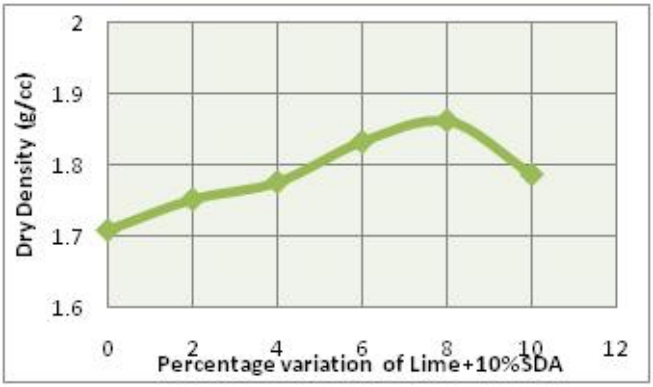
MixProportions	CBR(%)
100%Expansive soil	1.12
ES+5% SDA	1.82
ES+10%SDA	**2.62**
ES+15%SDA	1.98



Graph.2: Shows the variation of CBR w.r.t Different percentages of Saw Dust Ash.

Table 4 OMC and MDD Values of the Expansive soil with 10% of Saw Dust Ash and reinforced with different percentages of Quick lime

S.No	Mixproportion	Optimum MoistureContent (%)	MaximumDry Density(g/cc)
1	Expansive soil+10% SDA	25.82	1.71
2	Expansive soil+10% SDA +2%Lime	25.35	1.75
3	Expansive soil+10% SDA +4%Lime	24.89	1.776
4	Expansive soil+10% SDA +6%Lime	24.05	1.833
5	**Expansive soil+10% SDA +8%Lime**	**23.24**	**1.862**
4	Expansive soil+10% SDA +10%Lime	23.18	1.788

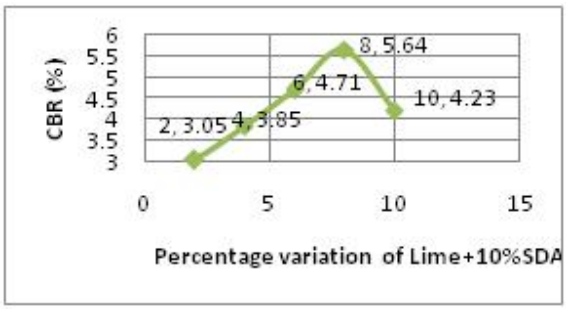


Graph 3: OMC and MDD values of Expansive soil with 10% of Saw Dust Ash with various percentages of Quick Lime

Table 5 CBR Values of 10% Saw Dust Ash Treated Expansive soil with Various Percentages of Quick Lime

S.No	MixProportions	CBR (%)
1	100%Expansivesoil	1.12
2	Expansivesoil+10%SDA	2.62
3	Expansive soil+10% SDA + 2% Lime	3.05
4	Expansive soil+10% SDA + 4% Lime	3.85
5	Expansive soil+10% SDA + 6% Lime	4.71
6	**Expansive soil+10% SDA + 8% Lime**	**5.64**
7	Expansive soil+10% SDA + 10% Lime	4.23

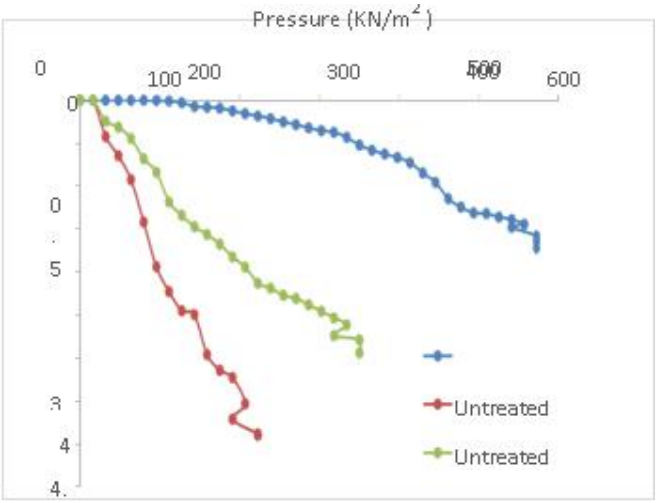
Graph 4: Variation of Soaked CBR values withExpansivesoil+10% Saw Dust Ash+different% Quick Lime



Graph 4: Shows the Graph Variation of Soaked CBR values withExpansivesoil+10% Saw Dust Ash+different% Quick Lime

Table 6: Variation of LL, PL, PI for Expansive soil treated with percentage of Saw Dust Ash and Lime

%SDA	LiquidLimit(%)	PlasticLimit(%)	PlasticityIndex(PI)
100% Expansivesoil	75	35.5	39.5
ES+10%SDA	**55.23**	**24.52**	**30.71**
ES+10%SDA+8%Lime	46.46	21.36	25.1



Graph 5: Laboratory Static Plate Load Test results of Expansive soil treated with 10% SAW Dust Ash+ 8% Quick Lime

IV. CONCLUSIONS

- It is observed from the laboratory test results, that the liquid limit of treated Expansive Soil has been decreased by 26.36% on addition of 10% Saw Dust Ash and it has been further decreased by 38.05% on addition of 8% of

lime as an optimum compared with the Untreated Expansive Soil.

- It is observed from the laboratory test results, that the plastic limit of treated Expansive Soil has been decreased by 30.92% on addition of 10% Saw Dust Ash and it has been further decreased by 39.83% on addition of 8% of Lime as an optimum compared with the Untreated Expansive Soil
- It is observed from the laboratory test results, that the plasticity index of treated Expansive Soil has been decreased by 22.25% on addition of 10% Saw Dust Ash and it has been further decreased by 36.45% on addition of 8% of Lime as an optimum compared with the Untreated Expansive Soil.
- It is observed from the laboratory test results, that the specific gravity of treated Expansive Soil has been increased by 2.63% on addition of 10% Saw Dust Ash and it has been further increased by 10.31% on addition of 8% of lime as an optimum compared with the Untreated Expansive Soil.
- It is observed from the laboratory test results, that the Differential free swell of treated Expansive Soil has been decreased by 53.84% on addition of 10% Saw Dust Ash and it has been further decreased by 76.92% on addition of 8% of lime as an optimum compared with the Untreated Expansive Soil.
- It is found that the Optimum Moisture Content (OMC) of treated Expansive Soil has been decreased by 5.10% on addition of 10% Saw Dust Ash and it has been further decreased by 14.59% on addition of 8% of lime as an optimum compared with the Untreated Expansive Soil.
- It is found that the Maximum Dry Density (MDD) of treated Expansive Soil has been increased by 11.03% on addition of 10% Saw Dust Ash and it has been further increased by 20.78% on addition of 8% of lime as an optimum compared with the Untreated Expansive Soil.
- It is noticed that the CBR value of treated Expansive Soil has been improved by 133.92% on addition of 10% Saw Dust Ash and it has been further improved by 403.57% on addition of 8% of Lime as an optimum compared with the Untreated Expansive Soil.
- It is observed from the laboratory test results, that the cohesion value of treated Expansive Soil has been decreased by 11.52% on addition of 10% Saw Dust
- Ash and it has been further decreased by 35.13% on addition of 8% of Lime as an optimum compared with the Untreated Expansive Soil.
- It is observed from the laboratory test results, that the angle of internal friction of treated Expansive Soil has been improved by 63.57% on addition of 10% Saw Dust Ash and it has been further improved by 171.78% on addition of 8% of Lime as an optimum compared with the Untreated Expansive Soil.
- It is observed from the laboratory test results, Static Plate Load test results of Expansive Soils treated with optimum of 10% Saw Dust Ash and 8% Lime foundation bed treated with gravel cushion which has exhibited the ultimate Static Plate Load of 556.828 KN/m2 with the deformation of 1.45 mm at OMC.

REFERENCES

[1] Wajid Ali Butt, Karan Gupta and K.N Jha (2016). “Strength behaviour of clayey soil stabilized with saw dust ash”, International Journal of Geo-Engineering. DOI 10.1186/s40703-016-0032-9.

[2] Agarwala, V.S and Khanna, J.S (1969), Construction techniques for foundations of buildings on black cottonsoils

[3] Improvement of Mechanical Properties by Waste Sawdust Ash Addition into Soil by Shaheer Khan volume 20 2015 EJGE and Haziq khan

[4] Al-khafaji, WadiAmir and Orlando B. Andersland—Geotechnical Engineering and Soil Testing‖

[5] Amu et al. (2005)—Cement and flyashmixture forstabilization of expansivesoil.

[6] Arrora, K. R. (2001), Soil Mechanics and Foundation Engineering. R. D. Holtz and W.D. Kovacs, an Introduction to Geotechnical Engineering. New York: Prentice Hall,1981.

[7] Pallavi, Pradeep Tiwari, Dr P D Poorey (2016), “Stabilization of Black Cotton Soil using Fly Ash and Nylon Fibre”, “International Research Journal of Engineering and Technology (IRJET)”, e-ISSN: 2395 - 0056 Volume: 03 Issue: 11 | Nov -2016 p-ISSN: 2395-0072.