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Stabilization of Black Cotton Soil with Sea Sand, Lime, Plastic Waste

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Abstract: Black cotton soil are not suitable for sub grade material for high way development. The mechanical behavior of such nature of soil has to be improved by employing stabilization and reinforcement techniques to make it reliable for construction activities. Black cotton soils are very weak soils and shows poor values in engineering and index properties. Black cotton soils are one of the waste soils in civil engineering point of view which we have to stabilized (or) replaced before going to take any project. The basic properties of soil were determined. Changes in various soil properties like free swell index, liquid limit, plastic limit, optimum moisture content and maximum dry density, California bearing ratio (CBR) of soil were analyzed. Laboratory tests were conducted on various proportions of stabilizers lime (2%,4%,6%) plastic waste(2%,4%,6%) and sea sand (5%,10%,15%,20%,25%,30%,35%,40%,45%,50%) of mixes with soil. So finally to we expecting get better results after stabilizing black cotton soil with Sea sand and lime, plastic waste then compare to normal black cotton soil
Keywords: Stabilizers, sea sand, lime, plastic waste, free swell index, liquid limit, plastic limit, OMC, MDD, CBR.

I. INTRODUCTION

Black Cotton soils are one of the most serious problems that the geotechnical engineers encounter. They are considered as a potential natural hazard, which can cause extensive damage to any land-based structures. For any land-based structure, the foundation is very important and has to be strong to support the entire structure.

In India, the modern era of soil stabilization began in early 1970's, with a general shortage of petroleum and aggregates, it became necessary for the civil engineers to look at the means to improve soil rather than replacing the entire poor soil at the building site. Soil stabilization was used but due to the use of obsolete methods and also due to the absence of proper technique, soil stabilization lost favor.

Traditional ways of soil reinforcement involve the use of continuous planar inclusions (e.g. metallic strips, geo-grids and geo-textiles) in soil structures. The advances of these materials have usually been considered by an increase in their applications. The randomly short discrete fibers are easily added and mixed randomly with soil part, the same way as cement, lime or other additives are added.

Here in this study, soil stabilization has been done with the help of groundnut shell ash and randomly distributed polypropylene fibers obtained from waste materials.The improvement of soil strength parameters has been stressed upon and comparative studies have been carried out using different methods.

II. LITERATURE REVIEW

Expansive soils exist all over the world and cause damages to foundations and associated structures (Kariuki, P. C., 2004). It has been ascertained that expansive clays cause billions of dollars damage every year in the USA, more than all other natural hazards combined (Jones and Holtz, 1973, Chen F. H., 1988 and Day, R. W., 1999). The problem is also extensive in someareas of Tanzania but no statistics are available. Geotechnical engineers did not recognize damages associated with buildings on expansive soils until the late 1930s. The U.S. Bureau of reclamation made the first recorded observation about soil heaving in 1938 (Chen, F. H., 1988). Since then a number of researchers have pioneered researches into expansive soils.

Apart from increased research in expansive soil, design of shallow foundations to support Lightweight structures on expansive soils are a potential problem than design of foundations for heavy loads (Meehan and Karp, 1994). The traditional design criteria of considering bearing capacity proves failure in expansive soils.

Soils with a high percentage of swelling clay have a very high affinity for water partly because of their small size and partly because of their positive ions (Day, R. W., 1999).Expansive soils usually swell and stick when wetted, and shrink when dry developing wide cracks or a puffy appearance (desiccated clay).The swelling behavior is usually attributed to the intake of water into the montmorillonite, an expanding lattice clay mineral in expansive soils. According to Chen, F. H. (1988), montmorillonite is made up of a central octahedral sheet, usually occupied by aluminum or magnesium, sandwiched between two sheets of tetrahedral silicon sites to give a 2 to 1 lattice structure.

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The three-layer clay mineral as shown in Figure 2.2 has a structural configuration and chemical makeup, which permits a large amount of water to be adsorbed in the interlayer and peripheral positions on the clay crystalline, resulting in the remarkable swelling of soil (Patrick,M. D. and Snethen, D. R., 1976). The presence of various minerals such as montmorillonite in the expansive soil is determined by the use of x-ray diffraction method, among other methods.

III. MATERIALS

A. Sea sand

Sea sand mainly contains much salinity as sodium chloride. If the salt is not treated and sea sand is directly utilized for civil engineering and construction concrete project, the durability of the structural may be affected and as the result the concrete might be swelling, precipitating, sulphating and other adverse consequences. Therefore, the salt content of the sea sand must be eliminated before it is utilized to avoid the potential hazards. The top most layers of sand dunes contain higher chloride content due to continuous exposure to sea breeze. However, when sea sand is actually utilized, the first problem encountered is the salt contained in the sea sand. A distinction must also be made between sea sand and sand deposits in dry coastal areas. The latter would tend to have very high chloride contents resulting from salt spray and evaporation over long periods of time.

B. Lime

Lime stabilization is done by adding lime to soil. It is useful for stabilization of clayey soils. When lime reacts with soil, of cations in there is exchange the adsorbed water layer and a decrease in plasticity of the soil occurs. The resulting material is more friable than the original clay, and is, therefore, more suitable as sub grade.

C. Plastic Waste

Plastic and materials made with plastic have become the integral part of our day to day life in various stages and also in various forms, but then, the disposal and dumping of the used and unwanted plastic has become a major threat for the civilized society, as the production and usage of new plastic and plastic associated materials are not in balance with its recycling recycled plastic products status. Plastic bottle and plastic pen recycling has not kept pace with the dramatic increase in virgin resin polyethylene Terephthalate (PET) sales and the aspect of reduce / reuse / recycle, has emerged as the one that needs to be given prominence. The general survey shows that 1500 bottles are dumped as garbage every second. PET is reported as one of the most abundant plastics in solid urban waste whose effective reuse/recycling is one of the critical issue which needs immediate attention.

IV. METHODOLOGY

A. Liquid Limit

The Liquid Limit is determined in the laboratory by Casagrande’s Apparatus. About 300 gms of an air dried sample passing through 425µ IS Sieve is taken in a dish & mixed with distilled water to form an uniform paste. A portion of this paste is placed in this cup of liquid limit device & surface is smoothened & leveled with a spatula to a maximum depth of 1em. A groove is cut through the sample along the symmetrical axis of the cup, The handle is turned at the rate of 2 revolutions / second until the two parts of soil sample come into the contact at the bottom of the groove along the distance of 12 mm. Number of blows is counted care is taken that Number of blows is fall in between 10 & 40. A plot is made between the water content as ordinate & the Number of blows on Log Scale as abscissa. The liquid limit is obtained from the plot corresponding to 25 blows and express as nearest whole number.

B. Plastic Limit

A bout 100 gms of air dried sample passing through 425µ IS Sieve is taken in evaporating dish, It is mixed thoroughly with distilled water till it becomes plastic &can be easily moulded with fingers About 10gms of Plastic soil mass is taken in One hand & a ball is formed. The ball is rolled with fingers on glass plate to form a soil thread of Uniform diameter the rate of rolling is kept about 80-90 strokes per minute. If the diameter of the thread becomes smaller than3mm without crack formation, it shows that the water content is more than plastic limit & the soil is kneaded further. This results in the reduction of water content as some water is evaporated due to the heat of the hand. The soil is re-rolled and the procedure repeated till the thread crumbles. The water content at which the soil can be rolled into thread approximately 3mm in diameter without crumbling is known as Plastic Limit.

C. Standard Proctor Test

The Standard Proctor Mould is cleaned, dried and greased lightly. The mass of the empty mould with the base plate, but without collar, is taken. The collar is then fitted to the mould. The mould is placed on a Solid Base & filled with fully matured soil to about 1/3 rd its height. The Soil is compacted by 25 blows of the rammer with a free fall of 310mm. The blows are evenly distributed over the surface. The soil surface is scratched with a spatula before the second layer is placed. The mould is filled to about 2/3 rd height with the soil and compacted again by 25 blows. Similarly, the third layer is placed & compacted. The third layer should project above the top of the mould into the collar by not more than 6mm.

The mass of the mould, base plate & the compacted soil is taken, and thus the mass of the compacted soil is determined. The Bulk Density of the soil is computed from the mass of compacted soil & the volume of the mould. Representative soil samples are taken from the bottom middle & top of the mould for determining the water content. The Dry Density is computed from the bulk density & water content.

A Compaction Curve is plotted between the water content as abscissa & corresponding dry density as ordinate. The water content corresponding maximum dry density is called as Optimum Moisture Content.

D. California Bearing Ratio Test

The test consists of causing the plunger to penetrate the specimen at the rate of 1.25 mm per minute. The loads required for penetration of 2.5mm & 5mm are recorded by the proving ring attached to the plunger. The Load is expressed as a percentage of Standard Load at the respective deformation level and is known as California Bearing Ratio (CBR) Value.

The CBR Value is determined corresponding to both 2.5mm & 5mm Penetration and the greater value is used for design purpose.

E. Free Swell Index

The free swell index is obtained by conducting Free Swell Index Test as per IS 2720 (Part XL)-1980 but using saline water.

TABLE I
Geotechnical properties of soil

S.NO.	property	value
1	free swell index. %	68
2	liquid limit. %	60
3	plastic limit. %	25
4	plasticity index. %	35
5	M.D.D. g/m^3	1.396
6	OMC. %	23.98
7	C.B.R value %	2.0

TABLE II
Free swell index values

S.NO.	Mixed proportions	FSI
1	95% soil + 5% Sea sand	50
2	90% Soil + 10% Sea Sand	42
3	85% Soil + 15% Sea Sand	36
4	80% Soil + 20% Sea Sand	32
5	75% Soil + 25% Sea Sand	30
6	70% Soil + 30% Sea Sand	27
7	65% Soil + 35% Sea Sand	25
8	60% Soil + 40% Sea Sand	20
9	55% Soil + 45% Sea Sand	18
10	50% Soil + 50% Sea Sand	22
11	Soil + 2% Lime	42
12	Soil + 4% Lime	20
13	Soil + 6% Lime	22

TABLE III
Liquid limit values

S.NO.	Mixed proportions	liquid limit
1	95% soil + 5% Sea sand	52.04
2	90% Soil + 10% Sea Sand	45.05
3	85% Soil + 15% Sea Sand	40.05
4	80% Soil + 20% Sea Sand	39
5	75% Soil + 25% Sea Sand	37.5
6	70% Soil + 30% Sea Sand	33
7	65% Soil + 35% Sea Sand	30
8	60% Soil + 40% Sea Sand	29
9	55% Soil + 45% Sea Sand	26
10	50% Soil + 50% Sea Sand	29
11	Soil + 2% Lime	45
12	Soil + 4% Lime	26
13	Soil + 6% Lime	29

TABLE VI
Plastic limit values

S.NO.	Mixed proportions	Plastic limit
1	95% soil + 5% Sea sand	24.08
2	90% Soil + 10% Sea Sand	22.88
3	85% Soil + 15% Sea Sand	22.60
4	80% Soil + 20% Sea Sand	22.47
5	75% Soil + 25% Sea Sand	21.91
6	70% Soil + 30% Sea Sand	21.40
7	65% Soil + 35% Sea Sand	20.96
8	60% Soil + 40% Sea Sand	20.56
9	55% Soil + 45% Sea Sand	20
10	50% Soil + 50% Sea Sand	20.5
11	Soil + 2% Lime	22
12	Soil + 4% Lime	12
13	Soil + 6% Lime	15

TABLE V
Standard proctor test values

S.NO.	Mixed proportions	MDD	OMC
1	95% soil + 5% Sea sand	1.526	23.96
2	90% Soil + 10% Sea Sand	1.614	22.06
3	85% Soil + 15% Sea Sand	1.680	21.66
4	80% Soil + 20% Sea Sand	1.702	18.26
5	75% Soil + 25% Sea Sand	1.848	17.80
6	70% Soil + 30% Sea Sand	1.889	16.70
7	65% Soil + 35% Sea Sand	1.910	14.20
8	60% Soil + 40% Sea Sand	1.925	12.90
9	55% Soil + 45% Sea Sand	2.150	11.2
10	50% Soil + 50% Sea Sand	2.000	11.05
11	Soil + 2% Lime	1.620	16
12	Soil + 4% Lime	1.930	12
13	Soil + 6% Lime	1.810	15
14	Soil + 2% plastic waste	1.490	14.68
15	Soil + 4% plastic waste	1.656	14.52
16	Soil + 6% plastic waste	1.410	14.98

Table VI
CBR values

S.NO.	Mixed proportions	CBR
1	95% soil + 5% Sea sand	2.5
2	90% Soil + 10% Sea Sand	2.6
3	85% Soil + 15% Sea Sand	2.76
4	80% Soil + 20% Sea Sand	3.5
5	75% Soil + 25% Sea Sand	3.9
6	70% Soil + 30% Sea Sand	4.0
7	65% Soil + 35% Sea Sand	4.42
8	60% Soil + 40% Sea Sand	4.92
9	55% Soil + 45% Sea Sand	5.1
10	50% Soil + 50% Sea Sand	5.0
11	Soil + 2% Lime	3.9
12	Soil + 4% Lime	5.0
13	Soil + 6% Lime	4.8
14	Soil + 2% plastic waste	4.75
15	Soil + 4% plastic waste	5.8
16	Soil + 6% plastic waste	4.8

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V. RESULTS

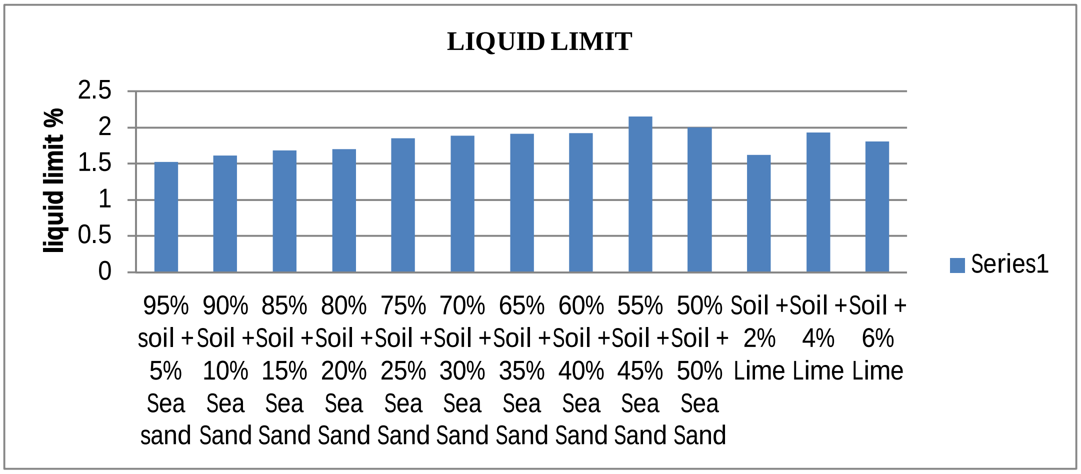

Figure 1 : liquid limits of stabilising soil

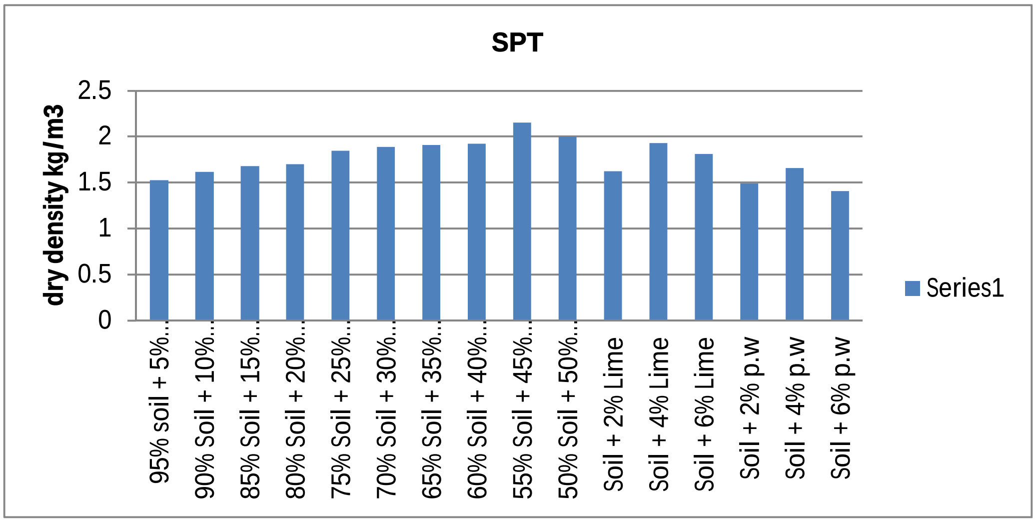

Figure 2 : dry densities of stabilising soil

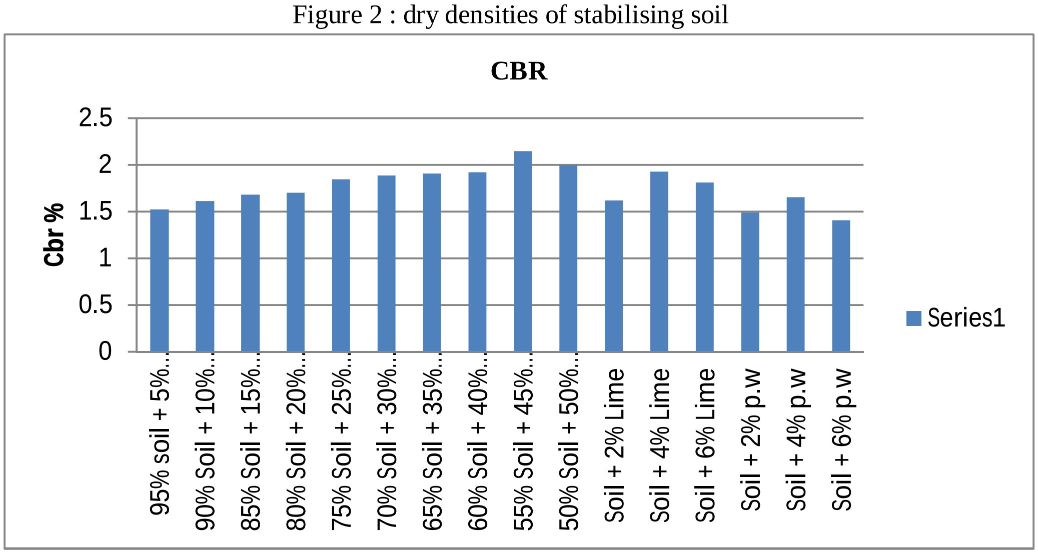

Figure 3 : cbr values of stabilising soil

VI CONCLUSION

In this present project, based on the laboratory investigation conducted on the soil ,it is not a suitable for pavement subgrade due to its poor engineering properties. So the admixtures (sea sand, plastic waste and lime) were added to the soil. From the above data and observations, the following conclusions were made.

A. Addition of admixtures into the black cotton soil has changed the free swell index parameters.
B. Addition of Sea Sand into the black cotton soil The FSI of the Black Cotton Soil has decreased from 60% to 26%.
C. Addition of Lime into the black cotton soil The FSI of the Black Cotton Soil has decreased from 60% to 22%.
D. Addition of Sea Sand into the black cotton soil The Liquid Limit of the Black Cotton Soil has decreased from 60% to 26%.
E. Addition of Lime into the black cotton soil The Liquid Limit of the Black Cotton Soil has decreased from 60% to 45%.
F. Addition of Sea Sand into the black cotton soil The Plastic Limit of the Black Cotton Soil has decreased from 25% to 20.5%.
G. Addition of Lime into the black cotton soil The Plastic Limit of the Black Cotton Soil has decreased from 25% to 12%.
H. Addition of Sea Sand into the black cotton soil The OMC of the Black Cotton Soil has decreased from 23.98% to 11.20% and Maximum Dry Density (MDD) increased from 1.396g/cm^3 to 2.2g/cm^3.
I. Addition of Lime into the black cotton soil The OMC of the Black Cotton Soil has decreased from 23.98% to 12% and Maximum dry density (MDD) increased from 1.396g/cm^3 to 1.930g/cm^3.
J. Addition of Plastic Waste into the black cotton soil The OMC of the Black Cotton Soil has decreased from 23.98% to 14.52% and Maximum dry density (MDD) increased from 1.396g/cm^3 to 1.656g/cm^3.
K. Unsoaked CBR values have also increased with the replacement of admixtures in soil.
L. The replacement of Sea Sand into the black cotton soil, increases the CBR value from 2.0% to 5.1%, which can be used for construction of sub grade in pavements.
M. The replacement of lime into the black cotton soil, increases the CBR value from 2.0 % to 5.0% ,which can be used for construction of sub grade in pavements.
N. The replacement of Plastic Waste into the black cotton soil, increases the CBR value from 2.0 % to 5.8%, which can be used for construction of sub grade in pavements.

Hence, finally i would conclude that plastic waste, sea sand and lime can be used as stabilizing agents for improving the performance of black cotton soil of athukuru region, But where the proportion of soil 45% Soil + 45% Sea Sand Gives Better Results Compared to Lime And Plastic Waste soil samples, so that the soil(45% Soil + 45% Sea Sand) can be used as sub grade material for pavement construction which is cheap & economical compared with remaining processes.

REFERENCES

[1] S.W. Thakare and S. K. Sonule, (2013) carried out various laboratory tests to investigate the effect of reinforcement of sandy soil with model plastic water bottle through model plate load tests. The study showed that the ultimate bearing capacity of footing increases with increasing the layer of plastic bottles as reinforcement. The increase in bearing capacity may be due to the additional confinement to the soil in the vicinity of footing similar to that in case of Geo cell. The bearing capacity increases with the increase in width of reinforcement and number of layers.
[2] Dr. P. D. Arumairaj and A. Sivajothi, EJGE Vol. 15 [2011], Bund.J, had investigated “Effect of Saline water on Expansive Soils’’.
[3] G. R. Otoko, European International Journal of Science and Technology Vol. 3 No. 2 March, 2014 had investigated “The Effect of Salt water on the Physical Properties, Compaction Characteristics and Unconfined Compressive Strength of a Clay, Clayey Sand and Base Course”.
[4] AyininuolaGbenga Matthew and AgbedeOluwoleAkinyele, Journal of Earth Sciences and Geotechnical Engineering, vol. 4, no. 3, 2014, 37-45 ISSN: 1792-9040 (print), 1792-9660 (online) Scienpress Ltd, 2014 has investigated “Sodium and Calcium Salts Impact on Soil Permeability”.
[5] George Rowland Otoko and Jonathan Godlook Manasseh, GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES, Otoko, 1(6): Aug, 2014, had investigated “USE OF SALT COMPOUNDS FOR THE STABILIZATION OF NIGERIAN LATERITES”.
[6] Frydman, I. R. and Ehrenreich, T. (1977). Stabilizationof heavy clay with potassium chloride. Journal of Geotechnical Engineering, 8, 95-107.
[7] Venkatabor Rad, G. (1977). Physico-chemical mechanism governing the plasticity behaviors of soils.Journal of Indian Geotechnical. 7, 261-282.
[8] S .A. Naeini and M. A. Jahanfar, “Effect of Salt Solution and Plasticity Index on undrained Shear Strength of Clays”, World Academy of Science, Engineering and Technology. Vol 49, 2011, ppr1 M. Chittaranjan, T.
[9] Srikanth, B. Yamini Lakshmi & D. Pavani,“Effect of saline water on some geo technical properties of clayey soil”, International Journal of Earth Sciences and Engineering, Vol 04, 2011.
[10] Soil Mechanics and Foundation Engineering by Arora.
[11] Eldon J. Yoder (1957), “principles of soil stabilization”, JHRD publications
[12] Air F Haji, A Adnan and Chew K C (1992),Geotechnical properties of a chemically stabilized soil from Malaysia with rice husk ash as an additive, Journal of Geotechnical and Geological Engineering, 10,No.2,pp. 117-134.
[13] Agarwal, B. M. (1989). “Utilization of rice husk ash.” Assumption University journal of Thailand, 12(2): 115-120