A Systematic Study To Strengthen The Sub Grade of The Pavement By Stabilization of Expansive Soil With Molasses And Jute Fibre

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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 stabilise the strength of expansive soil like Jute, gypsum, fly ash, rise-husk ash, cement, lime, used rubber tyres etc. In this thesis the Jute Fibre inserted as a stabilizer and Molasses 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 Jute Fibre and Molasses mixture. Addition stabiliser of Jute Fibre different lengths are using i.e. 1cm, 2cm, 3cm, 4cm and different percentages of 0.5%, 1%, 1.5% and 2%. Another stabiliser is Molasses of varying percentage of 5%, 8%, 12%, 15%. 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 12% Molasses and 1.5% Jute Fibre as an optimum when compared with untreated Expansive Soil. It was observed from laboratory cyclic load test results that the load carrying capacity of the treated Expansive soil sub grade flexible pavement has been Improved 62% when compared with untreated Expansive soil flexible pavement.The utilization of Construction wastes like Molasses is an alternative to reduce the construction cost of roads particularly in the rural areas of developing countries and also Jute Fibre will give good Reinforcement to Expansive soils.*

Keywords- Expansive soil, Molasses, Jute Fiber, CBR.

I. INTRODUCTION

A land based structure of any type is only as strong as its foundation. For that reason, soil is a critical element influencing 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 critical to obtain strength and economic performance. Soil stabilization is the process of maximizing the suitability of soil for a given construction purpose.

II. LITERATURE REVIEW

Ramya (2017), have described application of support vector machines based on bound theorems. The application of SVMs in stability analysis is studied and presented in this paper. The use of SVMs is very advantageous for the prediction of FoS because it can perform nonlinear regression efficiently for high dimensional data sets. As the SVM is mainly branded by the type of its kernel function, it is indispensable to elect the proper kernel for each precise application problem in order to promise acceptable results. The outcome of sigmoid function shows that SVMs have the capability to calculate the FoS with an adequate degree ofexactness

DebanganaSharmah (2016), have suggested that the expansive soils are very hard when dry, but loses its strength completely in wet condition. These expansive soils pose several problems for the civil engineers. Various methods are adopted to improve the engineering characteristics of expansive soils. Soil stabilization is one of the important features for construction because it improves the engineering properties of soil such as strength, durability and volume stability. In this paper, sugarcane straw ash is used at varying percentage and at varying curing periods to stabilize the soil. Various geotechnical laboratory tests like Unconfined Compression Test (UCS), California Bearing Test (CBR) and Free Swelling Index Test (FSI) were carried by varying the percentage of sugar canestra wash (5%, 10% and 15%) at varying curing periods (3, 5 and 7 days).

Kottuppillil*et al* (2016) have explained about the civil engineering structure resting on expansive soils needs more attention since it causes undesirable engineering behavior when the soil comes in contact with water. The areas consisting of expansive soil need a proper stabilization method to solve the site problems faced by the civil engineers. Pavements constructed on such soil shows signs of damage continuously during the service life of the pavement eventually increase the maintenance costs. Stabilization of these soils is a usual practice for improving the strength. In this work an attempt was made on the utilization of Phospho Gypsum (PG) with soil by adding various percentages of 2, 4, and 6% in soils and accessed their geotechnical behavior for different curing periods. The effects of PG treatment on the microstructure and strength improvement of compacted expansive clays are studied based on Microstuctural analysis and Unconfined Compression tests for different curing periods of 0, 14 and28 days. UCS performed on these mixes and identified that addition of phosphogypsum attained high strength with the increasing percent of phosphogypsum in soils.

III. METHODOLOGY, EXPERIMENTAL STUDY AND RESULT:

The study is carried out on Expansive soil, Expansive soil blended with Molasses and Expansive Soil with optimum percentage of Molasses Reinforced with Jute fiber in the following percentages. Molasses was varied in percentages of <u>5%, 8%, 12% and 15%</u> by weight of Expansive soil throughout the experiments.To increase the CBR of Molasses treated Expansive soil, Jute Fiber was added in percentages of <u>0.5%, 1%, 1.5% and 2%.</u>

3.1 Soilproperties: The soil used for current study has been taken from MUMMIDIVARAM near Amalapuram area of East Godavari district, AP, India. It is collected from a depth of 2 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:

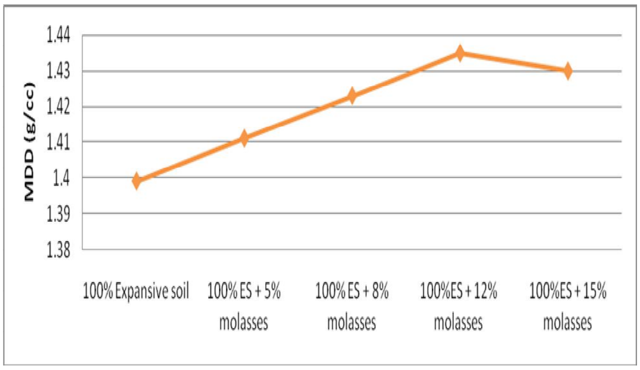
S.No	Property	Symbol	Untreated Expansive soil
1	Liquid Limit (%)	W_L	80
2	Plastic Limit (%)	W_P	35
3	Plasticity Index (%)	I_P	45
4	Soil Classification	--	CH
5	Specific Gravity	G	2.60
6	Free Swell (%)	FS	126
7	Optimum Moisture Content(%)	OMC	26.66
8	Maximum Dry Density (g/cc)	MDD	1.399
9	CBR (%)	--	1.98

3.2 Molasses: Molasses collected from the sugar industry. Molasses is a very thick, dark brown, syrupy liquid obtained as a by-product in processing cane sugar. It is also called treacle. It contains resinous and some inorganic constituents that render it unfit for human consumption. The molasses are collected from the sugar industry near erode.

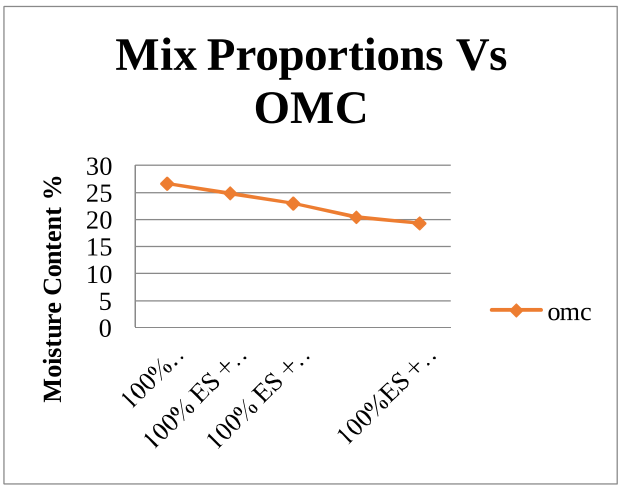
3.3 Jute Fibre: Jute Fibres possess good pliancy and render a high degree of flexibility and fineness to fabric construction. High initial modulus, consistency in tenacity (depends on thickness of the filament), high torsional rigidity and low percentage of elongation-at-break make Jute a suitable fibre for geosynthetics. Jute Fibreshas been taken from near Amalapuram area of East Godavari district, AP, India

Table: 2 Compaction Characteristics of Expansive soil treated with percentage of Molasses

Mix Proportion	Water Content (%)	Dry Density(g/cc)
100% Expansive soil	26.66	1.399
100% ES + 5% Molasses	24.86	1.411
100% ES + 8% Molasses	22.96	1.423
100%ES + 12% Molasses	**20.42**	**1.435**
100%ES + 15% Molasses	19.29	1.430



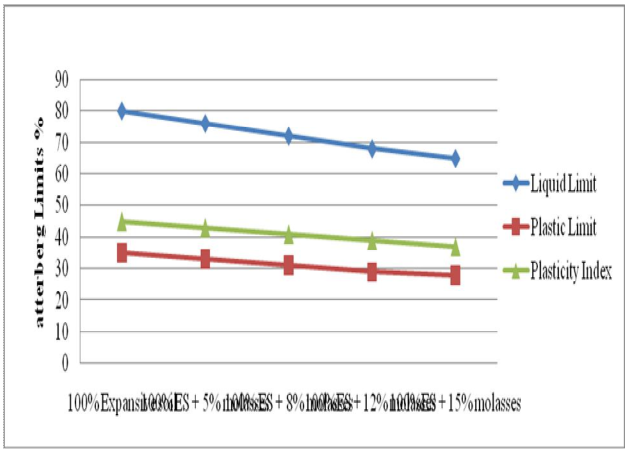
Graph 1: Shows the Variation of MDD (g/cc) w.r.t percentage of Molasses



Graph 2: Shows the Variation of moisture content w.r.t different percentage of molasses.

Table 3: Variation of LL, PL, PI for Expansive soil treated with percentage of Molasses

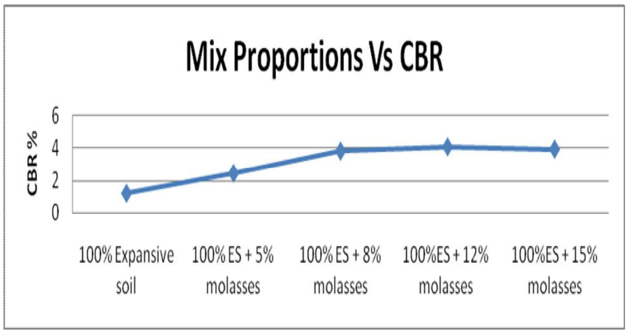
Particular	Liquid Limit (%)	PlasticLimit (%)	Plasticity Index(PI)
100% Expansive soil	80	35	45
100% ES + 5% Molasses	76	33	43
100% ES + 8% Molasses	72	31	41
100%ES + 12% Molasses	**68**	**29**	**39**
100%ES + 15% Molasses	65	28	37



Graph 3: Shows the variation of Atterberg Limits for expansive soil treated with % of Molasses.

Table 4 CBR Values of Expansive soil treated with Percentage Variations ofMolasses

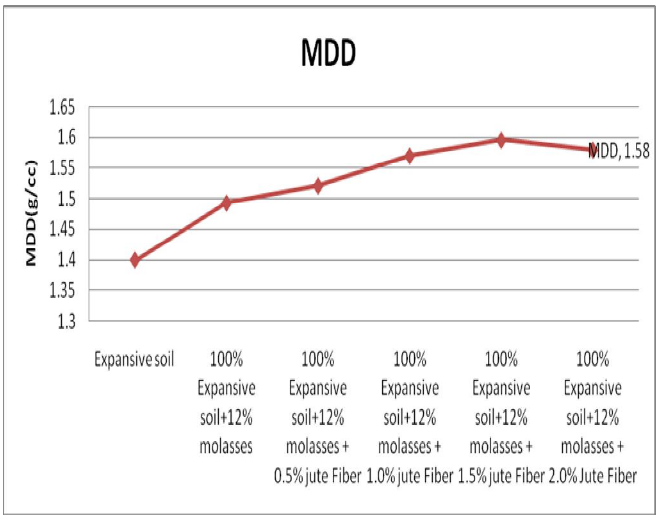
Mix Proportions	CBR (%)
100% Expansive soil	1.98
100% ES + 5% Molasses	2.465
100% ES + 8% Molasses	**3.826**
100%ES + 12% Molasses	4.09
100%ES + 15% Molasses	3.95



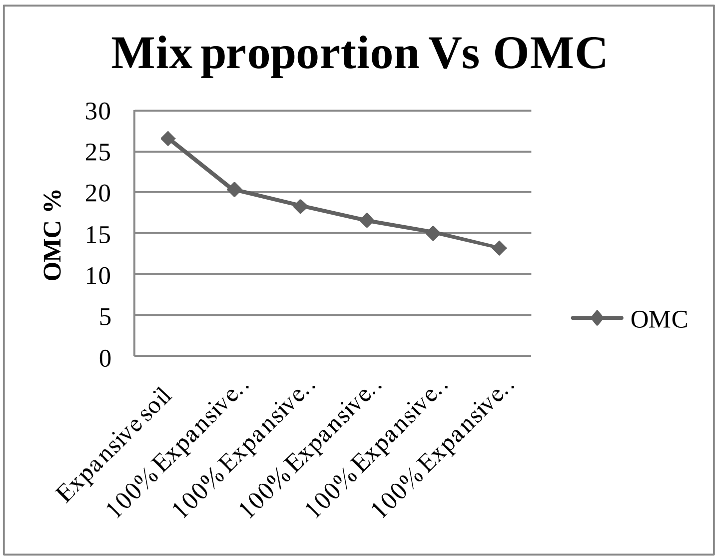
Graph.4: Shows the variation of CBR w.r.t different percentages of Molasses.

Table 5 OMC and MDD Values of the Expansive soil with 12% of Molasses and reinforced with different percentages of Jute Fibre.

S.No	Mix proportion	Optimum Moisture Content (%)	Maximum Dry Density(g/cc)
1	Expansive soil	26.66	1.399
2	100% Expansive soil+12% Molasses	20.42	1.435
3	100% Expansive soil+12% Molasses + 0.5% JuteFiber	18.32	1.521
4	100% Expansive soil+12% Molasses + 1.0% JuteFiber	16.65	1.57
5	100% Expansive soil+12% Molasses + 1.5% JuteFiber	**15.05**	**1.596**
6	100% Expansive soil+12% Molasses + 2.0% JuteFiber	13.25	1.580



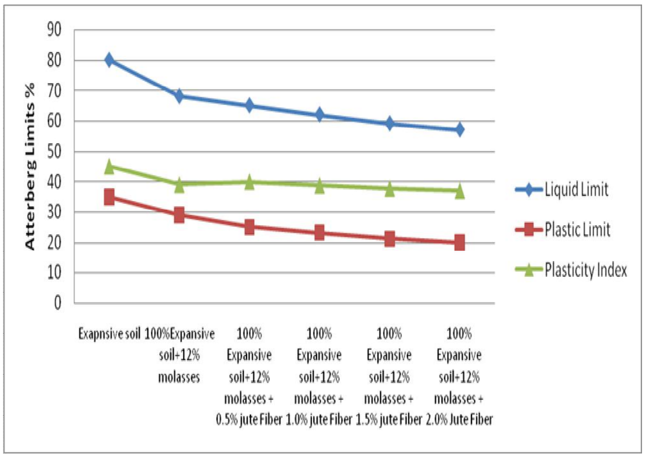
Graph 5: MDD Values of the Expansive soil with 12% of Molasses and reinforced with different percentages of Jute Fibre.



Graph 6: OMC values of Expansive soil with 12% of molasses with various percentages of Jute fibre

Table 6: Variation of LL, PL, PI for Combination of Expansive soil with 12% Molasses and reinforced with different percentages of Jute Fibre

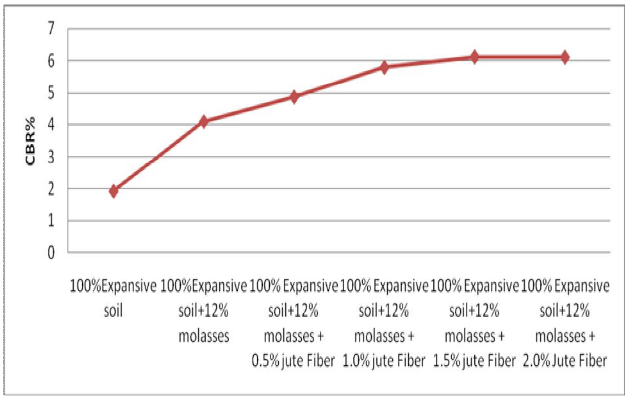
Mix Proportions	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
Expansive soil	80	35	45
100%Expansive soil+12%Molasses	68	29	39
100% Expansive soil+12%Molasses +0.5% Jute Fiber	65	25.03	39.97
100% Expansive soil+12%Molasses +1.0% Jute Fiber	62	23.25	38.75
100% Expansive soil+12% Molasses + 1.5% Jute Fiber	**59**	**21.22**	**37.89**
100% Expansive soil+12%Molasses +2.0% Jute Fiber	57	19.95	37.05



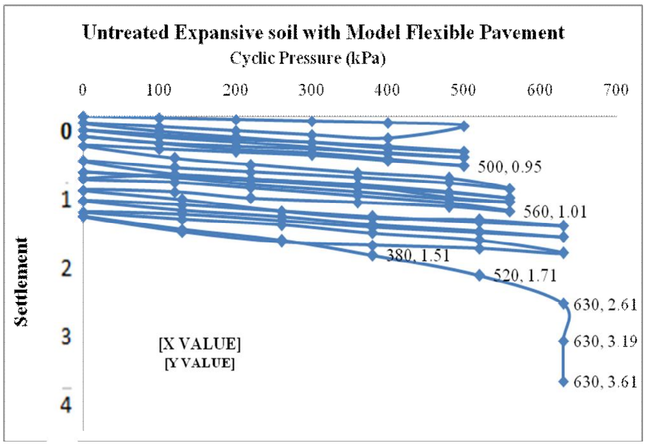
Graph 7:Represents variation Atterberg limits for the Expansive soil with 12 % Molasses is reinforced with various percentages of Jute Fibre

Table 7 CBR Values of 12% Molasses Treated Expansive soil with Various Percentages of Jute Fibre

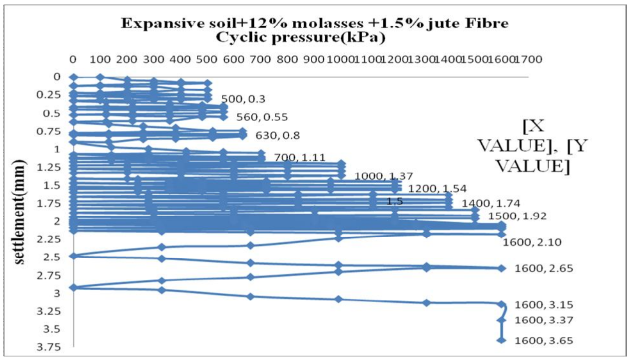
S.No	Mix Proportions	CBR (%)
1	100%Expansive soil	1.98
2	100%Expansive soil+12% Molasses	4.09
3	100% Expansive soil+12% Molasses + 0.5% Jute Fiber	4.86
4	100% Expansive soil+12% Molasses + 1.0% Jute Fiber	5.788
5	**100% Expansive soil+12% Molasses + 1.5% Jute Fiber**	**6.11**
6	100% Expansive soil+12% Molasses + 2.0% Jute Fiber	6.10



Graph 8:Variation of Soaked CBR values with Expansive soil+12%Molasses + different %Jute Fibre



Graph 9: Laboratory Cyclic Plate Load Test Results of Untreated Expansive soil with model Flexible pavement at OMC



Graph 10: Laboratory Cyclic Plate Load Test results of Expansive soil treated with 12% Molasses + 1.5% Jute Fibre

IV. CONCLUSIONS

- It is noticed from the laboratory investigations that the liquid limit of the Expansive soil has been decreased by 17.64% on addition of 12% Molasses and further the liquid limit of Molasses treated Expansive soil has been decreased by 35.59% with the addition of 1.5% Jute Fibre as an optimum when compared with untreated Expansive Soil.

- It is observed from the laboratory investigations that the plastic limit of the Expansive soil has been decreased by 20.68% on addition of 12% Molasses and further the plastic limit of Molasses treated Expansive soil has been decreased by 64.93% with the addition of 1.5% Jute Fibre as an optimum when compared with untreated Expansive Soil.
- It is observed from the laboratory investigations that the plasticity index of the Expansive soil has been decreased by 15.38% on addition of 12% Molasses and further the plasticity index of Molasses treated Expansive soil has been decreased by 18.76% with the addition of 1.5% Jute Fibre as an optimum when compared with untreated Expansive soil.
- It is found from the laboratory investigations that the optimum moisture content of the Expansive soil has been decreased by 30.55% on addition of 12% Molasses and further the optimum moisture content of Molasses treated Expansive soil has been decreased by 77.14% with the addition of 1.5% Jute Fibre as an optimum when compared with untreated Expansive soil.
- It is found from the laboratory investigations that the maximum dry density of the Expansive soil has been increased by 2.57% on addition of 12% Molasses and further the maximum dry density of Molasses treated Expansive soil has been increased by 14.08% with the addition of 1.5% Jute Fibre as an optimum when compared with untreated Expansive soil.
- It is observed from the laboratory investigations that the Soaked C.B.R. value of the Expansive soil has been increased by 106% on addition of 12% Molasses and further the Soaked C.B.R of Molasses treated Expansive soil has been increased by 208% with the addition of 1.5% Jute Fibre as an optimum when compared with untreated Expansive soil.
- It is noticed from the laboratory investigations of the cyclic plate load test results that, the ultimate cyclic pressure of treated Expansive soil subgrade flexible pavement has been improved by 630kPa to 1600Pa when compared with untreated Expansive soil.
- It is noticed from the laboratory investigations of the cyclic plate load test results that, the total deformations of treated expansive clay subgrade flexible pavement with has been improved by 24.30% when compared with Expansive soil.
- It was observed from laboratory cyclic load test results that the load carrying capacity of the treated Expansive soil sub grade flexible pavement has been Improved 154% when compared with untreated Expansive soil flexible pavement.
- The soaked CBR values of Expansive soil on stabilizing treated with Molasses and Jute Fibre was found to be 208% and it is satisfying standard specifications. So finally it is concluded from the above results that Molasses and Jute Fibre can potentially stabilize the Expansive soil.
- The utilization of Construction wastes like Molasses is an alternative to reduce the construction cost of roads particularly in the rural areas of developing countries and also Jute Fibre will give good Reinforcement to Expansive soils.

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