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Soil Stabilization using Used Tea Leaves with Lime

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Abstract: ***Soil stabilization is a method with many techniques of improving the physical properties of soil, with help of mixing the admixtures. The bearing capacity of black cotton soil have been an unhelpful task for the geotechnical engineer as the resting structure get cracked without any intimation. Black Cotton Soil is mostly found in Malwa region of M.P., Vidharba region of Maharashtra Karnataka, Andhra Pradesh and some part of Gujrat in our country. The main objective of this research is to the use the waste of tea leaves for the stabilization of black cotton soil. The soil is stabilized using different percentage of black cotton soil. The research is done with the help of doing experiments like Proctor Test, Liquid Limit, Plastic Limit, and California Bearing Ratio (CBR). Then the results are compared to see the effect in the soil stabilization. It is one of the eco-friendly way to deal with one of the house hold waste material.***

Keywords: Black Cotton Soil,Soil Stabilization, California Bearing Ratio (CBR), Proctor Test, Used Tea Leaves

I. INTRODUCTION

For any structure, the sub base is critical and must be more noteworthy quality to bolster the whole structure. On the off chance that we need to work with soils, we ought to have appropriate information about their physical properties and components, which tells about their conduct. The procedure of soil adjustment is utilized to give the required properties in a dirt required for conveying the heap on the structure. It is critical for the development designers to contemplate the dirt and to enhance soil other than supplanting the poor soil.

Territories situated with powerless soils have been customarily enhanced by changing soil properties by utilizing different techniques. Soil Stabilization has accomplished for a few development work, the most widely recognized utilize is in the development of street and asphalts, where the principle target is to expand the quality of soil and to balance out it furthermore to diminish the cost of development by making best utilize day by day family unit misuse of utilized Tea powder. Long the traverse, bond and lime are the two principle materials utilized for adjustment of soils. So the utilization of family unit waste, (for example, Used Tea powder) will significantly decrease the cost of development. Utilized Tea Powder are house hold squander acquired from numerous houses and additionally the significant coffee bars in the city. Around 10 kg of utilized tea powder is produced day by day frame significant tea slows down. Subsequently, utilization of utilized tea powder for updating of soil ought to be finished.

In the present study, a little measure of Lime was blended with Tea Leaves and the impact of soil adjustment on soil properties like, most extreme dry thickness (MDD), ideal Moisture content (OMC), California bearing Ratio (CBR) and unconfined compressive push (UCS) is watched and the ideal substance is discovered with the change. By paying less cost for lime, an enormous change of CBR-estimation of soil is watched which demonstrates the cost-adequacy of development of asphalt.

Soil–sand-lime-tea leaves is a very much blended of soil when water is added to the blend and compaction is done, the little extent of lime is not ready to tie every one of the particles but rather it collaborates with the residue and earth divisions and diminishes their partiality to water and lessens the swelling conduct of blend adjusts the properties of soil and increment the quality of soil.

In India Black Cotton soil otherwise called "Kali Mitti" are discovered generally in Malwa Region. As indicated by Geotechnical Engineering, Black Cotton soil is one which when connected with as designing structure and in nearness of water will demonstrate an inclination to swell or therapist bringing on the structure to experience minutes which are to a great extent inconsequential to the immediate impact of stacking by the structure. Dark cotton soil is unacceptable for the development function as it changes its volume. It swells and psychologists unnecessarily with change of water substance. Such propensity of soil is because of the nearness of fine dirt particles which swell, when they interact with water, bringing about interchange swelling and contracting of soil because of which differential settlement of structure happens, so the adjustment is being accomplished for the Stabilization of dark cotton soil has been done in this venture work by utilizing lime as an admixture. Dark cotton soil is comprised of volcanic rocks and magma. Dark soil is otherwise called "regur" which is gotten from a Telugu word 'reguda'. Dark soil is otherwise called Black Cotton Soil as cotton is an imperative harvest which is developed in this sort of soil. The dirt substance is rich in calcium carbonate, potash, lime and magnesium carbonate however has poor phosphorus content. It is generally found in territories, for example, Gujarat, Madhya Pradesh and Maharashtra. It is likewise found in states like Tamil Nadu, Andhra Pradesh and Karnataka.

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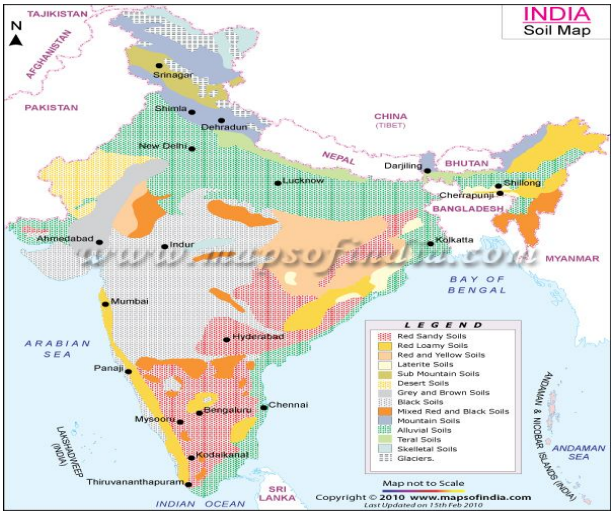
II. AREA OF STUDY

Malwa Plateau is situated in the western piece of Madhya Pradesh. This level lies between 20°17' N to 25°8' N scope and 74°20' E to 79°20' E longitude.

Malwa Plateau lies 300 to 600 meter high over the ocean level. Dark cotton soil is found on this level. The purpose for the nearness of Black soil on this level is that this level is comprised of Basalt rocks of Deccan trap. Dark soil is the aftereffect of the disintegration of basalt rocks.

The atmosphere of this level is calm i.e. neither there is rich warmth amid summer nor there is excessive chilly amid winter.

Amid summer the normal temperature of this territory is 40°C – 42.5°C. Ganjbausada of Vidisha locale is the region of this level which achieves most astounding temperature amid summer. Amid winter the normal temperature of this territory is 10°C - 12°C.



III. MATERIALS

The dark cotton soil test utilized is gathered from Indore of Malwa Region in Madhya Pradesh, India at a profundity of 1m to 2m utilizing the technique for aggravated inspecting.

The Materials utilized as a part of this study are:-

1) *Black Cotton Soil:* Black cotton soil test were gathered from Indore District in Madhya Pradesh, India. The dirt taken was air dried and permitted to go through IS 425 microns sifter and after that broiler dried at 110°C preceding testing.
2) *Lime:* In this venture different rate of lime (i.e. 2%,) is utilized as admixture.
3) *Utilized Tea Leaves:* Caffeine constitutes around 3% of tea's dry weight, meaning between 30 mg and 90 mg for every 8-oz (250-ml) glass contingent upon sort, brand and preparing strategy. A study found that the caffeine substance of 1 g of dark tea extended from 22 to 28 mg, while the caffeine substance of 1g of green tea ran from 11 to 20 mg, mirroring a huge distinction.

As a result of advanced natural contamination, fluoride and aluminum likewise now and then happen in tea. Certain sorts of block tea produced using old leaves and stems have the most abnormal amounts.

IV. EXPERIMENTAL WORK

In this study it have led different lab test to discover the dirt adjustment utilizing the Utilized tea leaves waste and lime. The different sorts of test had been led to discover the dirt adjustment in light of the strategy are recorded underneath:-

1) *Liquid Limit:* Liquid point of confinement is characterized as the dampness content at which soil starts to carry on as a fluid material and starts to stream. The significance of as far as possible test is to characterize soils. Distinctive soils have changing fluid cutoff points. Likewise, once should utilize as far as possible to decide its plasticity limit.
2) *Plastic Limit:* Plastic Limit is characterized as the to the projected dampness content and communicated as a rate of the projected of the stove dried soil at which the dirt can be moved into the strings one-eighth crawl in a breadth without the dirt breaking into pieces. This is likewise the dampness substance of a strong at which a dirt changes from a plastic state to a semisolid state.
3) *Standard Proctor Compaction Test:* Compaction is the procedure of densification of soil mass by lessening air voids under element stacking. This test is directed to discover the ideal dampness substance and greatest dry thickness of the dirt.

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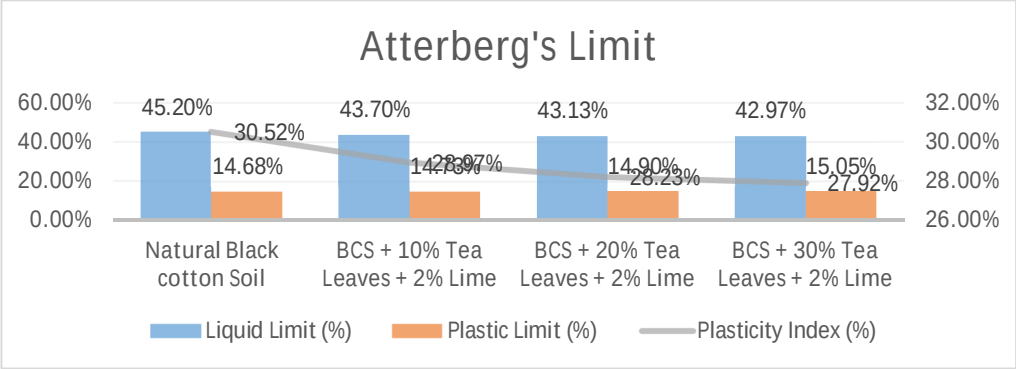
4) *California Bearing Ratio Test:* The California bearing proportion (CBR) is an infiltration test for assessment of the mechanical quality of street subgrades and base courses. The test is performed by measuring the weight required to infiltrate a dirt specimen with a plunger of standard region. The deliberate weight is then isolated by the weight required to accomplish an equivalent infiltration on a standard pulverized shake material. The CBR rating was produced for measuring the heap bearing limit of soils utilized for building streets.

V. RESULTS AND DISCUSSION

A. *Atterberg's limit test*

Consistency is a term which used to describe the degree of fineness of a soil is in a qualitative manner by using descriptions such as soft, medium, firm, stiff or hard. It indicates the relative is with which a soil can be deformed generally the properties of consistency associated only with fine grained soil especially clay. The engineering properties of clay are considerably influence by the amount of water present in them depending upon the water content the four stage and stages namely liquid stage, plastic stage, semi-solid stage and solid stage of the consistency are used to describe consistency of a clay soil. The boundary water content at which the soil undergoes a change from one state to another is called consistency or Atterberg"s limits. In 1911 a Swedish soil scientist Atterberg"s first demonstrate the significance of these limit on the basis of change of state there are mainly three consistency limit.

Atterberg's Limit



B. *Proctor Compaction Test*

The variations of MDD and OMC with used tea leaves contents mixed with black cotton soil and 2% lime are shown in Figure. The MDD is decreased while the OMC is increased with increase in the tea leaves content. The decrease in the MDD can be attributed to the replacement of soil and by the mixture The decrease in the MDD may also be explained by considering the tea leaves as filler (with lower specific gravity) in the soil voids. There is increase in OMC with increase in tea leaves contents. The increase is due to the addition of tea leaves, which decreases the quantity of free silt and clay fraction and coarser materials with larger surface areas are formed. These processes need water to take place. This implies also that more water is needed in order to compact the soil-mixtures.

Proctor Compaction Test

Soil Type	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
Natural Black Cotton Soil	45.2%	14.68%	30.52%
BCS + 10% Tea Leaves + 2% Lime	43.7%	14.73%	28.97%
BCS + 20% Tea Leaves + 2% Lime	43.134%	14.9%	28.234%
BCS + 30% Tea Leaves + 2% Lime	42.97%	15.05%	27.92%

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C. California Bearing Ratio (CBR) test.

The California bearing ratio (CBR) test was developed by the California Division of highway as a method of evaluating soil-subgrade and base course materials for flexible pavement. The CBR is a measure of resistance of a material to penetration of standard plunger under maximum density and optimum moisture conditions. The test consists of causing a cylindrical plunger of 50 mm diameter to penetrate a pavement component material at 1.25 mm/minute. The load, for 2.5 mm and 5 mm are recorded. The load is expressed as a percentage of standard load value at a respective deformation level to obtain CBR value. The soil samples for CBR test were prepared as per standard procedure. The CBR value is determined corresponding to both 2.5 mm and 5 mm penetration, and greater value is to be used for the design.

CBR = (Test load /Standard load) x 100

Comparison of CBR of different proportion of soil samples

Soil Type	Optimum Moisture Content (%)	Maximum Dry Density (KN/m3)
Natural Black Cotton Soil	27.6	1.21
BCS + 10% Tea Leaves + 2% Lime	23.9	1.52
BCS + 20% Tea Leaves + 2% Lime	22.54	1.59
BCS + 30% Tea Leaves + 2% Lime	20.2	1.64

Soil Type	C.B.R. Values
Natural Black Cotton Soil	2.1
BCS + 10% Tea Leaves + 2% Lime	3.0
BCS + 20% Tea Leaves + 2% Lime	3.2
BCS + 30% Tea Leaves + 2% Lime	3.6

VI. CONCLUSION

On the basis of study and experimentalinvestigations it was observed that the property of black cotton soil effectively improved by use of used tea leaveswith lime contents. In this research 2 percentage of lime was used to stabilize the black cotton soil. Points which were drawn from this study are listed below-

A. It was observed that on addition of 10%of used tea leaves with 2% of lime decreases the liquid limit by 1.55% while In 20% of used tea leaves with 2% of limedecreases the liquid limit by .74% In 30% of used tea leaves with 2% of limedecreases the liquid limit by .32%.

B. M.D.D. was increased slightly by 6.29% and 5.59% at 3% and 5% lime content respectively.

C. It was observed that there was a decrease in O.M.C. of 3.4% and 10.7% at 3% and at 5% lime content respectively.

D. The C.B.R. value of black cotton soil improve considerably to 3.25 times and 4.76 times with 3% and 5% lime respectively.

The Following Conclusions Can Be Drawn On The Basis Of Present Work

1) The Cost Economy: The Unit Cost Is Lowest With Jute Geotextile AndHighest With Sand Stabilization.

2) The CBR: The CBR Value Is Maximum With Sand Stabilization
(Approx. 10% On The Basis Of Test Conducted With 40%
Sand Mixing). However, the Road Is Designed With CBR
= 7% As the Enhancement of CBR Values Is Not
Uniform atthe Site.
In Case Of Jute Geotextile, the Value of CBR Was
Obtained Around 6% (As Per Values Given In Literature).

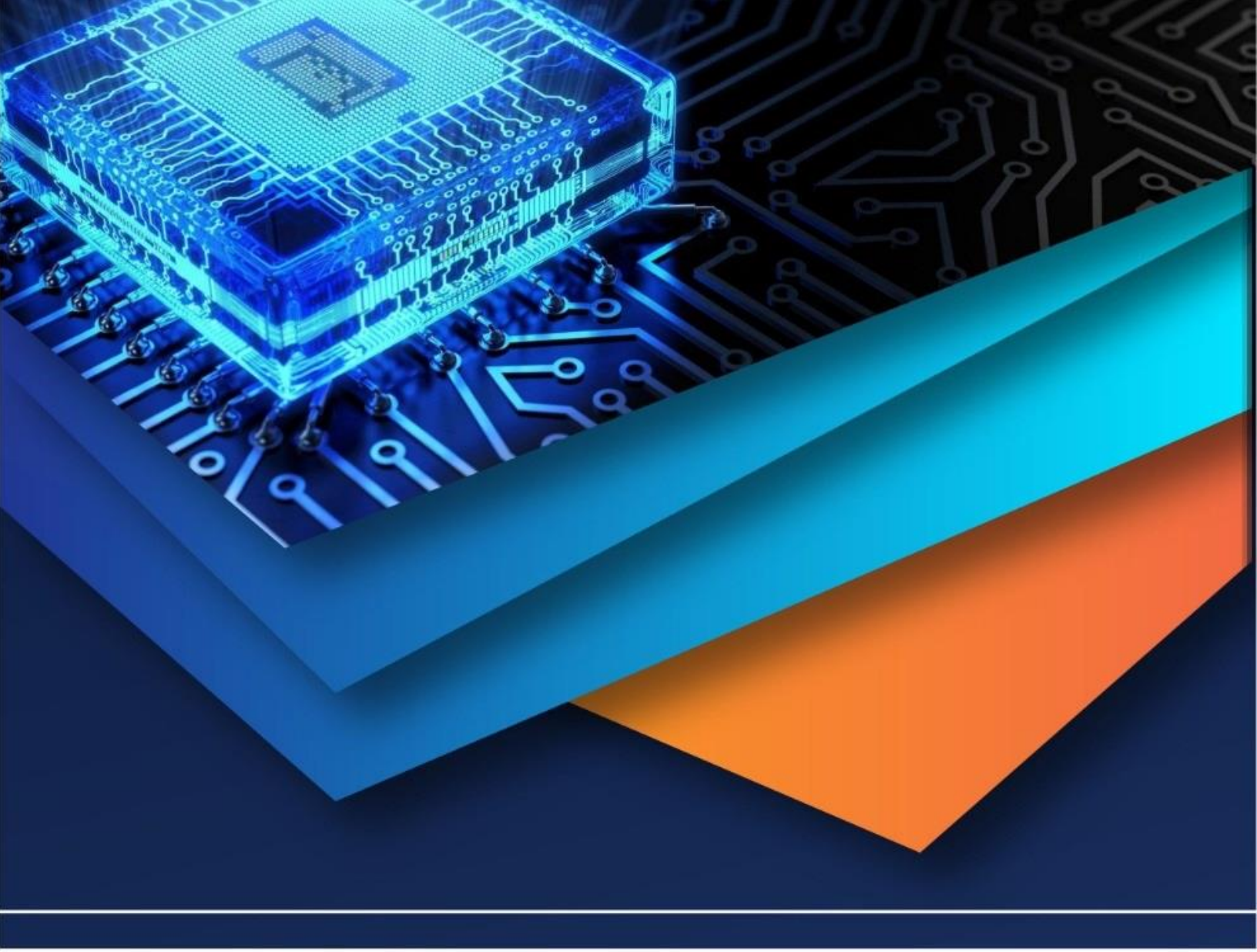
3) Time Economy: Time of Construction Is Less inthe Case with Jute Geotextile In Comparison To Sand Stabilization.

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