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Stabilazation of Black Cotton Soil by Using Brick Powder & Wheat Husk Ask

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Abstract **- In India about 51.8 million hectors of land area are covered with expansive soils black cotton soil . The black cotton soils are very hard when dry, but loses its strength completely in wet condition . Soil stabilization is one of the ground improvement method for treating weak soil .Which is unfit for engineering purposes & makes them into suitable for construction. Mixing properties of is mixing brick powder &wheat husk ash 5 %,10 %,15 % of dry weight of soil & make it suitable for construction.**

Key Words**: Black Cotton Soil, Brick Powder, Wheat Husk Ash.**

1. INTRODUCTION:

Foundation is a very important part of a structure. It transfers all the load to the bottom strata of the soil. Hence soil needs to be of sufficient bearing capacity. When the excavation is done for the foundation work, the soil on the sides is very unstable and hence it may collapse while construction, due to any type of vibration in the soil. So, in order to prevent the soil from collapsing the soil stabilization is done. Soil

Stabilization is a process of enhancing properties of soil with the addition of different type of material like wheat husk ash and Brick powder. In this research we have used Wheat Husk ash and Brick powder as additive for the stabilization of soil. We have tested soil with only wheat husk ash and with the combination of wheat husk ash and Brick powder.A large amount of earth material is essential for infrastructural works such as reservoirs, railway, highway and land reclamation etc. And the good bearing subsoil is an essential prerequisite for every construction process above soil strata. The strengthening and stabilization of soil are essential in case if the soil is weak and lacks the strength and engineering properties to withstand the loads coming over it. In the case of highly compressible soils with very low shear strength such as expansive soils such as black cotton soil has to be strengthened

When it comes to stabilizing black cotton soil, using brick powder and wheat husk ash can be really effective. The brick powder helps to strengthen the soil structure, while the wheat husk ash improves its drainage properties. By combining these two materials, you can enhance the stability and usability of soil.

2. LITERATURE REVIEW

Various researches of Stabilization of black cotton soil by using Brick powder and Wheat husk ash:

- Srikanth, et al., (2018) Hence the lime-stabilized black cotton soil is proportioned with brick powder to obtain optimum mixture that yields a better CBR value. The mixture of 20% brick powder and 80% lime-stabilized black cotton soil under study resulted in increase in the CBR value by about 135% in comparison with lime-stabilized black cotton soil. Thus it is promising to use the mixture of brick powder and lime-stabilized black cotton soil as subbase material in flexible pavements.
- Humberto (2007) quantified the research on finding out the bond between the crop residue and soil which shows alterations in soil organic carbon(SOC) concentration. Thus,addition of ash alters the properties of the soil by the process of mulching which shows that straw mulching with soil retains the soil organic carbon for longer times. This research focuses only on segregating soil organic carbon,increase the tensile strength and didnʒt increase the shear strength. This is because 2/3 of wheat straw ash doesnʒt converted into SOC.Thus, mulched soil shows higher amount of carbon in contrary to non-mulched one.
- Andrzej and Bledzk (2010) investigate the potential ofwheathusk for reinforcement in plastics by the scanning of electronusing microscope. The materials incorporated in thisresearch includes wheat husk and rye husk. The thermal,physical property was measured and analyzed by theinstruments and chemical contents contained in the mixturewere investigated by the electron microprobe analyzer. Theimprovement is due to the soft wood material in the particlesize distribution range 100-200 micrometer. The impactstrength and tensile strength was investigated whichconcludes that wheat husk contain more silicon surface thanother materials .
- Chittaranjan et al., (2011) studied theAgricultural wastes as soil stabilizersʒ. In this research, sugarcane bagasse ash, rice husk ash and groundnut shell collected from the industry are used to stabilize the weak sub gradesoil. The given soil is mingled with the given three wastesseparately at 0 %, 3 %, 6 %, 9 %,12 % and 15 % and CBR test iscarried

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out for each per cent. The results of these testsshowed revamp in CBR value with the inclined percentage ofwaste [8]

- Nazar Omer Hassan Salih (2012) researched on the fertility of the soil by using wheat residues over the all seasons of the crop yielding. The results of the study are marvelous which shows that crop fertility in the field of residual crop is more as compared to the no residue soil.
- Pinar Terzioglu (2012) uses thewheat husk ash to produce the magnesium salt using the Fourier transform series. This research is done to solve the waste problem and contribute enormously in the recovery of industries. Wheat husk is burned at an optimum temperature then it is chemically reacted with the sodium hydroxide with flame to extractthe silica. The obtained ash was composed of different elements and silicon dioxide has the highest percentage consists of 44%. Thus, obtained ash has completely amorphous structure. This element is suitable to synthesizetherequired outcomes. The research proves that study does not affected the chemical composition of the magnesium silicate.
- Ogunniyi (2013) noticed the positiveoutcomes of the incorporating the wheat straw ash in thecultivated fields. The soil was treated with different nitrogensources to investigate the quality of the soil. The incorporation of straw always has positive result but here the problem is the rate of decomposition gets slow. The mainreason behind this is the Carbon to nitrogen ratio. Thus,experiment conducted which consists of 17 pots with four imitations. Each pot containing 150 gm of soil and 1.125 gmof straw and the moisture content adjusted to 80 % of the field ability. The addition of wheat straw resulted in highermicrobial biomass accumulation in contrary to maize straw.
- Shamle (2014) extracted the silica from the differentindustrial ashes using the fluorescence spectroscopy. Theamorphous silica is taken from the acha husk, wheat huskand rice husk ash by the processof calcination. These are usedas raw material. Thus, obtained silica is conglomerate withthe sodium hydroxide and it is obtained by lowering the pH value. The isolated amorphous silica from these ashes arecompared to find the better one in this paper. Finally, it isconcluded that out of three ashes, acha husk ash is a suitable material with minimum impurities and gives the highest yielding [14].
- Manimaran (2015) presents the study on the usage ofbagasse ash to stabilize the black cotton soil. This is taken from the Tamil Nadu region where soil possesses weak properties which results into failure of foundations and pavements. The whole process is natural and thus fibrous material is obtained after experimentation. The optimum moisture content and maximum drying density was measured which is good for replacement 6% bagasse ash. The experimentis conducted using the different proportion of theash replaced with the soil. The replacements are 0 %,3 %,6 %,9 % and 12 % of ash. The strength tests arecarried out with each blend and results are concluded by IS2720. The results are based on MDD, OMC, CBR and compressive stress test which proves successful to stabilize the soil.
- Habiba (2017) Soil stabilization is the process of improving the shear strength parameters of soil and thus increasing the bearing capacity of soil. It is required when the soil available for construction is not suitable to carry structural load. Soils exhibit generally undesirable engineering properties. Soil Stabilization is the alteration of soils to enhance their physical properties. Stabilization can increase the shear strength of a soil and/or control the shrink-swell properties of a soil, thus improving the load bearing capacity of a sub-grade to support pavements and foundations. Soil stabilization is used to reduce permeability and compressibility of the soil mass in earth structures and to increase its shear strength. The main objective of this paper is to determine the physical and chemical properties of soil in different types of stabilization methods. Stabilization and its effect on soil indicate the reaction mechanism with additives, effect on its strength, improve and maintain soil moisture content and suggestion for construction systems. Soil stabilization can be accomplished by several methods.
- Mallikarjun, et.al., (2018) It is of great importance for engineers to study the effectiveness and usefulness of all stabilizers. The present work deals with the alteration of BC soil using Construction and Demolition (C & D) waste (concrete and plastering debris) which resulted in soil + 10 % C & D waste optimum mix obtained through standard proctor test. Further, the cohesion (c) and angle of internal friction (ϕ) were evaluated using Direct Shear test and the Safe Bearing Capacity (SBC) of soil was calculated using Tirzah's equation for BC soil alone, BC+10 % C & D, BC + 12 % C & D and BC + 14 % C & D waste respectively. In the experimental studies carried out it can be seen that optimum addition of C & D waste can efficiently contribute in decreasing the swelling characteristics of black cotton soil by transmitting high bearing capacity and strength and can be contemplated as a substitute stabilizer which enhances the use of waste product obtained from construction industry
- Makegaonkar, et.al., (2018) The construction and demolition waste are the waste mainly generated from the two activities i.e., from the construction activity and demolition activity.The waste which is produced during construction activities are called as construction waste and the waste produced during demolition activities are called as demolition waste. The Demolition B. waste is generated from the demolition of old structures like buildings, bridges, malls and roads. Construction industry in India generates about 20-32 million Tons of waste annually. So, this C&D waste should be managed properly. Most of the construction and demolition waste in India is getting disposed into the landfills. This may lead to the environmental pollution. The rules and regulations regarding to the land filling disposal are not implemented properly. So, this paper gives finding that to reduce the landfill disposal of the construction and demolition waste and to achieve the aim of reuse and recycle of that construction and demolition waste. The objective of this paper is to study the various strategies of the reusing and recycling of the C&D waste adopted by different countries.

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- Pareek (2018) The main objective of study is to investigate the use of waste marble dust in geotechnical applications and to evaluate the effect of marble dust on OMC & MDD and CBR values of unsaturated soil by carrying out standard Proctor test and CBR test on different soil sample. The result obtained are compaired for different percentage of marble dust and inferences are drawn for the bearing strength soil with different combination of marble dust. Soil stabilization can be explain as the increasing or maintaining the soil properties by physical and chemical alteration of soil to enhance their engineering properties.
- Kanniyappan, et.al., (2019) Stabilization of sub-base and base soil improves its properties and strength. Red soil is the third largest soil group in India and it possess lower strength compared to other soil due to its porous and fragile structure and it has a higher swelling capacity, thereby it requires stabilization. Red soil stabilization is usually done using lime, fly ash, granulated blast slag etc., of which construction & demolition waste is the major factor. This project gives an idea to study the engineering properties of red soil & to determine the pavement thickness. The debris added in varying percentage to the soil & the CBR value is calculated. The variation in CBR value may result in the reduction of pavement thickness.

3. EXPERIMENTAL STUDY

3.1 Black cotton soil: Black cotton (BC) Construction of foundation in black cotton soil is very risky due to its swelling and shrinkage property as well as its bearing capacity is also very less. Black cotton soil does not take a higher load. It is required soil stabilization for improving its property or well process for construction of the foundation.

3.2 Brick Powder : Brick powder is basically crushed bricks that have been ground into a fine powder. It's often used in construction and as a filler material. It can help improve the strength and durability of concrete or mortar when mixed in.

Brick Powder

3.3 Wheat Husk Ash : Wheat husk ash is the ash that remains after burning wheat husks. It's often used in agriculture as a source of nutrients for plants or as a soil amendment. It can help improve soil quality and provide essential minerals for plant growth.

Figure -3 Wheat husk ash

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3.4 METHODOLOGY

V_1 = Only Black Cotton Soil
V_2 = 5 % Brick Powder + 5 % Wheat Husk Ash + 90 % Black Cotton Soil
V_3 = 10 % Brick Powder + 10 % Wheat Husk Ash + 80 % Black Cotton Soil
V_4 = 15 % Brick Powder + 15 % Wheat Husk Ash + 70 % Black Cotton Soil

4. TEST RESULTS

4.1 SWELLING INDEX: is performed by pouring 10g of dry soil, passing through 425 micron sieve, into 100 cc graduated cylinder filled with water. The volume of swelled soils is read after 24 hours

Table-1 Tests Results of Swelling Index

Swelling for	Only BCS	5% of brick powder +5% of and wheat husk ash	10% of brick powder +10% of and wheat husk ash	15% of brick powder +15% of and wheat husk ash
% of swelling	**29.62**	**26.89**	**25.21**	**11**

4.2 SPECIFIC GRAVITY: The ratio of specific gravity of the solid to the specific gravity of water. It can be obtained by measuring the weight of the solid to the weight of water occupying equivalent volume of wate.

TABLE:2 Tests results of specific gravity

Combination	Only BCS	5% of brick powder +5% of and wheat husk ash	10% of brick powder +10% of and wheat husk ash	15% of brick powder +15% of and wheat husk ash
Result	2.4	2.56	2.60	2.67

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4.3 Liquid limit: As per IS 383-2016, Coarse aggregates can be defined as irregular broken stone or naturally-occurringrounded gravel used for making concrete. Coarse aggregatesare retained on the sieve of mesh size 4.75mm. It acts as volume increasing component and is responsible forstrength, hardness and durability of concrete.

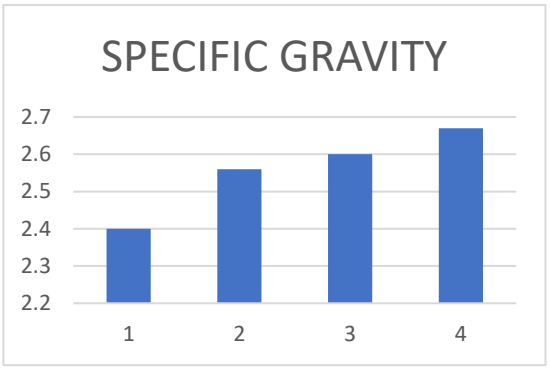

TABLE: 3 Tests Results Of Liquid Limit

SLNO	COMBINATION	Trail-1	Trail-2	Trail-3
1	Black Black Cotton	54.89	55.3	57.6
2	5% of brick powder +5% of and wheat husk ash	52.8	53	55.8
3	10% of brick powder +10% of and wheat husk ash	50.86	53.4	54.5
4	15% of brick powder +15% of and	51.2	52.5	53.8

4.5 Plastic Limit: Take 20g of soil passing 40 sieve into a dish. Add water and mix thoroughly. Prepare several ellipsoidal-shaped soil masses by quizzing the soil with your hand. Put the soil in rolling device, and roll the soil until the thread reaches 1/8 inch. Continue rolling until the thiladelling device several pieces. Determine the moisture content of about 6g of the crumbled soil

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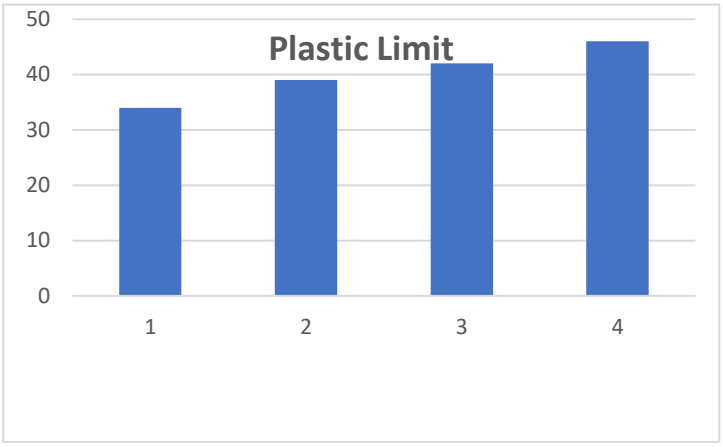

PLASTICITY INDEX (P. I)

4.6 Plasticity Index:The plasticity index is the size of the range of water contents where the soil exhibits plastic properties. The PI is the difference between the liquid limit and the plastic limit (PI = LL-PL).

Combination	Only BCS	5% of brick powder +5% of and wheat husk ash	10% of brick powder +10% of and wheat husk ash	15% of brick powder +15% of and wheat husk ash
Plasticity index (%)	**11.6**	**13.8**	**15.5**	**19.8**

3.6 Standard Proctor test: The empty mould at would is attached to the base plate and weighed. The collar is then attached to the outer the top. The wet and matured soil is compacted in three layers by giving 25 blows with content for each layer. A graph is plotted between % water content and dry density. The water content corresponding to the maximum dry density is called optimum moisture content (OMC).

Standard Proctor test

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Light compaction	Only BCS	5% of brick powder +5% of and wheat husk ash	10% of brick powder +10% of and wheat husk ash	15% of brick powder +15% of and wheat husk ash
Optimum moisture content (OMC) (%)	22.56	14	12	13
Maximum dry density (MDD) (g/cc)	1.56	1.69	1.79	2.0

3.6 California bearing ratio test: Take 5kg of soil sample and add water such that optimum moisture content is reached. Then soil and water are mixed thoroughly. Spacer disc is placed over the base plate at the bottom of the mould and a coarse filter is placed over the spacer disc.

The prepared soil water mix is divided into five. The mould is cleaned and oil is applied and soil is compacted in five layers with 56 blows. Remove base plate and invert the mould and is placed on testing machine. Surcharge weight of 2.5kg is placed on surface of soil. Dial readings are adjusted to zero. Load is applied such that penetration rate is 1.25mm per minute.

TABLE: 3 Tests Results California bearing ratio test

S.NO	COMBINATION	2.5 mm penetration	5mm
1	Black Black Cotton	0.196	0.185
2	5% of brick powder +5% of and wheat husk ash	0.653	0.518
3	10% of brick powder +10% of and wheat husk ash	0.781	0.662
4	15% of brick powder +15% of and wheat husk ash	0.796	0.767

3.6 Grain Size Analysis : Grain size analysis expresses quantitatively the proportions by mass of various sizes of particles present in the soil. The results of a grain size analysis may be represented in the form of a Grain Size Distribution (GSD) curve/ Particle Size Distribution (PSD) curve/ Gradation curve. The grain-size distribution is universally used in the engineering classification of the soils. In addition, the suitability criteria of soils used for road and airfield construction, dam and other embankment construction and the design of filters for earth dams are based partly on the results of grain-size analysis.

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TABLE: 3 Tests Results Of Grain Size Analysis

S.NO	COMBINATION	C_U	C_C
1	Black Black Cotton	3.78	0.882
2	5% of brick powder +5% of and wheat husk ash	6.29	0.969
3	10% of brick powder +10% of and wheat husk ash	5.58	1.12
4	15% of brick powder +15% of and wheat husk ash	4.89	1.19

Grain Size Analysis

Unconfined Compressive Strength test Unconfined compression test is one of the fastest and cheapest methods of measuring shear strength of clayey soil. Unconfined Compressive Strength (UCS) is the load per unit area at which an unconfined cylindrical specimen of soil will fail in the axial compression test.

TABLE: 3 Tests Results Of Unconfined Compressive Strength test

SLNO	COMBINATION	RESULT
1	Black cotton soil	186.9
2	5% of brick powder +5% of and wheat husk ash	194.64
3	10% of brick powder +10% of and wheat husk ash	226.145
4	15% of brick powder +15% of and wheat husk ash	315.93

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5. CONCLUSIONS:

Based on the experimental testing, following conclusions were drawn

- From the test results, it is observed 21.18 %, 14.11 % and 1.61 %. improvement in compressive strength when compared with target mean compressive strength of concrete at 5 %, 10 % and 15 % replacement of waste rubber tyre to coarse aggregate.
- From the test results, it is observed 7.57 %, 2.61 % and 1.04 %. improvement in split tensile strength when compared with target mean compressive strength of concrete at 5 %, 10 % and 15 % replacement of waste rubber tyre to coarse aggregate

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