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UTILIZATION OFPOLYSTERFIBRES IN BLACK COTTON SOIL: ALITERATUTE REVIEW

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ABSTRACT

In India, expansive soils are black cotton soil. The name' Black Cotton' as on agricultural origin. The black cotton soil is a type of expansive soil with high plasticity and can retain moisture through the dry season which is why they are valuable for growing crops. It exhibits low bearing capacity, low permeability and high volume change due to presence of montmorilonite minerals in its metrological content. Therefore prior to construction of a road and other engineering structures on such subgrade. It is important either replace it with no expansible soil or make it suitable for construction. Replacing the existing soil might not be a feasible option, therefore the best possible option is to stabilize the existing soil with suitable stabilizers. The process of soil stabilization helps to achieve the required strength in as soil needed for the construction work. There are many soil improvement techniques either chemical or mechanical. They may classified as a ground reinforcement , ground improvement and ground treatment.

Key Words: Black Cotton Soil, Coir fiber, Glass Fiber Tyrechips,Polysterfiber,Soil Reinforcement.

I INTRODUCTION

In India, expansive soils are black cotton soil. The name 'Black Cotton' as on agricultural origin. The black cotton soil is a type of expansive soil with high plasticity and can retain moisture through the dry season which is why they are valuable for growing crops. It exhibits low bearing capacity, low permeability and high volume change due to presence of montmorilonite minerals in its metrlogical content. Therefore prior to construction of a road and other engineering structures on such subgrade. It is important either replace it with no expansible soil or make it suitable for construction. Replacing the existing soil might not be a feasible option, therefore the best possible option is to stabilize the existing soil with suitable stabilizers. The process of soil stabilization helps to achieve the required strength in as soil needed for the construction work. There are many soil improvement techniques either chemical or mechanical. They may classified as a ground reinforcement, ground improvement and ground treatment.

Soil stability is one of the most important topics in geotechnical engineering practices. With frequent failure of soil mass, whether it is on slope or level ground have proved to be costly in terms of both life and property. Reinforcing soil using tension resisting elements is an attractive means of improving performance of the soil in cost effective manner. Various soil stabilization techniques including fiber reinforcement have been in use for a while and results in some of them is quite satisfactory. Whether of the Soil reinforcement has been introduced in

the field of geotechnical engineering in order to improve the properties of ground soil. Soil reinforcement is an effective and reliable technique for improving strength and stability of slopes, soil stability etc. Addition of fibers can be used as a reinforcement for improvement and modification in engineering properties of soil.

Soil reinforcement has been introduced in the field of geotechnical engineering in order to improve the properties of ground soil. Soil reinforcement is an effective and reliable technique for improving strength and stability of slopes, soil stability etc. Addition of fibers such as coir fiber,tyre chips, glass fiber,polysterfiber a reinforcement can be used for improvement and modification in engineering properties of black cotton soil.

II LITERATURE REVIEW

2.1 Parag M. Chaple et al. studied performance of coir fiber reinforced clayey soil . Model footing tests on the fiber reinforced soil were conducted to investigate the pressure settlement behaviour of randomly distributed fiber reinforced soil and effect on the bearing capacity of randomly distributed fiber reinforced soil. All tests were conducted on the square footing of size 100 mm in square tank of size 500mmX500mmX400mm (deep). 0%,0.25%,0.50%,0.75% and 1% of coir fiber used to reinforce the soil as layer of B,B/2 and B/4. Only one fourth width of the footing (B/4) is sufficient for increasing the safe bearing capacity (SBC). Results showed that the provision of coir fiber reinforced layer , reduces the settlement and improves the bearing capacity.

2.2 G.L.ShivkumarBabu et al. studied use of coir fibers on improving the engineering properties on expansive soils. In triaxial shear tests, swelling and consolidation tests were taken to quantify the improvement of strength , swelling, and compressibility. The results obtained were deviator stress at failure increases as fiber content increases . Deviator stress increases as confining pressure increases. Deviatior stress increases as fiber diameter increases. Cohesion increases as fiber content increases. Friction angle increases also increases as fiber content increases. Coir fiber also helps to reduce the swell potential of black cotton soil. Compression index also reduces due to inclusion of fiber.

2.3 Belas Ahmed Khan etal.found the effect of natural and synthetic fibers as a soil reinforcement. Research investigated that coir fiber retains much of its tensile strength when wet. It has low tensile strength but has more elongation. Fiber shows more resilient response against synthetic fibers by higher coefficient friction. If coir fiber randomly distributed it can reduce the swelling tendency of the soil. The compressive strength of the composite soil increases up to 1% of coir content and further increases in coir quantity results in reduction in strength. The water absorption increases with increases in the percentage of coir.

2.4 H.N. Ramesh et al. studied the performance of coated coir fibers on the compressive strength behaviour of reinforced soil. Research work did comparison between coated coir with kerosene and uncoated coir. Both fibers were in 100% in submerged condition. Both coated and uncoated fibers were used to reinforce the black cotton soil. 0.5% of uncoated coir found optimum for compaction and compressive strength. Further it was observed that 0.5% of kerosene coated coir fiber increases unconfined compressive strength by 55% compared to uncoated to coir fiber in black cotton soil at 60 days curing. Kerosene and Bitumen coated coir fibers are better substitute for reducing water absorption of soil fibers.

2.5 R.R. Singh et. Alstudied improvement of local subgrade soil for road construction by the use of coconut coir fibers. 0 to 1% White coir fibers were used for the investigation having diameter 0.5mm and length 3 to 5cm. Sample were tested in both soaked and unsoaked condition. Results showed that Unsoaked and soaked CBR values increases from 8.72% to 13.55% and 4.75 to 9.22% respectively. Unconfined compressive strength ranges between 2.75kg/cm^2 to 6.33kg/cm^2 with an addition of white coir.

2.6 Arpansenet al.st studied Soil stabilization using waste fiber materials This study investigate the use of waste fiber materials in geotechnical applications and to evaluate the effects of waste polypropylene fibers on shear strength of unsaturated soil by carrying out direct shear tests and unconfined compression tests on two different soil samples. The results obtained were compared for the two samples and inferences are drawn towards the usability and effectiveness of fiber reinforcement as a replacement for deep foundation or raft foundation, as a cost effective approach.

2.7 Rakesh Kumar Dutta et al. conducted laboratory tests on slay with inclusion of treated coir fibers (15mm length)with dry , sodium hydroxide, and Carbon tetrachloride. Results showed that unconfined compressive strength was highest with carbon tetra chloride treatment. The coir fiber content was varied from 0.4% to 1.6%. The clay with treated coir fibers can be used for making bricks for houses in rural India.

Although above mentioned fibers are successfully used in different types of soils to improve the engineering properties we can use polyster fibers to improve the engineering properties of black cotton soil. Polyster fibers are commonly used to increase the strength of concrete so we can use the polyster fibers in black cotton soil to observe the changed properties of it.polyster or polypropylene fibers are not commonly used in soil to improneit's properties.

2.8 Prof. S.Ayyapan,Ms.K.Hemalatha,Prof. M. sundaram carried out series of laboratory unconfined compression strength tests and California bearing ratio tests.Polypropylene fibers with different fiber length (6mm, 12mmand 24 mm) were used as reinforcement. Soil -fly ashspecimens were compacted at maximum dry density with low percentage of reinforcement (0 to 1.50 % of weight).Four primary conclusions were obtained from this investigation.First, inclusion of randomly distributed fibers significantlyimproved the unconfined compressive strength of soil fly ashmixtures. Second, increase in fiber length reduced thecontribution to peak compressive strength while increased thecontribution to strain energy absorption capacity in all soil flyash mixtures. Third, an optimum dosage rate of fibers wasidentified as 1.00 % by dry weight of soil- fly ash, for all soil flyash mixtures. Fourth, a maximum performance was achievedwith fiber length of 12mm as reinforcement of soil fly ashspecimens.

Dr.M.D.Subham stated Soil reinforcement as a technique to improve the engineering characteristics of soil. In this way,using natural fibers to reinforce soil is an old and ancient idea.The effect of randomly distributed polypropylene fibers on Maximum dry density (MDD),Optimum moisture content (OMC), unconfined compressive strength (UCS),soaked California bearing ratio (CBR), hydraulic conductivity and swelling pressure of an expansive soil stabilised with rice husk, ash and lime has been studied.MDD goes on decreasing and OMC goes on increasing, with increase in percentage of poly propylene fiber in the rice husk ash-lime

stabilized expansive soil.(ii) The addition of rice husk ash and lime increases the UCS and soaked CBR of theexpansive soil. With the addition of polypropylene fiber to ricehusk ash-lime stabilizedexpansive soil, the UCS and soaked CBR increases, up to 1.5 % addition of polypropylenefiber,and decreases with further increase in polypropylene fiber content. The UCS and soaked CBRincreases withincrease in curing period irrespective of the percentage of addition ofpolypropylene fiber in rice husk ash-limestabilized expansive soil.

2.9BabakAminiBehbahani,HadiSedaghathezhad,FoadChangizi presents results of an investigation into utilization of recycled polyester fiber that produced of polyethylene (PET) bottles in order to improve engineering properties of cohesive soils. This research in order to study effect of adding recycled polyester fiber on soil engineering properties, especially shear strength and California Bearing Ratio (CBR) used clay soil with low liquid limit (CL) and Atterberg's limits used high liquid limit (CH). Clay soil with recycled polyester fibers are mixed with soil in three different percentages 0.1%, 0.3% & 0.5% (the portion of stabilizer matters to soil net weight). Shear strength, CBR, Atterberg's limits of stabilizer samples were measured by direct shear test and CBR test and Atterberg limits test. Experiments results show this fact that using of recycled polyester leads to increasing shear strength and CBR and reduction in plasticity index. It is remarkable that according to economic problems, the most optimum quantity of recycled polyester is 0.5%.

2.10Prof. Shah Kinjal,A.K.Desai,C.H. Solanki stated that expansive soil reinforced with polyester fibers is a modified method developed in recent years. The results of laboratory study performed on expansive soil reinforced with polyester fiber and demonstrates that randomly distributed fibers are useful in restraining the shrinkage tendency of expansive soils. Polyester fibers of 12 mm size having triangular cross section were used. Attebergs limits of expansive soil reinforced with varying fiber content (f = 0%, 0.2%, 0.5% and 1%) were studied. The effect of fibers is studied for liquid limit, plastic limit and shrinkage limit. The chief conclusions are as follow: 1) Reinforcing expansive clay specimens with polyester fibers reduce the shrinkage tendency. 2) Optimum percentage fiber found as 0.5%.

2.11 Prof. F.Changizi&A.Haddadstated that the Subgrade soil stabilization is one of the primary and major processes in the construction of any highway; also environmental authorities are concerned about the growing amount of polyethylene (PET) bottles produced by household sectors. This research is intended to study effect of adding recycled polyester fiber on soil engineering properties, especially shear strength and California Bearing Ratio (CBR) using clay soil with low liquid limit (CL) and atterberg limits used high liquid limit (CH). Recycled polyester fibers were mixed with soil in three different percentages 0.1%, 0.3% & 0.5% (the portion of stabilizer matters to soil net weight). The shear strength, CBR, atterberg limits of treated samples were measured by direct shear test and CBR test and atterberg limits test. Experiments results show this fact that using of recycled polyester leads to increasing shear strength and CBR and reduction, plasticity index. It is remarkable that according to economic problems, the most optimum quantity of recycled polyester fiber to reach to favorite strength is 0.5%.

2.12 Prof. GiangNguyen,EvaHrubesava,AdamVotr studied soil improvement using polyester fibres of length 70mm mixed in soil SC as random reinforcement in
amount of 0.5%, 1.0% and 1.5%. Improvement of soil was measured by direct shear tests, using shear box of size 0.3m x 0.3m x0.15m. It will be shown that for tested soil, optimal amount of fibres is 1.0%, when increase of angle of internal friction was up to 6.00 (from 45.3o to 51.3o) and increase of cohesion was up to 17.5kPa (from 0 kPa to 17.5 kPa) in comparison with soil withoutfibers.

2.13 Dr.M.D.Subhamexplainedthatsoil reinforcement is defined as a technique to improve the engineering characteristics of soil. In this way,using natural fibers to reinforce soil is an old and ancient idea.The effect of randomly distributed polypropylene fibers on Maximum dry density (MDD),Optimum moisture content (OMC), unconfined compressive strength (UCS),soaked Californiabearing ratio (CBR), hydraulic conductivity and swelling pressure of an expansive soil stabilized with rice husk ash and lime has studied. Following conclusions are drawn from this study: (i) The addition of rice husk ash and lime decreases the MDD and increases the OMC of theexpansive soil. MDD goes on decreasing and OMC goes on increasing, with increase in percentage of poly propylene fiber in the rice husk ash-lime stabilized expansive soil.(ii) The addition of rice husk,ash and lime increases the UCS and soaked CBR of theexpansive soil. With the addition of polypropylene fiber to rice husk ash-lime stabilizedexpansive soil, the UCS and soaked CBR increases, up to 1.5 % addition of polypropylene fiber,and decreases with further increase in polypropylene fiber content. The UCS and soaked CBRincreases with increase in curing period irrespective of the percentage of addition ofpolypropylene fiber in rice husk ash-lime stabilized expansive soil.

2.14 Prof. KalpanaMaheshwari,Dr.C.H.Solanki,Dr.A.k.Desai studied the effect of polyster fibers on strength properties of clayey soil of high plasticity.In this study polyster fibers were mixed with clayey soil in various proportions (0%,0.25%,0.50%,0.75%,1%,1.5%by weight of dry clayey soil) to investigate the relative strength gained in terms of compaction,CBR,Unconfinedcompression,shear parameters and consolidation.It was foundthat strength properties of clayey soil increases with the inclusion of 0.5%.

2.15 Polyster fiber-3S Recron fibers:

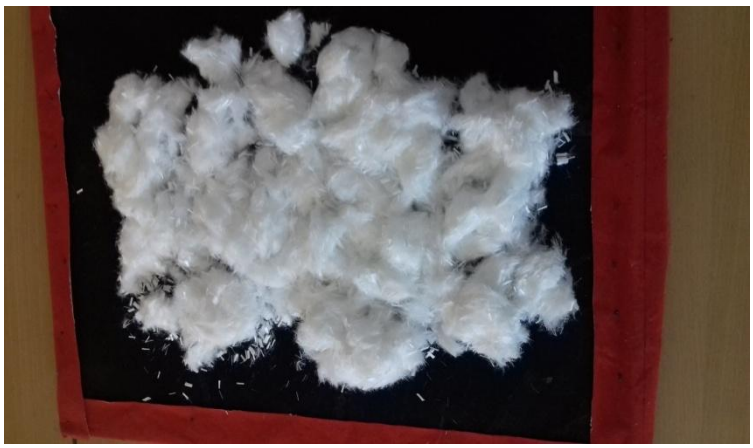
Basically in polyster fiber the fiber forming substance is any long chain synthetic polymer composed of at least 85%by weight of an ester of a substituted aromatic carboxylic acid including terephthalicunits,parasubstituted hydroxyl-benzoate units.polyester fibers are normally used in concrete to increase tensile strength and flexural strength of concrete. Such fibers can be used to stabilize the soil, hence there is need to use polyester fibers as a reinforcement to check the effect of on engineering properties of black cotton soil.

TABLE

Properties of polyester fibers are as follows

Sr. no.	Properties	Polyester fiber	Unit
1	Shape	Triangular	
2	Cut length	12	mm
3	Effective diameter	20-40	microns
4	Specific gravity	1.35	-

5	Melting point	250-265	Deg.C
6	Tensile Strength	4-6	GPa
7	Young's Modulus	>5000	Mpa



Polyster Fibers-3S Recron fibers

III CONCLUSION

Studies have been conducted in the past about the problems and damages posed by the black cotton soil. A large number of research has been done on the improvement of engineering properties of expansive soils to find out economical and efficient means of using artificial & natural fibers which are available in plenty. However less work has been carried out on polysterfiber's effect on engineering properties of black cotton soil.Mostlypoyster fibers are used in concrete to improve flexural strength,tensile strength of it.Use of Coconut fibers,tyrechips,glass fibers geofibers to improve strength of all types of soils is general practice. From the above literature it is clear that polyster fibers of different length,shape can also drastically improve the strength characteristics of soil like clay,expansive soils etc. So there is need to study the effect of polyster fibers on engineering properties of expansive soil like black cotton soil.All the laboratory tests will be conducted in accordance with Indian standards codes. Index properties, swelling properties and OMC of black cotton soil will be determined in laboratory.Index properties such as liquid limit, plastic limit and plasticity index of black cotton soils will be tested with addition of polyster fibers in different proportions with soil and without addition of fibers to soil to compare the results and to draw some conclusion. Engineering properties of soil may be changed,but authors are not sure about the changes in engineering properties of black cotton soil. Number of tests will be required on soil of different plasticity to draw a certain conclusion regarding the change in strength of soil. Swelling characteristic is a main characteristic of black cotton soil and tests will be carried out with the addition of polyster fibers. swelling pressure and swelling index properties will be studied by a significant amount. Optimum moisture content will also be observed. From all observation made in present study it will be concluded that sustainability of soil and structure on black cotton soil will increase or decrease with the addition of polyster fibers.

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