International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 01 | Jan 2019 www.irjet.net p-ISSN: 2395-0072

EFFECT OF SURKHI AND POLYPROPYLENE FIBERS ON GEOTECHNICAL PROPERTIES OF EXPANSIVE SOIL

Rachit Mishra[1], Mohit Verma[2]

[1]M.E. Geotechnical Engineering, Department of Civil Engineering, Jabalpur Engineering College (JEC), Jabalpur (M.P.)
[2]Assistant Professor, Department of Civil Engineering, Jabalpur Engineering College (JEC), Jabalpur (M.P.)

Abstract: - *With the increasing population and the reduction of available land, more and more construction of building and other civil engineering structures have to be carried out on weak or soft soil. Owing to such soil of poor shear strength and high swelling and shrinkage, a great diversity of ground improvement techniques such as soil stabilization employed to improve mechanical behavior of soil, thereby enhancing the reliability of construction. In this Study try to resolve the above problems by replacing the soil with stabilizing agents in different combination. The process includes study of water content, Atterberg's limit test, standard proctor test and UCS test.*

Key Words: Black Cotton Soil, Surkhi/Brick Powder (BP), Polypropylene Fiber (PP), Atterberg limits, OMC, MDD, C.B.R, UCS etc

I. INTRODUCTION

Soil is a basic construction material. It is the subgrade which supports the sub base and base in the pavement. The main function of pavement is to support and distribute the heavy wheel loads of vehicles over a wide area of the underlying subgrade soil andpermitting the deformations within elastic range. Subgrade performance is a function of the strength of soil and its behavior under traffic loading. The subgrade should be stable or even sometimes excessive swelling in case of expansive soils. The properties of soil can be improved by stabilization with admixtures. For many years admixtures such as lime, cement and cement kiln dust are used to improve the qualities of various types of soils. This study deals with the stabilization of locally available expansive soil in the region of Jabalpur, Madhya Pradesh with varying percentages of surkhi and polypropylene fiber. The objective is to determine the most appropriate concoction of surkhi and polypropylene fiber to augment the bearing capacity of the expansive soil. Also use of byproducts such as surkhi for stabilization of expansive soil would fulfill the dual purpose of waste disposal which could otherwise be an ecological hazard by using it for the purposes of elevating the bearing capacity of weak soils.

2. MATERIALS USED

2.1. Black cotton soil

Black cotton soil (BC soil) is a highly clayey soil. They are of variable thickness, underlain by black sticky material known as "Black soil". BC soil when comes in contact with water it either swells or shrinks and resulting in moments to the structure which are generally not related to direct effect of loading. On account of its high volumetric changes it is not suitable for construction. It swells and shrinks excessively due to present of fine clay particles. Hence black cotton soil must be treated by using suitable admixtures to stabilize it.

The soil used was locally collected from Panagar region in Jabalpur, Madhya Pradesh. As per the test conducted over the soil following properties were obtained

S.No.	Properties	Values
1	Liquid Limit (LL)	63%
2	Plastic Limit (PL)	30%
3	Plasticity Index (Ip)	33%
4	Specific Gravity (Gs)	2.58
5	Differential Free Swell (DFS)	70%
6	Optimum Moisture Content (OMC)	16.20%
7	Maximum Dry Density (MDD)	1.41
8	California Bearing Ratio (CBR)	7.11
9	Unconfined compression strength (UCS)	102.3 Kpa
10	Soil classification	CH

2.2. Surkhi

Brick dust with its component burnt brick powder is a waste powder generated from the burning of bricks with the soil covered by surroundings. Due to burning of soil bricks it hardened and at the time of removal the set up we get the powder form of brick. it has red color and fine in nature. it has great ability to reduce the swelling potential of black cotton soil. Brick due to burning of soil bricks it hardened and at the time of removal the set up we get the powder form of brick. It has red color and fine in nature. It has great ability to reduce the swelling potential of black cotton soil.

2.3. Polypropylene Fiber

Table -2 : Physical and chemical properties of fibre:

S.No.	Properties	Values
1	Fiber type	Single fibre
2	Unit weight	0.91 gm/cm3
3	Average diameter	0.034 mm
4	Average length	12 mm
5	Breaking tensile strength	350 MPa
6	Modulus of elasticity	3500 MPa
7	Fusion point	165®c
8	Fusion point	590®c
9	Acid and alkali	Very good
10	Dispersibility	Excellent

3. EXPERIMENTAL WORK

3.1 Preparation of Sample

The soil sample should be oven dried at approximately 105°C and then ground.

The different values adopted. For the percentage of Surkhi are 0%, 0.5%, 1% and 1.5%. The adopted content of Surkhi was first mixed into the air-dried soil sample in small increments by hand, making sure that all the material was mixed thoroughly, so that a fairly homogenous mixture is obtained, and then the required water was added. The Optimum Surkhi percentage was determined. Polypropylene fibers were added to different proportion (0.35%, 0.40% and 0.45%) to the sample having optimum surkhi content.

3.2 Compaction test

The test was performed as per IS 2720 (Part VII) 1980. The compaction tests were done on soil and surkhi blends and the optimum quantity of surkhi was obtained. Further to this optimum quantity of surkhi and soil mix polypropylene fibers were added in different proportions. The appropriate quantity of water was added to the mix and the wet specimen was compacted in mould in three layers utilizing standard proctor rammer of 2.6kg.The MDD and OMC for various samples were determined from this test.

3.3 Unconfined Compression Test

The mixture of soil-surkhi and polypropylene was compacted in a cylindrical mould to obtain standard proctor's MDD. Then the sample was extracted from the mould for the further test. The extracted samples were prepared with inclusion of soil with (0% and 40%) surkhi and soil with optimal percentage of polypropylrene fiber (0.35%). The experiments were regulated at a consistent strain rate of 0.125mm per min according to Indian Standard 2720 (part 10) 1991. Three samples were examined for each variable proportion. The UCS value was calculated from the Stress-Strain curve.

4. RESULTS AND DISCUSSIONS

According to experimental program, numerous tests were executed on soil with various percentages of surkhi and polypropylene fiber. The effects of surkhi and polypropylene fiber inclusion on OMC-MDD relationship, and CBR values were considered.

4.1 Standard Proctor Test

It is observed in Table-3 and Figure(a) that with the inclusion of surkhi, the MDD increased up to 40% surkhi addition and then decreased. On inclusion of 40% surkhi with soil, the optimum value of MDD was obtained. On addition of polypropylene fiber(0.30%,0.35% and 0.40%)to this optimum percentage of surkhi it was observed that the MDD increased for the sample containing 0.35% polypropylene fiber and 40% surkhi while it decreased for the sample containing 5% polypropylene fiber and 20% surkhi. The maximum value of MDD was obtained for a soil sample containing 20% surkhi and 2.5% polypropylene fiber by dry weight of the soil sample.

Table 3: OMC, MDD for soil samples containing varying percentages of surkhi (BP) and polypropylene fiber(PP)

Sample No.	Soil%+BP%+PP%	M.D.D. (g/cc)	O.M.C. (%)
1	100% + 0% + 0%	1.41	16.2
2	65% + 35% + 0%	1.53	11.12
3	60% + 40% + 0%	1.64	13.93
4	55% + 45% + 0%	1.56	14.48
5	50% + 50% + 0%	1.54	16.2
6	60% + 40% + 0.3%	1.69	14.11
7	60% + 40% + 0.35%	1.78	14.5
8	60% + 40% + 0.40%	1.64	14.9

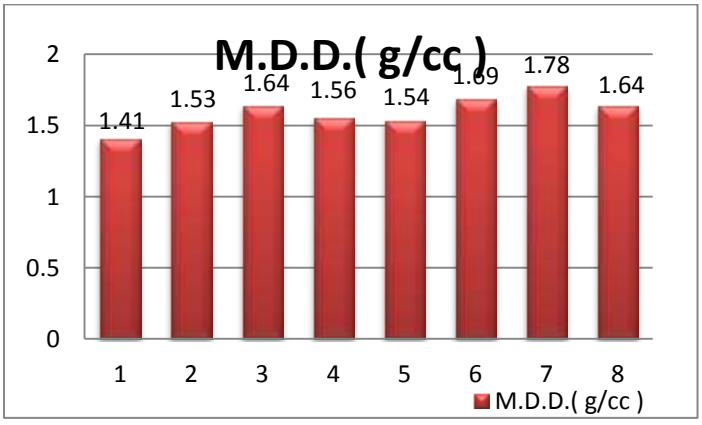

FIGURE (a) : MDD for soil samples containing varying percentages of surkhi(BP)and polypropylene fiber(PP)

4.2. Unconfined Compressive Strength Test

The outcomes UCS test from Table 4 and Figure (b) indicated that the UCS value increased upon inclusion of surkhi .Further polypropylene fiber was added to the soil sample containing 40% surkhi and 60% soil. The CBR value increased with addition of 0.35% polypropylene fiber and 40% surkhi to 60% soil. The maximum value of CBR was obtained for a soil sample containing 60% soil+40% surkhi+0.35% polypropylene fiber.

Table 4 : U.C.S. Value for soil samples containing varying percentages of surkhi(BP)and polypropylene fiber(PP)

Sample	SOIL%+BP%+PP%	UCS VALUE(KPa)
1	100% + 0% + 0%	102.3
2	60% + 40% + 0%	310.03
3	60% + 40% + 0.35%	350.2

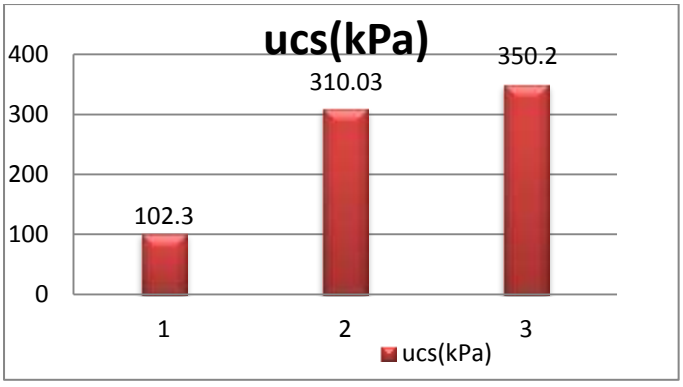

FIGURE (b) : UCS Value for soil samples containing varying percentages of surkhi(BP)and polypropylene fiber(PP)

5. CONCLUSION

For the stabilization of black cotton soil, the optimum quantity of surkhi and polypropylene fiber was found to be 40% and 0.35% for 60% soil. The two materials were mixed in the above proportion in the black cotton soil. The proctor density was increased from 1.41 g/cc to 1.78 g/cc. The CBR value increased from 102.3 Kpa to 350.2 Kpa.

6. REFERENCES:

1. ASTM D 854 “Standard test methods for specific gravity of soil solids by water pycnometer”.

2. Chaosheng Tang, Bin Shi, Wei Gao, Fengium chen, Yi Cai, (2006), “ Strength and mechanical behavior of short polypropylene fiber reinforced and cement stabilized clayey soil. Geotextiles and geo-membranes 25(2007) 194-202

3. Consoli, N.C, Prieto, P.D.M. and Ulbrich L.A. (1999). “The behaviour of a fiber reinforcement soil.” Ground improvement, London, 3(1), 21.

4. Kunal R,Yogesh R,Rahul R -Maharashtra, India(Aug-2015) “ Experimental Investigation for Stabilization of Black Cotton Soil By using waste material -Brick Dust”, International Research Journal of Engineering and Technology (IRJET) ,Volume: 02 Issue: 05 | Aug-2015

5. Loehr J.E., AxtellP.J. and Bowders J.J, “Reduction of soil swell potential with fiber reinforcement”, GeoEng (2000

6. Mahmood R. Abdi, parsapajouh Ali and Arjomand Mohammad A.(2008), “Effect of random fiber inclusion on consolidation, Hydraulic conductivity, swelling, shrinkage limit and desiccation cracking of clays”, International journal of civil engineering, vol 6, No.4, (284-292).

7. Naeini S.A and Sadiadi S.M. (2008), “Effect of waste polymer materials on shear strength of unsaturated clays”, EJGE journal, vol 13, bund k, (1-12).

8. Naranagowda M.J., et al (2016), “Effect of polypropylene fiber on stability of expansive soil”, IJER journal, vol 05, No. 8, (651-653).

9. Reddy S.Y., et al (2014), “Use of waste fiber materials in geotechnical applications”, IJOER journal, vol 02, No. 6, (2321-7758).

10. Tiwari S, (2016), “Soil stabilization using waste fiber materials”, IJITR journal, vol 04, No. 3, (2927-2930)

11. Yetimoglu, T., Inanir, M, Inanir, O.E., (2005), “A study on bearing capacity of randomly distributed fiber-reinforced sand fills overlying soft clay”, vol 23, No. 2, (174-183).