STABILIZATION OF BLACK COTTON SOIL USING TERRASIL AND ZYCOBOND

[1]T.Raghavendra, [2]B.Rohini, [3]G.Divya, [4]S. Abdul Sharooq, [5]B.Kalyanbabu
[1]Assistant Professor, [2]Assistant Professor, [3,4,5]B.Tech Student,
[1,2,3,4,5]Department of Civil engineering,
[1,2,3,4,5]Rajeev Gandhi Memorial college of Engineering and Technology, Nandyal, Andhra Pradesh, India.

Abstract: The rate of montmorillonite is more in black cotton soil which causes expansiveness and crack occurs in soil without any warning which is dangerous for construction. Such expansive soils are very susceptible to detrimental volume changes with changes in moisture content. Expensive soils because of their specific physical & chemical make are subjected to volume changes. In this study nano chemicals terrasil and zycobond used for soil stabilization. In this investigation Cement is used in the constant proportion of 3% of amount of soil and the nano chemicals terrasil and zycobond are used are 0.6kg/m^3, 0.8kg/m^3, 1kg/m^3, 1.2kg/m^3 of each. unconfined compressive strength test is performed after the curing period of 7days, 21days,28days.Free swell index test is performed for the proportions of 0.6kg/m^3,0.8kg/m^3,1kg/m^3,1.2kg/m^{3}of terrasil and zycobond.

Keywords :- Terrasil, Zycobond, Soil Stabilization, Strength, Black cotton soil.

I. INTRODUCTION

Many civil engineering structures fail due to failure of soil underlying the structure for e.g. construction of buildings, dam, bridges, etc. Building foundations need to be on stable and strong soils. Expansive soils pose several problems to civil engineers and to geotechnical engineers. Expansive soils such as black cotton soil have the tendency to increase in volume when water is available and to decrease in volume if water is removed. Black cotton soil contains the clay mineral montmorillonite which is responsible for the excessive shrinkage and swelling characteristics of soil. These volume changes in swelling soils are the cause of many problems in structures that come into their contact or constructed out of them.

A large part of India is covered with black cotton soil. Black cotton soils are residual deposits formed from basalt. And are highly clayey soils and grayish to blackish in colour. Some techniques are used for improving the strength of the soil and these are increasing the depth of the foundation, compacting the soil, replacing the soil under the foundation, and stabilizing the soil. Soil stabilization aims at improving soil strength and increasing resistance to softening by water through bonding the soil particles together, water proofing the particles or combination of the two. soil stabilization involves the use of stabilizing agents (binder materials) in weak soils to improve its geotechnical properties such as compressibility, strength, permeability and durability.

The components of stabilization technology include soils and or soil minerals and stabilizing agent or binders(Cementitious materials)

The commonly used stabilizing agents are:

- Cement
- Lime
- Flyash
- Blast Furnace Slag

Nano chemicals Terrasil and Zycobond are the nanotechnology based products which can provide solutions to moisture and bonding issues, Terrasil is a water proofing agent and Zycobond is a bonding material and are introduced by the Zydex industries. Addition of nano particles as an external factor to soil will result in soil manipulation at atomic or molecular level and it influences the strength, permeability indices and resistance properties of soil. Cement has also been used as a stabilizer. In this study soil with variable dosages of chemicals were tested for stabilization process and strength of the stabilized soil has been evaluated after curing period.

II. Literature Review

Mrudul etal (2016) studied the behaviour of black cotton soil with and without stabilization using terrasil chemical. It is noticed that using cement and terrasil as stabilizer for the Subgrade stabilisation affects the granular sub base and Dense bituminous macadam layers of the pavement which indicates that the thickness of pavement gets reduced.

Amadi, A.S. Osu(2016) performed research on to investigate the effect of curing time on strength development of black cotton soil stabilised with 10% quarry fine and varying percentages from 0-16% of cement kiln dust was measured in UCS test. The study revealed that the stabilised soil mixtures like soil stabilised with other materials(admixtures) have a scope for increase in strength dependent on time.

Nandan A. Patel(2015) studied the the properties of soil with and without addition of nano chemicals. In this it is observed that free swell index value decreases from 17.5% to 17% with the addition of terrasil and zycobond.

Roopika etal(2015) studied the suitability of nano chemicals for the Stabilisation of black cotton soil. The UCS tests performed indicated that UCS values increases with different curing period on addition of different dosages of Terrasil and Zycobond.

III. Methodology

The soil used for investigation is a typical black cotton soil collected nearby RGM College, Nandyal.

Various experiments specific gravity, liquid limit, plastic limit, sieve analysis, hydrometer analysis, IS light compaction, unconfined compression test, direct shear test, CBR test and free swell index test are conducted on the soil. Test procedures followed from IS 2720.

Cement is used in the constant proportion of 3% of amount of soil and the nano chemicals terrasil and zycobond are used are 0.6kg/m^3, 0.8kg/m^3, 1kg/m^3, 1.2kg/m^3 of each chemical. Soil mixing with cement and the unconfined compressive strength test is performed. Soil mixed with cement and chemicals with the respective proportions to the OMC calculated to the soil and mixed unconfined compressive strength test is performed after the curing period of 7days, 21days, 28 days. Free swell index test is performed for the same proportion of Terrasil and Zycobond. Terrasil is nanotechnology based water dissolvable, bright, appears in pale yellow colour in the form of a fluid.

***Fig3.1**: Zycobond and Terrasil*

***Fig3.2:** Soil mixed with chemical*

IV. Results and Discussions

Wet Sieve Analysis And Hydrometer Analysis

%Gravel: 1%
%Sand: 26%
%Silt: 38%
%Clay: 35%

Liquid Limit And Plasticlimit - By Casagrande Apparatus

Liquid limit (WL) =52%
Plastic limit (WP) =26.78%
Plasticity Index (WL-WP)=25.22%

Compaction Test

From the relationship between the moisture content and dry density of soils
Maximum dry density=1.63(g/cc)
Optimum moisture content=20.3%
Compaction test is performed by using Automatic compactor, average value of OMC is considered From 3 compaction tests

***Fig: 4.1**. Automatic compactor*

Soil Specific Gravity

Specific gravity value (G_s)=2.57

Direct Shear Test

Cohesion=0.316 kg/cm^2
Angle of shearing resistance=42 degrees

CBR Test

CBR value 3.85 at 2.5mm penetration.

Free Swell Index Of Soil

Free swell index=30%

Unconfined Compressive Strength Of Soil

Unconfined compressive strength of soil=4.79kg/cm^2

Fig: 4.2 *Failure of samples in UCS test*

Table4.1. UCS of All Samples Varying With Curing Period

PROPERTY	UCS kg/cm^2(7Days)	UCS kg/cm^2(21 Days)	UCS kg/cm^2(28Days)
SOIL+CEMENT	2.56	3.49	2.82
SOIL+CEMENT+0.6kg/m^3	2.77	3.57	2.64
SOIL+CEMENT+0.8kg/m^3	3.56	2.81	2.81
SOIL+CEMENT+1kg/m^3	3.9	2.8	2.55
SOIL+CEMENT+1.2kg/m^3	3.93	2.76	2.08

UCS of different proportions are taken for each proportion 3 samples are extruded and tested, average value of 3 samples taken

Table4.2. FREE SWELL INDEX TEST RESULTS

FREE SWELL INDEX %	TERRASIL	ZYCOBOND
30	0	0
27.5	0.6kg/m^3	0.6kg/m^3
26.3	0.8kg/m^3	0.8kg/m^3
25	1kg/m^3	1kg/m^3
21.05	1.2kg/m^3	1.2kg/m^3

Free Swell index test is performed by adding chemicals at the OMC of the soil which is calculated from compaction test and placed the soil under sun for one hour and is sieved again through 425 microns sieve to avoid the formation of lumps and 20g of soil is placed in two 100ml measuring jars one jar filled with water and another filled with kerosene upto 100ml, the volume readings are measured after 24 hours.

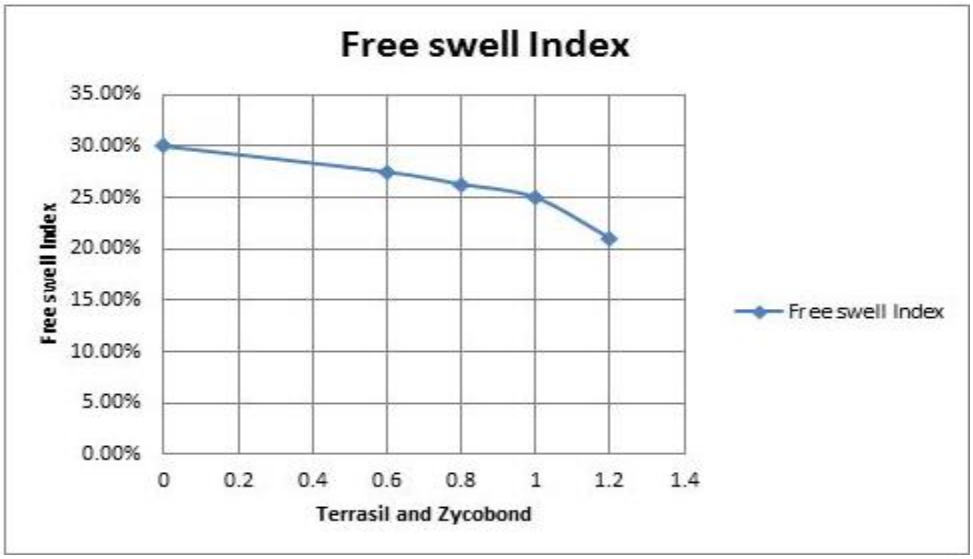

Fig 4.3.: *Variation of free swell index on addition of chemicals(Terrasil and Zycobond)*

V. Conclusion

• Free Swell index is decreases from 30% to 27.5% with the addition of 0.6kg/m^3 of Terrasil and Zycobond and decreased to 26.3%, 25%, 21.05% with the addition of 0.8kg/m^3,1.0kg/m^3,1.2kg/m^3 when compared to 0% of Terrasil and Zycobond.

• Unconfined compressive strength is decreased when the dosage of the Nano chemicals (Terrasil and Zycobond) is increased.

• But many of journals say that Unconfined compressive strength should be increases by adding cement, Terrasil and Zycobond. Further investigation need to be done why the unconfined compressive strength is decreases

REFERENCES

[1]. Amadi, A.S. Osu, 2016, "Effect of curing time on strength development in black cotton soil – Quarry fines composite stabilized with cement kiln dust (CKD)". Journal of King Saud University,1-8.

[2]. IS: 2720 (Part IV) - 1985, Determination of Grain Size ^{Analysis}.

[3]. IS: 2720 (Part V) - 1985, Determination of Liquid and Plastic Limit.

[4]. IS: 2720 (Part VIII) - 1987, Determination of Water Content - Dry Density Relation Using Light Compaction.

[5]. IS: 2720 (Part XVI) - 1997, Laboratory Determination of CBR.

[6]. IS: 2720-40(1977), free swell index of soil.

[7]. IS: 2720 (Part 10) - 1991, Unconfined compressive strength test.

[8]. Mrudul etal,2016, "Laboratory Investigation of Soil Stabilized using Terrasil", International Journal for Scientific Research and Development,Vol(4),3,1217-1221.

[9]. Nandan A. Patel, 2015, "Subgrade Soil Stabilization using Chemical Additives Using terrasil and zycobond",International Research Journal of Engineering and Technology ,vol(2),4,1089-1095.

[10]. Roopika etal worked on "Suitability of Nano Chemical Stabilisation of black cotton soil" UCS values increases with different curing period in addition of different dosages of Terrasil and Zycobond.