



Improvement of Soil Properties Using Nonchemical - Terrasil: A Review

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ABSTRACT

As the population is increasing day by day there is reduction of availability of a good sound land for construction, thus now a day's more construction of buildings and other civil engineering structures have to be carried out on weak or soft soil. These soil of poor shear strength and high swelling & shrinkage, has to be treated by some suitable means mostly soil stabilization and reinforcement are employed to improve mechanical behaviour of soil, thus improving the reliability of construction. As we look out the soil map of India the Black cotton soil is one of the major soil deposits. This soil has the property of high swelling and shrinkage when exposed to changes in moisture content and hence have been found to be most troublesome from engineering considerations. This paper deals with the review of some previous studies that are done to improve properties of weak soil by terrasil and some other stabilizing agents.

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

1. INTRODUCTION:

Many civil engineering structures fails due to failure of soil underlying the structure for e.g. construction of buildings, dam, bridges, etc. Out of these one of the major problem which country faces is failure of transportation system. An efficient transport system is a pre- requisite for sustained economic development. It is not only the key infrastructural input for the growth process but also plays a significant role in promoting national integration, which is particularly important in a large country like India thus roadways are essential component in nation building. In country like India which is

rich in monsoons, moisture becomes a huge problem to roads. Admission of water in rainy season weakens the roads soil base. For soil like black cotton soil these climatic changes are responsible for its swelling and shrinkage. Addition of nano chemical to soil in an optimum quantity can be proved beneficial to the problem discussed above. Terrasil is a nanotechnology based product.

1.1 Soil Stabilization:

Soil stabilization is a method of improving soil properties by blending and mixing other materials. Following are the various soil stabilization methods and materials:

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1.1.1 Soil Stabilization with Cement:

The soil stabilized with cement is known as soil cement. The cementing action is believed to be the result of chemical reactions of cement with siliceous soil during hydration reaction. The important factors affecting the soil-cement are nature of soil content, conditions of mixing, compaction, curing and admixtures used.

1.1.2. Soil Stabilization using Lime:

Slaked lime is very effective in treating heavy plastic clayey soils. Lime may be used alone or in combination with cement, bitumen or fly ash. Sandy soils can also be stabilized with these combinations. Lime has been mainly used for stabilizing the road bases and the subgrade.

1.1.3. Soil Stabilization with Bitumen:

Asphalts and tars are bituminous materials which are used for stabilization of soil, generally for pavement construction. Bituminous materials when added to a soil, it

imparts both cohesion and reduced water absorption.

1.1.4. Chemical Stabilization of Soil:

Calcium chloride being hygroscopic and deliquescent is used as a water retentive additive in mechanically stabilized soil bases and surfacing. Sodium chloride is the other chemical that can be used for this purpose with a stabilizing action similar to that of calcium chloride. Sodium silicate is yet another chemical used for this purpose in combination with other chemicals such as calcium chloride, polymers, chrome lignin, alkyl chlorosilanes, siliconites, amines and quarternary ammonium salts, sodium hexametaphosphate, phosphoric acid combined with a wetting agent. Now a days nano chemicals are widely used for improving the properties of soil, some nano chemicals are terrasil, zycobond, etc.

1.2 Terrasil:

Terrasil is nanotechnology based product produced by Zydex Industries Ltd., Gujarat. Terrasil is water soluble, ultra violet and heat stable, reactive soil modifier. It improves the frictional value, reduces water permeability and maintains breathability of the soil layer.

Table 1: Composition of Terrasil.

Chemical compound	Value in range, %
Hydroxyalkyl-alkoxy-alkylsil	65 – 70 %
Benzyl alcohol	25 – 27 %
Ethylene glycol	3 – 5 %

Table 2:- Physical properties of Terrasil.

Property	Description
Appearance	Pale yellow liquid
Density	1.01g/ml
Viscosity at 25°C	20-100 cP
Solubility	Forms water clear solution
Flash Point	>80°C
Freezing point	5°C

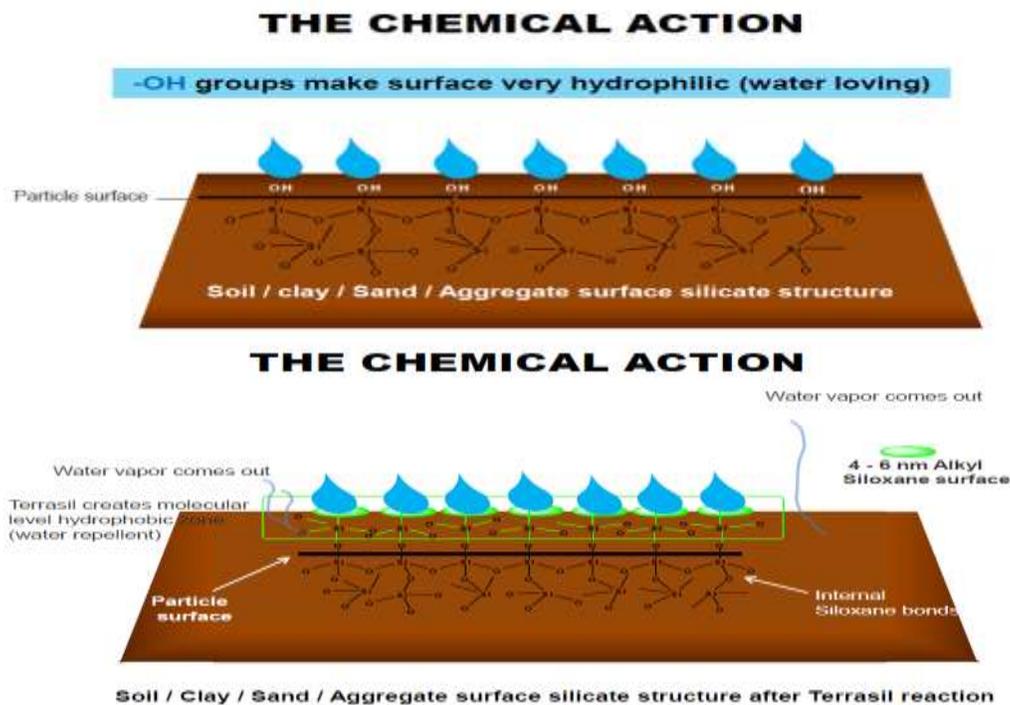


Fig. 1: Chemical Action of Terrasil on soil.

2. LITERATURE REVIEW:

A number of researchers have worked in improving the properties of soil for various engineering application which are practical and economical. The following literature review

describes important research results regarding use of terrasil and other material in soil improvement.

- I. Nandan A. Patel, C. B. Mishra, D. K. Parmar, Saurabh B. Gautam -(2015) in

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“Subgrade Soil Stabilization using Chemical Additives” stressed that it is the obligation of the road powers to utilize the nearby material and right the soil properties utilizing added substances upgrading the quality of soil and make the road sturdy. Test result shows that engineering properties got changed and CBR on balanced out clayey examples expanded impressively, which mirrors the lower thickness in connection with regular trademark soil properties. Also the cost is decreasing which points of interest the Road developer’s engineers, strategy producers and asphalt originators too also found that the addition of Terrasil (0.041%) + zycobond (0.020%) to the soil the CBR value increased from 6.64% to 12.15%. This signifies that the quality of subgrade soil is enhanced consequently expanding the load carrying limit of pavement .

- II. Rintu Johnson, Dr. Kodi Rangaswamy – (2015) in his work on “Improvement of soil properties as a road base material using nano chemical solution” The soil was collected from Kunnamangalam area of Calicut district in Kerala and the Terrasil nanochemical was collected from Zydex Industries Ltd. for the stabilisation studies. Experimental programme was carried out on both clay and cement treated clay treated with different dosages of Terrasil. Specimens were prepared with 0.05%, 0.07% and

0.09% Terrasil and 1% cement by weight of soil. Results obtained were compared and studied. It is found out that increment in dosage of Terrasil the CBR quality of soil blended with ideal dose of 0.07% terrasil chemical is enhanced around 6 times the CBR quality of clay soil. The treated soil was observed to be impermeable . The optimum dosage of terrasil was obtained as 0.07% by weight of soil and the strength was maximum for 4% cement content.

- III. Chaudhari Riddhi, Tabiyar Suman, Bholanda Heena, Chaudhari Shivani (2016): The focus is to evaluate engineering properties of adjacent soil material with and without using Nano chemical terrasil stabilizer of 0.041% percent dose and to explore the changes in CBR values for the thickness of adaptable flexible pavement design. Soil stabilization with terrasil offers the bitumen build a different. The procedure not just offers the capacity to improve the designing attributes of an unsatisfactory soil, additionally offers the specialist a more supportable way to deal with bituminous road development. Construction cost analysis for soil with and without additive is calculated. The results shows that soil mixed with 0.041% Terrasil, (as per Zydex Laboratory test protocol) is economical and is beneficial. Also load carrying capacity is increased. Thus it justifies



from economy point of view, benefit associated with the utilization of chemical stabilizer such as Terrasil for enhancing the sustainable development in road construction needs to be worked evaluated.

IV. B M Lekha, S Goutham, A U Ravi Shankar – (2013) in his work on "Laboratory investigation of soil stabilized with Nanochemical" communicates that the behavior of Black Cotton (BC) soil with and without modification with compound named Terrasil demonstrated particular estimations and cured for 7-28 days. The crucial geotechnical properties of soil were CBR qualities increase with the addition in rate of stabilizer. Vulnerability is seen to be nil for treated soil. The recognition record communicates those UCS quality augmentations with development in measurements of stabilizer and curing period.

V. D. K. S. Gandhi (2012) - "Expansive Soil Stabilization Using Bagasse Ash" in this study accentuation is offered to upgrade the nature of broad soil of Surat region, bagasse slag used as the included substance which builds the security of soil and decay the swelling of soil? The discoveries shows that Bagasse fiery debris adequately dries wet soils and gives a starting quick quality addition, which is valuable amid development in

wet, temperamental ground conditions. Bagasse cinder likewise diminishes swell capability of far replacing so as to reach soils a portion of the volume beforehand held by broad mud minerals and by solidifying the soil particles together.

VI. Nandan A. Patel, Prof.C. B. Mishra, Mr. Vasu V. Pancholi (2015) In their paper titled "Scientifically Surveying the Usage of Terrasil Chemical for Soil Stabilization" emphasized that it is the responsibility of the road authorities to use the local material and correct the soil properties using additives enhancing the strength of soil and make the road durable. The examination was completed to focus first soil engineering properties (with and without stabilizer), standard compaction; four days soaked California Bearing Ratio (CBR), permeability test and cyclic loading test according to codal procurement. A concoction named Terrasil was utilized as stabilizer and it was utilized for altered measurement i.e. 0.041% by dry aggregate weight of soil test according to the convention of Zydex Industries, Vadodara. Test outcome demonstrates that designing properties got modified and CBR on stabilized clayey samples increased considerably, which reflects the lower thickness in correlation with natural characteristic soil properties. Additionally the expense is diminishing which advantages the road builders,



engineers, policy makers and pavement designers as well.

- VII. Nandan A. Patel and C. B. Mishra (2014) – “Improvement the Strength of Inorganic Clayey Soil using Cement Additive” states that the failures of pavement in from of heave depression cracking and unevenness are caused by the seasonal moisture variation in subgrade soil. The correct stabilization of foundation soils constitutes an increasingly important issue in the present civil engineering world to alter the properties of soil to meet the desired engineering properties for improving strength and durability. Initially the investigation of soil is carried out to evaluate the physical and engineering properties as per Indian Standard classified as CL (Clay soil having low plasticity) as per Indian Standard (1498 – 1970) by conducting laboratory tests and to evaluate the improvement in properties by the addition of 2 % PPC as stabilizers to be used in pavement design for economy.

3. METHODOLOGY

The common tests that are performed by various researcher on use of terrasil to improve soil includes following laboratory tests.

- Grain size distribution
- Specific gravity
- Liquid Limit
- Plastic limit
- Differential Free Swell test

- Proctor test
- California Bearing Ratio test.
- Unconfined Compressive Strength test.
- Permeability test.

4. CONCLUSION:

Various type of possible and cost effective stabilization technique of the soil properties enhancement were presented in this literature review. It is clear that by use of terrasil almost all the engineering properties of weak soil get modified.

- i. The liquid limit and plastic limit of the soils decrease with the addition of terrasil to the soil in a proper proportion.
- ii. FSI value of treated soil reduces because the film of adsorbed water is greatly reduced for treated soil and the surface area reduces, resulting in decreased swelling capacity.
- iii. Permeability is found to be decreasing in the case of soil treated with terrasil.
- iv. All the studies concludes that the CBR value of soil get increased with addition of terrasil.
- v. Load controlled cyclic triaxial strength of soil indicates there is gradual reduction of deviator stress due to the buildup of excess pore water pressure in CL soil but the soil treated with 0.041% terrasil performance is good as it shows higher values of extension and compression which results in reducing the early period of liquefaction with number of cycles while soil will liquefy early during seismic forces as per the literature study.

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- vi. The UCC strength of soil mixed with optimum dosage of 0.07% terrasil chemical is improved about 441% higher than the strength of clay soil. This improvement may be possible due to the reaction of the chemical with the soil particles and as a result it water proofs the surface.
- vii. The effect of terrasil chemical on improvement of CBR is much effective in the presence of cement. This indicates initially the soil should be mixed with cement and then introduce the terrasil solution.

5. FUTURE SCOPE:

As per the above literature reviews and study the soil properties can be modified by the help of a nanochemical called terrasil. but it is found that terrasil alone is not that much beneficial to make it of full use terrasil must be added with some co-stabilizing agent like cement, zycobond (another nanochemical),etc. Terrasil along with ce,ent is commonly used in many of the research works. My suggestion is that terrasil along with lime can be used for the purpose of enhancement of soil properties espically for weak soil, the expected result are as follows:-

- i. The California Bearing Ratio (CBR) value is expected to be improved by the addition of terrasil and cement to the soil in right proportion.
- ii. It is expected that increment in dosages will resulted in decrement of consistency limits. So that the chemical may makes the soil stiff.

- iii. It is also expected that UCS strength increases with increase in dosages of terrasil to the soil.
- iv. It is also expected that soil may become impermeable completely.

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