

Influence Of Chemical Additive In Modification Of Subgrade Soil For Pavements

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Abstract— The root of far reaching soil is identified with a perplexing mix of condition soil forms that outcome in the development of clay mineral demonstrating a specific chemical makeup which, when in contact with water, will expand.. Increment in traffic activity alongside heavier size of wheel loads cause quick deterioration in pavements built over such soils. There is a critical need to go for the enhancement of designs to make road infrastructure financially cost effective and ensuring sustainability, especially as to utilization of vast material resources is getting increasing. Soil stabilization is the method to enhance the feeble soils and making them to meet certain prerequisites of the particular designing ventures. At first the examination of soil is done to assess the physical and engineering properties according to Indian Standard classified as CL (Clay soil having low plasticity) conducting so as to accord to Indian Standard (1498 – 1970) lab tests and to assess the properties utilizing the standardized procedure according to the protocol of Zydex industries, Vadodara by the addition of suitable proportions of Terrasil, Zycobond & PPC (blend) as stabilizers to be utilized as a part of sub grade soil pavement design and economy.

Keywords: PPC, Soil Stabilization, Stabilization, Strength, Terrasil, Zycobond

I. INTRODUCTION

India is a developing nation and may confront different difficulties to manage huge highway ventures for short conceivable time. India confronts fast populace development and industrialization created the utilization of transportation office to convey heavy commercial vehicle loads and repetitive applications of it thereby producing heavier stresses on subgrade soil exposed to regular evolving environment. Soil is probably a noteworthy part in development procedure and one of nature's most plenteous development materials having diverse properties which may change from area to area. Adjustment tasks are quite often site-particular, obliging the utilization of standard test routines, alongside central investigation and fundamental analysis, to build up an adequate arrangement by selecting the right stabilizer which oversees the achievement of adjustment. Likewise with any such process, adherence to strict natural requirements is essential to venture achievement. The utilization of chemical stabilization materials as an added substance to regular soil makes a positive commitment to monetary and asset maintainability in light of the fact that it permits upgrade of both standard and substandard in situ soils to levels predictable with the necessities of a given application.

II. OBJECTIVES

A. To study the physical & designing properties of nearby soil prior and then afterward the option by including chemicals in suitable measurements, for example, PPC, Terrasil, Zycobond or a blend of these by leading lab tests essentially consistency limit, Atterberg limit, standard proctor test & CBR value.

III. Literature Review

A number of researchers have worked in developing different methods of soil stabilization, which are practical and economical:

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.

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.

B M Lekha S Goutham, A U Ravi Shankar – (2013) in his work on " Fatigue and Engineering Properties of Chemically Stabilized Soil for Pavements" expresses that the conduct of Black Cotton (BC) soil with and without adjustment was contemplated. A chemical named Terrasil was utilized as stabilizer and it was utilized for distinctive measurements and cured for 7-28 days. Due to the compound response, the soil mass densifies by minimizing the voids in the middle of particles and it make the soil surface impermeable. The vital geotechnical properties of soil were resolved in the research facility. It is noticed that CBR qualities increment with the increment in rate of stabilizer. Penetrability is observed to be nil for treated soil. It makes the dirt impermeable totally. The XRD and SEM investigation led for the soil examples were not ready to legitimize the change for balanced out so. The study implies that addition in measurements of Terrasil as a stabilizer brought about decrement of consistency cutoff points. So it is clear that the substance makes the soil solid. It is noticed that CBR qualities increment with the increment in rate of stabilizer. The perception record expresses those UCS quality increments with expansion in dose of stabilizer and curing period.

Ibrahaim M.A. Moafaq, A.A. Abdulrahman, H.A. (2011) – in his study on "Long haul Quality and Durability of Clayey Soil stabilized with Lime" goes on that durability characteristics of clayey soil settled with lime were controlled by coordinating tests contains UCS for tests with the perfect lime percent (4%), and subjected to cycles of the WD, dry-wet and FT durability tests and moreover, long haul soaking and slake test.

Grytan sarkar, md. rafiqul Islam, Muhammed alamgir, md. Rokonzaman (2012) - "Study on the Geotechnical Properties of Cement based Composite Fine-grained Soil". In this study, the expansion of cement was found to enhance the designing properties of accessible soil in settled structures particularly quality, workability, and compaction and compressibility attributes. Thusly, lab tests, for example, compaction, Atterberg limits, unconfined compressive quality, direct shear and union tests for distinctive rates of concrete substance and unique soil tests were performed. These test outcomes demonstrate that the dirt can be made lighter which prompts diminish in dry thickness and increment in dampness content and decreased compressibility because of the expansion of bond with the dirt. Other than that the unconfined compressive quality and shear quality of soil can be improved with the expansion of 7.5% of bond substance.

IV. MATERIALS

Following are the materials which are to be used in this study.

A. Soil

In this study, the soil under scrutiny is gathered from Nadiad (Latitude 22.70000 N & Longitude 72.87000 E), Gujarat where the road is going to pass, Ahmedabad to Vadodara NH8. At first, so as to distinguish the wide soil sorts in the field with no research facility testing, a visual characterization is done, which demonstrates that soil under scrutiny is brown in shading, further examination is completed with water to make a paste and rubbed in the

middle of fingers leaves a stain which is not watched for residues. When it is wet it doesn't get to be dry soon. In like way, display swelling and shrinkage and are described by a typical shrinkage pattern.

B. Terrasil

Terrasil nanotechnology is 100% organosilane, water-solvent, Uv and warmth steady, receptive soil modifier to waterproof soil sub-grade. TERRASIL is anything but difficult to utilize and safe to handle item that renders treated soils very water repellent. Terrasil conveys demonstrated results with a wide range of soils and doesn't modify their appearance. Terrasil is a think that blends with water. Once connected, it attempts to bond with the soil's silica and oxygen atoms. This implanted synthetic response makes the treated soil 98% water safe. The holding procedure starts inside of 3 hours of the beginning application till the procedure is finished (72 hrs.), Terrasil turns into a changeless piece of every soil particle and won't separate or filter into groundwater.

C. Zycobond

Zycobond is acrylic co-polymer scattering for holding soil particles and bestowing to soil disintegration and dust controls resistance, it is blended with Terrasil arrangement and showered on compacted soils. Use consistent soil to cover the treated slopes and build shoulders. For additional tying of the side slopes blend Zycobond with Terrasil solution.

D. Portland Pozzolona cement (PPC)

Portland bond is a multi-mineral compound made up of oxides of calcium, silica, alumina and iron. At the point when cement is blended with water, solidifying mixes of calcium-silicate-hydrate (CS-H) and calcium-aluminate-hydrate (C-A-H) are shaped and over abundance calcium hydroxide is discharged. Some calcium is along these lines accessible to respond with the soil molecule right on time in the change process when the water is included, and extra calcium gets to be accessible later as it structures amid concrete hydration. The hydrates help to balance out flocculated earth particles through cementation. The hydration responses and quality increments happen generally between 24 hours and 28 day

V. TEST RESULTS

Various tests were performing for identify the Engineering property of soil as per Indian Standard are as below:

A. Properties of Clayey Soil with and without Additive

Comparative Graph for CL Soil and Terrasil (0.041%) + Zycobond (0.020%) + PPC (1%):

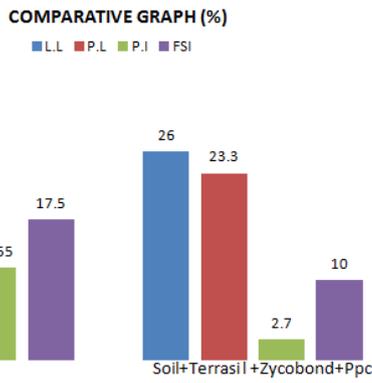


Fig. 1. Water Content – Dry Density Relation Using Heavy Compaction:

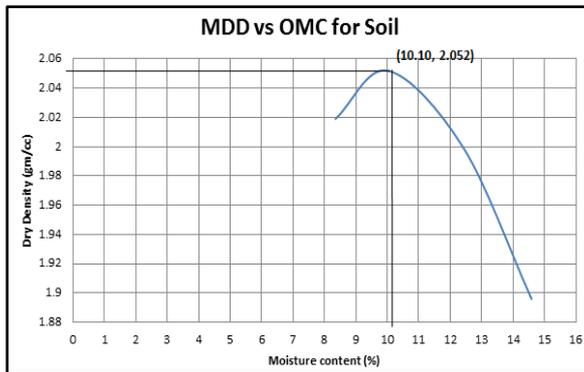


Fig. 2. MDD vs OMC for Soil

The California Bearing Ratio (CBR) tests were performed on soaked specimens for modified proctor densities. The specimens were set for curing beneath the halogen lamps for four days in climatic condition according to protocol of Zydus research center, Vadodara before testing. After the predefined curing was over, the CBR molds were taken out and tested.

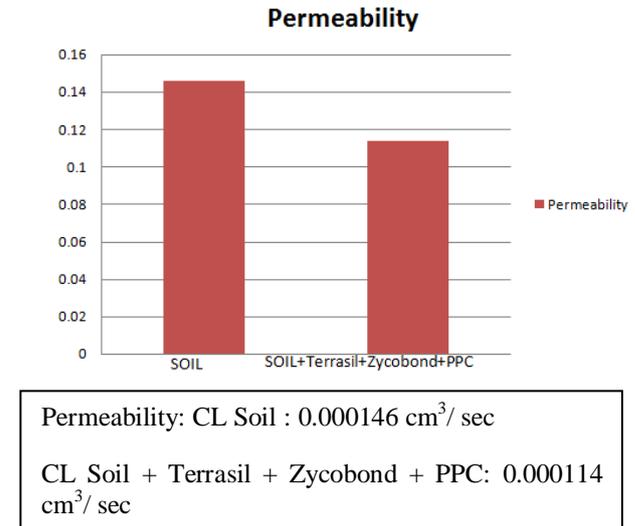
Table 1. CBR Test Result with and without additive:

CBR Value at St. Penetration 2.5 mm and St. load 1370 Kg		
Sample	CL Soil	CL Soil + Terrasil + Zycobond + PPC
Load at 2.5 mm	78	257.40
CBR Value (%)	5.69	18.79
CBR Value at St. Penetration 5 mm and St. load 2055 Kg		
Sample	CL Soil	CL Soil + Terrasil + Zycobond + PPC
Load at 5 mm	136.5	448.5
CBR Value (%)	6.64	21.82

The outcomes of CBR of 5 mm penetration CL soil are 6.64% and CL Soil + Terrasil + Zycobond + Cements are

21.82%. CBR of 5 mm penetration quality is taken for design as results are reiterated. It is evident that CL soil treated with Terrasil + Zycobond + Cements renders upgraded thickness values by lessening the void extents. This penchant may be a direct result of practical alert exchange process which all things considered takes longer period without such stabilizers. The low CBR of the CL soil is credited to its innate low quality which is because of the strength of the clay fraction.

Fig. 3. Laboratory Determination of Permeability test result for Soil with and without additive in cm³/sec (IS: 2720 (part 17)-1986)



Fabric or auxiliary course of action of particles is a vital soil trademark impacting porousness. It is obvious that porousness of CL soil changed utilizing terrasil + zycobond + cement are diminishing as the particles turns out to be near one another. This is because of synthetic response reaction between soil + 0.041% terrasil+0.020% Zycobond + 1%PPC prompts changing so as to endure siliconization of the surfaces over the water valuing silanol social occasions to water repellent siloxane bonds and this made the clayey soil waterproof.

VI. CONCLUSION

In the present examination, investigations were directed to balance out the inorganic clay with Terrasil (0.041%) + zycobond (0.020%) +1%PPC according to Zydex commercial enterprises test convention so that the engineering property of clayey soil is improved. The accompanying crucial conclusions are gotten from the study.

- The liquid limit of the CL soil decreases with the addition of stabilization additives. The relative decrease in the plasticity index of the soils is another favorable change since it increases the workability of these soils.
- FSI value of treated soil reduces to considerably compared to CL soil. This is because the film of adsorbed water is greatly reduced for treated soil and the surface area reduces, resulting in decreased swelling capacity.
- Permeability test results indicate that, as the treated soil considerably decreases. This may be due to chemical reaction which leads to permanent siliconization of the surfaces by converting the

water loving silanol groups to water repellent siloxane bonds.

- Comparing CBR value of untreated CL soil and same treated with Terrasil (0.041%) + zycobond (0.020%) +1%PPC indicates it rise from 6.64% to 21.81%. This signifies such stabilization technologies optimizes the potential improvements to strength of pavement foundation thereby increasing the load carrying capacity of pavement. From economy point of view benefit associated with the utilization of Terrasil (0.041%) + zycobond (0.020%) +1%PPC is attractive and supports the sustainable development in road construction.

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