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SOIL STABILIZATION BY PROTEKTA RGS 300

Irfan Manzoor
Research Scholar
Deptt. of Civil Engg., Galaxy Global Group of Institutions, Ambala
Email: sirfan205@gmail.com

Er. Abhishek
Assistant Professor
Deptt. of Civil Engg., Galaxy Global Group of Institutions, Ambala
Email: abhishek@galaxyglobaledu.com

Rubel Sharma
Assistant Professor
Deptt. of Civil Engg., Galaxy Global Group of Institutions, Ambala
Email: rubel@galaxyglobaledu.com

Abtract: Soil development implies the different methods which progress the load hauling ability of soil. Soil improvement in soil also includes the changes in properties like raise in stability, alter or enhancement in density and enlargement behavior, change in chemical properties and water proofing properties. By way of Soil Stabilization techniques the strength of nearby available substance, which if not is low, can be enhanced to the preferred level. Further over by resources of these techniques nearby obtainable substance can be worn in a variety of construction method like sub grade material. Such operation of locally obtainable substance will assist to reduce the transportation price, which alters on the whole cost of a plan. Soil Stabilization or in new terms the bearing ability enhancement of soil can be conceded out by via compaction techniques, proportioning of subgrade substance and calculation of appropriate ingredient agent. Depending on these basic definitions a variety forms of conventional soil improvement techniques are accepted around world in geotechnical organization.

1.0 Introduction

Soil improvement becomes a requirement at a site wherever the potency of nearby obtainable stuff is not adequate. Appropriate soil stabilization techniques should be used at such place to get better potency of the soil. In the present effort, potency characteristic have been considered for nearby existing extremely plastic clay treated with unusual dosages of a chemical RGS-Protekta 300. A sequence of Unconfined compression tests be conceded out to ascertain the effect of chemical on strength of the soil at various dosages and after curing period of 7, 14 and 28 days. The most favorable dosage of chemical viewing a marked development in the strength properties of soil is obtained.

Stabilization of the base layer with Fly Ash, Lime, cement etc. has made traditional designed roads very strong with good longevity, notwithstanding, the good properties of traditional designed roads, very little progress has been made during the last 100 years to utilize technology in reducing costs associated with bringing in borrow-pit or quarry materials for road construction. Researcher around the world has optimized these traditional for most of the soils. Traditional stabilizers have various advantages and disadvantages associated with them.

Various patented chemicals like polymer stabilizer are gaining popularity these days due to so many advantages associated with them over conventional stabilizer. Polymeric materials are characterized by long chains of repeated molecular units and give the plastic an amorphous structure having good impact strength and toughness.

2.0 Literature

majority of the patented chemicals are environmental friendly and green products. use of these chemicals stabilizer decreases the construction time substantially. such patented chemicals reduced the requirement of quarry material in road construction which further reduce the cost of construction.

experimental study has shown that soil after treatment with these chemicals, exceeds all strength parameters of standard code of practices. In India researcher has studied the effect of various such chemicals on strength properties of soil.

Greeshma Nizy Eujine, Dr. S. Chandrakaran, Dr. N. Sankar et. Al (2014) studied the effect of Terrazyme on Loam soil and concluded that chemical alters the hydrophilic nature of clay materials to hydrophobic and rendered the clay minerals inert to the water. The chemical has a significant effect on atterberg limits of soil and plastic limit and liquid limit showed an appreciable reduction. A significant improvement in unconfined strength of soil was also observed.

Purnima Bajpai (2014) studied the various benefits associated in the construction using Terrazyme and concluded that Terrazyme stabilized subgrade is not only economic but the stability of subgrade is also better or comparable to the conventional subgrade.

Puneet Agarwal, Suneet Kaur (2014), investigated the effect of Terrazyme, a Bio-enzymatic soil Stabilizer, on UCS of black cotton soil. UCS value of soil showed an increment of up to 200 percent when treated with Terrazyme. Chemical gave best result after a curing period of seven days.

Er.Tejinder Singh, Er. Navjot Riar (2013) studied the effect of RBI Grade 81 on strength parameters of a locally available with 62.5 percent of silt and clay and found that the chemical reduces the plasticity Index of soil and has a marked effect on the CBR value of the soil. The dosage of the chemical which is economic for that soil sample was also suggested.

K.V. Madurwar, P.P. Dahale et.al.(2013), compared the effect of RBI Grade 81 and sodium silicate on engineering properties of expansive soils. The engineering properties considered in this study are Atterberg's limit, Compaction, California Bearing ratio (C.B.R), Unconfined Compressive Strength (UCS). Curing of samples was done for 7 days, 14 days and 28 days. Liquid limit and plastic limit showed a decrease with increasing percentage of RBI Grade 81 but the same properties showed an increase with increasing percentage of sodium silicates. Swelling Potential of soil mixed with RBI Grade81 decreases by 83 percent while swelling potential of soil when mixed with sodium silicates showed an increase of about 166 percent. It indicates that sodium silicates are not effective as soil stabilizer in case of expansive soil. Unconfined compressive strength initially increases with both the chemicals. As number of days of curing increases, the unconfined compressive strength of samples treated with sodium silicates decreases. The reason behind this decrease may be attributed to immersion of sodium silicates in to water. It also limits the use of sodium silicates as stabilizer. CBR value of soil treated with RBI Grade 81 showed an increase. CBR of RBI Grade 81 treated soil also showed and increase with curing days. In case of sodium silicate CBR value decreases with curing days may be due to the reason as stated above.

Mamta, Mallikarjun, Honna (2014) compared the effect of RBI Grade 81 on Black Cotton soil and Lateritic soil. Curing of samples was done for zero and three days. The engineering properties which were analysed in this study are Atterberg's limits, unconfined compressive strength and CBR value. The consistency limits of both the soil showed a decrease with varying percentage of RBI Grade 81. Unconfined compressive strength and CBR value of both the soil showed a marked increase as comparison to that of the parent soil.

Lekha B.M., A.U. Ravi Shankar (2014), studied the effect of RBI Grade 81 on Black Cotton Soil. RBI Grade 81 was applied in percentage in percentage by weight to the soil varying from 0 prcent to 6 percent. The curing period of 4hour to 28 days was selected for different soil samples. The investigation includes the unconfined compressive strength test California Bearing Radio Test and Fatigue Test. The maximum dry density of soil decreases gradually while optimum moisture content of soil first showed an increase and then it decrease slightly. For unsoaked condition the unconfined compressive strength of soil first decrease after one day of curing but on further curing UCS value increases. CBR value of heavy compacted soil samples after 7 days of moist curing and 4 days of soaking showed an increase with increasing percentage of RBI Grade 81. Fatigue test indicates that the soil stabilized with RBI Grade 81, has an improved fatigue or endurance life. The possible cause of this increase in strength due to RBI Grade 81 is formation of calcium oxides, alumina and sulphate.

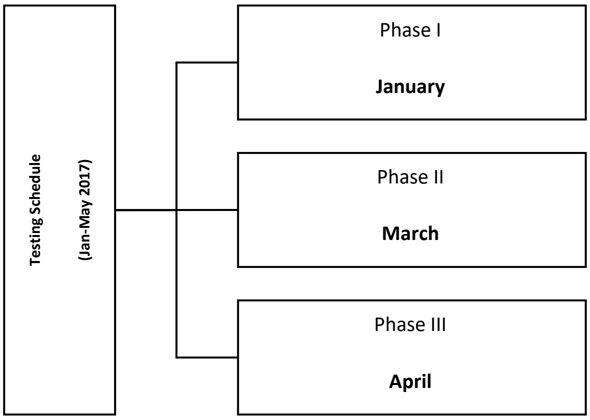
3.0 Proposed Work

3.1 Soil Used

Soil used in the experiments has been collected from a village Nepra, near Rajpura. The soil is classified as intermediate compressible clay, CI, as per IS: 1498(1970). The liquid limit of the soil is determined by reading the water content corresponding to 25 blows on the flow curve. The specific gravity of soil was calculated using Pycnometer as per IS: 2720-(1970). Various index properties of the soil under investigation are reported in table 4.1.

3.2 Chemical Stabilizer: RGS Protekta 300

Protekta RGS 300 has been procured from Tech-Dry (India) Pvt. Ltd., Krishna Temple Road, Indiranagar, Bangalore. It is a chemical, soil stabilizer and strengthener product. It is supplied as a viscous liquid based on a blend of silicates and proprietary chemical that can be spray applied. Its intended use is as a penetrating sealer and surface hardener for soil. It is an odourless chemical and it is completely soluble in water. Solid content in the chemical is about 65 percent.



3.3 Dosage of Chemical

Protekta RGS 300 was applied in the diluted form to the soil. The ratio of the chemical to that of the water is chosen as 1:55, 1:45, 1:35 and 1:25 and three different dosages of the chemical were made. The solution of chemical and water was then used in Proctor Test. Amount of chemical used in 1 liter of water to prepare different dosage is reported in table 4.3.

3.4 Standard Proctor Test

Standard proctor tests have been conducted to determine optimum moisture content and maximum dry density of parent soil and soil treated with Protekta RGS #)) applied various dilutions (chemical dilution=1:55, 1:45, !:35) on to the parent soil.

These tests were conducted so as to prepare specimens at maximum dry density by adding desired optimum moisture content as per specifications of IS: 2720 (Part7)(1974). The results of Standard Proctor Test have been reported in Table 4.5 and Graph 4.1 to Graph 4.6.

4.0 Sample Preparation

4.1 Composition of Specimens

Specimens of parent soil and soil treated with Dosage 1,2,3 and 4 of RGS Protekta 300 were prepared at maximum dry density and optimum moisture content as per IS:2720 (Part 7) (1974).

4.2 Mixing

Soil was dried in the oven. Chemical RGS Protekta 300 was mixed in water at appropriate proportion to prepare Dosage 1, 2, 3 and 4 of chemical. Sufficient quantities of these Dosages were added in to the oven dry soil to bring the optimum moisture content to the desired level. The mixture was then mixed thoroughly with a spatula. All the specimens were kept in polythene bags for maturing for three days.

4. 3 Compaction

4.3.1 For Unconfined Compression Test : Cylindrical specimens will be compacted by static compaction in 3.81 cm diameter and 7.62 cm high mould. The inner surface of the mould will be smeared with mobile oil (of low velocity which does not affect the property of sample) so as to extrude the sample from mould with minimum disturbance. The wet homogeneous mixture will be placed inside the specimen mould in seven layers using spoon, leveled and gently tap-compacted by 1 cm diameter ram. Pressure pad will be inserted into the mould and the whole assembly will be statically compacted in loading frame to the desired density. The sample will be kept under static load for not less than 10 minutes in order to account for any subsequent increase in height of sample due to swelling. The sample will then be removed from the mould with the help of sample extruder.

5.0 Testing Program

A series of unconfined compressive strength tests after a curing period of 7, 14 and 28 days will be conducted to determine the shear strength characteristics of untreated soil and soil treated with different dosage of RGS Protekta 300 to evaluate the effect of RGS Protekta 300 on shear strength of the soil at different curing period. These characteristics will be illustrated by establishing the relationships between resulting axial stress and applied axial strain in strain controlled tests. Unconfined compressive strength determined as peak strength value and respective failure strain will be calculated from the observations taken during the tests.

5.1 Unconfined Compressive Strength Test

5.1.1 Apparatus Used: Strain controlled tri-axial apparatus will be used to conduct unconfined compressive strength tests to determine the shear strength and deformation characteristics of untreated soil and soil treated with different dosage of RGS Protekta 300. For conducting Unconfined Compressive Strength Test, triaxial cell is not filled with water so that there is no confining pressure, and axial stress is applied to fail the specimen.

1. Strain controlled tri-axial test apparatus.
2. Strain controlled mechanism consisting of strain setting lever and turret level for inducing axial strains in the sample at rates varying from 0.02 mm/minute to 1.00 mm/minute.
3. For measurement of compressive stress taken by the sample, 250 kg capacity proving ring with ring constant of 0.176 kg/division.
4. Load gauge installed in proving ring with a least count of 0.002 mm.
5. For measurement of vertical deformation in the sample, deformations dial gauge with a least count of 0.01 mm.

5.1.2 Procedure : The Remoulded sample will be placed on the pedestal of the tri axial ell with non-previous disc at the top and bottom. A loading platen will be placed at the top which is connected through loading piston to the proving ring. The axial strain rate is chosen as 1.0 mm/minute by appropriate setting of turret lever and train setting lever. The compressive stress taken by the sample will be recorded at various strain levels. At failure, peak compressive stress will be noted as unconfined compressive strength and failure strain will also be recorded. The results of unconfined compressive tests have been reported in Table 4.6 and Graph 4.7 to Graph 4.22.

5.1.3 Precautions

1. The specimens should be handled carefully to prevent disturbances, change in density or loss of moisture.
2. Two ends of the specimen should be perpendicular to the long axis of the specimen.
3. The seating of the sample should be proper on the upper and lower plates.
4. The strain should be induced in the specimen at a constant rate and perpendicular to cross-sectional area of the sample.

6.0 Test Results And Discussions

The objective of the present study is to investigate the strength characteristic of locally available clay treated with different dosage of RGS Protekta 300. This has been done to make the soil suitable for construction of subgrade over it. Shear strength of soil treated with chemical is analyzed by unconfined compressive strength tests A series of unconfined compressive strength test is carried out after an air curing of 7,14 and 28 days of sample preparation to study the effect of chemical on strength properties with passage of time. The

Results of these tests have been analysed under the following headings.

6.1 Moisture Density Relationship: Standard Proctor Test have been conducted to determine the optimum moisture content(OMC) and maximum dry density (MDD) of soil under investigation, stabilized with various dosages of chemical stabilizer RGS Protekta-300. Graph 5.1 and Graph 5.2 shows the comparison of MDD and OMC for soil under investigation stabilized with various dosages of chemical stabilizer.

For parent soil OMC and MDD have been observed as 1.59 g/cc and 24% respectively. The Optimum Moisture content (OMC) of soil treated with various dosages of chemical stabilizer first increases from 23.5% of parent soil to 25.5% at Dosage 2. On further increment of chemical dosage the OMC of treated dosage the OMC of treated soil decreases up to 23.9%. It has been observed that OMC of treated soil varies slightly as compared to the OMC of parent soil. Moreover a general specific trend is not seen in the variation of OMC of treated soil. It can be said that as the time taken to complete the standard proctor test is very less and this time is not sufficient for chemical reactions to complete so OMC of treated soil remain more or less similar to that of the parent soil.

Maximum Dry Density of parent soil is 15.95 KN/m^3. The MDD of soil decreases with increase in Dosage of chemical up to Dosage 2.At Dosage 3, MDD increases slightly and it further decreases slightly at Dosage 4. In general it can be said that MDD of treated soil decreases slightly with the increase in the chemical content in the dosage. The possible reason of this decrease in the value of MDD is the formation of some new chemical product after reaction between lay mineral and chemical.

6.2 Unconfined Compressive Strength: The stress strain relationship of chemically treated soil (Treated with RGS Protekta 300) has been determined from unconfined compression tests. The results of unconfined compression test have been shown in graph no.5.3 to graph no.5.6; the percentage increase in the unconfined compressive strength of soil after various days of air curing has been reported in table no.4.7.For Parent soil, the unconfined compressive strength value has been determined as 0.5 kg/cm^2 at a peak failure strain of 0.034.It has been observed that 7 day unconfined compressive strength of soil treated with RGS Protekta 300 vary from 0.5 kg/cm^2 to 1.63 kg/cm^2 with increase in the chemical content from dosage 1 to dosage 4. The value of strain at failure varies from 0.034 to 0.052 with increase in chemical content from dosage 1 to dosage 4.It has been observed that 14 days unconfined compressive strength of soil treated with RGS Protekta 300 vary from 0.5 kg/cm^2 to 1.6 kg/cm^2 with increase in the chemical content from dosage 1 to dosage 4. The value of strain at failure varies from 0.041 to 0.060 with increase in chemical content from dosage 1 to dosage 4.It has been observed that 28 days unconfined compressive strength of soil treated with RGS Protekta 300 vary from 0.5 kg/cm^2 to 1.8 kg/cm^2 with increase in the chemical content dosage 1 to dosage 4. The value of strain at failure varies from 0.034 to 0.055 with increase in chemical content from dosage 1 to dosage 4.It has been observed that unconfined compressive showed a general increase as the chemical content in the treated soil increases from dosage 1to dosage 4 indicating the improvement in the strength properties of treated soil. The value of unconfined compressive strength treated with RGS Protekta 300 is greater to that of the parent sol at every dosage of chemical. Highest value of unconfined compressive strength has been observed as 1.8 kg/cm^{2}after 28 days of sample preparation. The value of strain at failure increases marginally as the chemical content in the treated soil increases from dosage1 to dosage4.

In general it can be summed up that greater unconfined compressive is obtained in soil treated with RGS Protekta 300 at a marginally higher failure strain. This trend confirms that the addition of Protekta 300 as a stabilizer improves the strength properties of soil.

7.0 Conclusions

1. The study demonstrates the influence of RGS Protekta 300 on strength properties of locally available clay with intermediate plasticity. The following conclusions can be drawn based on the investigations carried out during the study:
2. The chemicals used in soil stabilization are turning out a boon for developing countries as they help in expediting the process of road construction. Many of the chemicals discussed above are Bio-Enzyme and organic in nature. Such organic chemical poses no threats to environment.
3. The use of these chemicals can decrease the quantity of aggregates required in road construction. In some projects, like rural roads even aggregate free roads are possible by using the appropriate amount of such chemical stabilizer. Other than the main function of strength improvement, some of these chemicals are also effective in improving the subsidiary properties of the soil. For example chemicals are also being used as dust controller.
4. In general it can be said that Maximum Dry Density (MDD) of treated soil decreases slightly with increase in the chemical content in the dosage. It has been observed that Optimum Moisture Content (OMC) of treated soil varies slightly as compared to the OMC of the parent soil. Moreover a general specific trend is not seen in the variation of OMC of treated soil. It can be said that as the time taken to complete the Standard Proctor test is very less and hence not sufficient for chemical reactions(between clay minerals and stabilizer) to complete so OMC and MDD of treated soil remain more or less similar to that of the parent soil.
5. The unconfined compressive strength of soil treated with RGS Protekta 300 increases significantly with increase in chemical content from dosage 1 to dosage 4. The value of unconfined compressive strength treated with RGS Protekta 300 is greater to that of the parent soil at every dosage of chemical. Highest value of unconfined compressive strength has been observed as 1.8 kg/cm^2 at Dosage 4, after 28 days of sample preparation.
6. The value of strain at failure showed a marginal increase as the chemical content in the treated soil increases from Dosage 1 to Dosage 4.

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