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Stabilization of Soil Using Cement : A REVIEW

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ABSTRACT

When we are using soil for any construction work , such as subgrade in pavement ,or a foundation in building ,then there arises a need that a soil is to be stable, means the soil should able to withstand the stresses coming on it. When the work is done on granular soil (Garvel, sand or silt ,with little or no clay) then there occurs some problems, Granular soils are usually those type of soil which have low density and they also don't have sufficient strength.So to solve this problem , we are using the cement as a stabiliser , which when mixes with the soil in some definite proportions, then there is a considerable improvement in the properties of soil.

Keywords- Granular soil, cement, compressive strength, fineness, gradation, cement,w/c ratio.

INTRODUCTION

Stabilization is the process of altering or changing the properties of soil,in a manner that the soil will be able to take the required stresses ,without any failure.The soil- cement stabilization is the process of stabilising the soil by adding cement to it .The soil which is most suitable for stabilization by cement is Granular soil. Granular soil are those types of soil which have usually Gravel, sand and silt particles ,with little or no clay content ,The soil is mixed with definite proportion of of cement ,so to achieve the required strength and other properties of soil.

The proportion of cement should be such that it should not become uneconomical, and also it should give the required parameters. The soil stabilization by the cement is of various types ,depending upon the properties of soil taken ,for examples- the percentage of cement varies from 5-14% for normal soil cement, whereas it is less than 5% for cement modified soil. As it is stated above , it is usually used for Granular soils ,that are pulverised. However the granular soils which have little clay content, can also be stabilized using cement, but it should also be kept in mind in case of granular soils which have greater clay proportion ,will requires the greater amount of cement. The reason behind using the cement in stabilization of cement lies in the fact that granular soils have low density, and their particles are bulky or circular than clay particles , they both have nearly same structure but ,the difference occurs in densities, granular soils have less density, when little amount of moisture is added to such soils then the density increases ,but their molding is still difficult, and when it become dry, then it again crumbles or we can say that the density decreases.

The variation of quantity of cement utilised in stabilization process depends upon several factors, the very first factor is the type of soil, if the soil is well graded then the soil requires about 4-5% of cement, but if the uniform sand is taken then quantity of cement increases to about 12-14%.

The next factor is water cement ratio, as we know that the strength of cement decreases with increase in water content , therefore for attaining higher strength the w/c ratio should be low.

PRINCIPLE OF SOIL STABILIZATION

Stabilization involve various methods of improving the properties of soil an d enhances the engineering property . here cement is used for this purpose. Soil properties such as liquid limit , plastic limit, always changes with the varity of soils. It also help to improve the sub grade for road constructions, embankment etc.

SCOPE OF SOIL STABILIZATION

Its is an important industrial practices involve in constructions fields such as roads constructions. Its alters soil property like shear strength, prevention of shrinkage and swelling due to moisture & others agents. The admixtures enhances the soil cement property. Scanning electron microscope / X-rays diffractions studies should be carried out . Further

studies are done to find the property of adsorption of soil mixtures . metals like lead , cadmium , mercury , zinc , magnesium etc, effect the adsorption property.

CEMENT STABILIZATION – Its is done by mixing the pulverised soil and Portland cement with water and compaction is done of the mix. Its attains the strong Material . The material obtained by mixing soil and cement is known as ***SOIL – CEMENT***. The soil cement becomes a hard and durable structural material as the cement hydrates and developes strength.

TYPES OF SOIL CEMENT –

1) Normal – soil cement , 2) plastic -soil cement , 3) Cement-modified soil

FACTORS AFFECTING CEMENT STABILIZATION –

1) **Types of soil -** Granular soil with sufficient amount of fines pores are ideally suited for Cement stabilization. The quantity of cement increases in silty and clayey soils . if there is a presence of organic matters ,it form a colloidal form the data interfere Hydration of cement.

2) **Quantity of cement** – Well graded soil requires 5% cement, poorly graded , uniform graded sand requires about 9% cement . Non plastic silts requires about 10% , clays about 13%.for the base course samples are subjected to Durability tests for the determination of the quantity of the cement required .it consist of 12 cycles of freezing and thawing or 12 cycles of wetting and drying . high strength is obtained by decreasing the water - cement ratio.

3) **Quantity of Water -** Water must be taken in the sufficient for Hydration of cement and silty – clay soil cement make its workable . water must be clean , free from salts , alkalies , acids and organic matter.

4) **Mixing , Compaction and Curing -** The mixture of soil , cement , and water should be thoroughly mixed, the success of stabilization depends on this . after the Hydration started the mixing must be stopped , otherwise its result in loss of strength.

5) **Admixture -** To increase the effectiveness of cement as stabiliser , admixtures res are added . its permits the reduction in amount of cement required. Lime and calcium chloride are used as admixtures for clays and soils . sodium carbonate and sodium sulphate is also used sometimes.

CONSTRUCTION METHODS-

1) **Mix in place method -** In this sub grade is cleared from boulders , debris etc and being levelled . the sub grade is scarified to the proposed depths .the levelled sub grade is pulverised till atleast 80% of the soil process 4.75 mm IS sieve .it can be done by machine or manually. pulverisation is done by 4% of cement is added to soil. at the last the quantity of cement is spread uniformally over the surface . its is then mixed dry with rotary tillers or special soil mixers .the quantity of water is spread over the sub grade. the operation must be for 3 hours .The surface is graded using Tower graders . compaction is done for 2 hours. The compacted soil is cured for the atleast 7 days by providing bituminous primary coats , the light water is sprayed .the main disadvantage is that is that mixing is done at uniform rate and high strength cannot be achieved.

2) **Plant mix method -** There are two types plants used in plant – mix methods = a) stationary plant , b)travelling plant

- **Stationary plant -** In this method ,the excavated soil is transposed to a stationary plant located at a suitable place .The required quantity of cement is added to the soil in the plant .Mixing is done after adding water The time required to obtain a uniform mix depending upon the the soil type .The mixed material is then discharged into dumper trucks and transported back to the subgrade .It is spread and properly compacted .The stationary plant is useful for obtaining a uniform mix .In this method ,the depth of treatment can be controlled .However ,the method is quiet expensive as compared with mix-in method .The material has to be compacted as delivered and not as a complete section of the road .A further disadvantage is that the work may have to be stopped even after a minor breakdown in the plant .

- **Travelling plant** - A travelling plant can move along the road under construction .The soil ,after placement of cement over it , is lifted up by an elevator and discharged into the hopper of the mixer of the travelling plant . Water is added and proper mixing is done .The mix is then discharged on the subgrade and spread over by a grader .It is then properly compacted .The travelling plant method , like the stationary plant , is useful for accurate proportioning and uniform mixing .The depth of treatment is also controlled and uniform subgrade is obtained , but cost is high

SOIL STABIIZATIONING EQUIPMENTS

1.CASAGRANDE ,**2.**TEREX ROADBUILDING RS445C RECLAMIER STABLZER, **3.**ROADTEC ,**4.**TEREX ROAD BUILDING,**5.**CATEPILLAR RM- 300 AND RM -500 ,**6.** BOMAG MPH122-2, ROADTEC SX-7

METHODOLOGIES

In any road construction, mechanical method conducted by compacting the soil through rollers, and chemical method includes utilisation of fly ash, lime, cement, etc. In chemical method two types of additives used at the time of stabilization of soil. First one is mechanical additives and the second one is chemical additives. As a mechanical additives **cemen**t used and its main function is to alter the soil property mechanically by adding an optimum quantity, thereby to improve the soil bearing capacity. In laboratory stabilization using cement was conducted in 3 steps.

- A mechanical additives and the second one is the chemical additives are used. the cement is used and the main function is to alters the property of soil mechanically by adding the optimum quantity , hence improves the soil bearing capacity. In laboratory stabilization using cement was done in 3 steps . In step one a sample is was prepared after that left in the air to dry and the dried sample is put into the oven at 1000 C foe one day. Remove the soil from the oven and crushed the sample using the crushing machine.
- In the second step , optimum quantity of cement is added to soil , stabilization process determines with the help of Ph -test .

- In the third step , cement stabilized sample prepared by the compacting it at a maximum dry density and the OMC , MDD, & OMC of specimens are obtained using Modified proctor test.

Physical properties of the soil determined and presented in Test to be performed before soil stabilization are a **Liquid limit** (LL), **Shrinkage limit** (SL), **Plastic limit** (PL), **Plasticity index**, **Maximum dry density** (MDD) , **OMC** , **CBR** value and **Bearing capacity.**

After the soil is been stabilised there is he enhancement of the property of soil - **liquid limit** (45- 48 %) , **plastic limit** (24 -27%) , **plasticity index** (10 - 18%), **shrinkage limit** (20-25%) , **gravel** (2- 3%), sand (46-52%) , **clay** (21-24%), **OMC** (11-14%) .

DE-MERITS OF VARIOUS STABILIZERS USED

At last, the major parts of stabilization of soil includes that using of cement or calcium-based stabilizers is always economically feasible as well as, it is also used to increase the strength of soil. The various problems of shrinking/swelling of the subgraded soil which are generally used for the Engineering purpose is also been resolved upto a great extent. Stabilization of soil has its both of the merits and demerits which are been discussed earlier, but summarizing a brief of it. If we use Cement as stabilizer in soil, then the excessive use can cause cracks in soil cement as well as the enormous gases which are been released can harm the environment. On the other hand, if Lime Stabilization is been used then the excessive use can cause flocculation and agglomeration of soil particles. Due to this the increased pH value can cause pozzolonic reactions with the dissolved silica and alumina. The number of disadvantages therefore changes the importance of lime to Magnesium Oxide. Cement and lime are not only the stabilizers used for providing various properties in the subgraded and normal soil but the other stabilizers are:- Bitumen, Chemical Stabilization, Electrical Stabilization, Grouting, Geo-Textiles and Fabrics, and all this thing are been mentioned in the theory earlier thus making the reader understand what are the various advantages and disadvantages of them. While using cement, as it is the most common used stabilizers till now, we need to check various times in soil whether the soil is reached upto a marked limit or not. Generally, the hit and trial method where the test is been performed on a small quantity of cement multiple times.

IMPACTS ON ROAD WORK

Coming to the other major part as we had studied earlier, we know that Stabilization came into action when Highway Engineers have limited sum of financial resources to make a Road Network, and the sanctioned amount for the road construction is not sufficient to bring the quality of soil which has the engineering properties upto the required mark. Thus, stabilizers were used and making the soil fit for purpose. The stabilization also made the government to save the transportation charge and make the locally available soil which are been present nearby the construction fit for the purpose. The use of Industrial Wastes for the use of the low cost construction roads, by various stabilizers are been studied under this project. The various construction procedures which are been used in the stabilization techniques starting from the Mechanical Soil Stabilization, to the Preparation of Soil Subgrade in the shape of crown and grade. Afterwards, the addition of Imported Soils is been done which make the mixing of the materials thus increases the property of the local soils upto some extent. Since, the mixing of soil materials generally do not transfer the properties between them but also the compaction is been done. The Lime Stabilization is been done and makes the soil more usable for the further purpose. Now the Preparation, Curing and the required amount of addition of water is been done to make the soil more consistent for the further use.

CONCLUSION

The various cautions which are been caused with the use of different kinds of stabilizers are been mentioned below:- Firstly, we need to increase only that amount of water in the Lime Stabilization, so that the whole of the lime stabilization is increased by 2% only. Mixing the lime with rotatory mixers is also a great task need to be cautioned. Shape the lime treated accordingly. we also need to cure the lime mixture from 0 to 48 hours, to permit the flow of water and the clay clods accordingly. The curing period for the lime is 7 days. We need to perform the various curing method as well as the various stabilization to provide the protective use of cement in day to day use.

At last, we need to strengthen the soil by the use of stabilization method. The various strengths is totally depend on the choice of stabilizers and the method of stabilization, either Electrical, Mechanical or Cement. Finally the Cement Stabilization is assumed to be the best in the world due to its availability and affordability. It also encourages the use of wastage method and hence its been recommended by the present Geotechnical Engineers, to make the use of the more economical method of soil stabilization and bring it in action as soon as possible.

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