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Stabilization of Soil by Waste Materials: A Review

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Abstract

This paper reviews various methods used for the stabilization of the soil in the past. Paper summarizes the experiments done by the various researchers. As the soil weakness is the major cause of failure or degradation of structures standing on weak soil. A stabilized soil provides good contact between the foundation and the structure. The transfer of load takes place easily if the soil is stabilized. So the stabilization of soil is required and this paper enlightens some techniques and experiments which was used in the past and were found to be correct in increasing the shear strength of soil.

Keywords: *Soil Stabilization, Waste Plastic, Lime, Bitumen, Cement, Fly Ash, Shear Strength, CBR Test*

I. INTRODUCTION

Now days, the major problem in constructing the roads, highways, airports or any other structures is the availability of proper soil conditions. In majority of places in India, the soil is found to be weak in shear strength for construction. So the need of soil stabilization arises. Soil Stabilization is any technique by which we can increase the shear strength of the soil by allowing proper compaction or by adding some chemicals and add mixture to it. There are many ways of stabilizing the weak soil like adding cements, lime, bitumen, blast furnace slag. In this paper, we focused on various methods used in stabilization of soil in the past. In recent studies, it has been found that all the stabilizing agents are proved to be costly. So the major concern in stabilization of soil is the cost reduction.

Then the idea of stabilization of soil by waste material like waste plastic, bottles, canes, polythene bags arises.

Because these are available in abundance in all over the world and it is almost cost free.

II. MATERIALS USED IN THE STABILIZATION OF SOIL

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

1. 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.

2. 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. Lime changes the nature of the adsorbed layer and provides pozzolana action. Plasticity index of highly plastic soils are reduced by the addition of lime with soil. There is an increase in the optimum water content and a decrease in the maximum compacted density and he strength and durability of soil increases.

3. 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. Depending upon the above actions and the nature of soils, bitumen stabilization is classified in following four types: Sand bitumen stabilization, Soil Bitumen stabilization, Water proofed mechanical stabilization and Oiled earth.

4. Chemical Stabilization: Calcium chloride being hygroscopic and deliquescent is used as a water retentive additive in mechanically stabilized soil bases and surfacing. The vapor pressure gets lowered, surface tension increases and rate of evaporation decreases. The freezing point of pure water gets lowered and it results in prevention or reduction of frost heave. The depressing the

electric double layer, the salt reduces the water pick up and thus the loss of strength of fine grained soils. Calcium chloride acts as a soil flocculent and facilitates compaction.

5. Electrical Stabilization: Electrical stabilization of clayey soils is done by method known as electro-osmosis. This is an expensive method of soil stabilization and is mainly used for drainage of cohesive soils.

6. Grouting: In this method, stabilizers are introduced by injection into the soil. This method is not useful for clayey soils because of their low permeability. This is a costly method for soil stabilization. This method is suitable for stabilizing buried zones of relatively limited extent.

7. Geotextiles and Fabrics: Geotextiles are porous fabrics made of synthetic materials such as polyethylene, polyester, nylons and polyvinyl chloride. Woven, non-woven and grid form varieties of geotextiles are available. Geotextiles have a high strength. When properly embedded in soil, it contributes to its stability. It is used in the construction of unpaved roads over soft soils.

8. Waste Plastic: Waste Plastic includes all the non-biodegradable waste such as polyethene, PVC, metals, cans, bottles, plastic bags etc.

III. LITERATURE REVIEW

Many researches has been done in the stabilization of soil. Here we summarized some of them after studying the works done by them. The literature review of the work done by the various researchers are presented below:

Mousa F. Attom , Munjed M. Al-Sharif (2003) carried out the experiments on Soil stabilization with burned olive waste. The conclusion, they found in their results is the addition of burned olive waste will reduce the plasticity of soil, especially when it has a high plastic index.

Mustafa Aytekin and Evin Nas(1998) did the investigation on red, yellow and brown soil. They conducted the studies on stabilization of soil with lime and cement and found that lime is a agent which can increase the shear strength of the soil but if it is added more than 30%, it decreases the compressibility of the soil.

T. D. V. Lakshmi, Dr. M Anjan Kumar, Dr. DSV Prasad, Dr. GVR Prasada Raju(2015) carried out the experiments on stabilization of industrial waste red mud with cement.Red mud is a fine grained Industrial waste dominated byfines with silt sizes as prominent with high specific gravity(2.9) and high percentages of reactive oxides (SiO2, Al2O3and Fe2O3) as 80%.Addition of cement to Red mud increases OMC values and decreases MDD values.

AminatonMarto, Nima Latifi, Houman Sohaei(2013) carried out the experiments on thestabilization of laterite soil using GKS soil stabilizer. GKS is a new liquid soil stabilizer. The results shows that the GKS is a suitable stabilizer for some of the practical project generally undertaken such as in increasing the road bearing capacity.

R. C. Stefanson(1973) carried out the factorial experiment on Soil Stabilization by Polyvinyl Alcohol to find its Effect on the Growth of Wheat. They found the conclusion that Polyvinyl alcohols have been shown effectively to increase the acceptance of simulated rain and to reduce soil loss from some red-brown earths.

JurateKumpiene, Anders Lagerkvist, Christian Maurice(2005) carried out the experiments on Stabilization of Pb and Cu contaminated soil using coal fly ash and peat. They found the conclusion thatsoil amendment with coal fly ash and peat reduced the leaching of Cu and Pb from contaminated soil by an average of 96% and 99.9% in laboratory batch experiments.

R. A. Janzen, C. F. Shaykewich, and Tee Boon Goh(1988) carried out the experiment on stabilization of Residual C And N in soil. Thatstudy demonstrated that in theshort term the properties of the soil and thecomposition of the amendments added to thatsoil influence active SOM dynamics. The datashown in that paper reveals that the clay and SOM contents of thesoils, and also the form of C and N and C:Nratio of the materials added to the soilsinfluence the incorporation of C and N into the active SOM pool. Thus apparent thateffective management of the soil resourcerequires attention to the characteristics bothof the soil and of the materials to be addedto the soil.

Tuncer B. Edil, Hector A. Acosta and Craig H. Benson(2006) carried out experiments on the stabilization of soft fine

grained soils with fly ash. After these experiments they found that CBR of soil–fly ash mixtures generally increases with fly ashcontent and decreases with increasing compaction water content.Soil–fly ash mixtures prepared with 10% fly ash and finegrainedsoil compacted 7% wet of optimum the typical in situ condition typically will have lower resilient modulusthan soil alone compacted at optimum water content.

KhelifaHarichane, Mohamed Ghrici, Said Kenai, Khaled Grine(2011) used natural pozzolana and Lime for stabilization of cohesive soils. The natural pozzolana (NP) used in this investigation was collected from a quarry at Beni-Saf region in the West of Algeria. They observed the results as the plasticity index decreased with increasing lime contents. The maximum dry density of lime stabilized soils decrease with increasing lime content, in contrast with natural pozzolana stabilized soils.

Megnath Neopaney, Ugyen, Kezang Wangchuk, Sherub Tenzin(2012) used various waste materials like plastic mixed with soil and carried out CBR test and found the conclusion that The maximum improvement in CBR is obtained while using 0.5% plastics strips having aspect ratio 3. The CBR value at AR 4 and 0.5% plastic strip decreased. The reinforcement benefit increases with an increase in AR and percentage of strip content up to certain limit, and beyond that it reduces its strength. The maximum CBR value of a reinforced system is approximately 1.70 times that of an unreinforced system.

FUTURE SCOPE

Several researches are done in the stabilization of soil by various stabilizing agents. Many studies are still going on in this field to improve the shear strength of soil. In future, the work can be extended in this field by using waste plastic materials. Because it is not self-decomposable and also pollute the environment if it is not decomposed. Using it in the stabilization of soil, we can achieve two goals, first that we can improve the quality of soil and the second is we can reduce the harmful effects of plastic waste on the environment.

CONCLUSION

After reviewing the above research papers, we found that lime, cement, bitumen are the stabilizing agents which can reduce the plasticity index of the soil. These methods of stabilizing the soil can be used in the variety of the civil engineering applications.

By using plastic wastes, it seems to be an economical method because there is a lack of good quality soil for embankment fills. Yearly, the waste plastic are generated in the mass level and occupied a great space also. So it is necessary to find the solution of this problem. Future work can be extended further in this field.

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