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SOIL STABILIZATION OF ROAD

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ABSTRACT

If good earth is not available at the construction site, it becomes imperative to opt for soil stabilization. Soil stabilization is a process to treat a soil to maintain or improve the performance of the soil as a construction material. The stabilizing agent improves the strength parameters of sub grade of road pavement and leads to strengthening of embankment. The objective of this paper is to review the applications of different stabilizing agents such as lime, fly ash, cement, rice husk, expanded polystyrene geo foam and waste paper sludge for different type of soil.

I INTRODUCTION

General: The soil which contains the silt and clay particles show considerable sign of distress accompanied by loss of strength of the soil during rainy seasons and shrinkage during summer. Black cotton soil is one such type of soil which loses its strength during rainy season due to their expansive behavior. The problems of expansive behavior of soil are as follows (N.B.O. 1962).

a. Expansive soils have high plasticity and compressible when they are saturated.

b. These types of soil have high strength in dry state, becomes soft after saturation. Filling up water into fissures and cracks, accentuates the process of softening causing reduction of shear strength and leading to low bearing capacity.

c. Structure built in a dry season show differential heaving as a result of swelling of soils during subsequent wet season. Restriction on swelling causes swelling pressure, making the structure unstable. This causes structure supported on soils to lift up with the development of cracks.

d Structure built at the end of wet season when the natural water content is high show shrinkage crack and settlement, during dry season. Shrinking cause a downward thrust on the foundation through skin friction thus increasing the foundation load.

Due to these reasons expansive soils need treatment prior to use as an engineering material. These treatments are generally classified into two process, viz. (1) soil modification and (2) soil stabilization. Soil stabilization is the process of blending and mixing materials with a soil to improve certain properties of the soil. The process may include the blending of soils to commercially available admixtures that may alter the gradation, texture or plasticity, or act as a binder for cementation of the soil (IRC:SP:89-2010). Soil modification is the stabilization process in

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which improvement in some property of the soil but does not result in a significant increase in soil strength and durability (IRC:SP:89-2010). Soil properties like strength, compressibility, workability, swelling potential and volume change tendencies may be altered by various soil stabilization and modification methods.

Stabilization is derived by thermal, mechanical, chemical or electrical means. Thermal and electrical is rarely used and less data is available about these two. Mechanical stabilization or compaction is the densification of soil by the use of mechanical energy. By the densification air is expelled from the soil voids without much change in moisture content. This method is used to stabilize cohesionless soils where compaction energy can cause rearrangement and interlocking of particles. But, the techniques are not effective if the soil is subjected to significant moisture fluctuation. The efficiency of compaction may also diminish with an increase of fine content, fraction smaller than 75micron, of the soil. This is because inter particle bonding and rearrangement during compaction. Changing the physio-chemical properties of fine grained soil by chemical stabilization is a more effective form of durable stabilization then densification. Chemical stabilization of non cohesive, coarse grained soil with greater than 50% by weight coarser than 75micron is also profitable if a substantial stabilization reaction achieved in the soil (Dallas and Syam, 2009).

II OBJECTIVE OF SOIL STABILIZATION

a) To increase compressive strength of soil.

b) To improve resistance to softening action of water.

c) To improve shear strength and bearing capacity of soil.

d) To improve the strength of soil against the adverse effects of moisture.

e) To increase the flexibility of soil to bear the wheel loads without deformation and cracking.

f) To allow clay or on other soft soils to be used as sub grade material after treatment.

III STABILIZATION TECHNIQUES

a) Stabilization with port land cement

Portland cement can be used either to modify or improve the quality of the soil into a cemented mass with increased strength and durability. The amount of cement used will depend upon whether the soil is to be modified or stabilized. Cement stabilization is most commonly used for stabilizing silt, sandy soils with small quantities of silt or clayey fractions stabilization of soil with cement has been extensively used in road construction. Mixing the pulverized soil and compact the mix to attain a strong material does this stabilization. The material thus obtained by mixing soil and cement is known as ‘soil cement’. The soil content becomes a hard and

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durable structural material as the cement hydrates and develops strength. The cementing action is believed to the result of chemical reaction of cement with the siliceous soil during hydration.

b) Stabilization with bitumen

Stabilization of soils and aggregates with asphalt differs greatly from cement and lime stabilization. The basic mechanism involved in asphalt stabilization of fine grained soils is a water proofing phenomenon. Soil particles soil agglomerates are coated with asphalt that prevents or slows the penetration of water, which could normally result in a decrease in soil strength. In addition, asphalt stabilization can improve durability characteristics by making the soil resistant to the detrimental effects of water such as volume. In non-cohesive material such as sand and gravel, crushed gravel, and crushed stone, two basic mechanisms are active: water proofing and adhesion. The asphalt coating on the cohesion less materials provides a membrane, which prevents or hinders the penetration of water and thereby reduces the tendency of the material to lose strength in the presence of water. The second mechanism has been identified as adhesion. The aggregate particle adheres to the asphalt and the asphalt acts as a binder or cement. The cementing effect thus increases the shear strength by increasing adhesion. Criteria for design of bituminous stabilized soils and aggregates are based almost entirely on stability and gradation requirements. Freeze-thaw and wet durability test are not applicable for asphalt-stabilized mixtures.

c) Stabilization by geo-textiles and fabric

Introducing geo-textiles and fabrics that are made of synthetic materials, such as polyethylene, polyester, and nylon, can stabilize the soil. The geo-textile sheets are manufactured in different thickness ranging from 10 to 300 mils (1mil=0.254mm).The width of sheet can be up to 10m. These are available in rolls of length up to about 600m.Geotextiles are permeable. Their permeability is compared to that of fine sand to course sand and they are strong and durable

d) Stabilization with fly ash

Fly ash is a finely divided residue obtained from combustion of powdered coal in thermal power plant. It is the silt size pozzolanic material obtained as a by product of coal burning power plant. About 120 millions tones of fly ash is being produced in India annually. The fly ash generated on such a large scale could cause economics and management problems and thus it is very essential to find new avenues for its utilization. The fly ash can be effected used for stabilization of granular soil. However with additives like cement, lime and randomly distributed fiber or meshes, it can also be used for stabilization of fine grained soil. When mixed with soil, fly ash can develop cementation bonds due either to pozzolanic effect or an inherent self hardening property under favourable condition of moisture and compaction. Thus the huge amount of fly ash which is not only causing environmental pollution but also creating problem associated with its safe disposal can be effectively used for soil stabilization. A waste material and threat to public health can suitable transform into a man-made resource material, if carefully used and handlede.

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e) Expanded polystyrene (EPS) Geo foam

Shelke and Murty (2010) used EPS Geofoam to reduce the swelling pressure of expansive soil. Black cotton soil from Ahmednagar district in Maharastra was taken for study. According to USCS soil classification, soil has CH type. The Liquid limit, Plastic limit, plasticity index, O.M.C, M.D.D and free swell index of soil was 61%, 31%, 30%, 20%, 16.2KN/m_3 and 85.7% respectively. In his study, authors used two type of geo foam, viz. (1) 6mm thickness and (2) 12mm thickness. Swelling of Black cotton soil reduces from 8.64%to 82.72% when EPS Geo foam of 6mm and 12mm are used. Swelling pressure of 6mm geo foam is reduced to 42.86% and for 12mm thickness swelling pressure is reduced about 90%.

f) Mechanical stabilization

The method of proportioning grading of locality available material or soil and its subsequent compaction to improve its stability is thermal as mechanical stabilization. In this method , two or more natural soils are mixed to obtain a composite material which is superior to any of its components. Thus the two basic principle of mechanical stabilization

1 Proportioning or grading
2 Compaction

In this method, locally available soil is verified properly and is proportioned and mixed with the deficient material to get a suitable gradation. For example, if a soil is coarse grained in nature. It is ploughed to a suitable depth, mixed with fine grained soil in proper proportion and then water is added and the mixture is compacted with the help of rollers to increase the stability. This method of stabilization is very commonly used in India.

Thus, it may be that proportioning of the mix affects the properties considerably. Effective compaction is desirable to produce high density and stability of mix. The method of mechanical stabilization has been successfully employed for construction of sub base course and base course layer. It is also used for the construction of surfacing for low cost village roads.

IV CONCLUSION

a) Soil treated or chemically altered with a 4% lime- 4%cement proved to be more stable as indicated test performed.
b) The 3% lime-3% cement treatment increase stability but not substantially compared to the 4% ratio.
c) Treatment proved stronger and more stable than control.
d) This research proved that all techniques of soil stabilization improves overall qualities and performance of the soil.
e) Research in this field is proving invaluable to stabilization there by long term of viability of structure.

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