SOIL STABILIZATION USING SILICAGEL AND BAMBOO SLAG

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Abstract**—** The engineering properties of problematic soils can be modified to meet the design requirements using soil improvement/stabilization techniques. Industrial waste materials are gaining popularity as a substitute to conventional stabilizers such as cement or lime, due to the concept of sustainable reuse, increased cost of waste disposal and environmental concerns. This paper investigates the feasibility of utilizing the silica gel as a stabilizer in the expansion soil where swelling characteristics are higher and causes severe damage to the structure and road pavement. In this study a laboratory experiment was conducted to evaluate the effects of waterborne polymer on unconfined compression strength and to study the effect of micro silica grout on clayey soils. The laboratory tests were performed including specific gravity, dry density, OMC, Atterberg limits and unconfined compressive strength test. The clay and various amounts of bamboo slag 5% and Silica gel (5%, 15%, 20%) were mixed with all of them into dough using mechanical kneader in laboratory conditions.the results of Maximum Dry Density (MDD), Optimum Moisture Content (OMC) and California Bearing Ratio (CBR) and unconfined compressive strength (UCC) are compared with the Indian standards for the design requirements of sub-grade for the flexible pavement.

Keywords**—** Bamboo slag, silica gel,Optimum Moisture Content, Maximum Dry Density, Unconfined Compressive Strength.

I.INTRODUCTION

Soil is highly heterogeneous, complex and unpredictable material which has been subjected to vagaries of nature, without any control. The properties of soil change not only from one place to other but also at the place with depth and with a change in the environmental, loading and drainage

conditions. The properties of a soil depend not only on its type but also on the conditions under which it exists. In comparison to other construction materials such as concrete or steel,

it is not economically feasible to transport the soils from one place to other, because a huge quantity of soil is involved and it is not opened to inspect at greater depth for foundations of different structures. Soil stabilization aims at improving soil strength and increasing resistance to softening by water through bonding the soil particles together, water proofing the particles or combination of the two (Sherwood, 1993). Usually, the technology provides an alternative provision structural solution to a practical problem. The simplest stabilization processes are compaction and drainage (if water drains out of wet soil it becomes stronger). The other process is by improving gradation of particle size and further. Improvement can be achieved by adding binders to the weak soils (Rogers et al, 1996). Soil stabilization can be accomplished by several methods. All these methods fall into two broad categories (FM 5-410) namely;

Mechanical stabilization

Under this category, soil stabilization can be achieved through physical process by altering the physical nature of native soil particles by either induced vibration or compaction or by incorporating other physical properties such as barriers and nailing. Mechanical stabilization is not the main subject of this review and will not be further discussed.

Chemical stabilization

Under this category, soil stabilization depends mainly on chemical reactions between stabilizer (cementitious material) and soil minerals (pozzolanic materials) to achieve the desired effect. A chemical stabilization method is the fundamental of this review and, therefore, throughout the rest of this report, the term soil stabilization will mean chemical stabilization.

Through soil stabilization, unbound materials can be stabilized with cementitious materials (cement, lime, fly ash, bitumen or combination of these). The stabilized soil materials have a higher strength, lower permeability and lower compressibility than the native soil (Keller bronchure 32-01E). The method can be achieved in two ways, namely; (1) in situ stabilization and

(2) ex-situ stabilization. Note that, stabilization not necessary a magic wand by which every soil properties can be improved for better (Ingles and Metcalf, 1972). The decision to technological usage depends on which soil properties have to be modified. The chief properties of soil which are of interest to engineers are volume stability, strength,

compressibility, permeability and durability (Ingles and Metcalf, 1972; Sherwood, 1993; EuroSoilStab, 2002). For a successful stabilization, a laboratory tests followed by field tests may be required in order to determine the engineering and environmental properties. Laboratory tests although may produce higher strength than corresponding material from the field, but will help to assess the effectiveness of stabilized materials in the field. Results from the laboratory tests, will enhance the knowledge on the choice of binders and amounts (EuroSoilStab, 2002).

II.MATERIALS AND METHOD SILICA

GEL:

Silica gel is an amorphous and porous form of silicon dioxide(silica), consisting of an irregular tridimensional framework of alternating silicon and oxygen atom with nanometer-scale voids and pores. The voids may contain water or some other liquids, or may be filled by gas or vacuum. In the latter case, the material is properly called silica xerogel.Silica xerogel with an average pore size of 2.4 nanometers has a strong affinity for water molecules and is widely used as a desiccant. It is hard and translucent, but considerably softer than massive silica glass or quartz;Passive site stabilization is a new technology proposed for nondisruptive mitigation of liquefaction risk at developed sites susceptible to liquefaction. It is based on the concept of slowly injecting colloidal silica at the edge of a site with subsequent delivery to the target location using natural or augmented groundwater flow. Colloidal silica is an aqueous dispersion of silica nanoparticles that can be made to gel by adjusting the pH or salt concentration of the dispersion. It stabilizes liquefiable soils by cementing individual grains together in addition to reducing the hydraulic conductivity of the formation. Centrifuge modeling was used to investigate the effect of colloidal silica treatment on the liquefaction and deformation resistance of loose, liquefiable sands during centrifuge in-flight shaking. Loose sand was successfully saturated with colloidal silica grout and subsequently subjected to two shaking events to evaluate the response of the treated sand layer. The treated soil did not liquefy during either shaking event.

BAMBOO SLAG:

Bamboo slag exhibits high shear strength

which is highly beneficial for its use as a geotechnical material.Inour country large number of crusher units is available, which produces huge quantity of stone dust. Stone dust not only pollutes water, air or land but also their disposal is a great problem. In the recent past some of the researchers have brought out interesting notes on utilization of stone dust. From the experimental findings confirmed that the plasticity index, activity and swelling potential of the samples decreased with increasing percent stabilizer and curing time and the optimum content of silica fume in decreasing the swell potential was found to be 20% .It has a good permeability and variation in water content does not seriously affect its desirable properties.

III.METHODOLOGY

The main purpose of this project is to stabilize the soil using the materials which are easily available and are cost effective. The silica gel material is taken from the glass industry and is available everywhere.bamboo slag is from the crushed stone and burnt bamboo. These materials have been thoroughly mixed with week soil and then compacted. Test are done on both the soils with different percentage. Finally the results are taken. The usage of this material in soil stabilization is considered as most feasible method. It increases the strength of soil .

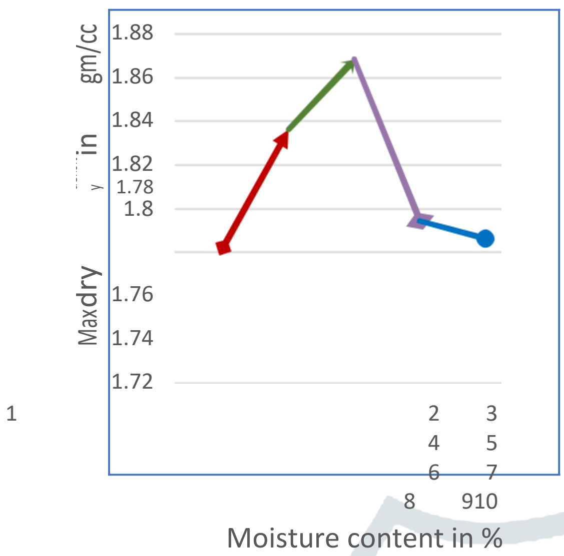
IV.RESULTS

The initial laboratory results of clay soil sample showed, soil is a solid or stiff (as consistency index is more than 1 and Liquidity index is less than zero), Ic = 1.05 and IL = -0.05. Collected black cotton soil is highly plastic (as plasticity index more than 17), Ip=44.42 . The results of Attenberg‟s limit, standard proctor test, unconfined compression test and California bearing ratio test are tabulated in with reference to IS . Specific gravity of bamboo slag is found to be very less (1.306), this may be due to its fibrous nature and very light in weight. Results of blend in selected proportions are tabulated in graphical presentation

A.MAXIMUM DRY DENSITY

Table 1

S.NO	MDD	OMC
1	4.18%	1.782
2	6.43%	1.836
3	8.45%	1.868
4	10.26%	1.794
5	12.31%	1.786

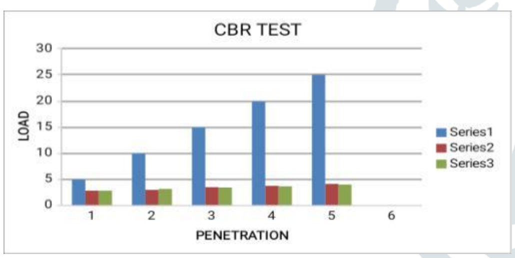


GRAPH 1

B.CALIFORNIA BEARING RATIO TEST

TABLE 2

TRIALS	5%	15%	20%
2.5	2.82	3.48	3.3
3	2.82	3.43	3.7



GRAPH 2

V CONCLUSION

From the experiment it is concluded that, Maximum California Bearing Ratio of soil is 135KN/mm at 15%silica gel and 5%Bamboo slag. Maximum dry density in proctor compaction test was 1.898gm/cc at 15%silicagel and 5%Bamboo slag. Bamboo slag is used as a replacement of soil,it reduces the environmental pollution and reduces the cost of work. Thus from the above experimental studies we concluded that, settlement in clay soil can be reducing by adding a silica gel. This will in turn improve the strength ,reduce permeability, increase density and improve shear strength.Thus use of bamboo slag and silica gel will be beneficed to clay soil in improving their soil properties. This method of stabilization used to improve the properties of clay soil.

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