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Soil Stabilization

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Abstract :- **This paper focus on the improving the properties of the soil which are required for road subgrade by adding admixtures. Construction of any type of structure along with roadways over soft subgrade is one of the most common problem in many parts of the world as well as in India. After the road construction, many problems usually arise like deterioration of the surface (potholes), maintenance problems, etc. thus making the road maintenance is costly and disruptive to the traffic flow. Therefore, during the construction stabilization of subgrade using some locally available material is necessary. The usual approach to soft subgrade stabilization is to remove the soft soil, and replace it with the stronger material of crushed rock is may be affordable for limited area of structure but the high cost of replacement has caused highway agencies to evaluate alternative methods of highway construction on soft subgrades. This paper highlights the importance of improving the properties of soft subgrade using huge amount of industrial waste like fly ash and also addressing the disposal problems. This study stresses that such admixtures can be used to achieve desired properties for construction of subgrade so that it meets the pavement design requirements making it economical.**

Keywords: **- Stabilization, Soft sub-grade, Pavement, Admixtures.**

I. INTRODUCTION

Soil stabilization is the process of altering some soil properties by different methods, mechanical or chemical in order to produce an improved soil material which has all the desired engineering properties.

Soils are generally stabilized to increase their strength and durability or to prevent erosion & dust formation in soils. The properties of soil vary at different places. The success of soil stabilization depends on soil testing. Various methods are employed to stabilize soil & the method should be verified in the lab with the soil material before applying it on the field.

II. OBJECTIVE

Evaluation the soil properties of the area under consideration.

Deciding the property of soil which needs to be altered to get the design value & choose the effective & economical method for stabilization.

Designing the stabilized soil mix sample & testing in the lab for intended stability &durability values.

III. LITERATURE REVIEW

Anita Agrawal and Rajendra Prasad proposed waste products from various Industries, normally deposited in landfill can be used as an alternate construction material. The utilization of these alternate materials needs to be encouraged for economy of construction and conservation of materials. One by-product that has shown as an alternate construction material is fly ash. In this paper an effort is made to use fly ash to stabilize soils for road construction, in order to reduce the amount of waste globally. In the present assignment, black cotton soils were stabilized with different quantities of fly ash. On the basis of preliminary investigations, it has been found that stabilization with fly ash, improves the CBR and plasticity characteristics of black cotton soils.For hydration of fly ash, the lime content is responsible, so substantial improvements in desired properties can be achieved by addition of small quantity of lime.

F. G. Bell researched that with the addition of lime, the plasticity of montmorillonite was reduced whilst that of kaolinite and quartz was increased somewhat however, the addition of lime to the till had little influence on its plasticity but a significant reduction occurred in that of laminated clay. All materials experienced an increase in their optimum moisture content and a decrease in their maximum dry dencity, as well as enhanced California bearing ratio, on addition of lime. Some notable increases in strength an Young's Modulus in this materials when they where treat with lime. Length of time curing and temperature at which curing took place had important influence on the amount of strength developed

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IV. METHODOLOGY

A. Material Used:

i. Soil stabilization by adding fly ash:

Fly ash is a pozzolonic material that consists mainly of silica and aluminum compounds that, when mixed with lime and water, forms hardened cementations mass capable of obtaining high compression strengths. Fly ash is a by-product of coal-fired, electric power-generation facilities. The liming quality of fly ash is highly dependent on the type of coal used in power generation. Fly ash is categorized into two broad classes by its calcium oxide (CaO) content. They are:

a) Class C
b) Class F

Class C:

This class of fly ash has a high CaO content (12 percent or more) and originates from sub-bituminous and lignite (soft) coal. Fly ash from lignite has the highest CaO content, often exceeding 30 percent. This type can be used as a standalone stabilizing agent. The strength characteristics of Class C fly ash having a CaO less than 25 percent can be improved by adding lime.

Class F:

This class of fly ash has a low CaO content (less than 10 percent) and originates from anthracite and bituminous coal. Class F fly ash has an insufficient CaO content for the pozzolanic reaction to occur. It is not effective as a stabilizing agent by itself; however, when mixed with either lime or lime and cement, the fly ash mixture becomes an effective desired lime content.

ii. Soil Stabilization by Adding Lime

Lime stabilization is done by adding lime to soil. This is useful for the stabilization of clayey soil. When lime reacts with soil there is exchange of cations in the absorbed water layer and a decrease in the plasticity of the soil. The resultant material is more friable than the original clay, and is more suitable as subgrade. Lime is produced by burning of limestone in kiln. The quality of lime obtained depends on the parent material and the production process. And there are basically5 types of limes

1. High calcium quick lime (CaO)
2. Hydrated high calcium lime [Ca(OH)
3. Dolomite lime [CaO+MgO]
4. Normal, hydrated Dolomite lime [Ca(OH) +MgO]
5. Normal, hydrated Dolomite lime [Ca(OH) 2+MgO]
6. Pressure, hydrated dolomitic lime[Ca(OH)2+MgO)]

The two primary types of lime used in construction today are quick lime and hydrated lime (calcium hydroxide). For this project we use quick lime.

B. Procedure

i. Scarification And Initial Pulverization

After the soil has been brought to line and grade, the sub grade can be scarified to the specified depth and width and then partially pulverized. It is desirable to remove non-soil materials larger than 3 inches, such as stumps, roots, turf, and aggregates. Scarification is done because a scarified or pulverized sub grade offers more soil surface contact area for the lime at the time of lime application.

Fig.no.1

ii. Lime Spreading

The soil is generally scarified and the slurry is applied by distributor truck. Because lime in slurry form is much less concentrated than dry lime, often two or more passes are required to provide the specified amount of lime solids. To prevent runoff and consequent non-uniform lime distribution, the slurry is mixed into the soil immediately after each spreading pass.

Fig.no.2

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iii. Preliminary Mixing and Watering

Preliminary mixing is required to distribute the lime throughout the soil and to initially pulverize the soil to prepare for the addition of water to initiate the chemical reaction for stabilization. During this process or immediately after, water should be added to ensure the complete hydration and a quality stabilization project.

Fig.no.3

iv. Final mixing and pulverization

To accomplish complete stabilization, adequate final pulverization of the clay fraction and thorough distribution of the lime throughout the soil are essential.

v. Compaction

Initial compaction is usually performed as soon as possible after mixing, using a sheeps foot type roller or a vibratory pad foot roller. After the section is shaped, final compaction can be accomplished using a smooth drum roller. The equipment should be appropriate for the depth of the section being constructed.

Fig.no.4

vi. Final curing:

Before placing the next layer of sub base (or base course), the compacted sub grade (or sub base) should be allowed to harden until loaded dump trucks can operate without rutting the surface. During this time, the surface of the lime treated soil should be kept moist to aid in strength gain. This is called "curing" and can be done in two ways: 1) Moist curing, which consists of maintaining the surface in a moist condition by light sprinkling and rolling when necessary, and 2) Membrane curing, which involves sealing the compacted layer with a bituminous prime coat emulsion, either in one or multiple layer.

Economic Benefits Of Lime Stabilization

a) Limitation of the need for embankment materials brought in from outside and the elimination of their transporting costs.
b) Reduction of transport movements in the immediate vicinity of the construction site.
c) Machines can move about with far greater ease. Delay due to weather conditions are reduced, leading to improved productivity. As a result, the overall construction duration and costs can be dramatically reduced.
d) Structures have a longer service life (embankments, capping layers) and are cheaper to maintain.
e) Lime is used as an excellent soil stabilizing materials for highly active soils which undergo through frequent expansion and shrinkage.

V. CONCLUSION

Comparative study

Particulars	Test results					
	Liquid limit	Plastic limit	Specific gravity	OMC	MDD	CBR (for 5cm) penetration
1. Original soil	49.72	26.87	2.85	30.14	1.79	3.70
2. Original soil +fly ash (5%)	54.40	28	2.13	27.87	1.79	5.59
3. Original soil +fly ash (10%)	56.48	31.93	2.32	30.01	1.80	8.75
4. Original soil + lime	55.20	40.06	2.31	25.34	1.69	3.69
5. Original soil +fly ash(12%) +lime(3%)	36.25	31.65	2.24	24.79	1.74	12.06

Table no.1

Above table shows comparison between the properties of original soil on the site and the soil which contents proper proportion of lime and fly ash (1:4).

This study shows that the strength of soil can be considerably improved by stabilization. The strength attainable depends on the composition of added stabilizer and on the choice of the stabilization. The increase in California bearing ratio and maximum

dry density is maximum for 10% fly ash mixture with black cotton soil. Black cotton soil of low or medium plasticity can be used for subgrades by stabilizing with fly ash due to improvement in its plasticity characteristics. Lime acts immediately and improves various properties of soil such as carrying capacity of soil, resistance to shrinkage during moist conditions, reduction in plasticity index, increase in CBR values and subsequent increase in the compression resistance with the increase in time. Thus, soil stabilization improves the strength, soil workability, durability and gradation of soil. It reduces the plasticity of soil and pavement thickness.

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