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A REVIEW ON THE COMBINED EFFECT OF LIME, FLYASH AND GEOSYNTHETIC REINFORCEMENT ON SOIL

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Abstract - *Soft soil possesses low strength and undergoes excessive volume changes, making its use in the construction activities very difficult. The properties of the soft soils may be altered in many ways viz, mechanical, thermal, chemical and other means. Modification of soft soils by chemical admixtures is a common stabilisation method for such soils. Soil reinforcement is one of the most popular ground improvement techniques, especially for granular soils. Geotextile and Geomembrane reinforcement are the suitable soil reinforcement techniques. In this seminar, traditional stabilising agents such as cement, lime, fly ash etc. are applied in addition to geotextile and geomembrane reinforcement. This seminar is an overview of the combined effect of geotextile and geomembrane reinforcement as well as traditional stabilizing agents in soil improvement.*

Key Words: stabilization, geotextile, geomembrane, reinforcement, lime, flyash

1. INTRODUCTION

Soft soil possesses low strength and undergoes excessive volume changes, making its use in the construction activities very difficult. The properties of the soft soils may be altered in many ways viz, mechanical, thermal, chemical and other means. Modification of soft soils by chemical admixtures is a common stabilization method for such soils. Among various admixtures available, lime, fly ash and cement are most widely and commonly used for the stabilization of soft soils. Fly ash contains siliceous and aluminous materials (pozzolans) and also certain amount of lime. When mixed with soft soil, it reacts chemically and forms cementitious compounds. The presence of free lime and inert particles in fly ash suggests that it can be used for stabilization of expansive soils.

Lime stabilization is a method of chemically transforming unstable soils into structurally sound construction foundations. Lime is added to a reactive soil to generate long-term strength gain through a pozzolanic reaction. That reaction produces stable calcium silicate hydrates and calcium aluminate hydrates as the calcium from the lime reacts with the aluminates and silicates solubilised from the clay. This pozzolanic reaction can continue for a very long period of time. As a result of this, lime treatment can produce high and long-lasting strength. Lime in the form of quicklime (calcium oxide – CaO), hydrated lime (calcium hydroxide – Ca[OH]2), or lime slurry can be used to treat the soils.

2. LITERATURE REVIEW

Soil stabilization is the process of altering some engineering properties of soil 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 and dust formation in soils. The main aim is the creation of a soil material or system that will hold under the design use conditions and for the designed life of the engineering project. The properties of soil vary a great deal at different places or in certain cases even at one place; the success of soil stabilization depends on soil testing. Various methods are employed to stabilize soil and the method should be verified in the lab with the soil material before applying it on the field.

2.1 GEOTEXTILE

Pavaniet A et.al (2016) conducted a study on subgrade soil using jute geotextile in Prakasam district of Andhra Pradesh. In this paper jute material is used in reinforcement of soil layer in pavement design. Several case studies in field showed that the strength of Jute Geotextile typically reduced about 60 to 70 percent after lying embedded in soil for around 18 months. Jute is bio-degradation material in this studies the span of JGT is increased by spraying bitumen on the jute and reinforcing the soil layer and structurally evaluating the stresses and strains under standard axle load condition 8T another method is also adopted by using the polythene sheets like sandwich layer to increase the span and strength of jute fiber and sub-grade strength of CBR value. Research studies will carried on sub-grade soil to increase the CBR value by using jute with bitumen coated/polythene sheets. Some experimental studies had been conducted on clay soil (CI) and results were not reliable for heavy compaction. Principal application of JGT is to reduce the pavement thickness layers and Appropriately designed woven JGT when placed on a road sub-grade enhances its bearing capacity (expressed as CBR %).The phenomenon is the result of the functions of separation and filtration performed by an appropriately designed woven JGT laid on the sub-grade.

Siva Gowri Prasad S et al. (2014) conducted a study on stabilization of pavement subgrade by using fly ash reinforced with geotextile. In this study, samples of fly ash compacted to its maximum dry density at the finest moisture content is organized without and with Geotextile layers in the CBR mould. Geotextile sheets equal to the plan dimensions of

CBR mould is placed in distinct preparations of 1st , 2nd , 3rd and 4th layers at different locations (i.e. at different embedment ratio, z/d) in the CBR mould. Subsequent to each arrangement of Geotextile, the CBR (California Bearing Ratio) values are evaluated and compared with the results of CBR values earlier than including geotextile. From the study they concluded that, by addition of fly ash, the CBR value is increased by 27% when compared to unmodified soil and by placing the geotextile in between the subgrade layers, the properties of the soil can be increased and ultimately reduces the subgrade layer thickness, showing cost- effective pavement

2.2 LIME STABILISATION

Ankit Singh Negi et al. (2013) studied about the soil stabilisation using lime. Soils containing significant levels of silt or clay, have changing geotechnical characteristics: they swell and become plastic in the presence of water, shrink when dry, and expand when exposed to frost. Site traffic is always a delicate and difficult issue when projects are carried out on such soils. In other words, the re-use of these materials is often difficult, if not impossible. Once they have been treated with lime, such soil can be used to create embankments or subgrade of structures, thus avoiding expensive excavation works and transport. Use of lime significantly changes the characteristics of a soil to produce long- term permanent strength and stability, particularly with respect to the action of water and frost. The mineralogical properties of the soils will determine their degree of reactivity with lime and the ultimate strength that the stabilised layers will develop. In general, fine- grained clay soils (with a minimum of 25percent passing the 200 sieve (74mm) and a Plasticity Index greater than 10) are considered to be good candidates for stabilisation. Soils containing significant amounts of organic material (greater than about 1 percent) or sulfates (greater than 0.3percent) may require additional lime or special construction procedures.

Pancar and Akpınar (2011) conducted a study on Comparison of Effects of Using Geosynthetics and Lime Stabilisation to Increase Bearing Capacity of Unpaved Road Subgrade. In this paper, lime stabilisation of clayey road base soil with high water content and its improvement with geosynthetics (geocell+geotextile) reinforcement and comparisons of these two different improvement methods were made. For this purpose, plate loading experimental comparisons of clayey soil, which had high water content by 10% increasing the optimum water content, were made after it was improved with lime at the rates of 3,6,12%, geotextile reinforcement, geocell reinforcement, geosynthetics reinforcement and geosynthetics reinforcement + lime stabilisation at various rates. And reinforcement with geosynthetics yields better results on these types of soils. Model plate loading experiments were done in the laboratory in this purpose. They found that lime stabilisation achieves decrease in soil settlement. 12% lime stabilisation gave the better results among 3, 6 and 12% lime treatments for reduction of settlements and only one state (geosynthetics + 12% lime stabilisation) among 10 states applied to improve the soil in this experiment met the Highways Technical Specifications.

2.3 FLYASH STABILISATION

Revikumar Sharma and Babita Singh (2013) conducted study on Modification of clayey soil using fly ash. An attempt has been made to improve the engineering properties of locally available clayey soil by making a composite mix with waste river sand and fly ash in appropriate proportions. A series of proctor compaction tests, unconfined compressive strength (UCS) tests and falling head permeability tests were carried out. It was revealed that both strength and permeability characteristics of clayey soil improve on addition of local sand and fly ash. Thus, a suitable mix proportion of clayey soil-sand-fly ash for various geotechnical applications like construction of embankments, low cost rural roads etc. can be obtained. The main objective of this research work was to obtain an improved construction material by making the best use of available clayey soil & sand and to make the effective utilisation of fly ash.

Gyamen Takhelmayum et al. (2013) conducted a Laboratory Study on Soil Stabilisation Using Fly ash Mixtures. This paper evaluated the compaction and unconfined compressive strength of stabilised black cotton soil using fine and coarse fly ash mixtures. The percentage of fine and coarse fly ash mixtures which is used in black cotton soil varied from 5 to 30. In the study concludes that with percentage addition of fine, coarse fly ash improves the strength of stabilised black cotton soil and exhibit relatively well-defined moisture-density relationship. It was found that the peak strength attained by fine fly ash mixture was 25% more when compared to coarse fly ash. They were conducted CBR tests and unconfined compressive tests. They found that the decrease of the maximum dry unit weight with the increase of the percentage of fly ash is mainly due to the lower specific gravity of the fly ash compared with expansive soil and the immediate formation of cemented products by hydration which reduces the density of soil. It was also observed that the optimum moisture content was increased with further increase in fly ash content.

2.4 COMBINED EFFECT

Surendra Maharjan and Saliq (2015) conducted a study on Stabilisation of Clay Soil Using Fly Ash and Lime for Construction Work. This paper studied modification of the engineering properties of the native problematic soils to meet the design specifications. Soil stabilisation occurs when lime is added to a reactive soil to generate long-term strength gain through a pozzolanic reaction. They found that Liquid limit and Plastic Limit of black soil is decreases with addition of fly ash and lime content. They conducted California bearing ratio test in this paper. Finally they found that when Lime is used as an excellent soil stabilising materials for highly active soils which undergo through frequent expansion and shrinkage. Lime acts immediately and improves various property of soil

such as carrying capacity of soil, resistance to shrinkage during moist conditions, reduction in plasticity index, and increase in CBR value and subsequent increase in the compression resistance with the increase in time. The reaction is very quick and stabilisation of soil starts within few hours.

3. CONCLUSIONS

•From the literature survey, various research works carried out the studies and experimental investigation on combined effect of traditional stabilizing agent and reinforced with geotextile. Properties of geosynthetics that influence performance include friction, stiffness, tensile strength, impact resistance, filtration, and retained strength of geosynthetics.

•Soil unconfined compressive strength was found to be increasing with an increasing percentage content of lime, flyash. So it can be concluded that in lime and flyash mixes, increase in lime content increases the strength. All strength properties of stabilized mixes namely UCS, CBR and BTS increase with the lime content and curing period.

•Flyash modifies the strength properties of clayey soils significantly and flyash addition up to 25% by soil weight in the soil mix found effective to improve strength properties.

•As the number of reinforcement layer increased, unconfined compressive strength of soil was found to be increasing. Even for a small replacement of geotextile we get a high percentage increase in the properties due to the combined effect of lime and geotextile.

•Lime has improved the strength characteristics and changed chemical composition of clay. It also reduced swelling potential of highly plastic clay.

•By addition of fly ash, the CBR value is increased by 27% when compared to unmodified soil

•By placing the geotextile in between the subgrade layers, the properties of the soil can be increased and ultimately reduces the subgrade layer thickness, showing cost- effective pavement.

•Subsequently, a comparison has been made between various physical and mechanical properties of needle punched nonwoven geotextiles. In this research work, it was found that hybrid geotextiles made of viscose can replace 100% polypropylene or polyester based geotextile.

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