A Review Paper on Comparative Study of Soil Stabilization with Widely used Admixtures Like Lime, Cement, Flyash and Bitumen Emulsion.

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Abstract
In road construction soil is used as sub base and base material. If strength of the soil is poor then soil stabilization is normally needed. Sub grade soil can be stabilised or replaced by stronger soil. There are numerous stabilizers used for soil stabilization such as Lime, Cement, Bitumen Emulsion and Flyash, in this paper we will use all these mentioned stabilizers. So that their percentage play crucial role to stabilize the soil. This will help in increasing the stability of soil mechanically.

Keywords- *Lime, Cement, Bitumen Emulsion, Flyash, stabilizers.*

I. INTRODUCTION

The soil, fails due to shear, crushing or shows excessive settlement can be taken as unsuitable soil. Many soils in natural state are very weak against shear load. Due to this their bearing capacity is also low. Thus shear capacity is also low. The shear strength and bearing capacity can be improved by soil stabilization. The soil stabilization can be used as to increase shear strength, to improve the stabilization of slope, to reduce settlement of structure, to increase density of soil.

Stabilization is technique of improving characteristics of native soil or granular material used for construction of pavement layers. Soil stabilization is required where the road alignment passing through poor soil sub grade does not comply with the engineering properties as per any given standard specification.

Stabilization of soil is employed for modifying the properties of soil to improve its engineering performance, both in terms of its strength and durability. Stabilization technique controls the unwanted properties in the sub grade soil such as, excessive compressibility, permeability, frost susceptibility, settlement, volume change, etc.

The following effects may take place in the stabilized mixture:
1. Strength gain in terms of any standard test value such as CBR, R-value, k-value or resilient modulus value or unconfined compression test value.
2. Decrease of liquid limit and plastic limit values
3. Important physical properties due to reaction with cementations agents mixed with the soil. The physical changes may be listed as density and stiffness, with controlled moisture retention capability.
4. The thickness of water film around the each particle of clay grain decreases due to flocculation/agglomeration of clay due to addition of lime/cement. Rapid change takes place in soil texture. The resulting textural changes lead to decrease in PI and increase in strength with workability. Its long term strength gain helps to provide durability against freeze thaw effects.
5. Swelling and shrinkage rates due to changes in climatic conditions may be brought under control (i.e. decreased) with increased stability.
6. Overall pavement structural integrity improves due to stabilization of sub grade or any granular layer of the pavement. Therefore, economy in construction of pavement can be obtained with the reduced overall thickness of the pavement.

Based on the above principles. The various technique of soil stabilization may be grouped as follows;
1. **Proportioning technique** -The native material is sieved and blended with other good borrowed material to meet the standard gradation and agency prescribed test values. If the basic test values do not

meet the standards, a suitable admixture is added to the graded soil mixture.

2. **Cementing agents -** Cement, lime and fly ash in combination with cement or lime are used commonly as stabilizing agents. Bituminous emulsions and cutbacks may be used for blinding non cohesive soil.

3. **Modifying agents-**If stabilizer added in small proportion could modify the undesirable properties of certain soil i.e. atterberg's limits making them more useful as construction material, such stabilizer may be called as Modifiers.

4. **Moisture /water proofing agents-**The agents may consist of certain types of bituminous materials including some kinds of resinous materials (such as polyvinyl acetate liquids) which provide stability to the soil mixture including water repelling capability. Membrane blankets such as single or double bituminous surface layer may be placed as the interlayer, above the stabilized base course Membrane treatment is considered as most efficient method of waterproofing, despite its high cost.

5. **Water repelling agents-** Almost the same function as water proofing agents may be performed by some water repelling or retarding agents like Vinsol Resin and other resinous materials.

6. **Moisture retaining agents-**Calcium chloride, sodium chloride and other chemicals are used mix with soil or granular material to retain certain amount of moisture or absorb moisture from atmosphere as dust palliative.

7. **Heat treatment-**Thermal stabilization has different useful aspect with regards to clayey soils. They are desirable for reduction in swelling properties and heat treated soil may be used as a soft aggregate in mechanical soil stabilization.

8. **Chemical stabilization-** Calcium acrylate, sulphite lignin and other applicable chemicals may be suitably explored to use for stabilization based on their availability nearby at low cost. For example- organic cationic compounds that induce hydrophobic nature to the stabilized soil.

Based on the type of stabilizing agents used principles. The various techniques of soil stabilization methods may be broadly categorized as follows: Mechanical Stabilization, Soil-lime stabilization, Soil-cement stabilization Soil-bitumen stabilization and Soil-fly ash stabilization.

Presently every road construction project will use one or both of these stabilization strategies. The most well-known type of mechanical soil stabilization is compaction of the soil, while the addition of cement, lime, bituminous or alternate executors is alluded to as a synthetic or added substance strategy for stabilization of soil. American Association of State Highway and Transportation Officials (AASHTO) classification system is a soil classification system specially designed for the construction of roads and highways used by transportation engineers. The system uses the grain-size distribution and Atterberg limits, such as Liquid Limits and Plasticity Index to classify the soil properties. There are different types of additives available. Not all additives work for all soil types. Generally, an additive may be used to act as a binder, after the effect of moisture to increase the soil density. Following are some most widely used additives: Portland cement, Quicklime or Hydrated Lime, Fly Ash, Calcium Chloride, Bitumen etc. But, mechanical soil stabilization alludes to either compaction or the introduction of sinewy and other non-biodegradable reinforcement of soil. This practice does not oblige compound change of the soil and it is regular to utilize both mechanical and concoction intends to attain detailed stabilization. There are a few routines used to accomplish mechanical stabilization like compaction, combining, soil reinforcement, expansion of graded aggregate materials and mechanical remediation.

LITRATURE REVIEW

1). Cokca Erdal (2001): Effect of Fly Ash on expansive soil was studied by Erdal Cokca,FLY ASH consists of often hollow spheres of silicon, aluminum and iron oxides and unoxidized carbon. There are two major classes of Fly Ash, class C and class F. The former is produced from burning anthracite or bituminous coal and the latter is produced from burning lignite and sub bituminous coal. Both the classes of Fly Ash are puzzolans, which are defined as siliceous and aluminous materials. Thus Fly Ash can provide an array of divalent and trivalent cations (Ca2+,Al3+,Fe3+etc) under ionized conditions that can promote flocculation of dispersed clay particles. Thus expansive soils can be potentially stabilized effectively by cation exchange using Fly Ash. He carried out investigations using Soma Fly Ash and Tuncbilek Fly Ash and added it to expansive soil at 0-25%. Specimens with Fly Ash were cured for 7days and 28 days after which they were subjected to Oedometer free swell tests. And his 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 Fly Ash in decreasing the swell potential was found to be 20%. The changes in the physical properties and swelling potential is a result of additional silt size particles to some extent and due to chemical reactions that cause immediate flocculation of clay particles and the time dependent puzzolanic
and self hardening properties of Fly Ash and he concluded that both high –calcium and low calcium class C Fly Ashes can be recommended as effective

stabilizing agents for improvement of expansive soils.

2). Bhuvaneshwari. S. and Gandhi .S.R.:
A study was carried out by S.Bhuvaneshwari and S.R. Gandhi on the effect of engineering properties of expansive soil through an experimental programme. Infrastructure projects such as highways, railways, water reservoirs, reclamation etc. requires earth material in very large quantity. In urban areas, borrow earth is not easily available which has to be hauled from a long distance. Quite often, large areas are covered with highly plastic and expansive soil, which is not suitable for such purpose. Extensive laboratory / field trials have been carried out by various researchers and have shown promising results for application of such expansive soil after stabilization with additives such as sand, silt, lime, Fly Ash, etc. As Fly Ash is freely available, for projects in the vicinity of a Thermal Power Plants, it can be used for stabilization of expansive soils for various uses. The present paper describes a study carried out to check the improvements in the properties of expansive soil with Fly Ash in varying percentages. Both laboratory trials and field tests have been carried out and results are reported in this paper. One of the major difficulties in field application is thorough mixing of the two materials (expansive soil and Fly Ash) in required proportion to form a homogeneous mass. The paper describes a method adopted for placing these materials in layers of required thickness and operating a "Disc Harrow". A trial embankment of 30m length by 6m width by 0.6m high was successfully constructed and the in-situ tests carried out proved its suitability for construction of embankment, ash dykes, filling low-laying areas, etc.

3) Hussain (2008) carried out an excellent work to establish the correlation between CBR value and undrained shear strength value from Vane Shear Test. It was shown that undrained shear strength value and CBR value increased with increasing plasticity index. Finally it was achieved that shear strength and CBR value is inversely proportional to the water content of that material.

4)Dr. Arora .K.R.:
Bitumen's are non-aqueous systems of hydrocarbons that are soluble in carbon-di-sulphide. Tars are obtained by the destructive distillation of organic materials such as coal. Asphalts are materials in which the primary components are natural or refined petroleum bitumen's. Bituminous stabilization is generally done with asphalt as binder. As asphalts are normally too viscous to be used directly, these are used as cutbacks with some solvent, such as gasoline. These are used as emulsions, but in this form they require a longer time period. Any inorganic soil which can be mixed with asphalt is suitable for bituminous stabilisation. In cohesion less soils, asphalt binds the soil particles together and thus serves as a bonding or cementing agent. In cohesive soils. Asphalt protects the soil by plugging its voids and water proofing it. It helps the cohesive soil to maintain low moisture content and to increase the bearing capacity.

5)Journal of Indian Road Congress,(2015):
Soil stabilization not only improves strength and ground water condition but also improve permeability and compressibility etc. With reduced available land resources, more structure are coming up over weak or soft soil, which necessitates development of various ground improvement techniques such as soil stabilization and reinforcement. Lime stabilization has been extensively applied in civil engineering projects such as foundations, roadbeds etc. Added lime reacts with soil particles, which leads improvements in many properties of soils. Few investigators observed that strength behaviour of lime treated soil has improved greatly (Balasubramaniam, 1989).

6) Kumar Srinivasa R:
The cement is basically used as binder to stabilise granular soils such as silt-sand, silt and silt-clay. The changes/improvements expected by using cement is similar to that of lime-soil stabilisation. The soil-cement stabilisation is one of the widely adopted techniques used for construction of sub-base or base course for all types of pavements. The cement soil stabilisation may involve addition of additives to improve the desired properties and they may be listed as lime, sodium hydroxide, sodium carbonate, calcium chloride and fly ash. These additives may also be incorporated in soil-lime stabilization of the similar purpose. The combined utilization of the cement with fly ash has also become a common practice of construction of granular sub-base (GSB) and base courses of pavements.

3) DISSCUSSION
Sub grade may be defined as a compacted soil layer, generally of naturally occurring local soil, assumed to be 300 mm in thickness, just below of the pavement crust. It provides a suitable foundation for the pavement. So it is very important to improve strength of Sub grade soil, it may be done by replacing good soil or by stabilization of existing soil. To check the Sub grade soil stability CBR test is very commonly used test.

4) CONCLUSION

From this study it is clear that there is a considerable improvement in California Bearing Ratio (CBR) of sub-grade due to use of following materials like cement, lime, fly ash and Bitumen emulsion if proper mixing is done. In each state of condition it was found that CBR value has increased. In this particular experimental study CBR value has increased up to fifty percent of the unmodified soil CBR. Observing its economic cost and quality of stabilization improvement, it is clear that this type of stabilization may be applicable in gravel soil. As we increase the amount of mentioned stabilizers CBR value of soil is increased. But the cost of certain materials used is so high so the amount of materials also depends upon budget and importance of structure.

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