IMPROVEMENT IN SOIL PROPERTIES USING VARIOUS COMBINATIONS OF CEMENT AND SAND FOR HIGHWAY PROJECT

*prof.sanjay saraswat ** Brijesh Soni

Abstract— Black cotton soil is a highly expensive soil and undergoes volume changes with change with change is water content. structures built on expensive soil are often subjected to distress due to high swelling and shrinkage of the soils of foundation etc. are some of the problems commonly encountered construction on these soils. Many attempts have been made to after the properties of black cotton soil.Soil improvement is a process of alteration of any property of soil and the treatment of ground, such that the soil may serve better their intended engineering purpose. Soil stabilization is an alternative term for soil improvement.

Index Terms— stabilization mathods, affecting factors,cement sand soil ,changes in physical properties of soil,experimental programme,discussion on changing the soil behavior, development of soil properties,relationship of various tests,

1 INTRODUCTION

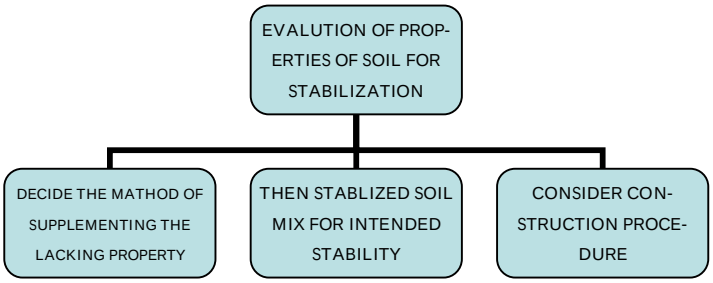
In developing countries like India the biggest handicap to pro vide a complete network of road system is the limited finance available to build by conventional methods.

The object of soil stabilization involves the effective utilization of local soils and other suitable stabilization agent. Thus there is a need to resort to one of the suitable methods of low cost road construction, followed by a process of stage development of the roads, to meet the growing needs of the road traffic. Thus a part from affecting economy in the initial construction cost of lower layers of the pavement such as sub base course. It should be possible to upgrade the low cost roads to higher specification at a later date without involving appreciable wastage, utilizing the principle of pavement construction in stages.

2. WHY USE A STABILIZATION

- To improve the shear strength, supporting capacity and ability.
- To improve the strength of sub-bases, bases and in case of low cost roads, surface courses.
- To bring about economy in the cost of road.
- To make use of locally available soils and other materials which are otherwise inferior.
- To eliminate or improve certain undesirable properties of soils such as excessive swelling or shrinkage, high plasticity, difficulty in compacting etc.
- To control dust.
- To facilitate compaction and increase load bearing capacity.
- To reduce frost susceptibility.
- To reduce compressibility and thereby settlements.
- To improve permeability characteristics

2.1 PROCESS INVOLVED



3. METHODS OF SOIL STABILIZATION

- Mechanical soil stabilization.
- Soil cement stabilization.
- Lime fly ash stabilization.

*Mr. S.saraswat Aisst prof in department of civil Engg.SATI vidisha mp (India)
**Brijesh soni is currently pursuing masters degree program in transportation engineering from Samrat Ashok Technological Institute vidisha underRagiv Gandhi Proudyogiki Vishwavidyalaya ,Bhopal University, India,. E-mail: b.soni612@gmail.com

International Journal of Scientific & Engineering Research Volume 4, Issue 9, September-2013
ISSN 2229-5518

- Soil bitumen stabilization.
- Chemical stabilization.
- Stabilization by heating.
- Electrical stabilization.

3.1 Mechanical soil stabilization

Correctly proportioned materials when adequately compacted to get a mechanically stable layer, the method is called mechanical stabilization. Thus the two basic principal in this method of stabilization are :-

1. Proportioning.
2. Compacting.

It a granular soil containing negligible fines is mixed with a certain proportioning of binder soil, it is possible to increase the stability. Similarly the stability of a fine grained soil could be considerable improved by mixing a suitable proportion of granular materials to get a suitable granular.

Mechanical stabilization has been successfully applied for sub-base and course construction. It has been used as surface course for low cost roads such as village roads when the traffic and rainfall are low.

3.2 Soil- Cement stabilization

Soil-cement is an intimate mix of soil, cement and water which is well compacted to from a strong base course. Cement treated or cement modified soil refers to the compacted mix when cement is used in small proportions to impact some strength or to modify the properties of the soil.

In granular soil, the mechanism of stabilization is due to the development of bond between the hydrated cement and the compacted soil particles at the points of contact. In fine grained soil, the stabilization is due to reduction in plasticity and formation of matrix enclosing small clay lumps. Degree of stabilization depends on nature of soil, proportion of cement compacting moisture cement and the dry density of the compacted mix. By the increasing percentage of cement added there is an increase in the strength and durability of soil-cement and a decrease in volume change, moisture movement and plasticity.

Soil-cement can be used a sub-base or base course of all types of pavement. However, as the material has poor resistance to abrasion and impact, this cannot be used as a surface course. A bituminous wearing course is placed over the base course.

3.3 Soil-Lime Stabilization

Soil-lime has been widely used either as a modifierfor clayey soil or as a binder. In several cases both actions of lime may be observed, when clayey soils with high plasticity are treated with lime, the plasticity index is decreased and the soil becomes friable and easy to be pulverized, having less affinity with water. All these modifications are considerable desirable for stabilization work. Lime also imparts some binding action even in granular soils. In fine grained soils there can also be pozzolanic action resulting in added strength.

Soil-lime to quite suitable as sub-base course for high types of pavement and base course for pavement with low traffic. As in the case of soil-cement, soil-lime also cannot be used as surface course even for traffic in view of its poor resistance to abrasion and impact. Soil-lime is quite suitable in warm regions; but it is not very suitable under freezing temperatures.

3.4 Soil- Bitumen Stabilization

The basics principals in bituminous stabilization are water proofing and binding by water proofing the inherent strength and other properties of the soil could be retained. In case of the cohesion less soils the binding action is also important. Generally both binding and water proofing actions are provided to soil

3.5 Chemical Stabilization

There are several chemical which when added single or in combination, even in trace quantities (less than 0.5% by wt. of soil) may impart useful. Changes in certain types of soils however considerable investigation and care is needed before adopting any of the costly chemicals. Chemicals have also been successfully used as additives in soil-cement and soil-lime stabilization.

3.6 Stabilization by heating

Thermal stabilization has different useful aspect and as regards clayey soils, there are desirable such as reduction in smelling properties and heat treated soil may be used as a soft aggregate in mechanical soil stabilization or as a pezzolanic additive in soil-lime stabilization.

International Journal of Scientific & Engineering Research Volume 4, Issue 9, September-2013
ISSN 2229-5518

3.7 Electrical stabilization

The stability or shear strength of fine-grained soils can be increased by draining them with the passage of direct current through them.

If direct current is passed between two electrodes into saturated soil mass, the soil water will travel from the positive electrode (anode) to the negative electrode (cathode).

4 CEMNT SAND STABILIZATION

4.1 introduction

Mixing Portland cement, sand and pulverized black cotton soil with the proper moisture content and compacting the mix to attain a strong material. The material obtained by mixing soil, cement and sand is known as cement sand soil, the cement sand soil becomes hard and durable structural material as cement hydrates and develops strength. Cement sand soil has been used mainly as bases under concrete pavement for highways & air fields. It is also used for wave protection on earth dams as canal lining and as a cheap building material.

4.2 Forms of soil cement

There are three forms of cement sand soil as discussed below in details

- Normal cement sand soil contains sufficient cement (5-15% by dry weight) & only enough moisture to facilitate compaction & satisfy the hydrogen requirements of cement and to make mixture workable. The resulting material is hard & offers a well defined resistance to weathering & mechanical forces. It is used for stabilizing sandy and other low plasticity soil.

- Plastic soil cement (5-15% by dry weight) has enough water at the time of placement to produce a wet consistency similar to that of plastering mortar. It used for canal lining & for erosion protection on steep slopes where road building equipment is difficult to be used. It also results in a hardened product.

- Cement sand modified soil (less than 5%) is a less rigid or semi hardened product of soil and contains relatively small quantity of cement, it is not able to bind all the soil particles in to a coherent mass. However, it interacts with the silt and clay fractions and reduces their affinity for water. It reduces the swelling characteristics of the soil, the cement sand modified soil is limited.

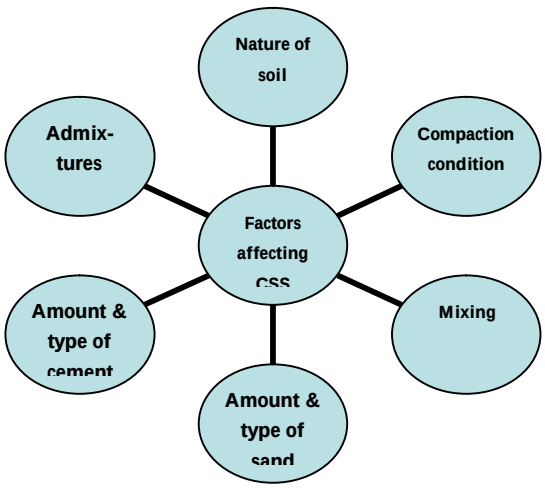
4.3 Chemical action involved in Cement sand soil

When water is added to cement, major cementations products like calcium silicate hydrates and calcium aluminum hydrates are produced. In stabilization of granular materials with cement, these cementations materials provided the bond between the mineral particles. In the case of fine-grained soil, the cmentitious bond provided by the calcium silicate hydrated and the calcium aluminates hydrates is further strengthened by the secondary hydrous calcium silicates and aluminates formed by the reaction of free lime in the cement paste and the clay mineral particle.

When lime is added to fine-grained soil, a number of reactions take place. Some of them occur immediately while others are slow to occur. One of the early reactions is base-exchange. Clay particles are negatively charged with exchangeable ions of sodium, potassium, magnesium or hydrogen adsorbed on the surface. The strong positively charged ions of calcium present in the lime replace the weaker ions of sodium, potassium or hydrogen, resulting in a preponderance of positively charged calcium ions on the surface of the clay particles. This in turn reduces the plasticity of the soil. The clay particles tend to agglomerate into large sized particles, imparting friability to the mixture.

After the above first stage reaction is complete, any additional quantity of lime will react chemically with the clay minerals. The aluminous and siliceous material in the clayey soils will react with line in the presence of water to form cementations gels, which increase the strength and durability of the mixture. These pozzolanic reactions are slow and extended over a long period of time, several years in some instances.

4.4 Factors affecting cement sand soil



International Journal of Scientific & Engineering Research Volume 4, Issue 9, September-2013
ISSN 2229-5518

5. EXPERIMENTAL PROGRAMME

Soil quality is assessed by measuring a number of soil properties to evaluate the soil's ability to perform basic functions.

- Bulk Density
- Porosity
- Atterberg Limit
- Shrinkage Limit
- UCS
- CBR

The above mention physical test carried out over cement sand soil mixture and observation recorded

6. CONCLUSION

After performing a series of experiments with increasing % of cement and sand following conclusion can be drawn:-

The effect of increasing cement content :-

- With increasing in cement content it has been observed that.
- Maximum Dry Density :- There is no definite relationship between proctor density and cement content. However the max dry density increase with addition of cement in all cases except one where cement is 4% and sand content is 10% with may be because of some experiment error & careless in observation.
- CBR :- CBR value increases with cement contents.
- Optimum Moisture Content :- There is no definite relationship between optimum moisture content and cement content.
- Swelling Pressure :- It decreases with cement content.
- Shrinkage Limit :- There is no definite relationship between shrinkage limit and cement
- Liquid Limit :- It increases with increases in cement content.
- Plastic Limit :- It decreases with increases of cement content.

The effect of increasing sand content. :-

- Maximum Dry Density :- Not shows any definite relationship in general MDD should increases with increases in sand.
- CBR :- CBR values increase with increasing sand content.
- OMC :- It has no any definite relationship.

- Swelling Pressure :- It decreases with increases of sand content for all % of cement.
- Shrinkage Limit :- It decreases with higher sand content for 2% and 8% cement content but in case of 4% and 6% there is no found certain relationship.
- Liquid Limit :- It decreases with increases sand content
- Plastic Limit :- It decreases with increases of sand content.

7. REFERENCES

1. "Soil Mechanics and foundation" by Dr. B.C. Punmia.
2. "Soil Mechanics and foundation Engineering" By K.R. Arora.
3. "Highway engineering" By Khanna and Justo.
4. "Laboratory Testing in Soil Engineering" by Akroyd T.N.W.
5. "Indian Geotechnical Society Manual in Soil Engineering" By IGS Publications.
6. "Indian Highways (Vol. 35) Jan. 2007" by Indian Road Congress.
7. "Manual by Ministry of Road Transport and Highways

I.S. Codes referred

1. IS 2720:1971 All parts

Websites referred

1. http://www.wikipedia.org/
2. http://www.irc.org.in/