ENHANCEMENT OF SHEAR STRENGTH OF SOIL USING BITUMEN

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***Abstract*: The Indian Road Congress encodes the accurate outline methodologies of the pavement layers based upon the subgrade quality. Subgrade quality is generally communicated as far as CBR. That is the California Bearing Ratio communicated in rate. Consequently, in all, the pavement and the subgrade together must sustain the activity volume. In this project locally available red colored Laterite type gravel soil is taken as experimenting material. Medium setting emulsion (MS) is used as stabilizing agent in this particular study. Bitumen sand stabilization is an effective process as bitumen makes soil stronger and improves resistance capacity against water and frost. The main objective of this experimental study is to improve the properties of the gravely soil by adding bitumen emulsion as stabilizing agent and little bit cement as filler. An attempt has been made to use emulsion for improving the strength and geotechnical properties of gravel soil. Very mostly, use of use of bitumen emulsion is environmentally accepted. To achieve the whole project some experimental investigation is needed in laboratory. The experiments which to be conducted are Specific Gravity of the soil sample, Grain size Distribution of soil sample and liquid limit plastic limit test to identify the material and Standard Proctor test to obtain maximum dry density and optimum moisture content of soil sample, Unconfined shear strength test of soil sample mixing with emulsion. So the main objective is to maximize the shear strength by checking some conditions.**

***Keywords*: Shear strength, Bitumen emulsion, Soil Stabilization, Plastic limit**

1 INTRODUCTION

The construction cost of the pavements will be considerably decreased if locally available low cost materials are used for construction of lower layer of pavements such as sub grade, sub base etc. If the stability of local soils is not adequate for supporting the loads, suitable methods to enhance the properties of soil need to be adopted. Soil stabilization is one such method. Stabilizing the sub grade with an appropriate chemical stabilizer (such as Quicklime, Portland cement, Fly Ash or Composites) increases sub grade stiffness and reduces expansion tendencies, it performs as a foundation. The quality and life of pavements are prominently affected by the sub-grade Strength. Pavement design is based on the premise that minimum specified structural quality will be achieved for each layer of material in the pavement system. Each layer must resist shearing, avoid excessive deflections that cause fatigue cracking within the layer or in overlying layers, and prevent excessive permanent deformation through densification. As the quality of a soil layer is increased, the ability of that layer to distribute the load over a greater area is generally increased so that a reduction in the required thickness of the soil and surface layers may be permitted. Developments in the country have awakened the sense of economical resource management in the populace. People are being inspired to go back and take a closer look at the resources which they have earlier condemned, so as to find ways through which they could put such materials into use again. This is mainly because there is an increased competition for available materials as multiple uses of such resources are being discovered, and the cost of acquiring these suitable materials increases alongside. The development of any country depends on the transportation facilities and the construction projects. For the projects to be successful, the soil used for the foundation beds must be strong which requires better soil properties. Expansive soils have the tendency to swell when they come in contact with moisture and to shrink if moisture is removed from them. These volume changes in swelling soils are the cause of many problems in structures that come into their contact or constructed out of them. Major steps have thus being taken to make research into putting abandoned materials into full use again. Moreover, various studies are being carried out to discover better ways of achieving this goal, ways that will cost less and would be more economical when compared to using materials that naturally meet requirement standards.

2 SOIL STABILIZATION METHODS

In road construction projects, soil or gravelly material is used as the road main body in pavement layers. To have required strength against tensile stresses and strains spectrum, the soil used for constructing pavement should have special specification. 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. The method can be achieved in two ways, namely;

1) In situ stabilization and
2) Ex - situ stabilization.

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.

Following are the types of stabilization:

1. Mechanical Stabilization
2. Stabilization by using different types admixers

Lime Stabilization
Cement Stabilization
Chemical Stabilization
Fly ash Stabilization
Rice Husk ash Stabilization
Bituminous Stabilization
Thermal Stabilization
Electrical Stabilization
Stabilization by Geo-textile and Fabrics

3 USES OF STABILIZATION

Following are the various uses of Stabilization:

1. **Quality improvement:** The most common improvements achieved through stabilization include better soil gradation, reduction of plasticity index or swelling potential, and increases in durability and strength. In wet weather, stabilization may also be used to provide a working platform for construction operations. These types of soil quality improvement are referred to as soil modification.
2. **Thickness reduction:** The strength and stiffness of a soil layer can be improved through the use of additives to permit a reduction in design thickness of the stabilized material compared with an unstabilized or unbound material. The design thickness strength, stability, and durability requirements of a base or subbase course can be reduced if further analysis indicates suitability.

4. LIQUID LIMIT AND PLASTIC LIMIT TEST

The liquid limit of a soil is the dampness substance or the existing moisture, communicated in rate of the mass of the broiler dried soil at the limit organized between the liquid and plastic states. The dampness content at this limit condition is self-assertively defined as the liquid limit and is the dampness content at a consistency as determined by method for the standard liquid limit mechanical assembly. The liquid limit is the moisture content corresponding to the boundary between liquid state and plastic states of soil mass. The plastic limit (PL) is the moisture content at which the soil remains in plastic state. It is the water content at which the soil just begins to crumble when rolled into a thread of 3mm diameter.

Table 1: Liquid limit of soil samples

Sr. No	Sample	Liquid Limit (%)
1.	Normal Soil Sample	32.56
2.	Soil with 7 % bitumen emulsion	34.52
3.	Soil with 14 % bitumen emulsion	48.52
4.	Soil with 21 % bitumen emulsion	54.65
5.	Soil with 28 % bitumen emulsion	42.56

Table 2: Plastic limit of soil samples

Sr. No	Sample	Plastic Limit (%)
1.	Normal Soil Sample	25.54
2.	Soil with 7 % bitumen emulsion	17.85
3.	Soil with 14 % bitumen emulsion	18.24
4.	Soil with 21 % bitumen emulsion	15.58
5.	Soil with 28 % bitumen emulsion	16.54

5. UNCONFINED COMPRESSION TEST

The unconfined compressive strength is the load per unit area at which the cylindrical specimen of a cohesive soil falls in compression and by plotting the axial stress and strain in the graph, following unconfined strengths are computed as per reinforcement. This test was also conducted on test soil with different percentage of cutback bitumen content.

Table 3: Unconfined Compression Strength of soil samples

Sr. No	Sample	Unconfined Compression Strength
1.	Normal Soil Sample	0.0845
2.	Soil with 7 % bitumen emulsion	0.0864
3.	Soil with 14 % bitumen emulsion	0.0954
4.	Soil with 21 % bitumen emulsion	0.1058
5.	Soil with 28 % bitumen emulsion	0.1024

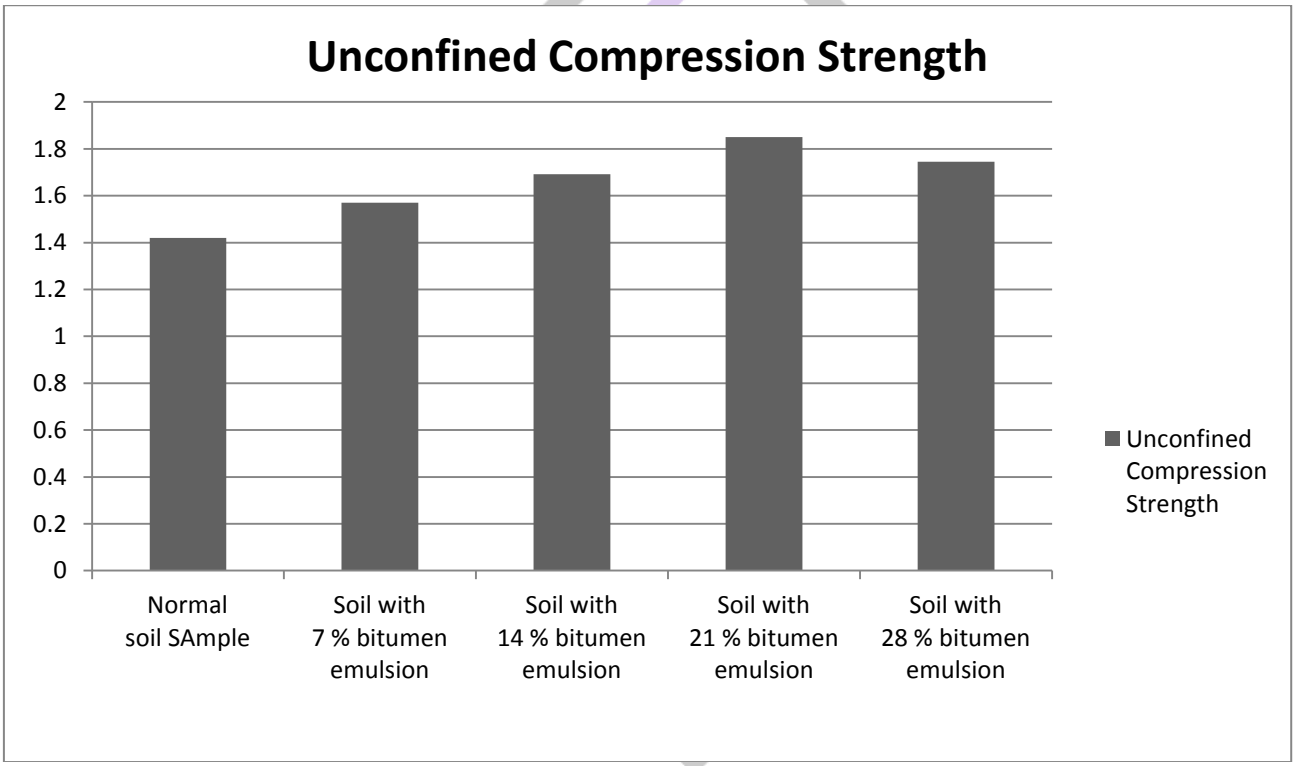

Figure 1: Maximum dry density (g/cc) of Soil Samples

CONCLUSION

As technology advances and economic conditions change, many more chemical agents will be introduced into subgrades to improve their compactability, durability, and strength. At the same time, more performance-based testing will be necessary to prove the effectiveness of these stabilization agents. Following are the various conclusions drawn from this study:

1. The results indicate that with the increase of bitumen emulsion in the soil sample at 21 % proportion ratio the soil strength is increased and after certain percentages it's getting decrease.
2. The cost of Bitumen Emulsion is more than various traditional materials used for the Soil Stabilization but it can be used in places having very poor soil due to its Shear Strength enhancing property.
3. Unstabilized soil sample has a high Atterberg's limits and swelling percentage.
4. Liquid Limit increases, as the percentage of bitumen emulsion increases.
5. Plastic Limit decreases, as the percentage of bitumen emulsion increases.
6. In proctor test (low compactive effort), Maximum dry density of 1.85 g/cm^3 was achieved at a moisture content of 12.24%. Further increase in moisture content tends to decrease dry density of the specimen.
7. The use of bitumen emulsion to stabilize uniform grained soil can create improved ground layer but also a surface base.

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