Soil Strength Improvement By Using Bitumen Emulsion

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Abstract- *shear strength of soil is an important factor for any analysis associated with stability including slope stability analysis. Mechanical and chemical processes are used in order to increase soil shear strength. Necessity for strengthening of soil in civil engineering project requires use of new materials. In this study, we have tried to increase soil shear strength using bitumen emulsion. Bitumen emulsion is used to increase the shear strength of soil. The bitumen emulsion is a mixture of water and bitumen. Initially the basic properties of soil are determined. Shear strength of normal soil is compared with the soil treated with various percent of bitumen emulsion.*

Keywords- shear strength, bitumen, bitumen emulsion, stabilization

I. INTRODUCTION

In design and construction of any structure, the role of soil is very crucial. Since the soil is in direct contact with the structure, it acts as a medium of load transfer and hence for any analysis of forces acting on structure, one has to consider the aspect of stress distribution through soil, as stability of structure itself depends on soil properties. Geotechnical study of site is crucial at feasibility stage, taking place before the design begins (a critical design input) in order to understand the characteristics of subsoil upon which the structure will stand.

The process of improving the engineering properties of weak soil by using various stabilizing agents is called soil stabilization. Stabilization makes soil more stable by reduction in the permeability, compressibility and with increase in shear strength; it makes the soil more stable thus enhancing bearing capacity of soil.

Structures need a stable foundation for their proper construction and lifelong durability. Foundation needs to rest on soil ultimately, transferring whole load to the soil. If weak soil base is used for construction, with passage of time it compacts and consolidates, which results in differential settlement of structure. It may result in cracks in structure which can have catastrophic affect too. To avoid these future problems in weak soil, stabilized soil should be considered.

Bitumen emulsions are a dispersion of bitumen in an aqueous continuous phase, stabilized by the addition of an emulsifier. They are prepared as emulsions at high temperatures, but applied as solid dispersions at ambient temperatures. Initially the properties of soil are determined by using conducting sieve analysis, plastic limit, liquid limit, specific gravity and shrinkage limit. Different percentage of bitumen emulsion was added and the obtained shear strength is compared with the shear strength obtained for normal soil.

II. OBJECTIVES

- To study the basic properties of soil
- To determine the strength of soil by adding various percentage of bitumen emulsion.
- Obtain the optimum value by adding various percentage of bitumen emulsion.

III. MATERIALS AND METHODOLOGY

The soil was collected from Muthuvara,Thrissur at an average depth of 1.5m. The undisturbed soil was cleared and large particles were removed. After the soil was air dried and stored in bags under room temperature. Bitumen emulsion was collected.

The tests were carried out on the collected soil without adding bitumen emulsion, such that the effect of the additive could easily be measured. Basic properties of the soil were determined.

Fig 3.1: UCC test

The shear strength was determined by using unconfined compression test. Shear strength was determined without bitumen emulsion. After that shear strength was determined by adding various percentage of bitumen emulsion as shown in figure 3.1.

IV. RESULT AND DISCUSSION

The basic properties of was determined. Properties of soil were tabulated in table 4.1.

Table-4.1: Properties of soil

Properties	Values
Specific gravity ,G	2.62
Liquid Limit ,WL (%)	41
Plastic Limit, WP(%)	23
Shrinkage Limit, WS (%)	14
Plasticity Index, I P	18
Soil type	MI
Optimum moisture content %	13.3
Maximum dry density (kN/m^3)	19.4
Unconfined compressive strength (Kg/cm^2)	0.832

Shear strength of soil was determines by adding various percentage of bitumen emulsion. Bitumen emulsion was directly added to the soil and mixed well. After 1 minute soil was filled in UCC mould and shear strength was determined by UCC test.

The figure 4.1 shows the variation of compressive stress with 4% of bitumen emulsion at optimum water content (13.3%). Here the compressive stress increases with respect to the axial strain, up to a certain point (0.307kg/cm$^{\wedge 2}$), then it became constant.

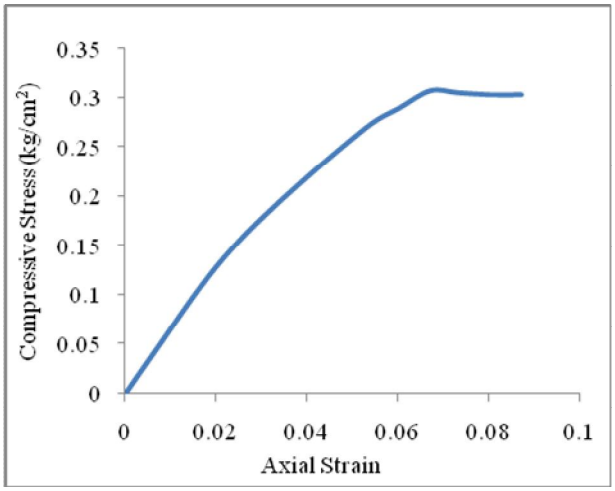

Fig.4.1: Variation of compressive stress at 4% of bitumen emulsion

The figure 4.2 shows the variation of compressive stress with 4% of bitumen emulsion at optimum water content .Here the compressive stress increases with respect to the axial strain, upto a certain point (0.606 kg/cm^2), then it became constant.

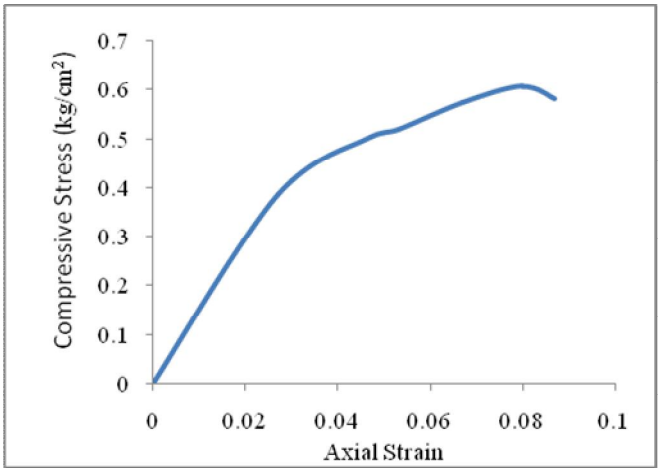

Fig 4.2: variation of compressive stress at 8% of bitumen emulsion

The figure 4.3 shows the variation of compressive stress with 6% of bitumen emulsion at optimum water content. Here the compressive stress increases with respect to the axial strain, upto a certain point (0.392 kg/cm^2), then it became constant.

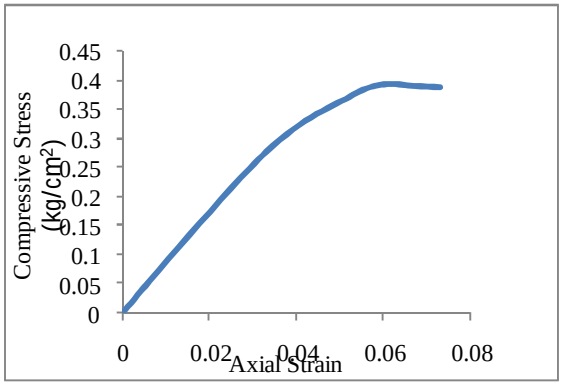

Fig 4.3: variation of compressive stress at 6% of bitumen emulsion

The figure 4.4 shows the variation of compressive stress with 12% of bitumen emulsion at optimum water content . Here the compressive stress increases with respect to the axial strain, up to a certain point (0.293 kg/cm^2), then it became constant

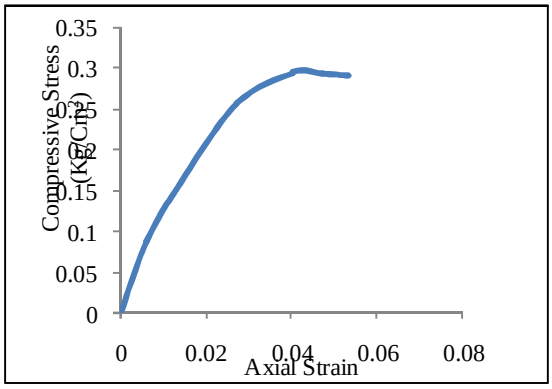

Fig.4.4: variation of compressive stress at 12% of bitumen emulsion

The figure 4.5 shows the variation of compressive stress with 16% of bitumen emulsion at optimum water content. Here the compressive stress increases with respect to the axial strain, up to a certain point (0.186 kg/cm^2), then it decrease.

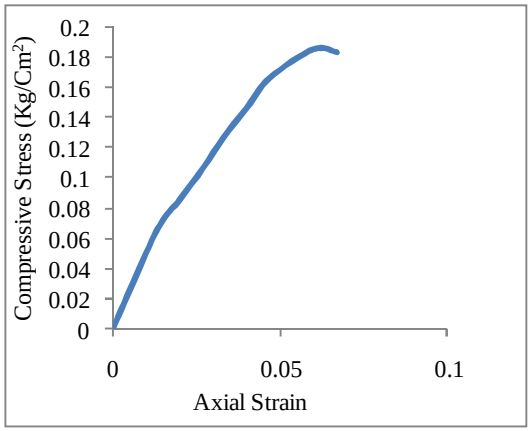

Fig.4.5: variation of compressive stress at 16% of bitumen emulsion

The figure 4.6 shows the variation of compressive stress with 10% of bitumen emulsion at optimum water content . Here the compressive stress increases with respect to the axial strain, up to a certain point (0.915kg/cm^2), then it became constanT

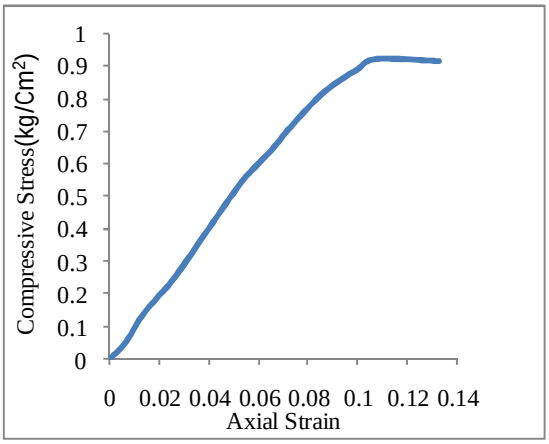

Fig.4.6: variation of compressive stress at 10% of bitumen emulsion

The figure 4.7 shows the variation of compressive stress with 14% of bitumen emulsion at optimum water content. Here the compressive stress increases with respect to the axial strain, up to a certain point (0.272kg/cm^2), then it decrease.

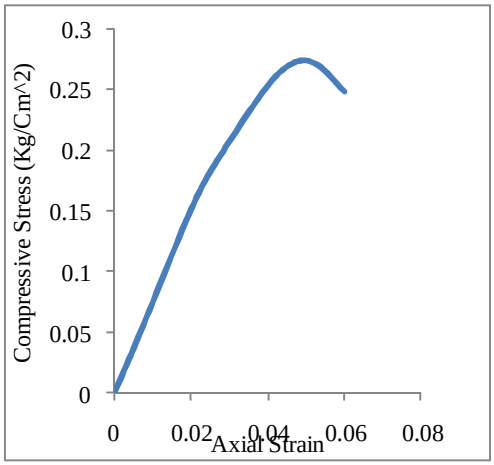

Fig.4.7: variation of compressive stress at 14% of bitumen emulsion

The figure 4.8 shows the variation of compressive stress with 9.5% of bitumen emulsion at optimum water content . Here the compressive stress increases with respect to the axial strain, up to a certain point (0.810kg/cm^2), then it decrease.

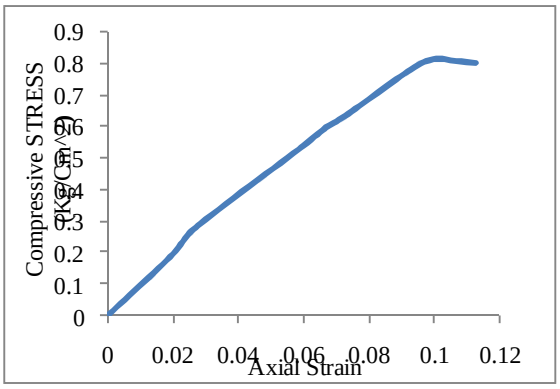

Fig.4.8: variation of compressive stress at 9.5% of bitumen emulsion

The figure 4. shows the variation of compressive stress with 10.5% of bitumen emulsion at optimum water content . Here the compressive stress increases with respect to the axial strain, up to a certain point (1.015 kg/cm^2), then it decreases.

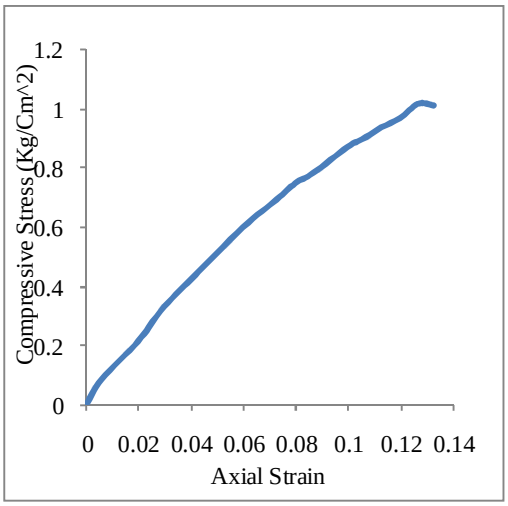

Fig.4.9: variation of compressive stress at 10.5% of bitumen emulsion

The figure 4.10 shows the variation of compressive stress with 11% of bitumen emulsion at optimum water content . Here the compressive stress increases with respect to the axial strain, up to a certain point (0.509kg/cm^2), then it became constant.

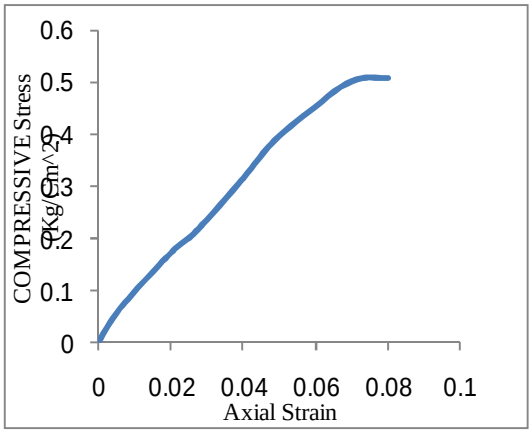

Fig.4.10: variation of compressive stress at 11% of bitumen emulsion

The figure 4.11 shows the variation of compressive stress with 11.5% of bitumen emulsion at optimum water content Here the compressive stress increases with respect to the axial strain, up to a certain point (0.414kg/cm^2), then it became constant.

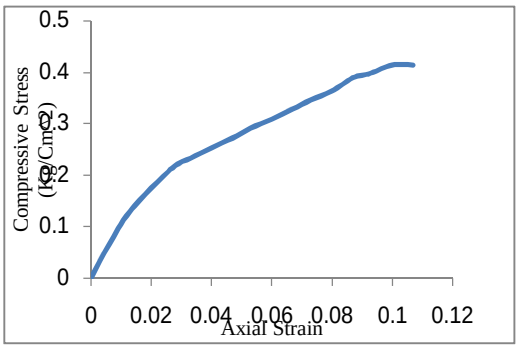

Fig.4.11: variation of compressive stress at 11.5% of bitumen emulsion

V. CONCLUSIONS

- This study made a comprehensive examination of the effectiveness shear strength on the addition of bitumen emulsion.
- Shear strength of the soil increases by the addition of bitumen emulsion up to 10.5% ,obtained value is 1.015 kg/cm^2 .After adding 9.5% bitumen emulsion to the soil the shear strength is decreasing.
- Bitumen emulsion can be use as a stabilizing agent. The increasing strength is due to increasing the binding nature of soil particle on the addition of bitumen emulsion.

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