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A REVIEW ON STRENGTH IMPROVEMENT OF EXPANSIVE SOILS BY BITUMINOUS ADMIXTURES

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ABSTRACT

Starting from the base, soil is one of nature's most abundant construction materials. Almost all type of construction is built with or upon the soil. The most important part of a road pavement is sub grade soil and its strength. If strength of soil is poor, then stabilization is normally needed. Sub grade is sometimes stabilized or replaced with stronger soil material so as to improve the strength. Such stabilization is also suitable when the available sub grade is made up of weak soil. Increase in sub grade strength may lead to economy in the structural thicknesses of a pavement. Cement, fly ash, lime, fibers etc. are very commonly used for soil stabilization. The main objective of this experimental study is to improve the properties of the gravel soil by adding bitumen emulsion. An attempt has been made to use emulsion for improving the strength of gravel soil expressed in terms of CBR values which may prove to be economical. In this study, the whole laboratory work revolves around the basic properties of soil and its strength in terms of CBR. A little cement added to provide better soil strength. It is observed that excellent soil strength results by using cationic bitumen emulsion (CMS) with little quantity of cement used as filler. The appropriate mixing conditions for gravelly soil with CMS Bitumen emulsion have been first attempted. This is followed by deciding four particular material conditions to show the variation in dry density and CBR value to achieve the best possible strength properties of gravel soil.

***Key words*—Bitumen, CBR, Subgrade, Emulsion**

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I. INTRODUCTION

Transport in the Republic of India is an important part of the nation's economy. Roads are the vital lifelines of the economy making possible trade and commerce. They are the most preferred modes of transportation and considered as one of the cost effective modes. An efficient and well-established network of roads is desired for promoting trade and commerce in any country and also fulfills the needs of a sound transportation system for sustained economic development.

To provide mobility and accessibility, all weather roads should connect every nook and corner of the country. To sustain both static and dynamic load, the pavement should be designed and constructed with utmost care. The performance of the pavement depends on the quality of materials used in road construction. Sub grade is the in situ material upon which the pavement structure is placed. Although there is a tendency to look at pavement performance in terms of pavement structures and mix design alone, the sub grade soils can often be the overriding factor in pavement performance.

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 (able to support and distribute loads under saturated conditions).

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. The expansive soils in India have liquid limit values ranging from 50 to 100 %, plasticity index ranging from 20 to 65 % and shrinkage limit from 9 to 14 %.

II.NEED OF PRESENT STUDY

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, CBR test of soil sample mixing with emulsion and cement. So the main objective is to maximize the CBR value by checking some conditions to increase the CBR value of soil sub grade.

III.OBJECTIVES

i. To determine the properties of the Expansive soil.
ii. To evaluate the performance of Expansive soil when stabilized with Bitumen Emulsion as an admixtures and its suitability for the pavement sub grade.
iii. To evaluate the performance of stabilized Expansive soil with an optimum of Bitumen Emulsion and their suitability for the pavements.

IV. MATERIALS

1. Expansive soil (Mud soil).
2. Bitumen Emulsions.
3. Binder (Cement).

V. EXPERIMENTAL INVESTIGATION

- To stabilize or improve the soil sample taken, the considered additives to be added in percentages to soil so that at what point does the soil given its best results to additive percentage.
- The tests required to be done again with added additive percentages to the soil. To know the strength variation against the addition of additives to the soil CBR test is the main lab test to be done.
- To do CBR test at different percentages of additives with soil, the OMC & MDD of the soil with the added additive percentages to be known. The standard proctor test to be done at different percentages of additives added to the soil.

The tests performed with addition of added percentages of additives to the soil sample taken.

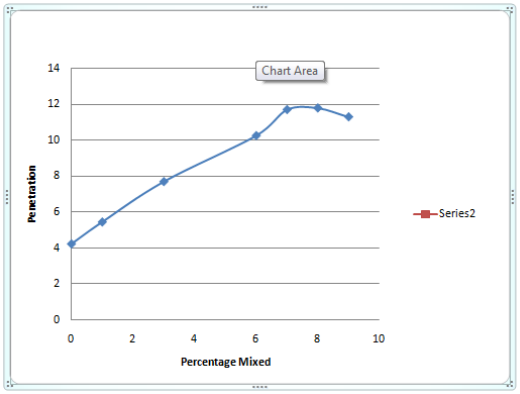
1. Standard proctor test
2. CBR test
   a. Unsoaked soil sample
   b. Soaked soil sample

VI. RESULTS AND DISCUSSIONS

1. EFFECT OF BITUMEN EMULSION ON CBR OF SOIL

1.1. UNSOAKED CONDITION

Numbers of tests were carried out to know the effect of bitumen emulsion on CBR value of soil. By addition of bitumen emulsion in increasing quantity with an increment of 0.5% CBR value increased to a maximum of 11.77% (i.e. 2.87 times the CBR of soil without bitumen emulsion) when 8% of bitumen emulsion is added.



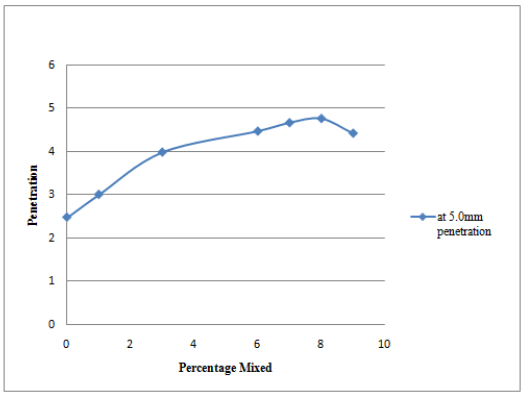
Graph 1. Graph Showing Variation Unsoaked CBR Values at Certain Percentages

Table.1: Comparison of Unsoaked CBR Values

s.no	Mix proportions	CBR at 2.5mm	CBR at 5mm
1	100% soil	6.2043	4.233
2	Soil + 1% Bitumen Emulsion	6.423	5.450
3	Soil + 3% Bitumen Emulsion	6.5	7.688
4	Soil + 6% Bitumen Emulsion	6.569	10.26
5	Soil + 7% Bitumen Emulsion	6.788	11.68
6	Soil + 8% Bitumen Emulsion	7.3722	11.77
7	Soil + 9% Bitumen Emulsion	7.226	11.28

1.2. SOAKED CONDITION

Numbers of tests were carried out to know the effect of bitumen emulsion on CBR value of soil. By addition of bitumen emulsion in increasing quantity with an increment of 0.5% CBR value increased to a maximum of 4.766% (i.e. 2.15 times the CBR of soil without bitumen emulsion) when 8% of bitumen emulsion is added.



Graph 2. Graph Showing Variation soaked CBR Values at Certain Percentages

Table.2: Comparison of soaked CBR Values

S.no	Mix proportions	CBR at 2.5mm	CBR at 5mm
1	100% soil	1.8248	2.48175
2	Soil + 1% Bitumen Emulsion	2.48	3.010
3	Soil + 3% Bitumen Emulsion	2.77	3.9902
4	Soil + 6% Bitumen Emulsion	2.99	4.4768
5	Soil + 7% Bitumen Emulsion	3.64	4.6715
6	Soil + 8% Bitumen Emulsion	3.77	4.7688
7	Soil + 9% Bitumen Emulsion	3.57	4.428

As the graphs & tables plotted above describes that the bitumen emulsion addition to the soil sample was optimized at 8% of replacement. To improve strength or strengthening water proofing nature was done at the 8% addition of bitumen emulsion to the soil. More than 8% of bitumen emulsion shows the negative impact on soil, which means minimizes the soil strength as compared to the 8% of bitumen emulsion replacement.

VII.CONCLUSION

- It is found that the O.M.C of the Expansive soil has been increased by addition of 6%, 7% & 8% Bitumen emulsion.
- It is found that the MDD of the soil is increased when Bitumen emulsion added to the soil
- It is also found that in the permeability test the passage of water in soil is more when are added to the Bitumen emulsion soil when compared to the only soil.
- It is observed that the C.B.R. value of the soil has been increased by addition of Bitumen emulsion
- After several tests carried out the bitumen emulsion addition minimizes various things such as sub grade thickness, quantity of the soil, cost of soil required etc
- That's why combination of additives are used in this project to check the CBR values of the soil. By this combination of additives CBR values of the soil are increased. By this we can reduce the cost by using less cost of additives.
- Bitumen emulsion is easily available and less in cost.
- This concludes that maximum limit of replacement of bitumen emulsion in this soil is 8% only, because at the 9% the values of CBR are decreased.
- It was confirmed far before when the max.dry density value of soil with 9% bitumen emulsion values turned down (decreased).
- Until the replacing of bitumen emulsion by 8% it shows very good results for strength improvement & water proofing of the soil.
- After several tests carried out the bitumen emulsion addition minimizes various things such as sub grade thickness, quantity of the soil, cost of soil required etc.

VIII.REFERENCES

- B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, soil mechanics and foundation, New Delhi. Laxmi, publications pvt Ltd
- K.R. Arora, soil mechanics and foundation engineering, Delhi, standard publishers and distributors.
- Manoj Dutta & Gulati S.K, Geotechnical engineering, New Delhi, Tata Mc.Grawhill publishers.
- C.Venkataramiah, Geotechnical engineering Newage international pvt ltd, (2000).
- T.W.Lambe and Whitman, soil mechanics, Newyork. Mc.graw hill publishing company,
- Gopal Ranjan &Asr Rao, Basic and applied soil mechanics, Newage international pvt ltd, (2004).
- VNS Murthy, Geotechnical engineering principles and practices of soil mechanics and foundation engineering, Taylor & Francis group.