A LABORATORY STUDY ON THE ROAD SUB-SURFACE HAVING STABILIZED GRAVEL

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ABSTRACT:

High quality aggregates that meet the specifications are getting increasingly scarce and expensive in many localities in India. Traditional flexible pavement specifications require high quality aggregates in both base and sub base course. In many cases locally available aggregates are not satisfying the specifications and the aggregates that meet the specifications have to be hauled in long distances. This act significantly increases the cost associated with the construction and subsequent maintenance and rehabilitation of them. Thus, the use of locally available marginal aggregates in flexible pavement construction is one of the possible answers to high pavement construction costs and lack of quality aggregates sources in a vast country like India. A broad definition of a marginal aggregate is "any aggregate not in fully accordance with the specifications used in a country for normal road aggregates but can be used successfully either in special conditions, made possible because of climatic characteristics or recent progress in road techniques or after subjecting to particular treatment". So if through appropriate modification of the materials or structural design the use of local materials can be permitted, the construction can accelerated and significant monetary benefits can be achieved.

So the main objective of the study is to improve the properties of the locally available gravel soil/ marginal aggregate (Moorum) by adding cement and bitumen emulsion. An attempt has been made to use cement for increasing the strength of the gravel and emulsion for increasing the water resisting capacity. The whole work involves increasing strength of gravel soil (Moorum) and expressed in terms of CBR and UCS value.

***Key words**: - Marginal aggregate, CBR, UCS, Bitumen Emulsion.*

1.0 INTRODUCTION:

High quality aggregates are becoming increasingly scarce and expensive in many localities. Traditional flexible pavement specifications require high quality aggregates in the flexible pavement base course materials and asphalt concrete mixtures. In an increasing number of cases, locally available aggregates are not meeting applicable specifications, and aggregates that meet the specifications must be imported to the site at considerable expense.

Need for present research:

In order to decide whether to use marginal materials in both advantages and disadvantages should be weighed. This is not simple judgement since some aspects involved can‟t be quantified in monetary terms. An evaluation of marginal materials for use should be based on technical. Economical and environmental factor, and due consideration should be given to them. *(Source:-Enabling use of marginal aggregates in road construction, Manuel C.M. Nunes, University of Nottingham, 1994)*

OBJECTIVE AND SCOPE OF WORK:

Moorum

Shales

IMPORTANCE AND BENEFITS:

- The reduction of energy cost related to extraction and transportation of conventional aggregates.
- The reduction in environmental cost related to conventional aggregates quarrying.
- The reduction in environmental and economic problem associated with waste storage and dumping.

2.0 REVIEW OF LITERATURE:

Evans and Hicks (1982) tried excellent basalt, two low quality marine basalts, and a fine grained hill sand. The blend properties assessed which incorporate dia. metral versatile modulus and a dia. metral weakness life for both as compacted example and example moulded by dampness introduction. Layered versatile outline standard were utilized with the dynamic test results to create layer equivalencies for emulsion treated negligible total contrasted and hot blend black-top cement. The outcomes show that that beneficiation of

minor total with black-top emulsion ought to make satisfactory clearing quiets, especially for low volume streets.

Al-Abdul Wahab and Asi (1997) utilized moderate setting emulsified black-top and medium curing lessening black-top to settle both marl and rise sand. Lime and Portland bond (2% and 4%) were added to the settled soils to quicken the curing procedure and to lessen strength misfortune because of water harm. It was found that balanced out operators enhanced both shear quality and imperviousness to the broke down soils to water harm. It was watched that Portland concrete was more compelling than lime.

Asi et al. (1999) completed test to explore the practical utilization of frothed black-top innovation in Saudi Arabia to enhance the common ridge sands for conceivable use as a base or sub base material. A few variables were explored to assess the relative change of ridge sand and to allow the improvement of outline methodology for the future utilization of frothed black-top innovation in the cruel climatic states of eastern Saudi Arabia. Measurable examination of the outcomes was utilized to confirm the impacts of emulsified black-top and frothed black-top treatment, with and without the expansion of Portland concrete, on the quality attributes of the treated blends, top blends, when contrasted with that of the emulsified black-top blends.

Nageim et al. (2012) led different tests which went for growing new icy bituminous emulsion blends (CBEM) containing fly slag from burned residential and mechanical by-items contrasted and those after effects of customary control frosty containing OPC and hot blend black-top. The principle targets of the analyses were to examine the change in mechanical properties of CBEM‟s because of consolidating OPC, and recognize the likelihood of supplanting the OPC with waste fly fiery remains materials. The blends mechanical properties explored were; ITSM, creep firmness. Toughness in term of water affectability was examined as well.

Khadijeh Moosavi, Behzad Kalantari (2011) directed examinations to enhance bearing limit of wind-blown sand. The change in the mechanical quality of settled examples was contemplated by California Bearing Ratio (CBR) test. The curing period utilized are 7, and 28 days for both, un-drenched and splashed specimens. The got results demonstrate that CBR estimations of windblown sand treated with concrete fundamentally increments by rate of bond increments. Imperviousness to disappointment because of forced heaps of this kind of sand treated with concrete increments with time. 1%, 3%, 5%, 7%, 9%, 11%, and 13% of the mounts of concrete was added to the dirt and it was turned out to be clear that if under (100 kg/m³) of customary bond Portland is blended with wind-blown sand and compacted at their ideal dampness content, following 28 days of curing expand the CBR of in-situ wind-passed up more than 23 folds (from 7.2% to 172%) for un doused examples.

3.0 EXPERIMENTAL METHODOLOGY:

This chapter describes the experimental works carried out in this present investigation. This chapter is divided into two parts. First part deals with the Materials used second part deals with the tests carried out on the mixture.

Materials Used:

- **Moorum**
- **Bitumen Emulsion**
- **Cement**

3.1 Tests carried out on the Materials used and their Mixtures:

Specific Gravity

The proportion between the mass of any substance of an unequivocal volume partitioned by mass of equivalent volume of water is characterized as Specific Gravity. For soils, it is the quantity of times the dirt solids are heavier in the appraisal to the equivalent volume of water present. So it is fundamentally the quantity of times that dirt is heavier than water. Particular gravities for distinctive sort of soils are not same

Table 3.1: Standard Specific Gravity

Types of Soil	Specific Gravity
Sand	2.63 – 2.67
Silt	2.65 – 2.70
Clay and silt Soil	2.67 – 2.90
Organic Soil	1.00 – 2.67

Particle Size Distribution:

The synthesis of soil particles are of a mixed bag of sizes and shapes. The scope of molecule size present in the same soil test is from a couple of microns to a couple penny meters. Numerous physical properties of the dirt, for example, its quality, porousness, thickness and so on are relied on upon distinctive size and state of particles present in the dirt specimen.

Sifter examination which is ruined coarse grained soils just and the other system is sedimentation investigation utilized for fine grained soil test, are the two strategies for discovering Particle size appropriation. Both are trailed by plotting the outcomes on a semi-log diagram where ordinate is the rate better and the abscissa is the molecule distance across i.e. sifter sizes on a logarithmic scale. The strainer investigation for coarse grained soil has been directed.

Residue Test for Emulsion:

Determine the weight of each of three beakers containing a glass rod to 0.1 g. Weigh 50 $\pm$ 0.1 g of thoroughly mixed, emulsified asphalt into each of three beakers. Place the beakers containing the rods and sample in the oven, which has been adjusted to 163 $\pm$ 3.0°C, for 2 h. At the end of this period remove each beaker and stir the residue thoroughly. Replace in the oven for 1 h, and then remove the beakers from the oven, allowed to cool to room temperature, and weigh with the rods.

Residue, % = 2 (A - B)

Where: -A = weight of beaker, rod, residue

B = tare weight of beaker

4.0 RESULTS AND DISCUSSIONS:

The experimental test was conducted on moorum with adding two additives OPC 43 grade cement and bitumen emulsion. SS-2 emulsion is used in this to study to observe the changing properties of moorum after adding the additives.

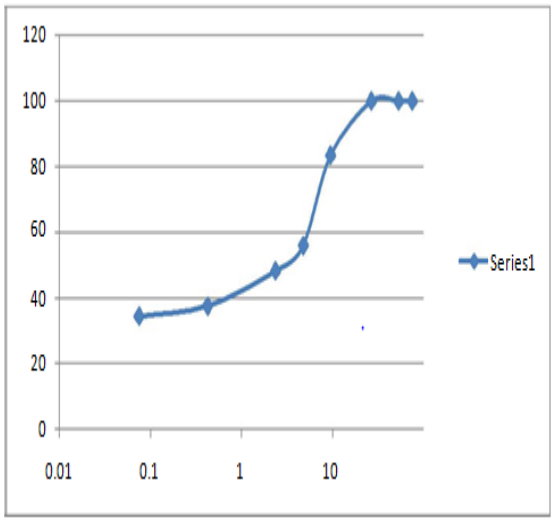
Tests conducted on Moorum

Basic Physical Properties

The basic physical properties of gravel (moorum) used in this study have been determined and are presented in Table 4.1.

Grain size distribution (sieve analysis)

It is defined that the grain size of an object can be determined and tested by using the grain size distribution and is to be obtained by below graphical representation.



Grain size distribution graph

The gradation followed as per section 404 of "Specifications for Rural Roads" Ministry of Rural Development (first revision 2010) published by Indian Road Congress.

C.B.R. Test:

The CBR is the measure of resistance of a material to infiltration of a standard plunger under controlled thickness and dampness conditions. This is a to a great degree typical test to appreciate the sub-level quality before development of roadways. The test has been comprehensively explored for the field association of adaptable asphalt thickness need. In a far-reaching way testing is done taking after IS: 2720 (Part 16). The test includes bringing on a round and barrel shaped plunger of 50mm distance across to enter an asphalt part material at 1.25mm/moment. This worth is communicated in rate. Standard heap of diverse infiltration is talked about some time.

Mould size: standard volume 2250 cc

Normal available tested soil is used for testing in this case Used proctor test result of previous case

Maximum Dry Density value: 2.02 gm./cc

Optimum Moisture Content: 10.12%

CBR test is done for 4 days soaked condition. CBR value at 2.5mm penetration and 5mm penetration is calculated. 4 days Soaked C.B.R. value of Moorum is found to be 14.62%.

C.B.R. Testing Apparatus

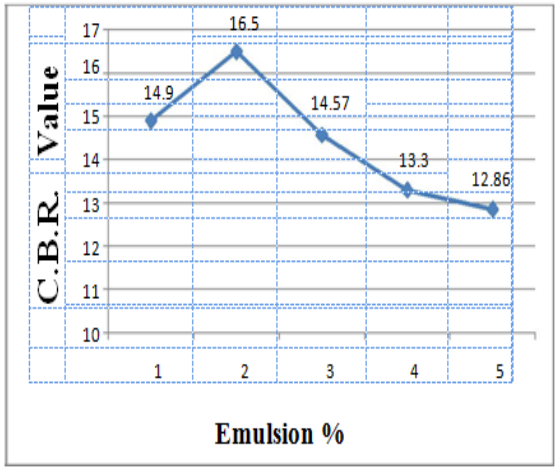
U.C.S. Test:

The unconfined compression test for remoulded sample of Moorum is conducted and load applied uni-axially until failure of specimen occurs. This test provides a good assessment to the shear strength of cohesive soils. Test is conducted as IS 4332 – part (v) for gravel soils. 100 mm dia. and 200 mm height sample is prepared using the UCS mould and the sample is then tested in the U.C.S.

The U.C.S. value for Moorum is found to be 0.729 kg/cm^2.

U.C.S. testing apparatus

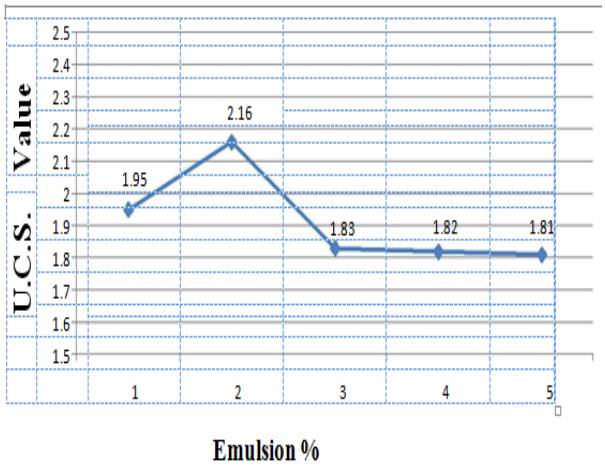
Change in C.B.R.



C.B.R. Tests comparison graph

Increase in C.B.R. value with increase in emulsion percentage from 1 to 2, and then Gradual decrease in the value of C.B.R. with more percentage of emulsion. C.B.R. value at 2 % is slightly more than the C.B.R. value of normal Moorum.

Changein U.C.S values with varying % of emulsion.



U.C.S. test comparison graph

The result is as follows:-

UCS of specimen kept for 14 days in oven = 26.40 kg/cm^2

UCS of specimen kept for 7 days in oven and 7 days in water = 21.30 kg/cm^2

The strength of set immersed in water as a percentage of strength of set cured at constant moisture content is found to be 80.68%. This index is a measure of resistance to the effect of water on strength. As the value comes above 80% so the stabiliser % is found to be correct and hence the specimen containing this combination of stabiliser is found to be durable.

Testing of durability sample after 14 days dry curing

5.0 CONCLUSIONS AND FUTURE SCOPE:

Summary of Observations:

Sub-level may be characterized as a compacted soil layer, for the most part of normally happening neighbourhood soil, thought to be 300 mm in thickness, only underneath of the asphalt hull. It gives a suitable establishment to the asphalt. So it is imperative to enhance quality of sub-evaluation soil, it might be by supplanting great soil or by adjustment of existing soil. So a study has been done to enhance the quality of Moorum by adding cement and bitumen emulsion to it to make it suitable for utilization in sub-base course of low volume roads. The accompanying conclusion has been drawn from the above studies.

Adjustment utilizing cement and bitumen emulsion builds the bearing limit of Moorum adequately. This reasons extensive increment in number of suitable proportionate standard axle load (ESAL) and therefore, the lifetime of the road will increment separately. Thus, it is clear that this kind of adjustment may be relevant in low volume road for enhancing its quality. This adjustment is able for high point of confinement of stacking in the area with absence of conventional material.

Future Scope:

- Analysis the strength of Moorum using any other soil test like I.T.S. or modulus of elasticity.
- Same Experiments can be performed with SS-1 or MS emulsion.
- Same experiments can be performed with adding mixture of lime and emulsion to see the variation in result.

- Same experiments can be done using cut back bitumen and cement or lime.

REFERENCES:

Al-abdul Wahhab, H.I., & Asi, I.M.,(1997) "Improvement of Marl and Dune Sand for Highway Construction in Arid Areas "*Budding and Environment,* Vol. 32, No. 3, pp. 271-279, 1997.

Asi, I.M., Wahhab Al-Abdul, H.I., "Stabilization of Dune Sand Using Foamed Asphalt," Geotechnical Testing Journal, GTJODJ, Vol. 25, No. 2, June 2002, pp. 168–176

ASTM D 244 (2004) . "Standard Test Method for Residue by Evaporation of Emulsified Asphalt" , American Society for Testing and Materials, Philadelphia, USA

Ahlrich, R.C., & Rollings, R.S., "Marginal Aggregates in Flexible Pavements: Background Survey and Experimental Plan" US Army Engineer Waterways Experiment Station Geotechnical Laboratory 1993

Brandl, H., „Quality Requirements and Tests for Earthworks and Granular Bases", only Available in German, Proceedings of an International Meeting, 1977 (Road Research Society, 1977), pp. 15-43.

Brown, S.F., & Needham, D., "A Study of Cement Modified Bitumen Emulsion Mixtures" Annual Meeting of the Association of Asphalt Paving Technologist 2000.