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A LABORATORY STUDY ON IMPLEMENTATION OF BITUMEN EMULSION IN GRAVEL ROAD

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ABSTRACT Ranging from the bottom, soil is one among nature's most plenteous construction materials. Most sort of construction is constructed with or upon the soil. The foremost necessary a part of a road pavement is subgrade soil and its strength. If strength of soil is poor, then stabilization is generally required. The most objective of this experimental study is to improve the properties of the gravel soil by adding hydrocarbon emulsion. A trial has been created to use emulsion for up the strength of gravel soil expressed in terms of cosmic radiation values which can persuade be economical. During this study, the entire laboratory work revolves round the basic properties of soil and its strength in terms of cosmic radiation. Somewhat cement another to supply higher soil strength. It's determined that glorious soil strength results by mistreatment bitumen emulsion with very little amount of cement used as filler. 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 black soil with CMS Bitumen emulsion have been 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 black soil. Here we use ideal soil of passing 600 microns IS Sieve.

Key Words: bitumen emulsion, bitumen stabilization, black soil, CBR, liquid limit test, modified proctor test, particle size distribution, plastic limit, pycnometer, sieve analysis, specific gravity.

1.0 INTRODUCTION

The Indian Road Congress encodes the correct define methodologies of the pavement layers based mostly upon the subgrade quality. Subgrade quality is usually communicated as so much as cosmic radiation. That's the American state bearing magnitude relation communicated in rate. Consequently, in all, the pavement and also the subgrade along should sustain the activity volume. During this project domestically obtainable red colored dirt sort gravel soil is taken as experimenting material. Medium setting emulsion (MS) is employed as stabilizing agent in this explicit study. Hydrocarbon sand stabilization is a good method as hydrocarbon makes soil stronger and improves resistance capability against water and frost. The main objective of this experimental study is to enhance the properties of the gravely soil by adding hydrocarbon emulsion as stabilizing agent and tiny bit cement as filler. a trial has been created to use emulsion for up the strength and geotechnical properties of gravel soil. Terribly principally, use of use of hydrocarbon emulsion is environmentally accepted. To realize the entire project some experimental investigation is required in laboratory. The experiments that to be conducted are relative density of the soil sample, Grain size Distribution of soil sample and liquid limit plastic limit check to spot the fabric and customary Proctor check to get most dry density and optimum wet content of soil sample, cosmic radiation check of soil sample mix with emulsion and cement. That the main objective is to maximize the cosmic radiation price by checking some conditions to extend the cosmic radiation price of soil subgrade.

2. 0 LITERATURE REVIEW

Bitumen emulsion is used as chemical stabilizer. Cement is used here as a binder only to improve strength of road. Previously lots of work was done on sand bitumen stabilization and gravel soil bitumen stabilization in different places. This study is being inspired from those researches. Here gravel red colored soil is used, as it is available in many states of India. Some similar works, done before, is discussed below.

Marandi and Safapour (2012) worked on Base Course Modification through Stabilization using cement and bitumen. The main objective of this research was to analyze the use of bitumen emulsion in base course stabilization. So that it was examined as replacement with conventional pavement in regions with low quality materials. Stabilization of soils and aggregates with bitumen shows it differs greatly from cement stabilization. The basic mechanism involved in bitumen stabilization was a waterproofing phenomenon.

Jones et al. (2012) conducted an experimental study on bitumen soil stabilization. Here asphalt emulsion is a mix of asphalt binder, water, and emulsifying agent. In this case, a series of Indirect Tensile Strength (ITS), Unconfined Compressive Strength (UCS) and Marshal Tests were carried out. It is liquid at ambient temperature to facilitate handling at lower application temperatures. It accelerates breaking of the emulsion and for additional early strength to accommodate traffic during curing of the layer.

Nikraz (2012) worked on Bitumen-cement Stabilized Layer in Pavement Construction Using Indirect Tensile Strength (ITS) Method. In this study, the goal was to mix and blend Portland concrete and bitumen emulsion with soil for upgrading the quality, strength and durability of the dirt. So as to upgrade the soil quality and decrease its weakness to water, soil stabilization is obliged to be connected to the soil. In accordance with this, enhanced burden exchange was added to the asphalt establishment by having the bond impact which really supports the firmness and Bitumen emulsion impacts which enhance versatility and soil penetrability of the settled layer.

L. Lauren (2011) performed an experimental take a shot at soil stabilization products like the polymer emulsion for having all the earmarks of being the stabilization executors for what's to come. Every one of the three polymer-emulsions was utilized as a part of this testing project performed eminently making solid examples that all gave suitable CBR qualities to ways. The CBR test was utilized for this venture on the grounds that it has been effectively related with quality capability of the subgrade, sub base, and base course material for utilization in street and runway development.

Paul et al. (2011) suggested an introduction to soil stabilization in pavement taking a mixture of bitumen and well-graded gravel or crushed aggregate. After compaction it gave an exceedingly steady waterproof mass of sub base or base course quality. The fundamental system involved in asphalt stabilization of fine-grained soils is a waterproofing wonder. Soil particles or soil agglomerates were covered with asphalt that forestalls or abates the entrance of water which could regularly bring about abatement in soil quality. What's more, asphalt stabilization can enhance durability qualities by making the soil impervious to the unfavorable impacts of water, for example, volume. In non-iron materials, for example, sands and gravel, pounded gravel, and smashed stone, two fundamental systems are dynamic: waterproofing and adhesion. The asphalt coating on the union less materials gives a film which anticipates or hinders the entrance of water; subsequently reducing the inclination of the material to lose quality in the vicinity of water. The second instrument had been distinguished as adhesion and characteristics of gravelly soils.

Yuehuan et al. (2010) worked on foamed bitumen stabilization for Western Australian pavements. Currently, the popularity of soil cement stabilization had been challenged by anew innovative soil improvement technique, known as foamed bitumen stabilization. Very few of work have been done on it and application of this type of stabilization is currently applied in flexible pavement subgrade stabilization. Numerous Australian roadway and way offices have committed noteworthy investigation and stores to investigate this system so as to attain a more adaptable and weakness safe balanced out material suitable for an extensive variety of pavement conditions. Percent of froth bitumen utilized as 3 to 5 percent. It was one kind of mix design however here after the mix design process stabilization done and CBR quality tried.

Chinkulkijniwat and Man-Koksung (2010) directed a test research on compaction aspects of non-gravel and gravelly Soils using a little compaction device. The standard delegate test has been broadly utilized and acknowledged for characterizing soil similarity for field compaction control. Here additionally indicates about the influence of gravel size and gravel content on standard delegate test results. In this study a relationship developed between the summed up optimum water substance of the fine division in the gravelly soil and the gravel content in standard molds using compaction results from the proposed little device.

3.0 EXPERIMENTAL PROGRAMME

3.1 Materials

The local soil (shown in Fig-1) was obtained from Geeta Engineering College, Panipat. The properties of the soil are mentioned in Table-1.The details of Bitumen Emulsion used in the study are mentioned in Table-2.

Table-1: Properties of Soil

Parameter	Value
Bulk Density (γ) g/cc	1.5
Optimum Moisture Content (OMC)	11.87 %
Max. Dry Density (MDD) g/cc	1.95

Specific Gravity (Gs)	2.68
Fines Fraction	0.94
Coarse Fraction	0.03
IS Classification	SW-MI

Table-2: Details of Cationic Bitumen Emulsion

Name of the company	Jai Bitumen
Type	MS
Application	Maintenance
Water Content	48 %

3.2 METHODOLOGY

The Gradation Test on the collected soil sample was carried out in accordance with IS 2720 (Part 4):1985 to know the details of type of soil. After knowing the natural properties of soil, The Direct Shear Test was conducted in accordance with IS 2720 (Part 13):1986 on untreated soil at OMC as well as on mixture of soil and Bitumen Emulsion at different water contents shown in Table-3.Due to presence of presence of 50% water in the emulsion, the quantity of water content is reduced in the mixture with the increasing contents of Bitumen Emulsion.

Table-3: Quantities of Water content corresponding to different amount of Bitumen emulsions

Bitumen Emulsion	Water Content
0 %	13 %
3 %	12 %
6 %	11 %
8 %	10 %

DIRECT SHEAR TEST

The test is conducted in a soil specimen in a shear box which is split in to two halves along the horizontal plane at its middle. The size of the shear box is 60 x 60 x 50 mm. the box is divided horizontally such that the dividing plane passes through the centre. The two halves are held together by locking pins the box is also provided with gripper plates plain or perforated according to the testing conditions

Fig1: Direct Shear Test Apparatus

4.0 RESULTS

The test was conducted on the soil sample with various percentages of emulsion (0, 3, and 6, 8 %). The values of cohesion and angles of internal friction for various percentage of plastic are tabulated in Table 4. The figure 2, 3 and 4 show the variation of Cohesion, angle of internal friction and Maximum shear stress for various percentage of plastic.

Table 4: Cohesion and angle of friction

% of Emulsion	Cohesion (kg/cm2)	Angle of internal friction (0)	Maximum shear stress (kg/cm2)
0	0.09	19.23	0.487
3	0.05	20.57	0.574
6	0.04	26.52	0.589
8	0.03	23.57	0.386

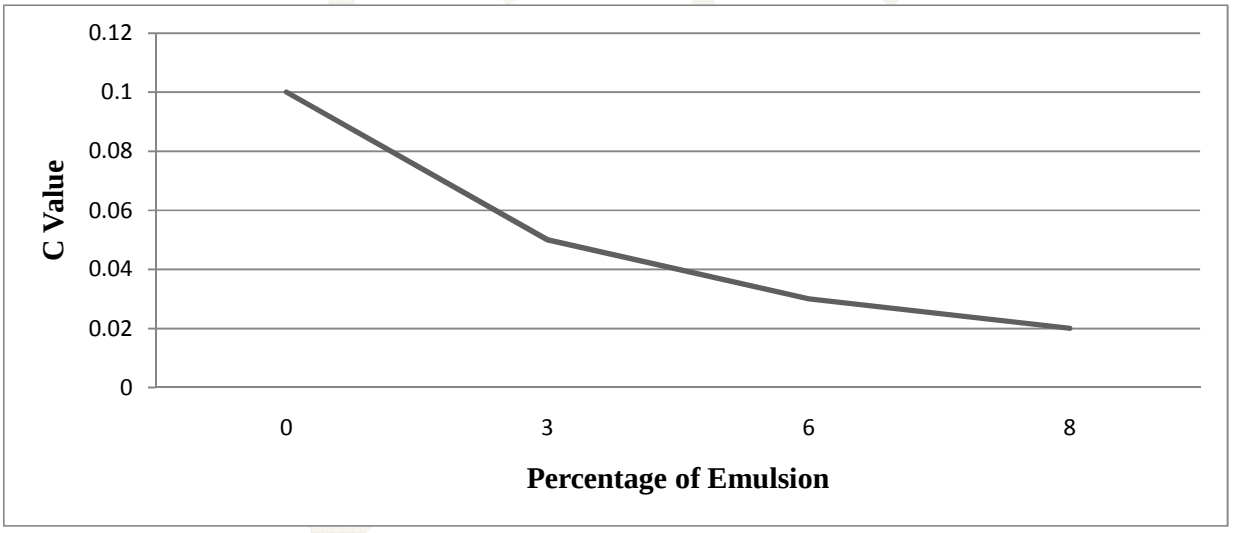

Fig 2: cohesion Vs % of Emulsion

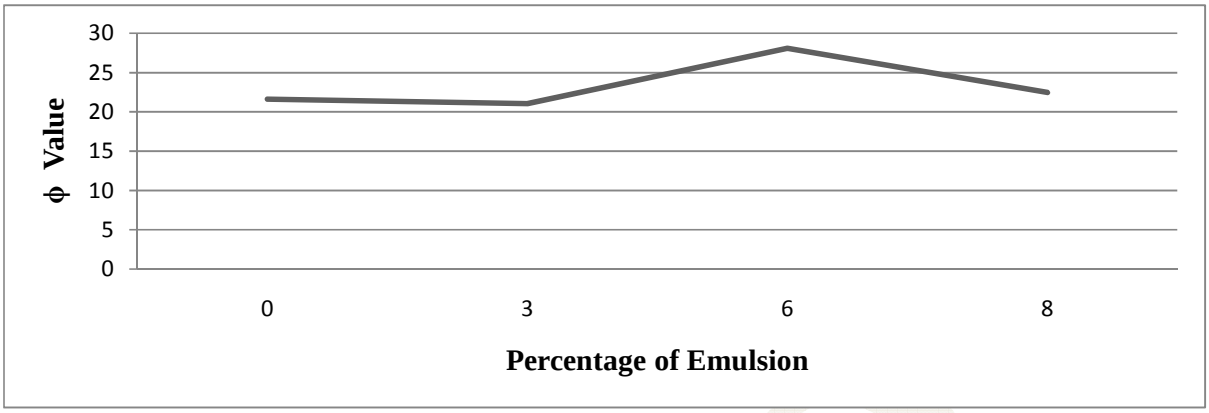

Fig 3: angle of internal friction Vs %of Emulsion

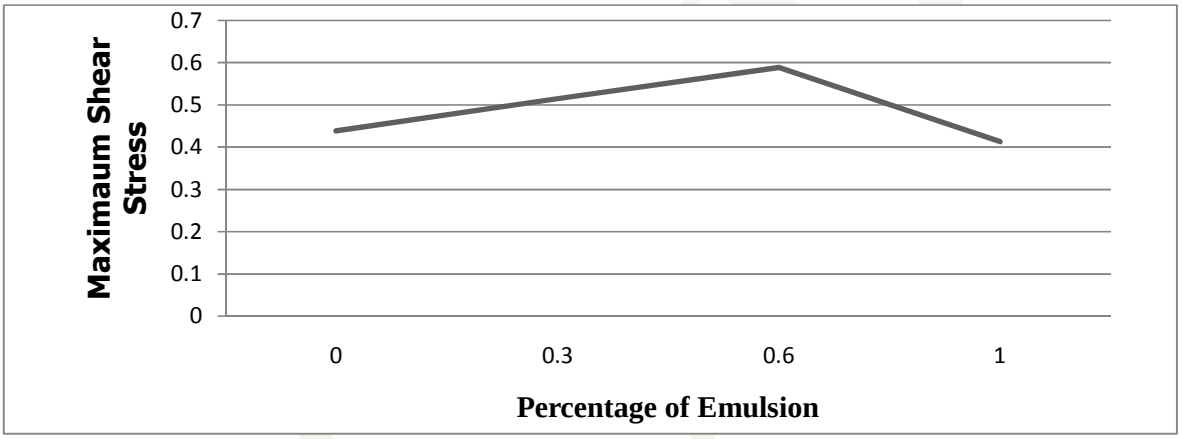

Fig 4: Max shear stress Vs % of Emulsion

5. CONCLUSION

From the experiments carried out on the soil sample to study the effect of Bitumen Emulsion on Shear Strength parameters using Direct Shear Test, the following points are observed:

1. At 6% Bitumen Emulsion, the cohesion between soil particles was reduced to 0.1638 N/mm2 but at the same time angle of Internal Friction υ‟ was drastically increased resulting in appx. 65% increase in Shear Strength of soil due to sticking property of Bitumen particles that binds the soil particles resulting in increased friction among soil particles.
2. The Optimum Mix containing 9% Water and 6% Jai Bitumen Emulsion gives the maximum Shear Strength of soil equal to 0.589 kg/cm2.
3. 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.

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