Study on Stabilization of Expansive Soil for Road Sub-Grade by Use of Chemical Additives

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Abstract— High cost of traditional stabilizers like lime, cement, bitumen etc. and problem of disposal of agricultural industry waste resulted into investigation of potential of agricultural industry waste in stabilizing the clayey soils. Sugarcane ash and chemical additive is mixed in the subgrade soil in different proportions and various geotechnical characteristics are investigate through unconfined compression test, compaction test. In this study I will focus on the improve the stability of subgrade soil with use of local available material like sugarcane ash and chemical additives to be used as highway construction material at appropriate layer specially in sub grade soil.

Keywords: Soil Stabilization, Chemical Additives

I. INTRODUCTION

Soil Stabilization is the alteration of one or more properties of one or more soil properties by mechanical or chemical means, to create an improved soil material possessing the desired engineering properties. Soils may be stabilized to increase strength and durability or to prevent erosion and dust generation.

Protekta RGS 300 would be procured from Tech-Dry (India) Pvt. Ltd., Krishna Temple Road, Indiranagar, Bangalore. It is a chemical, soil stabilizer and strengthener product. It is supplied as a viscous liquid based on a blend of silicates and proprietary chemical that can be spray applied.
Properties of Protekta RGS 300:

Property	Value (%)
Appearance	Viscous liquid
Color	Clear to cloud
Odor	Odorless
Solubility	Complete
Solid content	65 percent
Specific gravity	2.53
Flash point	Boils at 101 °C
pH Value	11 – 12.5

II. OBJECTIVE OF THE STUDY

1) To study the geotechnical properties of soil before and after addition of the sugarcane ash and chemical additive in suitable dosages.
2) To carry out the flexible pavement design for subgrade soil before and after addition of the sugarcane ash and additive in suitable dosages.

III. EXPERIMENTAL METHODOLOGY

The high expansive soil had been collected from Barela village located in Santrampur taluka of Gujarat.

The low expansive soil had been collected from Sarsav village located in Godhra taluka of Gujarat.

Protekta RGS 300: It is a chemical, soil stabilizer and strengthener product. It is supplied as a viscous liquid based on a blend of silicates and proprietary chemical that can be spray applied. Its intended use is as a penetrating sealer and surface hardener for soil. It is an odourless chemical and it is completely soluble in water. Solid content in the chemical is about 65 percent.

Laboratory Tests for Soil (As per Indian Standards):
To identify the engineering properties as per Indian Standard provision, various tests were performed which are enlisted as follows.

1) Determination of Grain Size Analysis (IS: 2720 (Part IV) – 1985)
2) Determination of Liquid & Plastic Limit (IS: 2720 (Part V) – 1986)
3) Determination of Free Swell Index of Soils (IS: 2720 (Part XL) – 1977)
4) Determination of Water Content - Dry Density Relation Using Heavy Compaction (IS: 2720 (Part VIII) – 1997)
5) Laboratory Determination of California Bearing Ratio (IS: 2720 (Part XVI) – 1987)
6) Determination of Unconfined Compressive Strength (IS: 2720 (Part X) – 1991)

IV. LITERATURE REVIEW

Shivam Bachchhas, D.K. Soni (2017), High cost of traditional stabilizers like lime, cement, bitumen etc. and problem of disposal of agricultural industry waste resulted into investigation of potential of agricultural industry wastein stabilizing the clayey soils.

Prakash Chavan and Dr.M.S.Nagakumar, from the results, it was observed that the basic tests carried out proved significant after the addition of Bagasse Ash. Furthermore California bearing ratio (CBR) value improved from 1.16% to 6.8 %. And the unconfined compressive strength of specimens increased from 93KN/m^2 to 429 KN/m.

P.A.Sivasubramani, C.Arya, R.Karunya, This study evaluates the potential of Bagasse Ash (BA) and Egg Shell Powder (ESP) to stabilize soft and expansive soil. The physical properties of clay, BA and ESP have been studied by conducting Specific gravity, wet sieve analysis, Liquid Limit (wL) and Plastic Limit (wP) tests. The soil has been classified as Clay of Medium Compressibility (CI). Light Compaction Test (LCT) has been carried out to determine the Optimum Moisture Content (OMC) of virgin soil

V. RESULTS & DISCUSSIONS

The results obtained from a series of consistency tests, free swell index tests, compaction tests, CBR tests, UCS tests & shear tests conducted on expansive soils with and without additives have been presented in this chapter in the form of tables and figures.

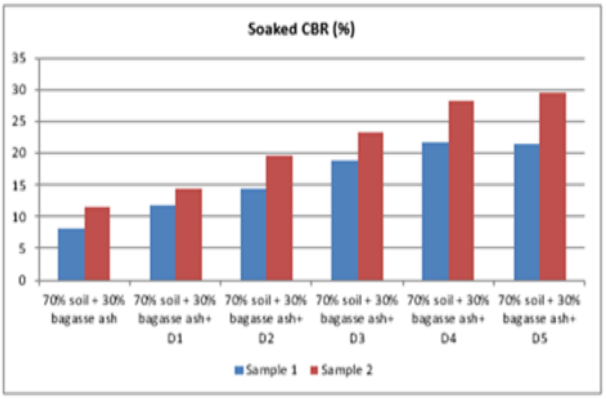
Protekta RGS 300 was diluted first and then it was applied to optimum mixture of soil. The ratios of chemical to water chosen were 1:30, 1:35, 1:40, 1:45 and 1:50

Nomenclature for dosage	Ratio	Amount of chemical / litre of water
D1	1:30	33 ml
D2	1:35	29 ml
D3	1:40	25 ml
D4	1:45	22 ml
D5	1:50	20 ml

Table 1: Chemical dosage

Nature of sample	Sample – 1 Soaked CBR (%)	Sample – 2 Soaked CBR (%)
70% soil + 30% bagasse ash	8.16	11.40
70% soil + 30% bagasse ash+ D1	11.9	14.52
70% soil + 30% bagasse ash+ D2	14.39	19.65
70% soil + 30% bagasse ash+ D3	18.91	23.34
70% soil + 30% bagasse ash+ D4	21.64	28.33
70% soil + 30% bagasse ash+ D5	21.47	29.60

Table 2:-California bearing ratio for various mixtures



Graph 1: California bearing ratio for various mixtures

VI. THICKNESS DESIGN & COST

Thickness Design for Soil + Sugarcane baggase ash and chemical additives.

In 70% soil + 30 % baggase ash composition CBR for soaked sample increased from 3.61% to 8.16%. Pavement composition is shown below.

After 30% replacement of baggase ash,
Total Pavement Thickness = 575 mm
Pavement Composition

1) Granular Sub base = 200 mm
2) Granular Base Course = 250 mm = 125 mm +125 mm
3) Dense Bound Macadam = 85 mm
4) Bituminous Course = 40 mm

Initial cost is generally the major factor in deciding the type of the pavement design. Generally the construction cost is based on tender pricing. It is assumed that the initial cost reflects correct design and the best workmanship of required quality. Here the Rate is taken from NH Standard Data Book (Road & Bridge) 2013.

VII. FINDINGS FROM THE STUDY

The main aim of present study was to check the usability of sugarcane baggase ash and RGS Protekta 300 in expansive soil stabilization. To justify objectives various tests had been conducted on various compositions of soil and replacement materials. Following conclusions were drawn from the study.

Two samples were collected from two different locations but in initial testing it was found that sample 1 is having low properties. Therefore sample 1 had been chosen as designing purpose.

The soil-1 is classified as highly compressible clay (CH) as per IS: 1498 – 1970. The mean grain size (D50) of the soil is found to be 0.0055 mm.

The specific gravity of bagasse ash is 2.48. The bagasse ash specific gravity is less than both soil samples

VIII. FUTURE SCOPE

Addition of chemical additive Protekta RGS 300 was found satisfactory during practical work. But, when we try it in practical field right now there is no any mechanism to mix natural soil with chemical additive in bulk. Hence, it is required to develop mechanism for mixing soil with chemical additive in practical field.

Sugarcane baggase ash with another additive like dolchar, lime and cement can be used together, and may be varied in quantity to obtain the best possible stabilizing mixture.

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