Studies on Polymer Based Chemical Treated Clay Soil

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Abstract

Studies in Indian road conditions of polymer based chemical as well as enzyme stabilizers are necessary. Such studies are site specific. A number of enzymes are in the market such Fujibeton, Terrazyme and Renolith, etc. These aid in Aggregate Free Pavement Technology resulting in minimization or elimination of aggregate-usage. The dosage depends on the characteristics of the soil forming the base. Hence, preliminary studies on such soils are of utmost importance, in the absence of available data. In the current study , Renolith, a polymer based chemical stabilizer was used. The soil samples were collected from Tiruvachur on NH45, National Highway. To determine the soil characteristics, tests for specific gravity, consistency limits, Standard Proctor Compaction, Sieve Analysis, California Bearing Ratio Test corresponding to OMC and soaked condition, Unconfined compression test were conducted. The results obtained are summarized.

1. Introduction

Rural connectivity is the buzzword of the Pradhan Mantri Grama Sadak Yojana Programme in India.(Chandrasekhar B.P., 2006) In many states, prescribed standards are not available at normal leads resulting in longer haulage and higher costs. New materials(Prasad D.S.V. et al., 2009) which are polymeric as well as enzyme based, when used, amount to elimination or minimization of aggregates, reduction in maintenance cost and increased durability. They exhibit semi-rigid characteristics. The soil samples for this study consist of locally available clayey soil from MRF Company of Thiruvachur on NH 45 Trichy. The soil sample is tested for its geotechnical properties and strength characteristics.

2.0 Literature Review

Limited research has been carried out with Renolith, a polymer based chemical(with high elastic modulus) in India. The ready reckoner chart for Renolith specifies the cement and renolith content in percentages
(supplemented with actual tests) (Table 1)

Table 1 Required dosage of cement and Renolith

Soil Type	Cement (%)	Renolith (l/m^2)
Sandy lateritic	3	1.2
Sandy clay (orange)	4	1.6
Black clay soils (high PI)	4	1.6
Sandy clay with pavement gravel (orange/brown)	6	2.4

In India, lack of awareness, has discouraged the use of such polymer based chemical stabilizers. However, in 2007, this technology has been used with considerable success by the Public Works Department of Arunachal Pradesh State, in India.
The following schemes were implemented.

- Lumla township roads under CRF and Zimithang ring road under RIDF;
- Dirangdzong-Namthung-Sangti road under CRF and Nafra-Nakhu road
- under NLCPR;Lhou to Mukto road under NLCPR
- Shergaon-Doimara road ;
- Road from PWD IB to Bali at Seijosa under RIDF

PWD, Rajasthan has also undertaken works with Renolith in 2001.

3.0 Objective and Methodology

The following specific objective is outlined:
To investigate the material property characteristics and the associated variability of different cement and Renolith percentages for the soil (used as base course) considered.

The schematic of the methodology adopted is shown in Figure 1.

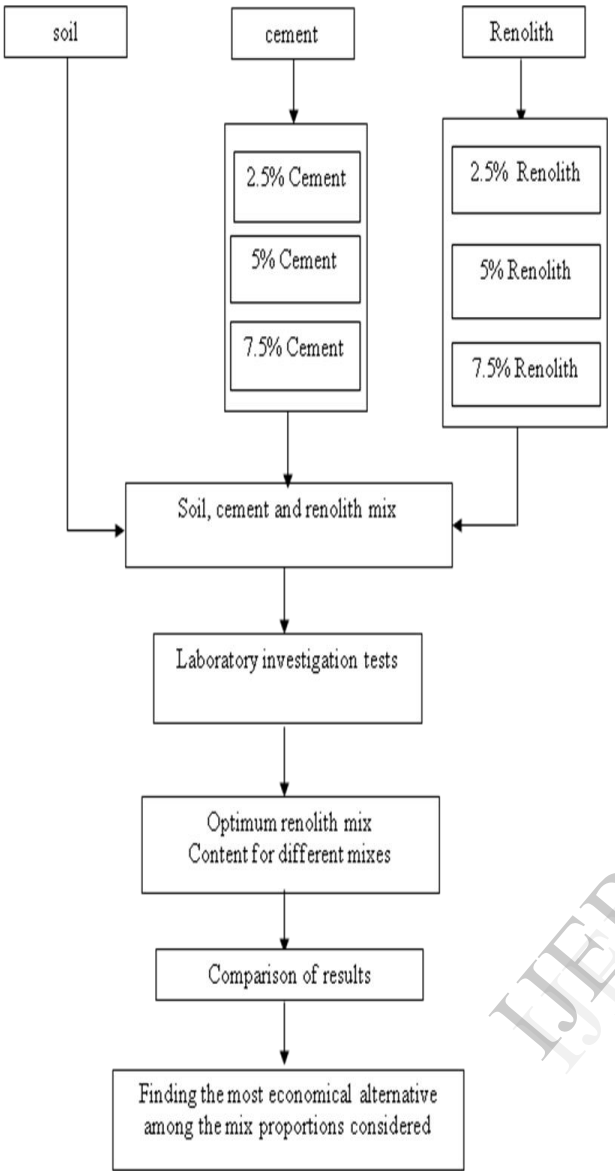

Fig.1 Schematic of Methodology Adopted.

4.0 Geotechnical Properties of Soil Sample

Table 2 Properties of Soil Sample

Sl. No.	Property	Sample
1	Specific gravity	2.4
2	Grain size distribution A) Gravel (%) B) Sand (%) C) Silt (%) D) Clay (%)	 0% 19% 18% 63%
3	Consistency limits (%) Liquid limit Plastic limit Shrinkage limit Plasticity index Shrinkage index	 63.91% 29.16% 17.11% 34.74% 46.8%
4	Hydrometer analysis Clay activity	 active
5	Free swell index	62%

5.0 Properties of Cement Used

The properties of cement used are indicated in Table 3.

Table 3 Cement Properties

Sl.No.	Property	Value
1.	Average Specific Gravity	3.1
2.	Initial Setting Time	27 minutes
3.	Final Setting Time	558 minutes
4.	Fineness: Passing 90 µ sieve	96%

6.0 Results and Conclusions

The CBR Values obtained are shown in Fig.2

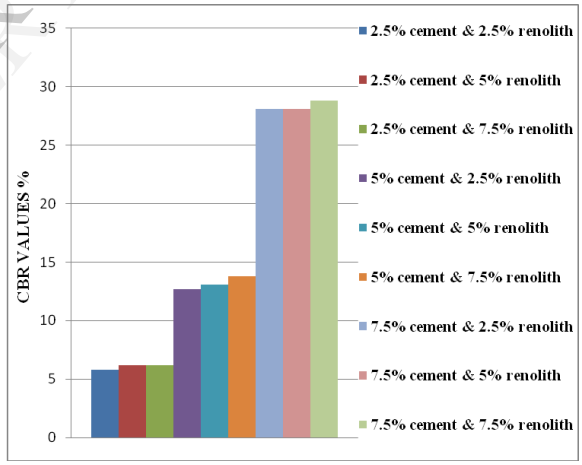

Fig.2 CBR values for various mixes

- The stabilised Unconfined Compressive Strength (UCS) value shows a 64% increase when cement content (CC) is 2.5% and Renolith Content(RC) is 2.5%.
- The stabilised UCS value shows a 78% increase when CC is 2.5% and RC is 5.0%.
- The stabilised UCS value shows a 95% increase when CC is 2.5% and RC is 7.5%.
- The stabilised UCS value shows a 114% increase when CC is 5.0% and RC is 2.5%.

- The stabilised UCS value shows a 143% increase when CC is 5.0% and RC is 5.0%.
- The stabilised UCS value shows a 166% increase when CC is 5.0% and RC is 7.5%.

Thus the addition of Renolith to the clayey soil improves the CBR and unconfined compressive strengths as indicated above.

References

[1] Chandrasekhar, B.P (2006) A Critical reviews of innovative rural road construction techniques and their impact NRRDA, New Delhi.
[2] IRC: SP: 20-2002. Rural Roads Manual, Indian Roads Congress.
[3] IS 2720: Part III: Sec 2: 1980 Test for Soils - Part III: Determination of Specific Gravity - Section 2: Fine, Medium and Course Grained Soils (Reaffirmed 2007)
[4] IS 2720: Part 4: 1985 Methods of Test for Soils - Part 4: Grain Size Analysis (Reaffirmed 2006)
[5] IS 2720: Part 5: 1985 Method of Test for Soils - Part 5: Determination of Liquid and Plastic Limit (Reaffirmed 2006)
[6] IS 2720: Part VI: 1980 Methods of Test for Soils - Part VII: Determination of Water Content-Dry Density Relation Using Light Compaction (Reaffirmed 2007)
[7] IS 2720: Part 8: 1983 Methods of Test for Soils - Part 8: Determination of Water Content-Dry Density Relation Using Heavy Compaction (Reaffirmed 2006)
[8] IS 2720: Part 10: 1991 Methods of test for soils: Part 10 Determination of unconfined compressive strength reaffirmed2006
[9] IS 2720: Part 31: 1990 Methods of Test for Soils - Part 31: Field Determination of California Bearing Ratio (Reaffirmed 2007)
[10] IS 2720: Part XL: 1977 Methods of Test for Soils - Part XL: Determination of Free Swell Index of Soils (Reaffirmed 2007)
[11] Methku Anvesh Reddy (2009) Soil Study Using a Polymer Based Chemical, M.Tech. Thesis, N.I.T., Tiruchirappalli
[12] Prasad, D.S.V., Prasada Raju.G.V.R. and Anjan Kumar .M (2009) Utilization of Industrial Waste in Flexible Pavement Construction *EJGE* Vol: 13, Bund.D.
[13] Report on Innovative Road Construction is using Renolith, by PWD Arunachal Pradesh, India, 2007.
[14] Report on Demonstration Project for Aggregate-Free Pavement Technology using Fujibeton for Rural Road Construction, NCCBM, New Delhi, India, 2005.
[15] Report on Demonstration Project using Soil-Cement – RENOLITH stabilization technique by PWD Rajasthan, India, 2001