Durability of Cement Stabilized Expansive Clay

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Abstract- **Stabilization of clay soils have been tried by a wide variety of materials and cement is one among them. Especially rural roads and approach roads in case of large construction sites in the proximity of clay soils, need stabilization to carry heavy loads. In this study an attempt is made to use Portland Pozzolana cement to stabilize clay soil to evaluate the optimum additive content in terms of durability. The study indicates that stabilization of expansive clay with cement required addition of 2% of lime to control swelling. Addition of cement at 2%,6%,10% and 14% indicated that the unconfined strength of the clay soil increases as the percentage of cement increases, however durability of the 7 day cured samples showed that the an optimum cement content of 6% results in both strength and durability.**

KEY WORDS: EXPANSIVE CLAY, DURABILITY, CEMENT STABILIZATION

I. INTRODUCTION

The concept of stabilization dates back to the Mesopotamia era, where the use of stabilized earth roads was reported. Historically, use of soil lime mixes was reported in Egypt and Greece. Engineers had often faced the problem of constructing roadbeds on expansive soils. These problematic soils do not possess enough strength to support the wheel loads upon them during the service life of the pavement. They must be, therefore, treated to provide a stable sub-grade or a working platform for the construction of the pavement. One of the strategies to achieve this is to stabilize the soil. Cement stabilization is one of the stabilization techniques to stabilize clay soils to achieve high strength. In this study, an attempt has been made to arrive at optimum Portland pozzolana cement content to stabilize expansive clay taking durability into consideration.

II. LITERATURE

The performance of a hot-mix asphalt pavement structure is dependent on the interaction between pavement responses and the strength and modulus of the different layers (Quintus, 2001). The accumulation of damage within the pavement layers eventually becomes visible at the surface of the pavement in form of rutting, cracking, and surface roughness.

Hopkins et al (2002) reported in-depth field and laboratory studies, carried out at 14 roadway sites containing 20 different treated subgrade sections in Kentucky. Rut depths of the pavements resting on the treated subgrades were less by about 6.8 mm than that on untreated subgrades.

Changes in pavement response and material characteristics monitored during a non-destructive testing revealed that the pavement distress is due to varying subgrade strength, water ingress (Hugo et al, 1997).

M. R. Asgari et al, reported that improvement in mechanical behavior of the soil due to cement treatment was noticeably higher than lime treatment and increasing of curing time results in increase of USC of the specimens.

III. MATERIALS AND THEIR PROPERTIES

Expansive soil was collected from Vijayawada area of Andhra Pradesh. Properties of the virgin soil are as shown in Table 1. Portland pozzolana cement and 98% pure hydraulic lime were

Table 1Properties of Clay

Property	Value
Grain Size Distribution	
Gravel (%)	-
Sand (%)	2.8
Silt size (%)	28.6
Clay size (%)	68.6
Atterberg Limits	
Liquid Limit (%)	66.3
Plastic Limit (%)	23.5
Plasticity Index	42.8
Shrinkage Limit (%)	12.2
Compaction properties	
Optimum moisture content (%)	19.20
Maximum Dry Density (g/cc)	1.68
UCC (kPa)	320
Specific gravity	2.70

IV. TESTING

Initially it was determined to check for the improvement in the properties of the clay soil by addition of cement alone. Portland pozzolana cement was added to the soil in the proportion of 2%, 6%, 10%, and 14% to check volume stability of the clay sample. Free swell index conducted showed that the value decreased from a very high value of 55% for virgin soil to high and moderate values ranging between 25% and 28%on addition of different percentages of Cement. In this regard addition of 2% lime was considered to check its effect on volume stability and the results indicated that the values of free swell index came down to low range with values less than 20%.Atterberg limits, compaction properties and unconfined compressive strength were conducted on all the samples. Unconfined compressive strength tests were conducted after curing the samples for 7 days, by warping them in plastic cover and placing the same in wet sand. Durability of the stabilized samples were evaluated after 7 day curing period as per I.S Specifications by subjecting them to alternate wet and dry cycles. The properties of the soil after stabilization are as depicted in Table.3.

Table 2 Properties of stabilized Clay with 2% Lime and Cement

Property / % of cement as admixture	2	6	10	14
Liquid limit (%)	48	49	41	39
Plasticity Index (%)	10	9	9	NP
OMC (%)	20.09	21.2	22.36	23.01
MDD (g/cc)	1.68	1.72	1.76	1.8
UCC (kPa)	680	920	1203	1380
% weight loss after wet and dry cycles	16.2	13.12	9.8	8.06

V. CONCLUSIONS

1. The clay soil collected confirmed to CH category and when pozzolana Portland cement was used as additive, it required 2% lime addition to control swell properties.
2. The Unconfined compressive strength of the CH soil increased with addition of cement by 330% at 14% additive
3. Durability tests showed that addition of 6 % of cement with 2% of lime can be considered as optimum amount of stabilizer with regard to strength and durability considerations.

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