Settlement Characteristics of Kuttanadu Soil In Sub Grade

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Abstract- ***For subgrade, strength is necessary in achieving the durability and preventing from the mechanical shocks occurred. The phosphogypsum and woodash were mixed together at various proportions and its settlement characteristics were studied. Soaked and unsoaked CBR tests with varying percentage of phosphogypsum and woodash were studied. Obtained results from the different mix proportions shows that up to12% of the weight of the wood ash shows an increasing trend and then it decreases. Settlement characteristics of kuttanadu soil were studied and its variations were observed***

Keywords- CBR Tests, phosphogypsum, woodash

I. INTRODUCTION

The “subgrade” is the in situ material upon which the pavement structure is placed. Although there is a tendency to look at pavement performance in terms of pavement structure and mix design alone, the subgrade can often be the overriding factor in pavement performance. The subgrade must be able to support loads transmitted from the pavement structure. This load bearing capacity is often affected by degree of compaction, moisture content, and soil type. A subgrade that can support a high amount of loading without excessive deformation is considered good. Most soils undergo some amount of volume change when exposed to excessive moisture or freezing conditions. Some clay soils shrink and swell depending upon their moisture content, while soils with excessive fines may be susceptible to frost heave in freezing areas (not really a concern in Hawai’i). Ash, especially on the Big Island, can present volume change problems. Poor subgrade should be avoided if possible, but when it is necessary to build over weak soils there are several methods used to improved subgrade performance:

Removal and replacement (over-excavation). Poor subgrade soil can simply be removed and replaced with higher quality fill. Although this is simple in concept, it can be expensive. Stabilization with a cementitious or asphaltic binder. The addition of an appropriate binder (such as lime, Portland cement or emulsified asphalt) can increase subgrade stiffness and/or reduce swelling tendencies. Additional base layers. Marginally poor subgrade soils may be made acceptable by using additional base layers. These layers spread pavement loads over a larger subgrade area. This option is rather perilous; when designing pavements for poor subgrades the temptation may be to just design a thicker section with more base material because the thicker section will satisfy most design equations. However, these equations are at least in part empirical and were usually not intended to be used in extreme cases. In short, a thick pavement structure over a poor subgrade may not make a good pavement.

This study details about the settlement characteristics of kuttanadu soil and also the strength obtained by performing CBR Tests

II. LITERATURE REVIEW

Gunturi et al. (2014) studied the effects of stabilizing agents like phosphogypsum and flyash through strength improvement techniques. The unconfined compression test and microstructure analysis of the soil with different percentage of additives were determined. The properties of soil with phosphogypsum in various percentages with fixed quantity of flyash is checked out Strength of stabilized soil is increased with increased amount of stabilizer

Oyedemi et al. (2013) studied the effect of hardwood and softwood ashes on geotechnical properties of soil. Two soil samples from two different locations were collected and properties of both stabilized and un stabilized soil samples are determined Properties such as particle size, specific gravity, Atterburg limit, Compaction test and CBR Test were carried out in varying percentage of hardwood ash and Softwood ash Results obtained as that softwood ash has higher influence on soil CBR than hardwood ash

Hooton et al. (2015) studied the effects of phosphogypsum by treating raw phosphate with sulfuric acid and its byproducts were observed. The research is conducted to compose a binder free of CO_2 emission, made only for phosphogypsum and blast furnace slag for a comparison study natural source of gypsum was also used

Obern berger (2012) conducted stabilization of soil with lime on several short –term and long term reactions chemical and mechanical characterization large Scale field test, results of Preliminary pressure resistance tests with lime and selected ash fractions as a binding agent. The research and development activities include preliminary laboratory tests, chemical and mechanical characteristisation of different wood ash fractions and their suitability as a binder for soil stabilization is evaluated

III. MATERIALS

The soil which contains high silt content is used as a material for soil stabilisation and the waste by products phosphogypsum and wood ash is used as the additive material.

The soil was collected from Ramankary, Alappuzha. The major properties related to the soil is shown in the table.

A. Silty soil

The soil was collected from Ramankary, Alappuzha the soil obtained was in a dark texture with water content.

The soil collected contain high silt content. The major properties related to the soil are shown in the Table 1

TABLE 1: Basic properties of soil

Properties	Values
Specific gravity (IS 2720 PART 3)	2.18
Liquid limit (%) (IS 2720 PART 5)	79%
Plastic limit (%) (IS 2720 PART 5)	49.8%
Plastic index (%) (IS 2720 PART 5)	29.2%
Shrinkage limit (%) (IS 2720 PART 5)	19.92%
IS Classification	MH
Natural moisture content (%)	115%
Optimum moisture content (%) (IS 2720 PART 7)	31.29
Maximum dry density (g/cc) (IS 2720 PART 7)	1.35
Percentage of clay (IS 2720 PART 4)	18
Percentage of silt (IS 2720 PART 4)	72.525
Percentage of sand (IS 2720 PART 4)	9.48

UCC strength (kg/cm^2) (IS 2720 PART 10)	0.34
Free Swell Index	3.92%

B. Phosphogypsum

The phosphogypsum material was being collected from Go Green products, Alwarthirunagar, Chennai.The important chemical properties are detailed in the Table 2.

TABLE 2: Chemical Properties of Phosphogypsum

Properties	Composition
Chemical Formula	$CaSO_4 \cdot 2H_2O$
$H_2O_{crystal}$	18.0
SO_2.	43.6
Ca O	32.0
Mg O	0.40
$Al_2\,O_3 + Fe_2\,O_3$	1.82
SiO_{2HCL}	1.64
Na_2O	0.36
$P_2O_{5\ total}$	1.03
F_{total}	0.76
Organic Matter	0.26
Colour	White

C.*WOODASH*

Wood ash is being collected from different households in Trivandrum districts

IV .EXPERIMENTAL INVESTIGATION

1.Consolidation tests

The consolidation tests on the soil were performed by using the square root time fitting method. The relationship between C_v value for different percentage of wood ash and constant percentage of phosphogypsum are measured.

2. California Bearing Ratio

CBR tests on the soil were performed to onserve the changes in strength of clay samples. The relationship between load and deformation for different percentage of wood ash and constant percentage of phosphogypsum are measured

IV. RESULTS AND DISCUSSIONS

Soil mixed with varying 4 percentage Phosphogypsum and varying percentage woodash. Its corresponding C_v value is determined. As the percentage of woodash increases its C_v value decreases.

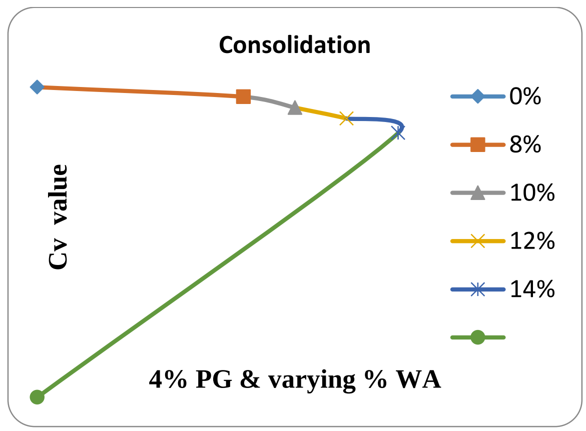

Fig 1: Variation of consolidation with 4% of phosphogypsum and different percentage of woodash

The soil samples were mixed with four different percentage of WA(8,10,12 and 14%) and with 4% PG by weight of dry soil and moulded at optimum moisture content to achieve the targeted density

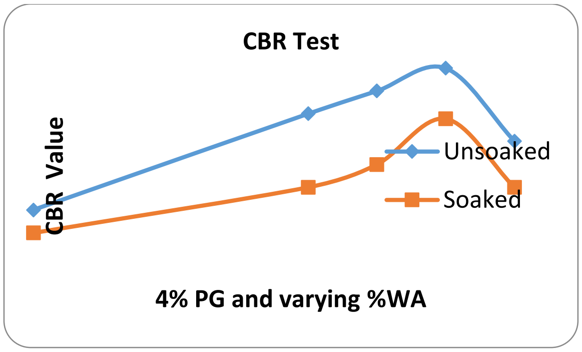

Fig 2: Variation of CBR value with 4% of Phosphogypsum and varying percentage woodash

V. CONCLUSION

- By the addition of 4% PG and varying percentage WA, as the percentage of woodash increases the C_v value decreases
- By the addition of 4% PG and varying percentage WA, as the percentage of woodash increases the CBR value increases and then decreases
- The maximum CBR value is observed at 12% and began to decrease at 14%.

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