A Study on Utilization of Plastic Waste Strips with $Cacl_2$ for Improving Weak Marine Clays

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Abstract— The soil found in the ocean bed is classified as marine soil. It can even be located onshore as well. India being peninsular country has alarge area coming under coastal region and also it has been the habitat for considerable percentage of population. The properties of marine soil depend significantly on its initial conditions. The properties of saturated marine soil differ significantly from moist soil and dry soil. Marine clay is microcrystalline in nature and clay minerals like chlorite, kaolinite and illite and non-clay minerals like quartz and feldspar are present in the soil. The soils have higher proportion of organic matters that acts as a cementing agent. The marine clays are found in the states of Andhra Pradesh, Karnataka, Kerala, Orissa, Maharashtra, West Bengal, Orissa, Tamilnadu and some parts of Gujarat. These soils are highly saturated, soft, sensitive and normally consolidated. These usually have low density and low shear strength in nature. This project will investigate the possibility of utilizing plastic waste strips to reinforce stabilized weak marine clays to pave way for its use in civil engineering projects such as in road bases, embankments etc.. A series of tests will be done on weak soil cacl2- plastic with varying percentages of the chosen materials for stabilization. The testing program will involve addition of different percentages of $Cacl_2$ and plastic waste strips to marine clay and the results will be analyzed to assess the efficacy of the materials used.
Key words: Marine Clay, Waste Plastic Strips, WPS

I. INTRODUCTION

Marine clay deposits are found both in the coast and in several offshore areas spread over many parts of the world. India being peninsular country has a large area coming under coastal region and also it has been the habitat for considerable percentage of population. The marine clays are not suitable as pavement sub grade & foundation soil bedsand pose problems due to their inability of strength criteria. More and more construction projects are encountering soft clays and hence there is a need to better quantifying theproperties of marine clays. Majority of the population in India depends on road-based transport. There aremany deposits of fine clays on coastal corridor and those soils are suffering from highsaturation, low density, low shear strength, sensitivity, and deformation problems and arenormally consolidated. The marine clays, because of the specific physico-chemical makeup, are subjected to volume change with the changes in their ambient environment. These soils are widely occupied in costal corridor and not easy to avoid marine clay regions for theconstruction of pavements and foundations due to the population density.

A. Objectives of the Study

The objectives of present experimental study are as follows.

- To identify the strategy of techniques to overcome the problems posed bymarine clays with a view to adopt suitable methodology through critical review of literature.
- To evaluate the performance of marine clay when stabilized with proposed additives and admixtures and their suitability for fill material and sub grade material.
- To investigate the suitability and adoptability of Waste plastics as discrete reinforcement.
- To investigate the suitability and adoptability of Calcium Chloride as Bonding through chemical reaction.

II. LITERATURE REVIEW

A comprehensive review of literature indicates that considerable amount of workrelated to determination of engineering behavior of marine soils has been carried outworldwide since last 50 years. Amongst various contributions, the investigations onphysical, chemical and mineralogical properties of marine clay conducted by Eden et al.(1957), Noorani (1984), Shridharan et al.(1989), Mathew et al. (1997) and Chew et al.(2004) are worthy of note. Significant research on strength and stiffness characteristics wasperformed by Koutsoftas et al.(1987) and Zhou et al. (2005). ; Zhuge et.al, (2007); Ameta,(2007); Basacket. al,(2009); Kamruzzaman et.al, (2009) and Fairfax Country, Virginia,(2010). The loss caused due to the damaged structures proved the need for more reliableinvestigation of such soils and necessitates methods to eliminate, or reduce, the effect ofsettlements. To overcome these problems, there is no other alternative, except to improve the sub-soil or sub grade for expected loads with suitable treatment to the in-situ soil.

Shridharan A et.al (1989), reported the Engineering properties of Cochin andMangalore Marine Clays. A research has been done on the Physico-Chemical effects on the engineering behavior of Indian marine clays by Rao, M.S et.al (1992)Thiam-Soon et al (2002), reported on improving the strength of the marine clay bythe stabilization technique. Chu, J et.al (2002), reported the consolidation and permeabilityproperties of the Singapore marine clay based on the laboratory and field investigations.

Basack,S et.al (2009), reported that the Engineering characteristics of marine claycollected form Visakhapatnam, India and the physical, chemical and mineralogicalproperties were presented and the strength, stiffness of the soil water matrix wereestablished.

III. METHODOLOGY

A. Marine Clay

The marine clay used in this study and was typical soft clay. The marine clay wascollected at a depth of 0.30m to 1.00m from ground level from Kakinada, Andhra PradeshState, India. The properties of soil are presented in the table below. All the tests carried on thesoil are as per IS specifications.

B. Properties of Marine Clay

S.No	Property	Value
1	Grain Size Distribution	
	Sand %	8.2
	Silt & clay %	91.8
2	Atterberg Limits	
	Liquid Limit %	75.20
	Plasti Limit %	29.80
	Plasticity Index %	45.40
3	Compaction Properties	
	Optimum Moisture Content %	30.70
	Maximum dry density %	1.440
4	Specific Gravity	2.45
5	IS Classification	CH
6	Soaked CBR %	0.87
7	Differential Free Swell %	50
8	Shear Strength Parameters	
	Cohesion Kn/m^2	81
	Angle of internal friction	2

C. Waste Plastic Strips

Plastic used in this study are disposal cement plastic bags. It has low weight and ease of transportation and very low impermeability. The disposal of waste plastic cement bags used in this study collected from CIT gubbi campus. By collecting this plastic bags are cut in to the pieces. The thickness of the plastic strips consists of 10µ. The length and breadth of the plastic strip is 3mm*20mm.

Calcium chloride is an inorganic compound, a salt with the chemical formula $CaCl_2$. It is a colorless crystalline solid at room temperature, highly soluble in water.Calcium chloride is commonly encountered as a hydrated solid with generic formula $CaCl_2(H_2O)_x$, where x = 0, 1, 2, 4, and 6. These compounds are mainly used for de-icing and dust control. Because the anhydrous salt is hygroscopic, it is used as a desiccant.

IV. Results and Discussions

In the laboratory, various experiments were conducted by adding different percentages of Waste Plastic Strips (WPS) in the Weak marine Soil and also further stabilizing it with $cacl_2$ as a binder. Liquid Limit, Plastic Limit and Compaction, CBR and Triaxial shear tests were conducted with a view to determine the optimum combination of Waste Polyethylene Strips (WPS) as additive in weak marine soil and $cacl_2$ as a binder. The influence of the above said materials on the Index.

A. Variation of OMC & MDD of Marine clay with $Cacl_2$

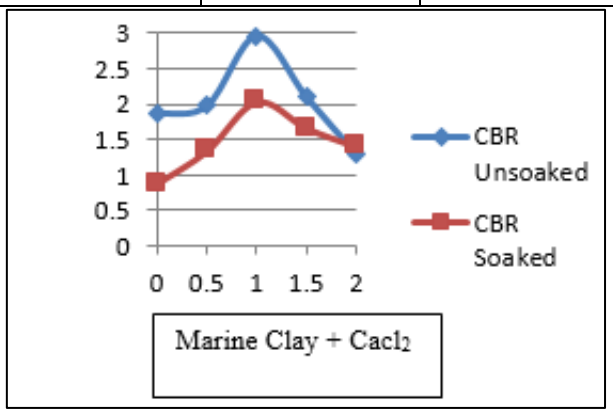
Marine Clay + $Cacl_2$	OMC %	MDD %
100+0	30.7	1.44
99.5+0.5	27.4	1.47
99+1	23	1.495
98.5+1.5	23.45	1.492
98+2	26.47	1.445

B. Variation of Cohesion and Angle of Internal friction of Marine clay with $Cacl_2$

Marine Clay + $Cacl_2$	C KPa	φ °
100+0	81	2
99.5+0.5	88	3
99+1	94	4
98.5+1.5	90	4
98+2	87	3

C. Variation of Soaked &UnSoaked CBR of Marine clay with $Cacl_2$

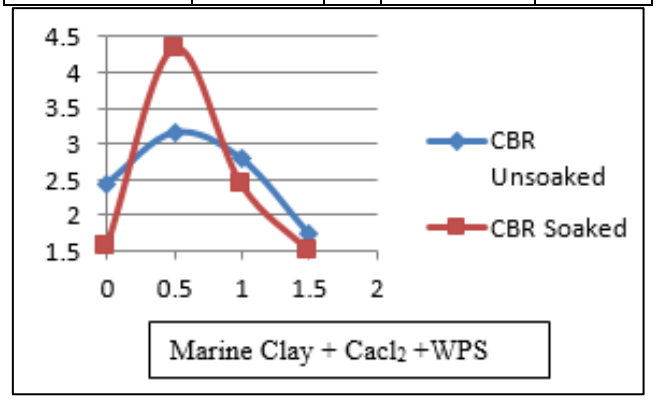
Marine Clay + $Cacl_2$	CBR UnSoaked %	CBR SOAKED %
100+0	1.86	0.89
99.5+0.5	1.98	1.35
99+1	2.96	2.04
98.5+1.5	2.1	1.67
98+2	1.3	1.41



Plot Showing Variation of CBR for Marine clay with calcium chloride

D. Results of the test conducted an optimum mix of Marine Clay +$Cacl_2$ and addition of different % of Waste Plastic Strips

Marine Clay + $Cacl_2$+WPS	C KPa	φ°	CBR UnSoaked %	CBR SOAKED %
99+1+0.5	91	3	2.45	1.56
99+1+1	101	5	3.16	4.34
99+1+1.5	94	4	2.8	2.43
99+1+2	89	3	1.75	1.50



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V. Conclusions

The following conclusions are made based on the laboratory experiments carried out in this investigation

– From the Laboratory Studies, it is observed that the marine clay chosen is problematic for construction works.

- It is observed that the treatment as individually with 0 to 2% of $Cacl_2$ has improved the weak marine clay at an optimum of 1%.
- It is evident that the addition of $Calc_2$ to the virgin marine clay showed as improvement in properties to some extent and on further blending it with waste plastic, the improvement was more pronounced.
- Finally it can be summarized that the materials waste plastic strips and $calc_2$ had promising influence on the properties of weak marine clay, thereby giving a two-fold advantage in improving weak marine clay and aslo solving a problem of waste disposal.

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