Geotechnical Characterization of Dredged Marine Clay From Cochin

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Abstract - *Kerala located on the southwest coast of India is bound by Arabian Sea on its west side. The soil found here is clay which is highly compressible and are highly instable thus making it unsuitable for engineering requirements. A large quantity of marine clay is dredged from the Cochin navigation channel to increase the depth of the channel so that the movement of bigger vessels becomes easier. Usually this dredged marine clay is dumped far away from the shore back into the sea so that it won't return back to the navigation channel. The present study deals with the geotechnical characterization of dredged marine clay collected from Cochin region. The physical properties, the geotechnical characterization and the engineering properties of dredged marine clay was determined. The optimum cement content for improving the Unconfined Compressive strength of dredged clay was determined.*

***Key Words*: Dredged marine clay, Geotechnical characterization, Index properties, Unconfined compressive strength, Cement stabilization.**

1.INTRODUCTION

Marine clay is the type of soil abundantly found at costal corridors, offshore areas and many other parts of the earth. This type of soil has high settlement and are highly instable, thus making it unsuitable for engineering requirements. It has low unconfined compressive strength between 25 to 50 kilopascals. The minerals present in marine clay are Chlorite, Kaolinite, Montmorillonite and Illite and other stone minerals such as Quartz and Feldspar. Because of the presence of these minerals and high organic content, dredged soils have a detrimental effect on environment. Hence dredged soil can be classified as a waste material and need to be disposed off.

In India, usually the marine clay deposited in navigation channels are removed for providing sufficient draft to ship. These clays are removed from the bed of channel using dredgers and are deposited back into the sea far away from the navigation channel. But this practice is uneconomical since it is unproductive and consumes valuable resources. This problem can be tackled by using the dredged clay in construction activities such that it will have no baleful effect on environment. This can be achieved by stabilizing the dredged marine clay with suitable stabilizers. This paper discusses about the geotechnical characteristics of dredged marine clay and stabilization of the same using cement. For the geotechnical characterization of dredged marine clay, basic engineering test for determining engineering properties viz. standard proctor test, sedimentation analysis specific gravity test etc. are carried out. The optimum cement content required for stabilization in an economic way, was determined by adding 5%, 10%, 15% & 20% cement and finding unconfined compressive strength.

2. COLLECTION & PREPARATION OF SAMPLES

Samples were collected for the present study from the Cochin port. The dredging was carried out by the Nehru Shadapthi dredger of the Cochin Port Trust. The clay was dredged from a depth of 8m-10m from the navigation channel in Cochin and samples were collected in properly sealed polythene bags in order to preserve the natural moisture content. In order to study the Index properties of the dredged marine clay the samples were oven dried or air dried as per the requirement of the test.

3. EXPERIMENTAL METHODS

3.1 Geotechnical Characterization

The tests which were carried out to determine the index properties were as per Indian Standards. The specific gravity of sample was determined using pycnometer. For this the clay in its natural form was used as such. The liquid limit was found out using standard Casagrande apparatus. The grain size distribution results were obtained by conventional sieve & hydrometer analysis. For grain size analysis distilled water was used. The Optimum Moisture Content (OMC) and Maximum Dry Density (MDD) were determined using Standard Proctor Test.

3.2 Cement Stabilization

Unconfined compressive tests were carried out on the remoulded sample. Samples were obtained by adding different concentrations of cement viz 5%, 10%, 15% and 20% by the dry weight of the soil taken. The unconfined compressive strength after 3, 7 and 28 days of curing was determined in order to assess the effect of curing.

4. RESULTS AND DISCUSSIONS

Followings are the results obtained from the tests conducted.

Table -1: Index Properties

Sl no.	Experiment	Value
1	Specific gravity	2.42
2	Liquid limit	100%

3	Plastic limit	33.3%
4	Clay content	48%
5	Silt content	42%
6	Optimum moisture content	23%
7	Max dry density	1.355g/cc

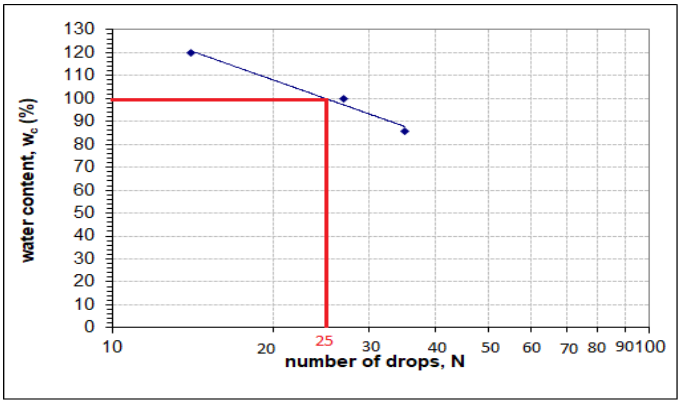

Chart -1: Flow graph to find the liquid limit

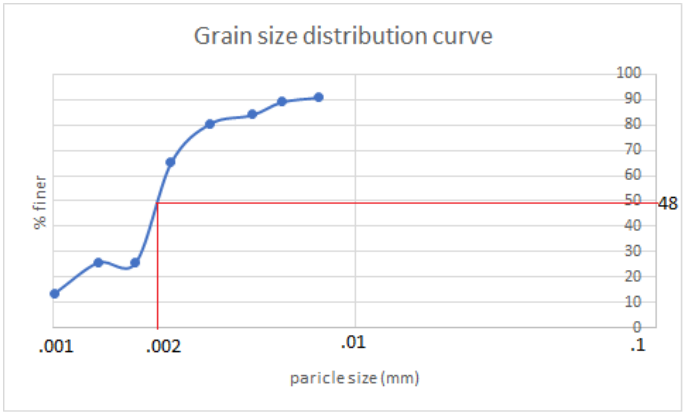

Chart -2: Grain size distribution graph

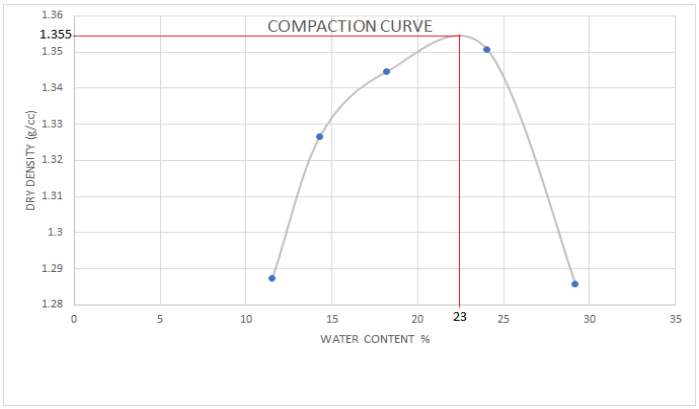

Chart -3: Compaction curve

The specific gravity of the sample was determined by Pycnometer method and the value was found to be 2.42. Liquid limit was obtained using Casagrande's apparatus and the value was 100%.Using sedimentation analysis the particle distribution curve of the sample was obtained, from which the clay content and silt content were found to be 48% and 42% respectively. By Indian Standard method of classification of soils, the sample was classified as clay of high compressibility. From the standard Proctor Test, the Optimum Moisture Content was found to be 23% and corresponding maximum dry density as 1.355g/cc.

Following are the graphs obtained for the unconfined compressive tests done on the samples containing 5, 10, 15 and 20% of cement by dry weight of the sample.

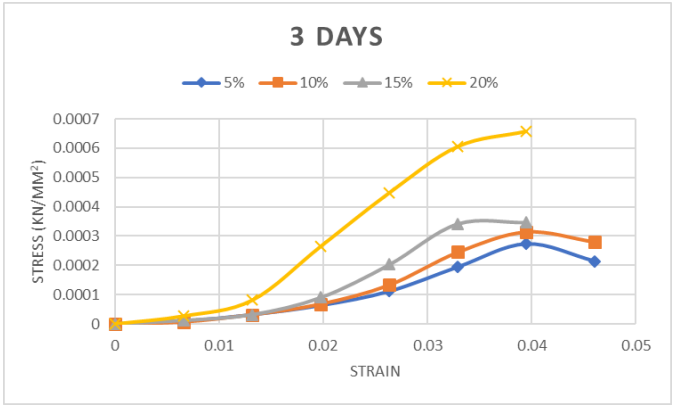

Chart -4: Compressive stress strain curve for 3 days curing

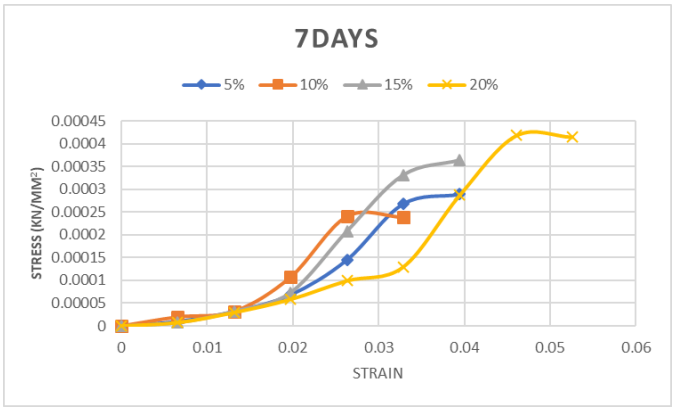

Chart -5: Compressive stress strain curve for 7 days curing

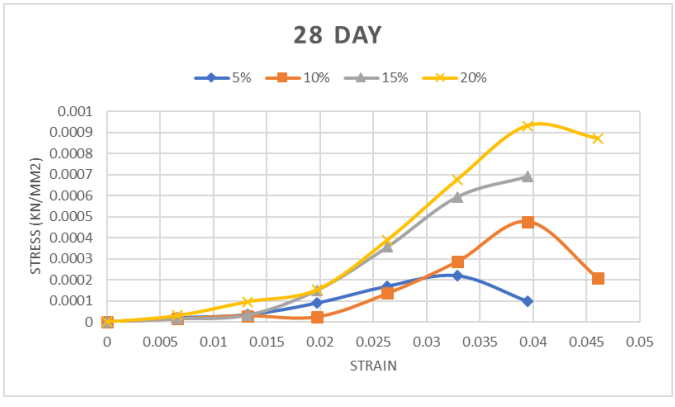

Chart -6: Compressive stress strain curve for 28 days curing

5. CONCLUSIONS

Dredged marine clay of Cochin navigation channel was used for testing, with the aim to investigate its engineering properties. The liquid limit of the clay was found to be 100% by using Casagrande's apparatus. From the sedimentation analysis using hydrometer, it was attained that it contains almost equal percentage of clay and silt content (48% and 42% respectively). The clay was found to be highly compressive in nature, as per the Indian Standard Classification of soils. Furthermore, the Optimum Moisture Content was found to be 23% and maximum dry density as 1.35g/cc.

As per the results of this study, the sample containing 20% cement gives maximum unconfined compressive strength. But on considering the economy factor, it can be concluded that the sample containing 15% cement is sufficient, since it attains considerable strength also. The below graph shows the effect of curing in the sample and hence conclusions can be drawn as the optimum cement content for stabilizing the dredge marine clay is 15%.

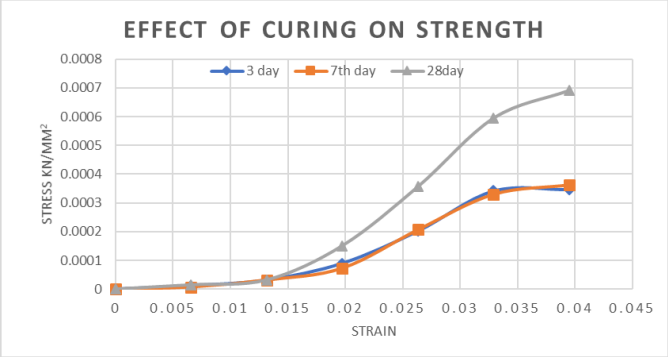

Chart -7: Effect of curing period on the sample containing 15% cement

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