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Effect Of Lime And Flyash On Geotechnical Properties Of Dredged Marine Soil

[1] Kishore M S , [2] Gayathri S
[1] PG Student, Department Of Civil Engineering, Marian Engineering College, TVM.
[2] Assistant Professor, Department Of Civil Engineering, Marian Engineering College, TVM.

Abstract: ***Large-scale land reclamation projects have been carrying out for the past decades. Aside from the availability of the landfill materials which normally use sands or hill-cut materials, dredged materials can be used for the land reclamation. Utilizing the dredged or excavated marine clay for land reclamation becomes more popular. This paper discusses the stabilization of Vizhinjam dredged marine soil using lime and fly ash with different concentrations. A laboratory study was conducted on dredged soil treated with lime and flyash. The additives were added in different concentrationsso as to identify optimum dosage. From various tests, it was observed that with the addition of lime, the UCS value has increased by about 2.38 times the initial value and with the addition of flyash, the UCS value has increased by about 1.05 times the initial value.***

Keywords: Lime,Flyash,Stabilization, Dredged Soil, Land Reclamation, Unconfined Compressive Strength

I. INTRODUCTION

In the modernization effort of the country, development of the coastal region is inevitable for a country with a rich maritime history like India. The developing works in coastal areas involve dredging works for construction of structures, such as ports, waterways, and breakwaters, land reclamation, and widening sections of river or sea to facilitate economic activities and to erect coastal protection systems.However, the dredging process can also cause negative impact on the environment, especially when the dredged soils are dumped into distant marine waters. Dumping activities from the dredging works could adversely affect the physical and biological elements of the sea. Contaminated dredged soils are harmful and could degrade the marine environment and result in long term, irreversible damages. Therefore, if a reuse potential can be derived for the dredged soils, dumping can be avoided and the environmental and ecological impact can be avoided.

This paper attempts to understand and evaluate the effect of the behaviors of two additives, namely lime and flyash in terms of engineering properties to Vizhinjam dredged clay. Different concentrations of both the additives were used in this study and the effects on compaction characteristics and compressive strength was evaluated.

II. Mechanism Of Lime And Flyash On Clays

The addition of lime to a fine grained soil in the presence of water initiates several reactions. Cation exchange and flocculation cause immediate improvement in soil plasticity, workability, and uncured strength and load deformation properties. A soil- pozzolanic reaction may also occur to form various cementing agents that increase compacted mixture strength and durability.

Flyash has little cementitious value, however, this changes in presence of moisture, with which it reacts chemically, and forms cementitious compounds. These compounds attributes to the improvement of compressibility and strength characteristic of a soil. Flyash can produce an assortment of divalent and trivalent cations under conditions that are ionized in nature, which in return can encourage flocculation of dispersed clay particles. Expansive soils thus can theoretically stabilize in an effective manner by cation exchange with flyash.

III. Materials

3.1. Vizhinjam Dredged Soil

Fig.1. Vizhinjam Dredged Soil

Table:1. Properties of Vizhinjam Dredged Soil

PROPERTIES	VALUE
Specific Gravity	2.14
Natural Moisture Content (%)	61.5
Max Dry Density (g/cc)	1.53
Optimum Moisture Content (%)	27
Liquid Limit (%)	61
Plastic Limit (%)	32
Plastic Index (%)	29
Shrinkage Limit (%)	11
Unconfined Compressive Strength (kN/m^2)	31.6
Organic Content (%)	16.66
Differential Free Swell Index	40
Grain Size Distribution (%)	
Clay(%)	36
Silt (%)	53
Sand(%)	11
Soil Classification	MH

3.2. Lime

Lime, chemically known as calcium oxide commonly known as quick or burnt lime, is a widely used chemical compound. It is a white, caustic, alkaline crystal solid at room temperature

Fig.2. Lime

Table:2.Properties of Lime

Components	**Amount (%)**
Calcium Hydroxide	90
Silica	1.5
Ferric oxide	0.5
Magnesium Oxide	1
Alumina	0.2
Carbon dioxide	3

3.3. Fly Ash

Class F flyashcollected from Thoothukudi thermal power plant, TamilNadu.

Table 3. Properties of Flyash

Properties	**Value**
Specific gravity	2.18
Max dry density (g/cc)	1.16
Optimum moisture content (%)	31.3
Liquid limit (%)	28.3
Plastic limit (%)	Non plastic
Plastic index (%)	Non plastic
Shrinkage limit (%)	11
Unconfined compressive strength (kpa)	92.33
Organic content (%)	16.66
Sand (%)	46
Silt(%)	29.75
Clay (%)	16.25
Class	F

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IV. Test Procedure

4.1 Specimen Preparation

The soil was oven dried for 24 h. The additives used in this study were processed as powders and mixed with water which can act as stabilizers and binders. The powder was

Gently added to water to avoid clumping, and then mixed until a homogenous solution was obtained. Soil was mixed with the solution and tested for variation in properties.

4.2compaction Test.a modified proctor compaction test as per is 2720 part 7 was performed for determining the maximum dry density and its corresponding optimum moisture content.the variation in optimum moisture content and maximum dry density was studied with the addition of various percentages of lime(2,4 6 & 8 %) and flyash (5,10,15 & 20%)

4.3 Unconfined Compressive Strength the unconfined compressive strength tests were conducted on marine clay, marine clay+ lime, marine clay + flyash, marine clay + lime-flyash as per is 2720 part 10 (1973). All the samples are prepared by static compaction using split mould at optimum moisture content and maximum dry density to maintain same initial dry density and water content. The test was conducted under a constant strain rate of 1.5mm/min. The proving ring reading is noted for 50 divisions, and loading was continued until 3 (or) more reading are decreasing (or) constant (or) strain 20% has been reach. The samples of marine clay –additive mixes were cured 3days, 7days, 14 days and 28days curing period and at the end of each curing period the samples were tested. Three samples for each mix were tested.

4.4 Atterberg Limits

The liquid limit and plastic limit test were carried out as per is: 2720 [part v] and shrinkage limit test was carried out as per is: 2720 [part vi].

V. Results And Discussion

5.1. Effect Of Lime On Compaction

Percentage of lime used for the test was 2,4,6 and 8. The result shows that the omc decreases and the dry density increases upon addition of lime upto2% and then vice-versa.

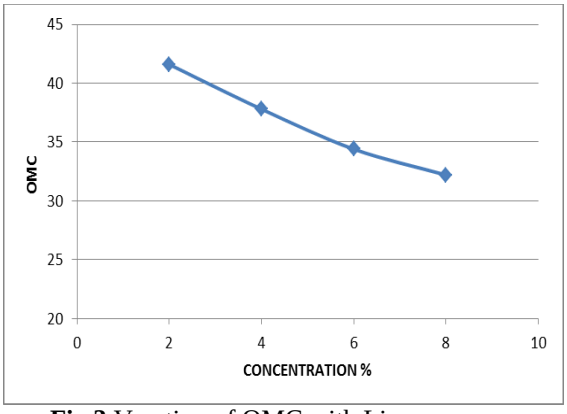

Fig.3. Varation of OMC with Lime

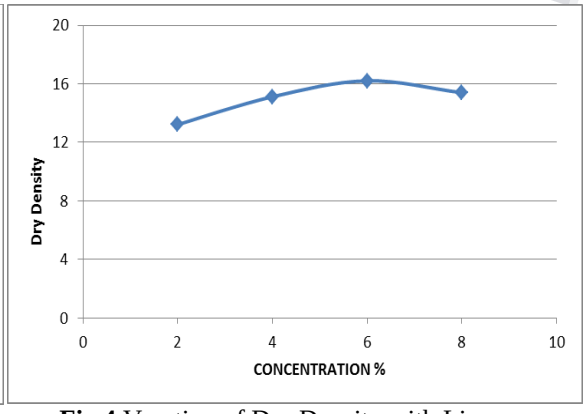

Fig.4. Varation of Dry Density with Lime

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5.2 .Effect Of Lime On Unconfined Compressive Strength

The optimum amount of lime is found to be 6% as the increase in strength is to be 2.38 times compared to the untreated soil.

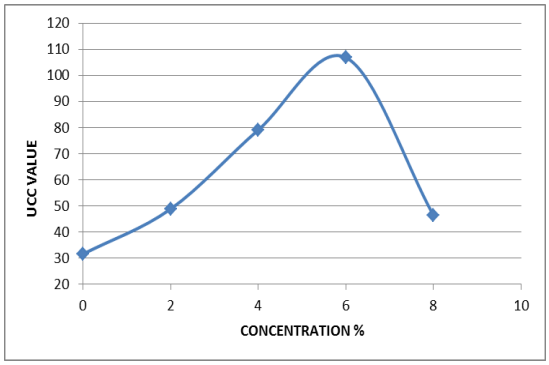

Fig.5. Variation of UCS with lime

5.3. Effect Offlyash On Compaction

Percentage of flyash used for the test was 5,10,15 and 20. The result shows that the OMC decreases and the dry density increases upon addition of flyash.

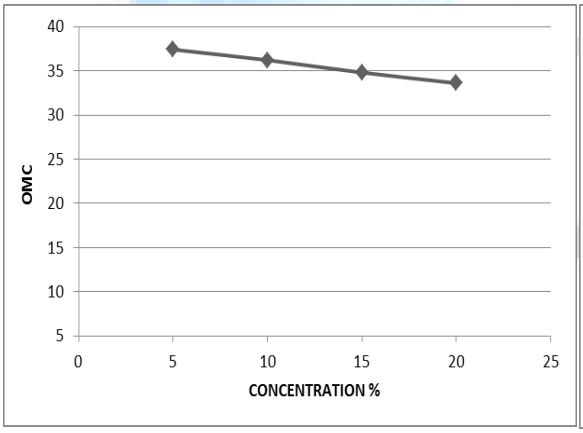

Fig.6. Variation of OMC with flyash

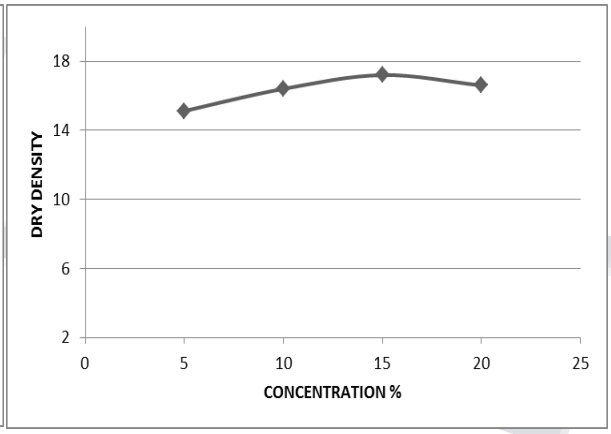

Fig.7. Variation of dry density with flyash

5.4. Effect Of Flyash On Unconfined Compressive Strength

The optimum amount of flyash is found to be 15% as the increase in strength is to be 1.05 times compared to the untreated soil.

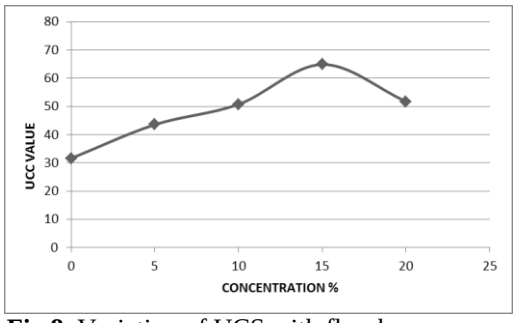

Fig.8. Variation of UCS with flyash

VI. Conclusions

This study investigates the effect of two additives, namely lime and flyashon Vizhinjam dredged soil with different concentrations. Using experimental investigations, the following conclusions can be drawn:

- Soil stabilization using lime and flyash is very effective for strengthening of clays
- Test results indicate that the optimum moisture content increases and maximum dry density reduces upto 2% of lime, beyond which it is vice-versa.
- The optimum moisture content decreases and maximum dry density increases upon addition of the flyash.
- The UCS value has increased by about 1.05 times with the addition of flyash and increased by about 2.38 times with the addition of lime.
- As the increased strength of soil with flyash was not adequate enough to be used as a foundation material, addition of lime in conjunction with flyash was adopted for stabilization.

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