International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Experimental Investigation of Compressive Strength on Earthen Dam (Vembakottai Dam)

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Abstract: ***This research is a main attempt to investigate the compressive strength using marble sludge powder(MSP) as an additive. Soil stabilization is defined as the alteration in properties of the soil samples. The main aim of this project is to identify the compressive strength details by adding various proportions of MSP with cement concrete. Data were collected from failure spot near embankment in Vembakottai dam located in Virudunagar District, Tamilnadu. Samples can be taken from different places at particular timings. Marble sludge material is a waste material which is generated from Marble processing industries. The compressive strength was revealed by Unconfined compressive machine***.

Keywords: Binding Material, Compaction test, Shear Strength, Stabilization, Sustainable Practices

1. Introduction

Waste materials are normally taken as replacement material in all practices. The main source of waste products from activities and purposes as agricultural, domestic and manufacturing purposes. Wastes from the various sources affect the environment, living beings, property and humans in many ways. In our future aspect, wastes are recycled and resused by proper technologies. Recycling process have implemented in many industries for avoiding pollution and creating a environment to be sustainable. In that case, marble sludge powder (MSP) is one of the waste products used in this study for stabilize the soil condition in Vembakottai dam situated in Virudhunagar District, Tamilnadu, India. Soil stabilization is the main important factor in construction work. Adding MSP as additives to make the embankment as strengthen and then find out the compressive strength using Unconfined Compression test.

2. Study Area

Vembakottai dam situated in the virudhunagar district and nestles on the distributaries of Vaippar River of southern Tamilnadu. It is normally termed reservoir for storage of water and consider this area as a gardenic spot and also availing boat facilities. It surrounds with lot of manmade and natural trees and plants. This dam was constructed by Tamilnadu government for the purpose of irrigation in the view of agricultural development. The retention of water from seven various distributaries of vaippar river. Vembakottai Reservoir is the prime source of water for a numerous villages and towns situated in the surrounding region.

3. Objectives of this Study

- To enhance the soil strength by the use of marble sludge powder
- To protect the environment from the marble sludge powder
- To execute in Vembakottai dam effectively.

4. Need for this Study

MSP is a waste product from Marble processing industries which is less cost compared to other materials. In environment point of view it creates lot of pollution if it is disposed on the ground. But it is rapidly strengthens the soil if it is properly mixed with natural soil in dam construction sites.

5. Research Methodology

This study mainly carried for increasing compressive and shears strength of soil by adding various percentages of MSP. Research samples were collected from Vembakottai dam closer to the failure spot in canal embankment. Samples are as both disturbed and undisturbed. Experimentally, research can be done by adding 10%, 20% and 30% of MSP from which respective values can be obtained.

6. Materials

Marble comes from the one of the types of rock as metamorphic, results from the chemical reaction between lime stone. It can be used as an admixture for all purposes but it is not easily obtained. It is rare material. The main advantage of the MSP is to fill the gaps or voids in the concrete and very much useful to escalate the compressive strength.

Table 1: Chemical properties of MSP

S. No	*Characteristics*	*Result*
1	Loss on Ignition, % by mass	40.63
2	Silica, % by mass	4.99
3	Iron, % by mass	1.09
4	Titanium, % by mass	Nil
5	Aluminium, % by mass	1.09
6	Calicum Oxide, % by mass	32.23
7	Magnesium Oxide, % by mass	18.94
8	Available Sodium Oxide, % by mass	0.02
9	Availble Potassium Oxide, % by mass	0.91
10	Available Sodium Oxide, % by mass	0.63

6.1 Particle Size Analyzer

The particle size analyzer works on the principle of Dynamic Light Scattering (DLS). In this instrument these measurements taken from 0.3nm to 8micro meter. This analysis can be done by the procedure of 1mg sample is dissolved in acetic acid for half an hour. The solute is kept inside the instrument for analysis. The following values are found from particle size analyzer.

Table 2: Particle size analysis

Peak No	S.P. Area Ratio	Mean	S.D	Mode
1	1.00	12.39 nm	11.19nm	121.3nm
2	-	-	-	-
3	-	-	-	-
Total	-	12.39nm	11.9nm	121.3nm

7. Mechanical Properties

7.1 Unconfined Compression test

It is one of the main forms of triaxial test in which that confining pressure is zero. This test can be conducted by using machine named as the compression testing machine. It is provided with a proving ring which is used for testing the soil sample by using testing machine. With the attachment of proving ring, reading can be obtained and also axial strain can be found out from the dial gauge. By the combination of readings from dial gauge and proving ring used to determine the compressive force. Tests were conducted by adding various proportions of mixture of MSP and cement. The results were represented in terms of Unconfined Compressive strength.

7.2 Purpose

This laboratory experiment is mainly used to determine the unconfined compressive strength of a soil sample which is in cohesive condition. Test can be conducted by Unconfined Compression machine is known as compression test. It is also termed as unconsolidated undrained test because of soil condition. In this condition lateral confining pressure is zero.

7.3 Shear Strength

Shear strength is defined as to describe the magnitude of the shear stress i.e how much soil can sustain in that condition. It also resists any deformation in soil particles by the way of continuous shear displacement. Shear resistance resulted from that bonding between particles and also friction. Some of the components are involved in shear strength as follows:

- Frictional component
- Cohesion component

7.3.1 Frictional Component

Frictional force is the resisting force in which those components are interlocking between particles and acts as frictional behavior.

7.3.2 Cohesion component

Basically results of shear strength can be found from comparative result of both friction and cohesion. As per soil condition, some cases cohesion less soil results from frictional component. Cohesion may be due to attraction between the soil particles.

7.4 The Coulomb Equation

First equation developed for shear strength by French Engineer Coulomb. This equation delivers the whenever frictional component increases, the cohesion component remains constant. Many research and experiments have shown that the shear strength developed for soil particles alone. Water and air particles have no shear strength. Figure illustrates the relation between friction and cohesion components. The Coulomb equation is as below

$$S = C + \sigma \tan(\emptyset)$$

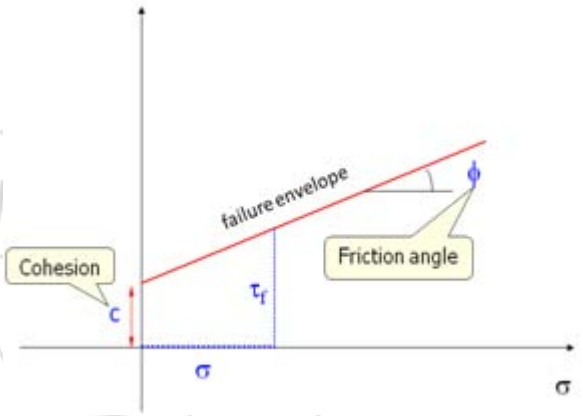

Figure 1: Shear Strength of soil

Where,
S – Shear Strength
C- Apparent Cohesion
σ - Total normal stress
$\emptyset$ - Angle of internal friction

8. Results and Discussion

The result shows that the MSP material is the best constituent material to strengthen the embankment. Selected samples as both disturbed and undisturbed soil has to be conducted strength test by unconfined compression test.

Table 1: Unconfined Compressive strength test result

S. No	Proportion		OMC (%)	UCS KN/m^2
	C	MSP		
1	10	10	14	20.11
2		20	12	20.54
3		30	14	20.76
4	20	10	13	20.97
5		20	14	21.19
6		30	16	21.40

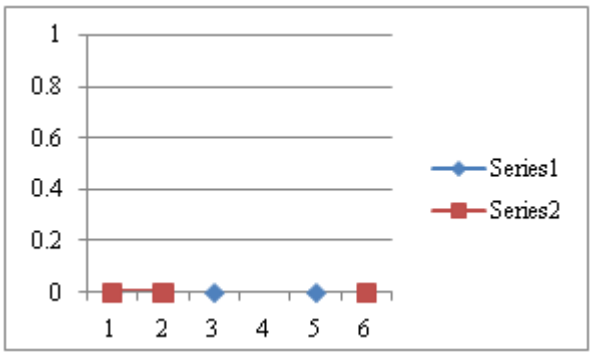

Figure 2: Graph between UCS and MSP

9. Conclusion

Basis of experimental work, this research concludes that soil stabilization using cement alone is a very difficult process. Some extra admixtures are used to increase the strength of soil. An admixture which reacts with cement undergone hydration process for that MSP plays important role in soil stabilization. In this research, better results can be achieved by using cement and MSP in a ratio of 20:30.

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