Effect Of Nano Particle On Shear Strength Of Soil

Murugesan[1] , Vasanthaseelan[1], M.Shahul Hameed[2]

[1]Research scholar, Department of Civil Engineering , P.S.R.Engineering college , Sivakasi

[1]Student Department of Civil Engineering , P.S.R.Engineering college , Sivakasi

[2]Head of Department, Civil Engineering , P.S.R.Engineering college , Sivakasi

Abstract:

Soil stabilization means alteration of the soils properties to meet the specified engineering requirements. In order to improve the shear strength and stability by adding Nano particle (marble sludge powder) with binding material as cement. A study is carried out to check the improvements in the properties of vembakottai soil with Marble sludge powder and cement in varying percentages. The test results such as Atterberg's limit, standard proctor compaction, and unconfined compression test obtained on soil mixed at different proportions of marble sludge powder and cement are presented and discussed in this paper

Keywords— Embankment, Shear, Marble sludge powder, Plastic material, quarry dust, environmental pollution.

I.INTRODUCTION:

Soil stabilization a general term for any physical, chemical, biological, or combined method of changing a natural soil to meet an engineering purpose Improvements including increasing the weight bearing capabilities and performance of in-situ subsoil's, sands and other waste material in order to strengthen the embankment.

The prime objective of soil stabilization is to improve the bearing ratio of in-situ soils by 4-6times. The other prime objective of soil stabilization is to improve on-site materials to create a solid and strong sub-base and base courses. In certain regions of the world, typically developing countries and now frequently in developed countries, soil stabilization is being used to construct the entire road.

In past,soil stabilization was done by utilizing the binding properties of clay soils, cement based products such as soil cement, and/or utilizing "rammed earth" technique (compaction) and lime.

The above provided are the up to date information relevant to soil stabilization. Our project totally rely upon stabilizing of soil. In such a way we have decided to use marble sludge powder a nano- particle to strengthen the soil .If the beneficial result have achieved in stabilization by using marble sludge powder then it will be applicable in embankment strengthening of vembakottai dam which have been damaged and caused the water to leak.

Nano Particles

Nanoparticles are particles between 1 and 100 nanometers in size. In nanotechnology, a particle is defined as a small object that behaves as a whole unit with respect to its transport and properties. Particles are further classified according to diameter.

List of nano particles

- Lime
- Silica
- Copper slag
- Cement kiln dust
- Fly ash
- Marble sludge powder
- Quarry rock dust
- Cement

According to cost and availability so we have chosen marble sludge powder.

Objective

- To use the marble sludge powder – Nano particle to strengthen the soil.

- To protect the environment from the pollutant marble sludge powder by effectively using it in the strengthening process.
- To implement this strengthening process in vembakottai dam.

Scope

- Environmental friendly
- Ecologically appropriate
- Cost effective material
- Appropriate technologies in stabilization
- Eliminate up to 98% of soil stability problems at the source.

II.MATERIALS AND DESCRIPTION:

1.Marble sludge powder

Fig 1: Marble sludge powder

Marble is a metamorphic rock resulting from the transformation of pure lime stone. Marble sludge powder is an industrial waste containing heavy metals as constitutes. Chemically, marbles are crystalline rocks composed predominantly of calcite, dolomite or serpentine materials. The other mineral constituents vary from origin to origin.

Table 1: Physical properties

Properties	Result
Specific gravity	2.857
Fineness modulus	2.04

Table 2: chemical properties

Characteristics	Result
Loss on ignition,	3.33
SiO_2	69.21
Fe_2O_3	4.40
TiO_2	Nil
Al_2O_3	13.48
CaO	8.40
MgO	0.81
Na_2O	0.26

1.1 Partice Size Analyser

The Particle Size Analyzer works on the principle of Dynamic Light Scattering (DLS).In this instrument particle size measurements can be made from 0.3nm to 8µm.1mg of the sample is dispersed in acetic acid taken in a test tube for half an hour. Then the test tube is kept inside the instrument for analysis.

Fig 2: Dynamic Light Scattering

Table 3: Particle size analyser

Peak No.	S.P.Area Ratio	Mean	S. D.	Mode
1	1.00	123.9 nm	11.9 nm	121.3 nm
2	---	--- nm	--- nm	--- nm
3	---	--- nm	--- nm	--- nm
Total	---	123.9 nm	11.9 nm	121.3 nm

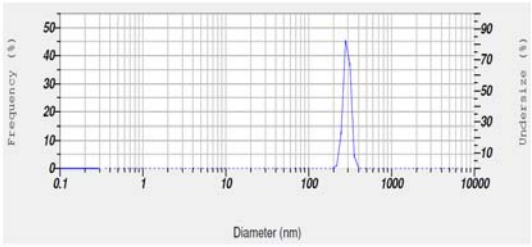

Fig 3: Graph of particle size

III.METHODOLOGY:

Data collection

⇩

Literature review

⇩

Scope of study

⇩

Collection of Sample

⇩

Determination of Index and Engineering Properties of soil sample

⇩

Laboratory investigation on soil with various percentage of marble sludge powder and cement

⇩

Result and Discussion

⇩

Conclusion

V.RESULT AND DISCUSSION

1. Standard proctor compaction test

Fig 4: Proctor Compaction Apparatus

S.N0	Proportion		OMC%	MDD g/cc
	C	MSP		
1	10	10	14	1.133
2		20	12	1.054
3		30	14	0.987

2. Unconfined compressive strength test

Fig 5: Testing Of Unconfined Compressive Strength

S.N0	Proportion		UCS kN/m^2
	C	MSP	
1	10	10	20.11
2		20	20.54
3		30	20.76

3. Direct shear strength

Fig 6: Direct Shear Apparatus

Table : Direct Shear Test Results for 0%

S.No	Normal load (kN)	Shear load (kN)	Deflection dial gauge (mm)	Proving ring reading (mm)	Normal stress (kN/m2)	Shear stress (kN/m2)
1	0.2	0.3	16	81.2	55.55	200
2	0.4	0.6	30	165.3	111.11	400
3	0.6	0.9	39	245.8	166.67	600
4	0.8	1.2	49	327.4	222.22	800
5	1	1.5	58	402.4	277.77	1000
6	1.2	1.8	69	486.6	333.33	1200
7	1.4	2.1	78	541.3	388.88	1400
8	1.6	2.4	89	645.2	444.44	1600
9	1.8	2.7	92	728.5	500	1800
10	2	3	110	804.6	555.55	1767

Table: Direct Shear Test Results for 10%

S.No.	Normal load (kN)	Shear load (kN)	Deflection dial gauge (mm)	Proving ring reading (mm)	Normal stress (kN/m2)	Shear stress kN/m2
1	0.2	0.22	16	81.2	55.55	146.6
2	0.4	0.39	30	165.3	111.11	260
3	0.6	0.76	39	245.8	166.67	506.67
4	0.8	1.24	49	327.4	222.22	826.66
5	1	1.81	58	402.4	277.77	1206.66
6	1.2	1.93	69	486.6	333.33	1286.66
7	1.4	2.45	78	541.3	388.88	1633.33
8	1.6	2.82	89	645.2	444.44	1880
9	1.8	2.94	92	728.5	500	1960
10	2	3.24	110	804.6	555.55	1860

Table : Direct Shear Test Results for 10 – 20%

S.No	Normal load (kN)	Shear load (kN)	Deflection dial gauge(mm)	Proving ring reading (mm)	Normal stress (kN/m^2)	Shear stress (kN/m^2)
1	0.2	0.25	16	81.2	55.55	166.6666667
2	0.4	0.54	30	165.3	111.11	360
13	0.6	0.98	39	245.8	166.67	653.3333333
4	0.8	1.32	49	327.4	222.22	880
5	1	1.67	58	402.4	277.77	1113.333333
6	1.2	1.93	69	486.6	333.33	1286.666667
7	1.4	2.3	78	541.3	388.88	1533.333333
8	1.6	2.52	89	645.2	444.44	1680
9	1.8	2.93	92	728.5	500	1953.333333
10	2	3.1	110	804.6	555.55	1933.666667

Table : Direct Shear Test Results for 10 – 30%

S.No	Normal load (kN)	Shear load (kN)	Deflection dial gauge(mm)	Proving ring reading (mm)	Normal stress (kN/m2)	Shear stress (kN/m2)
1	0.2	0.17	16	81.2	55.55	113.33
2	0.4	0.25	30	165.3	111.11	166.67
3	0.6	0.75	39	245.8	166.67	500
4	0.8	1.34	49	327.4	222.22	893.33
5	1	1.63	58	402.4	277.77	1086.67
6	1.2	1.92	69	486.6	333.33	1280
7	1.4	2.27	78	541.3	388.88	1513.33
8	1.6	2.57	89	645.2	444.44	1713.33
9	1.8	2.68	92	728.5	500	1786.67
10	2	3.24	110	804.6	555.55	1710

V. CONCLUSION

- On the basis of the experimental work , the following conclusions and suggestion are put forward ,
- It is difficult to stabilize soft soil using cement alone. however, appropriate extra admixtures can be used to enhance the soil strength . It has been show that different admixtures play a different role in cement soil stabilization .The main substance which reacts with cement hydration products and the admixtures is the loosely combined soil and marble sludge powder plays a important role in the stabilization of soft soil in foundations .In order to obtain a clear view of the soil ,the influence of different parameters shows good results ,
  1. The liquid limit of the soil is 24%
  2. The UCC strength of 10:20 is 20.65 kN/m^2
  3. The direct shear value is 200 kN/m^2
- Better results can be achieved by using soil –marble sludge powder-cement ratio of 10:20 And we suggest that for soil stabilization marble powder is the best alternative material for soil stabilization.

VI. REFERENCES

1. Shahul Hameed, M., Sekar, ASS, (2009), "Properties of green concrete containing quarry rock dust and marble sludge powder as fine aggregate", ARPN journal of Engineering and applied Science, volume 4 issue 4, Page 83-89.
2. Shahul Hameed, M., Sekar, ASS., Saraswathy V, (2012) "Strength and permeability characteristics study of self-compacting concrete using crusher rock dust and marble sludge powder", Arabian Journal for Science and Engineering, , volume 37, issue 3, pages 561-574.
3. Shahul Hameed, M., Sekar, ASS., Balamurugan, L., Saraswathy, V., (2012) "Self-compacting concrete using marble sludge powder and crushed rock dust", KSCE Journal
4. Majeed, Z.H and Taha, M.R., 2012, **"**Effect of nanomaterial treatment on geotechnical properties of Penang soft soil", Journal of Asian Scientific Research.
5. R. Ali1, H. Khan2, A. A. Shah3, 2012, "Expansive Soil Stabilization Using Marble Dust and Bagasse Ash", International Journal of Science and Research (IJSR).
6. Chayan Gupta1, Dr. Ravi Kumar Sharma2, 2014, " Influence of Marble Dust, Fly Ash and Beas Sand on Sub Grade Characteristics of Expansive Soil", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE).
7. Muthu Kumar M#1, Tamilarasan V S*2, 2015, "Experimental Study on Expansive Soil with Marble Powder", International Journal of Engineering Trends and Technology (IJETT) – Volume 22 Number 11.
8. Parte Shyam Singh1* and Yadav R K2, 2014, "Effect Of Marble Dust On Index Properties Of Black Cotton Soil", International Journal Of Engineering Research And Science & Technology.
9. IS 2720(part I)-1985 method of test for soil part 4: grain size analysis.
10. V.N.S Murthy " Test book of soil mechanics and foundation Engineering" CBS Publisher and distributions- New Delhi.