Stabilization of Black Cotton Soil using Flyash, Eggshell and E-Waste

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Abstract:- **Soil stabilization is that the development that deals with modifying the properties of soil (index and engineering) to boost its performance. Stabilization is getting used for a spread of engineering works either in its natural type or in an exceedingly processed type. Eventually all structures rest on soil foundation wherever the most objective is to extend the strength or stability of soil and to cut back the development price. Currently daily the use of waste product with soil has gained attention because of the increasing issues of waste management. This paper presents the results of associate in nursing experimental program undertaken to analyze the impact of Flyash, Eggshell and E-waste at completely different dosage on Black cotton soil. Behavior of soil was observed through various dosages of combination of Fly ash, Egg shell and E-waste. The performance of Fly ash, Egg shall and E-waste stable soil was evaluated victimization physical and strength performance tests namely; water content test, specific gravity test, grain size analysis, liquid limit test, modified proctor test, unconfined compressive test. These checks were conducted so as to judge the advance within the strength characteristics of the soil.**

***Keywords*: Flyash, Egg shell, E-waste, Black cotton soil, Soil stabilization.**

I. INTRODUCTION

Soil is one of the world's most important natural resource, together with air and water it is basic for life on planet earth. On volume a good quality soil is one that is 45% minerals(sand, silt and clay), 25% water, and 25% air, 5% organic material both live and dead.

II. STABILIZATION OF SOIL

A. soil stabilization

The alteration of soil properties to meet specific engineering requirements is known as "Soil stabilization". There are essentially two forms of improvement Modification and Stabilization.

B. Methods of soil stabilization

Mechanical stabilization.

Chemical admixture stabilization.

III. OBJECTIVES

- To find the optimum dosage of flash, eggshell, e-waste.
- To identify the properties of black cotton soil and stabilized BC soil with flash, eggshell, e-waste with different percentage replacement levels.
- To provide an economical solution for the soil stabilization using flash, eggshell
  e-waste.

IV. METERIALS AND METHODOLOGY

A. Materials used

The different materials used in this investigation are

1. Black cotton soil:

Fig.1: Black cotton soil

2. Fly ash :

Fig.2: Fly ash

3. **Egg shell:** Eggshell waste is fundamentally composed of calcium carbonate and has the potential to calcium carbonate and has the potential to be used as the raw material in the production of lime.

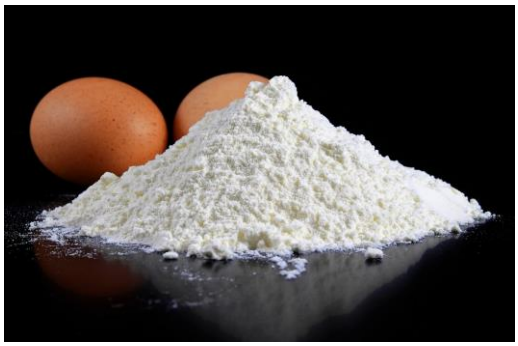

Fig.3: Egg shell

4. **E-waste:** Electronic waste is also represented because the discarded electric equipment's like mobile phones, computers, social unit appliances.

Fig.4: E-waste

B. Methodology

Following laboratory tests have been carry out as per IS: 2720.

1. Water content test – IS 2720 Part 2, 1973.
2. Grain size analysis – IS 2720 Part 4, 1985.
3. Specific gravity – IS 2720 Part-3, 1980.
4. Liquid limit – IS 2720 Part-5, 1985.
5. Proctor Compaction – IS 2720 Part-8, 1983.
6. Unconfined compression test – IS 2720 Part 10,1991.

C. Sampling of soil

Table No.1: Sampling of soil

Soil particulars	Percentage variance
Natural black cotton soil	0%
Soil sample 1	10%FA + 5%EP + 2%E-waste
Soil sample 2	10%FA + 10%EP + 2%E-waste
Soil sample 3	10%FA + 15%EP + 2%E-waste
Soil sample 4	20%FA + 5%EP + 2%E-waste
Soil sample 5	20%FA +10%EP + 2%E-waste
Soil sample 6	20%FA + 15%EP + 2%E-waste
Soil sample 7	30%FA + 5%EP + 2%E-waste
Soil sample 8	30%FA + 10%EP + 2%E-waste
Soil sample 9	30%FA + 15%EP + 2%E-waste

V. TESTING

A. Water content test:

Table No.2: Table Showing Variation of Soil Properties from water content

SAMPLES	WATER CONTENT (%)
Natural black cotton soil 0%	15
Sample 1 10%FA + 5%EP + 2%E-waste	14.8
Sample 2 10%FA + 10%EP + 2%E-waste	14.48
Sample 3 10%FA + 15%EP + 2%E-waste	14.1
Sample 4 20%FA + 5%EP + 2%E-waste	13.3
Sample 5 20%FA +10%EP + 2%E-waste	14.4
Sample 6 20%FA + 15%EP + 2%E-waste	14.28
Sample 7 30%FA + 5%EP + 2%E-waste	12.9
Sample 8 30%FA + 10%EP + 2%E-waste	13.44
Sample 9 30%FA + 15%EP + 2%E-waste	13

Showing graphical variation:

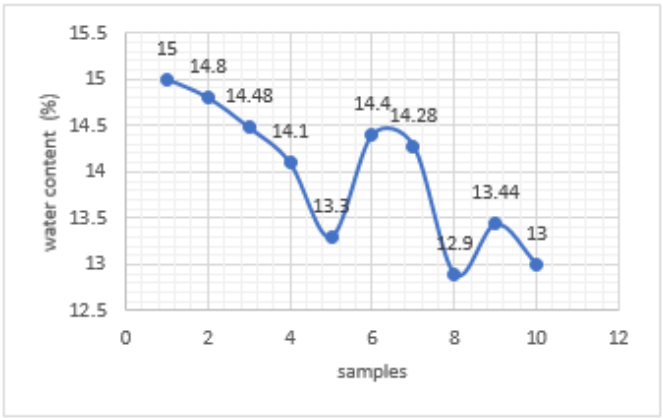

Fig.5: Showing graphical variation for water content

B. Grain size analysis:

Table No. 3: Table Showing Variation of Soil Properties from grain size analysis (sieve analysis)

SAMPLES	GRAIN SIZE ANALYSIS
Natural black cotton soil 0%	it is well graded.
Sample 1 10%FA + 5%EP + 2%E-waste	it is well graded.
Sample 2 10%FA + 10%EP + 2%E-waste	it is well graded.
Sample 3 10%FA + 15%EP + 2%E-waste	it is well graded.
Sample 4 20%FA + 5%EP + 2%E-waste	it is well graded.
Sample 5 20%FA +10%EP + 2%E-waste	it is well graded.
Sample 6 20%FA + 15%EP + 2%E-waste	it is well graded.
Sample 7 30%FA + 5%EP + 2%E-waste	it is well graded.
Sample 8 30%FA + 10%EP + 2%E-waste	it is well graded.
Sample 9 30%FA + 15%EP + 2%E-waste	it is well graded.

c. ***Specific gravity test by density bottle method:***

Table No. 4: Table Showing Variation of Soil Properties from specific gravity (density bottle method)

SAMPLES	SPECIFIC GRAVITY
Natural black cotton soil 0%	1.88
Sample 1 10%FA + 5%EP + 2%E-waste	2.1
Sample 2 10%FA + 10%EP + 2%E-waste	2.17
Sample 3 10%FA + 15%EP + 2%E-waste	2.2
Sample 4 20%FA + 5%EP + 2%E-waste	2.21
Sample 5 20%FA +10%EP + 2%E-waste	2.29
Sample 6 20%FA + 15%EP + 2%E-waste	2.34
Sample 7 30%FA + 5%EP + 2%E-waste	2.0
Sample 8 30%FA + 10%EP + 2%E-waste	2.09
Sample 9 30%FA + 15%EP + 2%E-waste	2.12

Fig.6: Showing graphical variation for specific gravity

C. ***Liquid limit by casagrande method:***

Table No. 5: Table Showing Variation of Soil Properties from liquid limit by Casagrande method

SAMPLES	LIQUID LIMIT (%)
Natural black cotton soil 0%	67.8
Sample 1 10%FA + 5%EP + 2%E-waste	60
Sample 2 10%FA + 10%EP + 2%E-waste	56
Sample 3 10%FA + 15%EP + 2%E-waste	52
Sample 4 20%FA + 5%EP + 2%E-waste	39
Sample 5 20%FA +10%EP + 2%E-waste	34
Sample 6 20%FA + 15%EP + 2%E-waste	30.07
Sample 7 30%FA + 5%EP + 2%E-waste	47
Sample 8 30%FA + 10%EP + 2%E-waste	46.33
Sample 9 30%FA + 15%EP + 2%E-waste	45

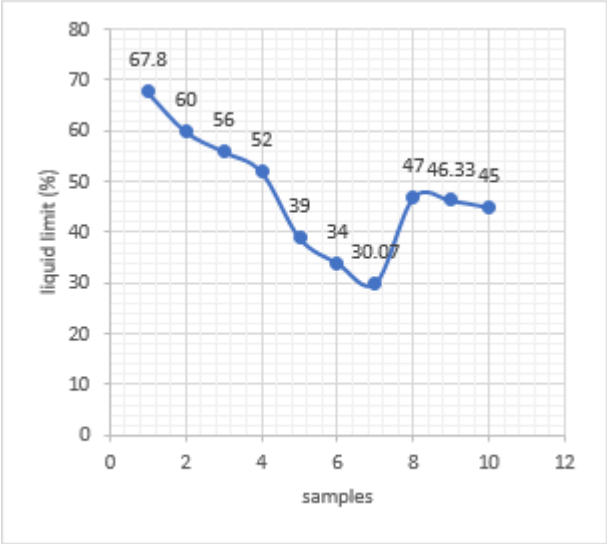

Fig.7: Showing graphical variation for liquid limit

D. ***Modified proctor test:***

OMC and MDD: it is determined by the compaction test. All the compactions were carried out with Modified proctor apparatus. For the determination of moisture density relationship, hammer of 4.89Kgmass falling from a height of 450mm in a 2250 mm³ mould. Each layer is compacted in 5 layers such that each layer receiving 56 blows.

Table No. 6: Table Showing Variation of Soil Properties from Modified proctor test (light compaction test)

SAMPLES	LIGHT COMPACTION RESULTS	
	OMC (%)	MDD (g/cc)
Natural black cotton soil 0%	10.8	1.88
Sample 1 10%FA + 5%EP + 2%E-waste	20.0	1.7
Sample 2 10%FA + 10%EP + 2%E-waste	27.2	1.58
Sample 3 10%FA + 15%EP + 2%E-waste	27.9	1.51
Sample 4 20%FA + 5%EP + 2%E-waste	20.0	1.60
Sample 5 20%FA +10%EP + 2%E-waste	17.3	1.70
Sample 6 20%FA + 15%EP + 2%E-waste	16.7	1.71
Sample 7 30%FA + 5%EP + 2%E-waste	46.4	1.73
Sample 8 30%FA + 10%EP + 2%E-waste	15.1	1.69
Sample 9 30%FA + 15%EP + 2%E-waste	15.0	1.65

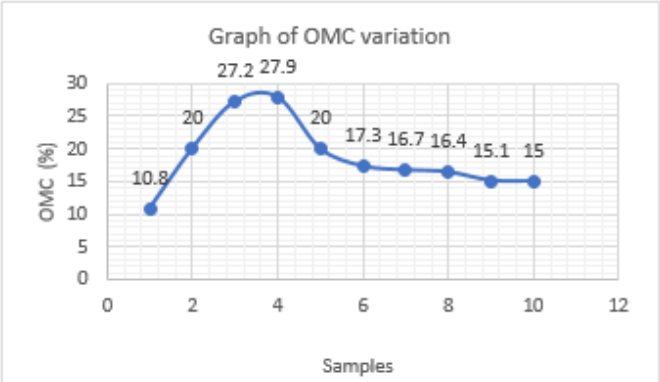

Fig.8: Showing graphical variation for OMC

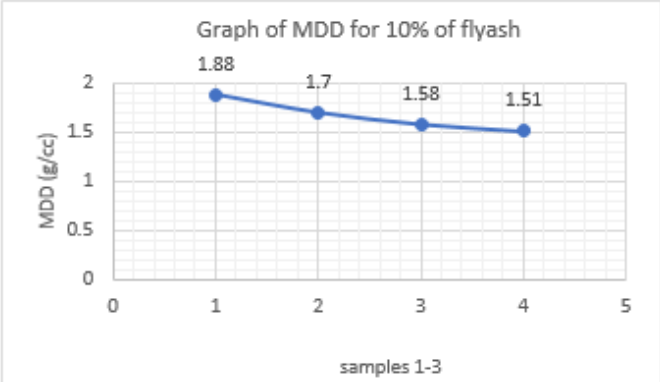

Fig.9: Showing graphical variation for MDD-10% flyash

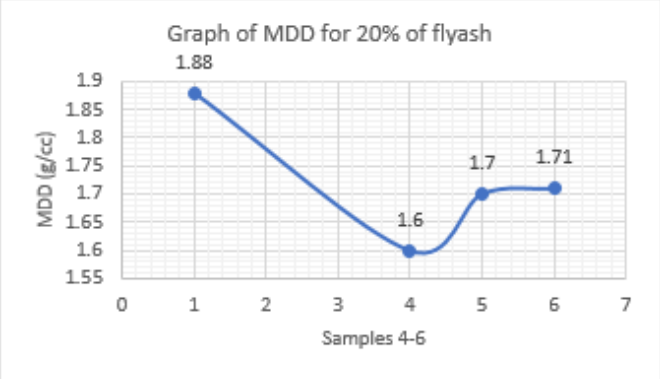

Fig.10: Showing graphical variation for MDD-20% flyash

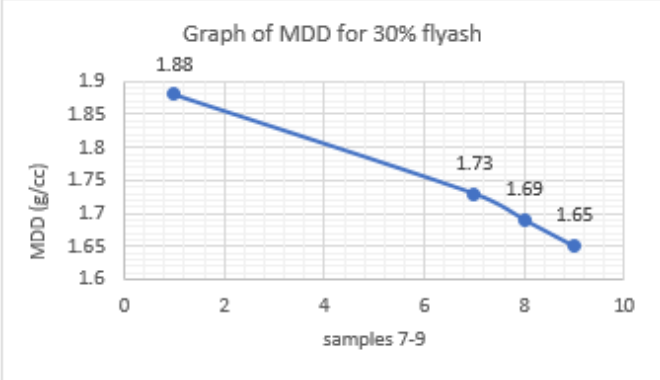

Fig.11: Showing graphical variation for MDD-30% flyash

E. Unconfined compression test:

Table No. 7: Table Showing Variation of Soil Properties from unconfined compression test

SAMPLES	COMPRESSIVE STRENGTH (kg/cm^2)
Natural black cotton soil 0%	23.73
Sample 1 10%FA + 5%EP + 2%E-waste	16.22
Sample 2 10%FA + 10%EP + 2%E-waste	10.46
Sample 3 10%FA + 15%EP + 2%E-waste	9.43
Sample 4 20%FA + 5%EP + 2%E-waste	15.43
Sample 5 20%FA +10%EP + 2%E-waste	16.01
Sample 6 20%FA + 15%EP + 2%E-waste	16.28
Sample 7 30%FA + 5%EP + 2%E-waste	7.16
Sample 8 30%FA + 10%EP + 2%E-waste	8.39
Sample 9 30%FA + 15%EP + 2%E-waste	8.51

Showing graphical variation:

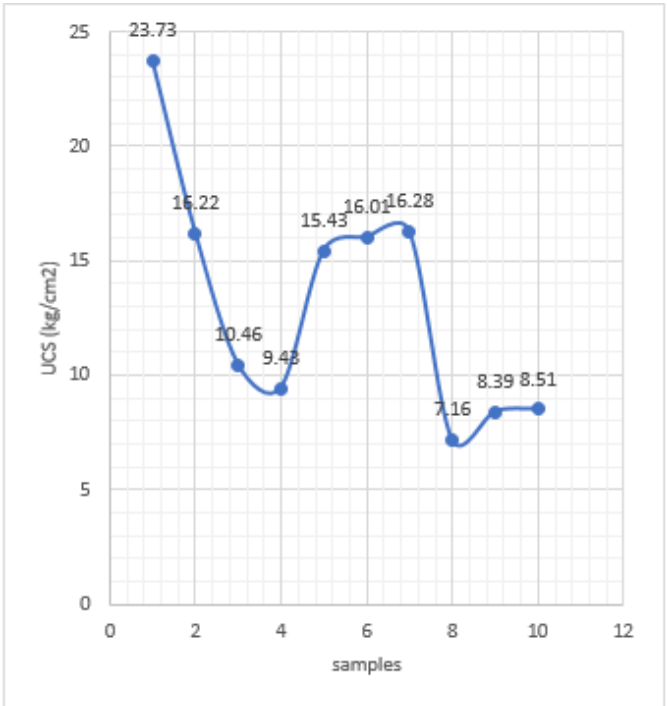

Fig.12: Showing graphical variation for Unconfined Compression Test

VI. CONCLUSIONS:

- Black cotton soil when added with fly ash, eggshell and e-waste are shown improved geotechnical properties of soil. This will provide solution for the use BC soil in the constructions.
- It is observed from the above graph that the addition of fly ash, eggshell and e-waste to black cotton soil, the water

content of the soil has been decreased gradually from 15% to 12% for Soil sample 1 to sample 9.

- The specific gravity for natural soil was 1.88 and it increased to 2.1 for Soil sample 1 to 2.34% for soil sample 9.
- The liquid limit for natural soil was 67.8% and it is decreases to 30% for sample 6 and increases to 47% for sample 7 then decreases to 45% for sample 9.
- From the graph the OMC has been increased from 10.8% to 15% for addition of fly ash, eggshell and e-waste.
- Similarly, The MDD for natural soil was 1.88g/cc and it gradually decreased to 1.65g/cc for sample 9.
- The UCS (q) value for natural soil was found to be 23.73kg/cm^2, while it drastically decreased to 16.22kg/cm^2 for Soil sample 1 to 8.51kg/cm^2 for soil sample 9.

VII. SCOPE FOR FUTURE WORK:

- This work has been carried out in laboratory conditions, Practical feasibility at site has to be studied.
- Other than the above admixture used, we can further use different types of admixtures from different industries to study their effect on stabilization of soil.
- Higher percentage of fly ash, eggshell and e-waste, combination can be used to stabilize the soil and can be tested.

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