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Studies on Improvement of Shear Strength of Sandy Soil using Egg Shell Powder and Quarry Dust

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***Abstract*— This research paper is focused on the experiment performed for the stabilization of the soil along the Ganga bank in the city of Kanpur with the help of egg shell powder and quarry dust and therefore helps in eradicating the problem of soil erosion.**

Egg shell and quarry dust are waste product and can be used for stabilizing the soil. The egg shell powder and quarry dust are sieved through IS200 sieve and then mix in different proportions to the soil to improve its shear strength. The experiment performed with different proportions mixes of egg shell powder and quarry dust shows that egg shell powder and quarry dust are most economical admixtures for improving the soil shear strength.

The result of our experiment work shows that the shear strength has increased to much extent than it can be increased by using chemical admixture.

Keywords*— *Eradication; Erosion; Stablization; Egg Shell Powder; Quarry Dust

I. INTRODUCTION

India has faced several natural disaster due to which properties of soil gets affected such as soil erosion. This will also affect the strength for further construction along the river site. The aim of the project is to check and improve the shear strength of the soil along the river and reduce soil erosion.

One of the most important engineering properties of soil is its shear strength which enables soil to maintain soil equilibrium. Sandy soil is collected from Kanpur to perform several tests which are used to improve the engineering and index properties.

In our experiment , Egg shell powder and Quarry dust admixtures are used to analyse the geotechnical properties of the sandy soil.

This analysis is done by addition of varying proportion of the admixtures to improve the strength of the soil.

II. LITERATURE REVIEW

A. Factors Affecting the Strength of Soil

*Gregory Paul Makusa***;** Department of Civil, Environmental and Natural resources engineering, Division of Mining and Geotechnical Engineering, Luleå University of Technology Luleå, Sweden.

According to him, presence of organic matters, sulphates, sulphides and carbon dioxide in the stabilized soils may contribute to undesirable strength of stabilized materials.

The factors which effect the strength of soil are:

- Organic matter
- Sulphates
- Sulphides
- Compaction
- Moisture content
- Temperature
- Freeze-thaw and dry-wet effect

B. Previous Work

1) Soil Stablization Using Lime

Ankit Singh Negi, Mohammed Faizan, Devashish Pandey Siddharth, Rehanjot singh stated that lime is an excellent stabilizing material for highly active soil which undergo through frequent expansion and shrinkage. It acts immediately and improves various property of soil such as increase in CBR value and compression resistance.

2) Soil Stablization Using Rice Husk Ash and Cement

Aparna roy explained that the use of 10% RHA and 6% cement is recommended as optimum amount for maximum improvement in strength for practical use.

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3) Soil Stablization Using Granulated Blast Furnace Slag and Fly Ash

Yadu and Tripathi stabilized the soft soil by the use of Granulated blast furnace slag and fly ash. Authors concluded that the optimum amount of GBS with fly ash was a 3% fly ash and 6% GBS.

4) Soil Stablization Using Waste Paper Sludge

Elias stabilized the soil using waste paper sludge. The UCS for soil for varying percentage such as 2%, 4%, 5%, 6%, 7% and 10% of WPS increased to better strength. The addition of WPS increased the strength at 5% and it was found to be constant and optimum value of strength to soil.

5) Soil Stablization Using Egg Shell Powder and Quarry Dust

From the literature, it was observed that the eggshell powder was added with the combination of any other stabilizing materials (cement, lime, flyash). Over the last years, environmental issues have forced human to use industrial wastes as alternatives to some construction materials. Engineers have paid considerable attention to use wastes in soil stabilization and improving physical and mechanical properties of soils. This may help both remove environmental problems and contribute to the economy.

From the literature, it was also seen that the eggshell powder is added with the combination of any other stabilizing materials (cement, lime, flyash). In this research paper, we have decided to add the eggshell powder in addition with quarry dust to study the properties properties of the soil. An improvement in the index and strength properties of soil by addition of egg shell powder will help to find an application for waste materials to improve the properties of soil and can be used as a better stabilizing agent.

III. OBJECTIVE OF STUDY

The main aim of our research is to:

A. Increases shear strength,
B. Reduces permeability, &
C. Reduces compressibility.

IV. MATERIALS USED

A. Soil

The soil used in this study were collected from Kanpur. The general properties of soil were studied in laboratory. The soil was tested for moisture content, dry density, sieve analysis, direct shear test.

The gradation curve shown in figure, shows the values of D_{10}, D_{30} and D_{60}. By it we can know that the soil is poorly graded sand.

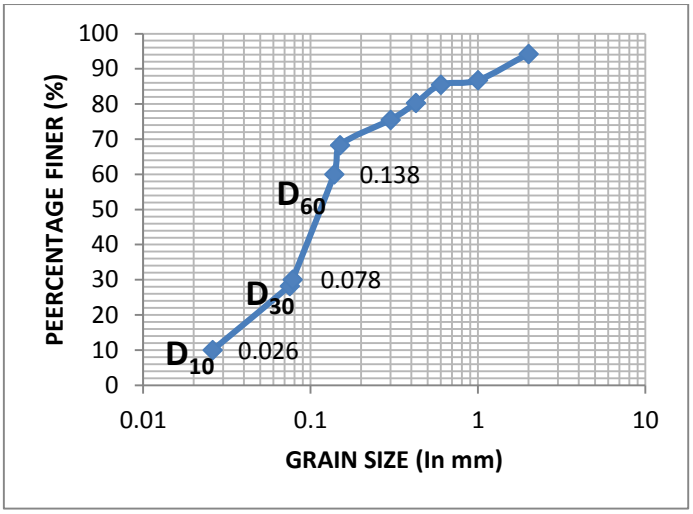

Fig. 1. Grain size analysis

The moisture content of sample is found to be 17.5 % and the dry density of sample is found to be approximately 1600 kg/m^3.

B. Egg Shell Powder

It is a waste material obtained from domestic source. It contains 98.62% carbon which will help to increase the strength of the soil. Egg shell waste was washed and dried before grinding. It was sieved using 75µ and powder passing sieve was used.

C. Quarry Dust

It is a by-product of crushing process through which rock has been crushed into different sizes and dust generated is called quarry dust and is formed as a waste. It is a useless material and also results in air pollution. It has high shear strength ehich is beneficial for our study.

V. RESULT AND DISCUSSION

From the experiments conducted with ESP, 23% was obtained as optimum percentage of ESP. Then experiments were conducted with optimum percentage of ESP and varying percentage of QD and the following results were shown as following:

Table 1: Influence of ESP on Direct Shear Test

ESP (%)	COHESION (c) (kg/cm^2)	ANGLE OF INTERNAL FRICTION (Φ)	SHEAR STRENGTH (kg/cm^2)
0	0.144	14.7	0.108
5	0.139	16.1	0.113
10	0.135	19.3	0.120
15	0.131	22.5	0.131
20	0.122	25.2	0.138
23	0.110	28.1	0.153

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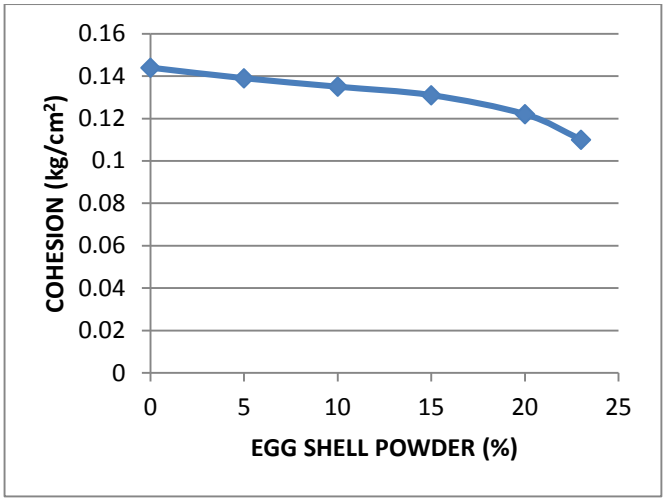

Fig. 2. Variation of Cohesion With Varying % of ESP

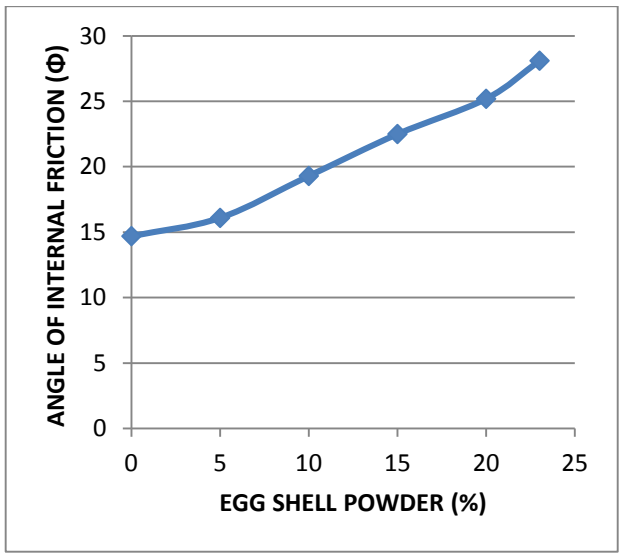

Fig. 3. Variation of Angle of Internal Friction With Varying % of ESP

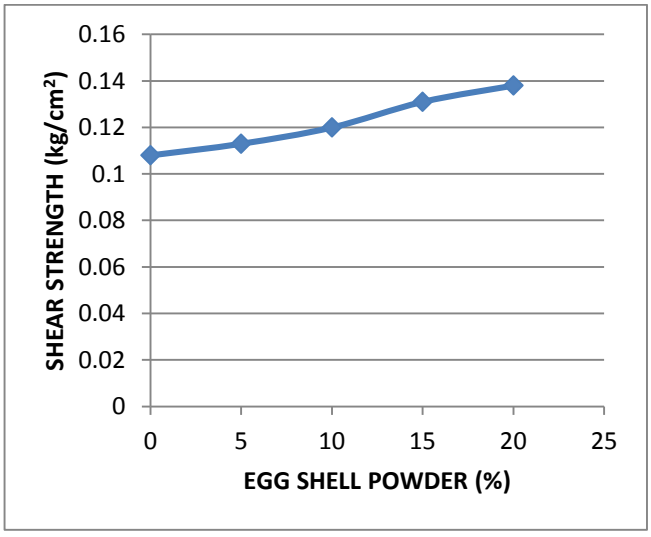

Fig. 4. Variation of Shear Strength With Varying % ESP

Table 2: Influence of ESP and QD on Direct Shear Test

QD (%) WITH OPTIMUM ESP (%)	COHESION (c) (kg/cm²)	ANGLE OF INTERNAL FRICTION (Φ)	SHEAR STRENGTH (kg/cm²)
23 % ESP + 10 % QD	0.107	31.7	0.181
23 % ESP + 15 % QD	0.101	35.2	0.188
23 % ESP + 20 % QD	0.099	38.6	0.197
23 % ESP + 24 % QD	0.096	42.3	0..218

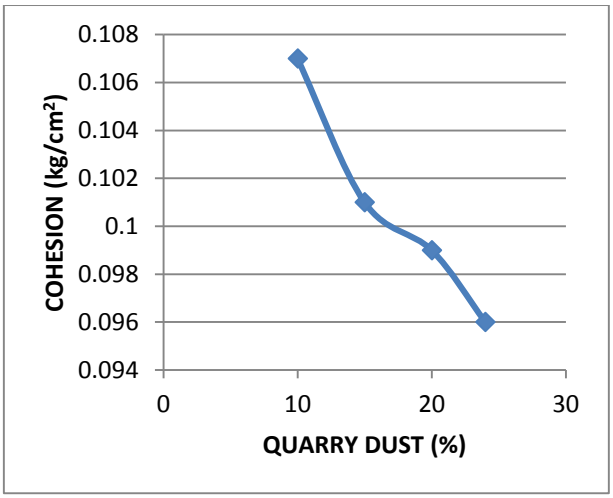

Fig. 5. Variation of Cohesion With Varying % of QD With Optimum Percentage of ESP

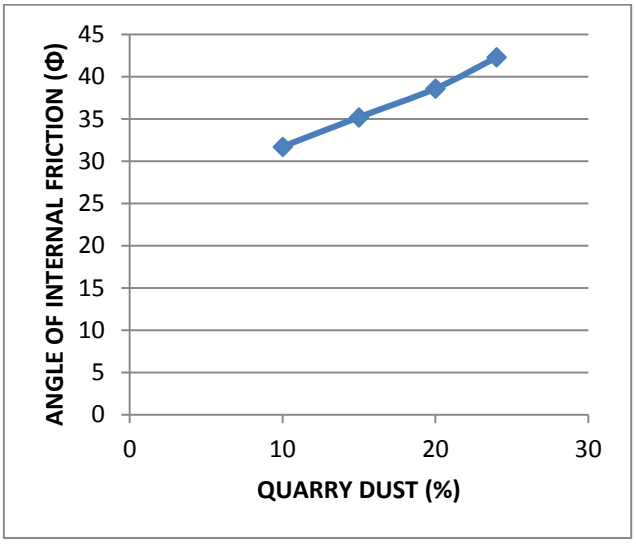

Fig. 6. Variation of Angle of Internal Friction With Varying % of QD With Optimum Percentage of ESP

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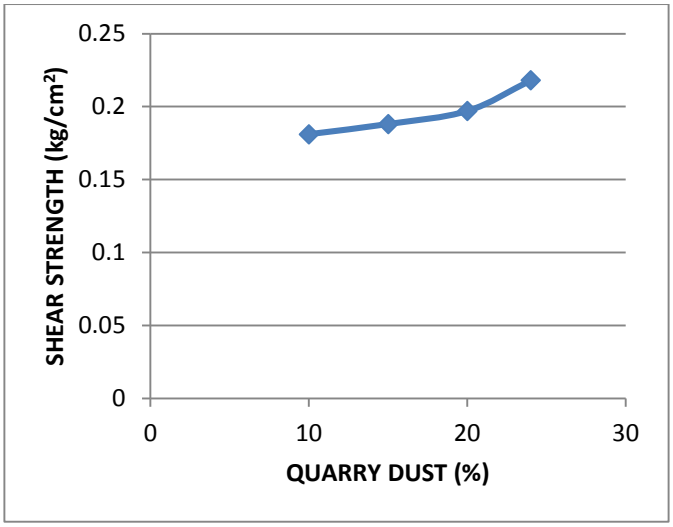

Fig. 7. Variation of Shear Strength With Varying % QD With Optimum Percentage of ESP

VI. CONCLUSION

The following conclusions were made from this experimental study:

- The optimum percentage of ESP for stabilization is found to 23%.
- The optimum percentage of QD for stabilization is found to 24% with keeping the percentage of 23% of ESP.
- Egg shell powder and quarry dust utilization will decrease the waste generation.

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