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Investigation Of Strength Properties Of Black Cotton Soil Stabilised With Fly Ash And Geo Reinforcement

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ABSTRACT

An experimental program was undertaken to study the effects of polyester fiber inclusions and lime stabilization on the geotechnical characteristics of fly ash-soil mixtures. An Indian fly ash was mixed with expansive soil in different proportions. The geotechnical characteristics of fly ash-soil specimens, lime-soil specimens and lime-fly ash-soil specimens mixed with different proportions of randomly oriented fibers were investigated. Lime and fly ash were added to an expansive soil at ranges of 1–10% and 1–20%, respectively. Test specimens were subjected to compaction tests, unconfined compression tests and split tensile strength tests. Specimens were cured for 7, 14, and 28 days after which they were tested for unconfined compression tests.

INTRODUCTION

Soil stabilization is defined as the modification of native soil or aggregate in an effort to improve its engineering properties. While stabilization techniques have been used to modify soil for thousands of years, modern stabilization utilizing laboratory experimentation began around 1930. Since then, a variety of stabilizers have been investigated, including lime, portland cement, fly ash, blast furnace slag, lime-fly ash, bituminous products in various forms, road tar, calcium chloride and other salts, and several non-traditional additives. As the popularity of each group of stabilizers has increased through time, various organizations have been created to promote particular stabilizers and to establish procedures for their use. These organizations have also created stabilizer-specific conditioning methods to predict performance in the adverse conditions unique to cold regions. Soil stabilization is a technique for improvement of weak soils. The engineering properties of soil can be improved by soil stabilization. Stabilization, in a broad sense, incorporates the various methods employed for modifying the properties of a soil to improve its engineering performance. Stabilization is being used for a variety of engineering, the most common application being in the construction of road and air-field pavements, where the main objective is to increase the strength or stability of soil and to reduce the construction cost by making best use of the locally available materials.

BENEFITS OF SOIL STABILIZATION INCLUDES

- Very substantial increases in resilient modulus values (by a factor of 10 or more in many cases)
- Very substantial improvements in shear strength (by a factor of 20 or more in some cases)
- Continued strength gain with time, even after periods of environmental or load damage (autogenous healing)
- Long-term durability over decades of service even under severe environmental conditions

MATERIALS AND EXPERIMENTAL RESULTS

The soil used in testing was black cotton soil. Physical and engineering properties of black cotton soil used for testing are given in Table 1. The fly ash was collected from the thermal power station at tuticorin in India. Table 2 presents the physical and engineering properties of the flyash. Table 3 presents the Physical and Engineering properties of hydrated lime. Table 4 presents the Physical and Engineering properties of Properties of Fibers Used. Fig. 1 and 2 shows the maximum dry density and Optimum moisture content respectively. Fig. 3 and 4 shows the unconfined compressive strength of lime & fly ash mixed soil and fibre mixed soil respectively.

Table 1 Physical and Engineering properties of block cotton soil

Property	Value
Specific gravity	2.72
Liquid limit	68
Plastic limit	49.65
Optimum moisture content (%)	29.4
Maximum dry density (g / cm^3)	1.32

Table 2 Physical and Engineering properties of fly ash

Property	Value
Specific gravity	2.14
Liquid limit	43
Plastic limit	Nonplastic
Optimum moisture content (%)	34
Maximum dry density (g / cm^3)	1.1

Table 3 Physical and Engineering properties of Hydrated lime

Property	Value
Specific gravity	2.05
Normal consistency	43.50
Initial setting time (min)	165
Final setting time (hr)	46.25
Fineness percentage	2.65
Soundness Lechatlier's expansion (mm)	1.8
Compressive strength 14 days (N/mm^2)	1.45
Compressive strength 28 days (N/mm^2)	2.18

Table 4 Physical and Engineering properties of Properties of Fibers Used

Property	Value
Type	polyester synthetic
Cut length (mm)	3, 6, 12 plain, and 6 crimped
Cross section	triangular
Size of cross section (mm)	30-40
Tensile elongation (%)	greater than 100
Specific gravity	1.34 -1.40
Tensile strength (N / mm^2)	400-600
Color	White

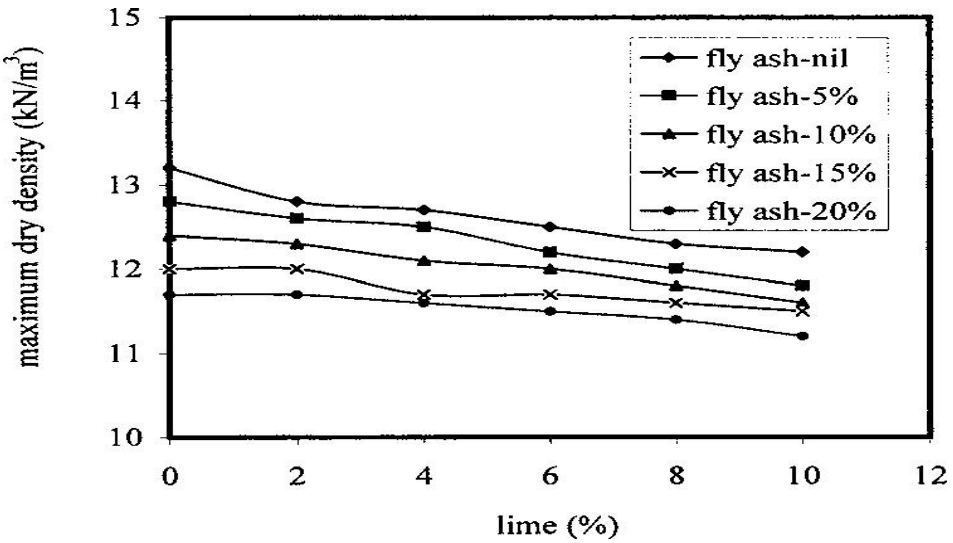

Fig. 1 Maximum dry density

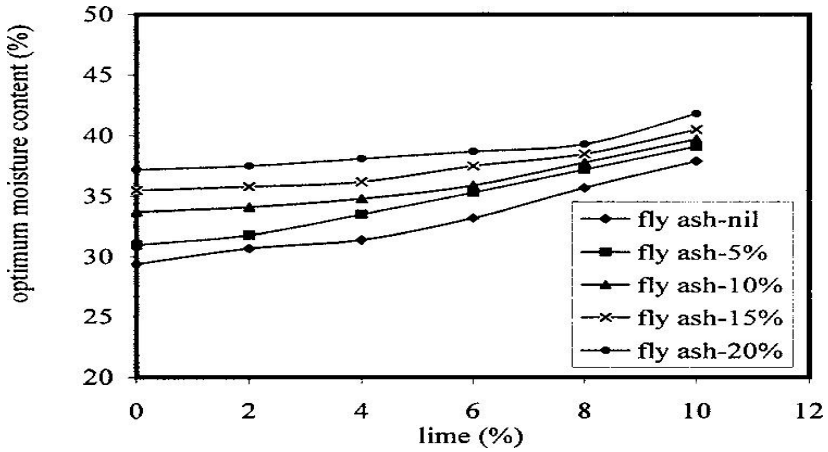

Fig. 2 Optimum moisture content

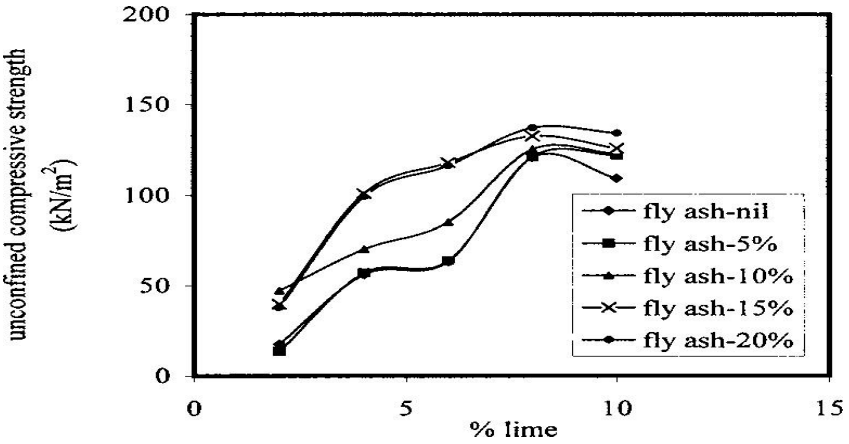

Fig. 3 Unconfined compressive strength (Flyash + Lime)

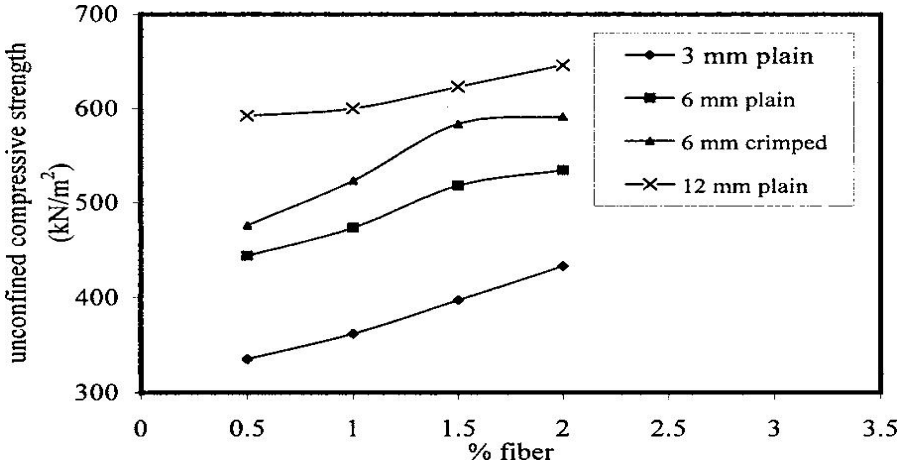

Fig. 3 Unconfined compressive strength (Fibre)

CONCLUSION

On the basis of the present study, the following conclusions are made,

1. With the increase in lime content, the maximum dry density of soil-lime mixes decreases and optimum moisture content increases. The fall in density is more significant at lower percentages of lime. When fly ash is added to soil-lime mix-ture, maximum dry density decreases further and optimum moisture content increases. The results of compaction tests showed that limited quantity of polyester fibers 0.5–2.0% had no significant effect on maximum dry density and optimum moisture content of fly ash-soil-lime-fiber mixtures.
2. Time of curing does not produce much increase in strength up to 4% of lime content.
3. Fly ash is beneficial in combination with lime in improving properties of soil. With the increase in the percentage of fly ash keeping amount of lime as constant, strength tends to increase and reaches a certain maximum value and thereafter it starts decreasing, but is always higher than that of the respective soil-lime mixture.
4. The optimum value of lime content and fly ash content in fly ash-soil-lime mixtures may be taken as 8 and 15%, respectively.
5. The addition of 1.5% of 6 mm plain fibers or 1.0% of 6 mm crimped fibers to fly ash-soil-lime-fiber mixtures at 8% lime content and 15% fly ash content increases unconfined com- pressive strength and split tensile strength by about 74 and 100% respectively, as compared to that of same mixture without fibers. Also, with the addition of 1.5% of 6 mm crimped fibers or 1% of 12 mm plain fibers, the gain in un- confined compressive strength and split tensile strength is about 100 and 135%, respectively, in comparison to that of the same mixture without fibers.
6. The ratio of split tensile strength and unconfined compres- sive strength increases with increase in fiber content, which shows that polyester fibers are more efficient when soil was subjected to tension rather than to compression.

REFERENCES

1. Al-Refeai, T. O. 1991 . “Behaviour of granular soils reinforced with discrete randomly oriented inclusions.” Geotext. Geomembr., 10, 319–333.
2. Cabrera, J. G., and Woolley, G. R. 1994 . “Fly ash utilization in civil engineering.” Environmental aspects of construction with waste materials, studies in environmental science, Vol. 60, Elsevier Science,Amsterdam, The Netherlands, 345–356.
3. Kumar, A., Walia, B. S., and Mohan, J. 2005 . “Compressive strength of fiber

reinforced highly compressible clay." Constr. Build. Mater.

4. Lawton, E. C., Khire, M. V., and Fox, N. S. 1993 . "Reinforcement of soils by multioriented geosynthetic inclusions." J. Geotech. Engrg., 119 2 , 258–273.
5. Maher, M. H., and Gray, D. H. 1990 . "Static response of sands reinforced with randomly distributed fibers." J. Geotech. Engrg., 116 11 ,1661–1677.
6. Maher, M. H., and Ho, Y. C. 1994 . "Mechanical properties of kaolinite fiber soil composite." J. Geotech. Engrg., 120 8 , 1381–1393.
7. Michalowski, R. L., and Zaho, A. 1996 . "Failure of fiber-reinforced granular soils." J. Geotech. Engrg., 122 3 , 226–234.
8. Ranjan, G., Singh, B., and Charan, H. D. 1999 . "Experimental study of soft clay reinforced with sand-fiber core." Indian Geotechnical J., 29 4 , 281–291.
9. Ranjan, G., Vasan, R. M., and Charan, H. D. 1996 . "Pobabilistic analysis of randomly distributed fiber reinforced soil." J. Geotech. Engrg.,122 6 , 419–426.