Impact Factor (SJIF): 4.542

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 4, Issue 4, April-2017

Evaluation of Modification in Expansive soil using AR Glass Fibre with Fly Ash under CBR and UCS Characteristics

Dr. Pratima A. Patel[1], Margi Dave[2], Tanay Balar[3]

[1,2,3] Department of Civil Engineering, Sarvajanik College of Engineering and Technology

Abstract* — Soil stability becomes a major factor of concern, especially when the soil is of expansive nature. Many methods have been developed to improve properties of soil by various additives. In this paper, an attempt has been made to utilize an environmental pollutant such as fly ash along with glass fibre. A series of CBR and UCS tests were conducted to evaluate the combined effect of fly ash and glass fibre on expansive soil of South Gujarat region. The tests were carried out with various proportion of Fly ash (0%, 5%, 10%, 15% and 20%) with Glass fibre (0% 0.25% and 0.50% by weight of dry soil). The purpose of this study work is to analyze the soil modification achieved from the given combination.

***Keywords* – AR Glass Fibre, Fly Ash, CBR, UCS, Soil Modification**

I. INTRODUCTION

As development in construction technology grows, the methods dealing with it also get updated. Soil is an integral part of Civil Engineering creations. Sometimes soil stability becomes a bothering issue when the soil is expansive. Expansive soil due to its swelling nature causes a lot of damages and severe failure to the structures which are constructed over them. Engineers are seeking effective methods to make expansive soil more stable. The concept of soil reinforcement is not new. In ancient time also, the people had used natural tensile constituents to reinforce the soil for construction of long lasting structure. Here the experiment was carried out using fly ash and randomly oriented Alkali Resistant (AR) glass fibres.

Himadri Baruah [1] studied the effects of glass fibres on the properties of Red Loam soil, Vikas Rameshrao Kulkarni et.al [2] attempted utilization of blast furnace slag and glass fibres as stabilizing agents in black cotton soil, Shivanand Mali et.al [3] carried out direct shear tests to find out the shear strength of fine sand reinforced with glass fibres, J.Lovisa et.al [4] evaluated shear strength of sand reinforced with 0.25% randomly distributed moist glass fibre, Kumar Pal & Ghosh [5] studied Volume change behaviour of fly ash–montmorillonite clay mixtures, Dr. Robert M. Brooks [6] researched Soil stabilization with fly ash and Rice Husk ash, Funsheng Zha et.al [7] analyzed the behaviour of expansive soils stabilized with fly ash, S.Bhuvaneshwari et.al [8] found out the change in properties of expansive soil by adding different content of fly ash.

II. TEST MATERIALS

The test materials used for the experimental work with their source and properties are as follows.

2.1. Soil Sample

The untreated soil sample was collected from Katargam zone of Surat city, Gujarat, India (below 2 to 3 m from ground level) for the experiment. Tests were carried out to determine the various properties of untreated soil. The results are tabulated in table 1 and table 2 given below.

Table 1 Properties of untreated soil

Grain size distribution			Atterberg Limits			Differential Free Swell Index (%)	Specific Gravity (G)	pH Value
Gravel (%)	Sand (%)	Silt + Clay (%)	Liquid Limit (W_L) (%)	Plastic Limit (W_P) (%)	Plasticity Index (I_P) (%)			
0.00	5.39	94.61	30.95	12.45	18.5	25	2.506	7.3

Table 2 Properties of untreated soil (Compaction, CBR, UCS)

Compaction Characteristics		California Bearing Ratio Value (%)		Unconfined Compressive Strength (kg/cm^2)
MDD (g/cc)	OMC (%)	2.5 mm penetration	5.0 mm penetration	
1.76	19.8	6.02	7.54	2.66

2.2. **Fly Ash**

Fly ash was obtained from Ultratech Cement Ltd., Magdalla road, Surat, Gujarat, India

2.3 **AR Glass Fibre**

The AR glass fibres were obtained from 'Hindustan Mortar', Near Pasodara Patiya, Surat Road, Kamrej, Dist- Surat.

The mechanical and chemical properties of AR glass fibre are tabulated in table 3 and table 4 given below.

Table 3. Mechanical properties of AR glass fibre

Property	**AR-glass**
Specific Gravity	2.70-2.74
Tensile Strength, MPa	1700
Modulus of Elasticity, GPa	72
Strain at Break,%	2.0
Effect of Temperature	Non-Combustible, Softening Point 860°C

Table 4. Chemical properties of AR glass fibre

Component	**Percentage by weight**
SiO_2	61-62
Na_2O	14.8-15
CaO	-
MgO	-
K_2O	0-2
Al_2O_3	0-0.8
Fe_2O_3	-
B_2O_3	-
ZrO_2	16.7-20
TiO_2	0-0.1
Li_2O	0-1

III. EXPERIMENTAL WORK

For this experimental investigation following mix proportions and method of mixing were adopted.

3.1. Mix Proportion

Soil with 5%, 10%, 15%, 20% Fly ash and 0.25% Glass Fibre (by weight of dry soil)
Soil with 5%, 10%, 15%, 20% Fly ash and 0.50% Glass Fibre (by weight of dry soil)

3.2 Method of mixing

The glass fibers were distributed randomly in the soil mass. The mixing was done manually until the soil and the reinforcement form a fairly homogeneous mixture.

3.3 Tests conducted

To study the combined effect of fly ash and glass fibres on soil, following tests were performed by adding these additives at different percentages with soil.

1. California Bearing Ratio Test (CBR Test)
2. Unconfined Compression Test (UCS Test)

IV. RESULTS

Table 5. Soil treated with fly ash (5%, 10%, 15% and 20%) and 12 mm glass fibre (0.25%)

Mix Proportion	CBR (%) at		UCS (kg/cm^2)
	2.5 mm penetration	5 mm penetration	
Soil + Fly ash (5%) + Glass Fibre (0.25%)	10	11.2	2.11
Soil + Fly ash (10%) + Glass Fibre (0.25%)	12.1	12.7	2.36
Soil + Fly ash (15%) + Glass Fibre (0.25%)	23.9	24.1	2.94
Soil + Fly ash (20%) + Glass Fibre (0.25%)	22.0	21.1	2.63

Table 6. Soil treated with fly ash (5%, 10%, 15% and 20%) and 12 mm glass fibre (0.50%)

Mix Proportion	CBR (%) at		UCS (kg/cm^2)
	2.5 mm penetration	5 mm penetration	
Soil + Fly ash (5%) + Glass Fibre (0.50%)	17.3	16.8	3.51
Soil + Fly ash (10%) + Glass Fibre (0.50%)	20.7	19.6	4.62
Soil + Fly ash (15%) + Glass Fibre (0.50%)	16.4	16.8	4.77
Soil + Fly ash (20%) + Glass Fibre (0.50%)	16.7	16.4	3.65

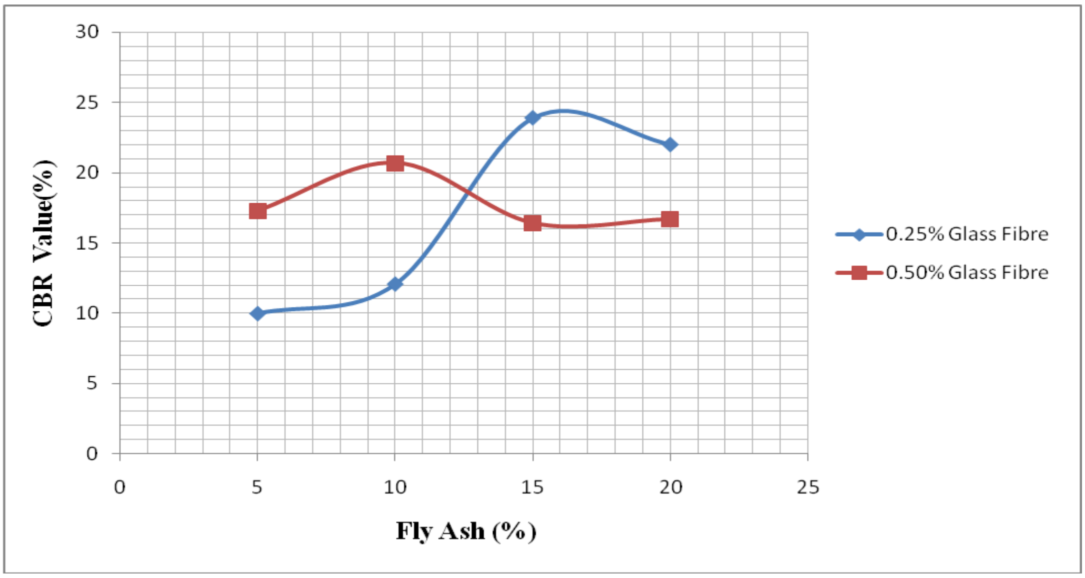

Figure 1 Variation of CBR value (at 2.5 mm penetration) with fly ash at different glass fibre content

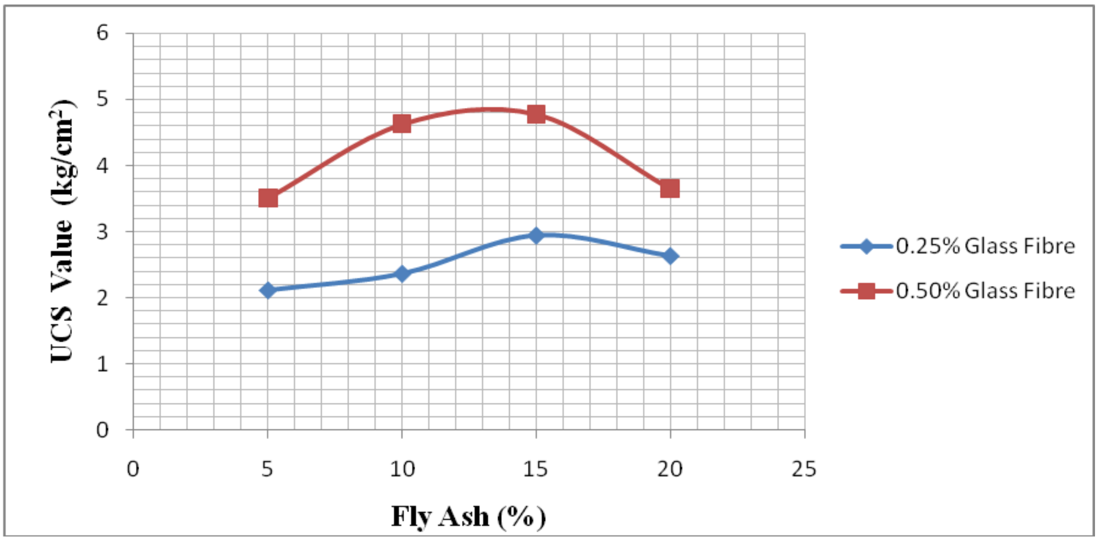

Figure 2 Variation of UCS value with fly ash at different glass fibre content

V. CONCLUSION

1. The CBR value is found to be maximum in case of addition of 15% fly ash and 0.25% glass fibre.
2. The UCS value is found to be maximum in case of addition of 15% fly ash and 0.50% glass fibre.

Acknowledge to the owner of Unique Engineering Testing Laboratory and his technical staff. Also express thanks to non teaching staff of Civil Engineering Department. Sincere thanks to our Guide Dr. Pratima A. Patel – Head of the department for preparation of this work.

REFERENCES

[1] Himadri Baruah, "Effects of Glass Fibers on Red Soil", International Conference on Technologies for Sustainability – Engineering, Information Technology, Management and the environment, pp: 508-514, 2015

[2] Vikas Rameshrao Kulkarni et.al, "Expermental Study of Stabilization of Black Cotton Soil by Using Slag and Glass Fibers", Journal of Civil Engineering and Environmental Technology,Volume 1, pp. 107-112, 2014

[3] Shivanand Mali et.al, “A study on shear strength of sand reinforced with glass fibres”, International Journal of Scientific & Engineering Research Volume 4, Issue 5, pp: 285-288, 2013

[4] J. Lovisa et.al , Shear strength of randomly distributed moist fiber-reinforcement sand, Geosynthetics International, Volume 17, Issue 2, pp. 100-106, 2010

[5] Kumar Pal & Ghosh, “ Volume Change Behaviour of Fly Ash-Montmorillonite Clay Mixtures”, Journal of Geomechanics, pp. 59-68, 2014

[6] Dr. Robert M. Brooks , SOIL STABILIZATION WITH FLYASH AND RICE HUSK ASH, International Journal of Reaseach and review in Applied Sciences ,Volume 1, Issue 3, pp:209-217, 2009

[7] Funsheng Zha et.al , Behaviour of expansive soils stabilized with fly ash, Nat Hazards, pp. 509-523, 2008

[8] S. Bhuvaneshwari et.al, STABILIZATION OF EXPANSIVE SOILS USING FLYASH, Fly ash Utilization Programme (FAUP), TIFAC, DST New Delhi, 2005