International Journal of Civil Engineering, Construction and Estate Management

Vol.7, No.3, pp.12-21, July 2019

Published by European Centre for Research Training and Development UK (www.eajournals.org)

EXPERIMENTAL ANALYSIS ON SOFT CLAY BY USING GEO-FOAM BEADS AND CEMENT POWDER

MD.Zunaud Siddiki Mamoon[1] Arghya Uthpal Mondal[2]

Lecturer, Civil Engineering, Rangpur Engineering Institute,Bangladesh[1]

Researcher, College of Civil and Transportation Engineering, Hohai University,China[2]

ABSTRACT: *Non-drainage shear quality, Cu generally characterizes soft clay. Estimates of Cu values of less than 12.5 kPa are related to soft clay, but soft clay has solid shear quality moving somewhere in the range from 12.5 kPa to 25 kPa. Although the soft sheer quality is low, they encounter high compressibility after stacking. This is the reason why soft clay is considered dangerous for the formation. Also, geo-forms are modern materials and are taken in low weight units (usually 20 kg / m 3) compared to dirt. When thickness reaches 1.0% to 2.5% of soil EPS, compressive strength will range from 70 kPa to 140 kPa and modulus of elasticity will be in the range of 5 MPa to 12 MPa, as shown by Horvath (2010). Geo-form square EPS is used for various geotechnical applications as lightweight fillers. Therefore, the primary objective of this test is to investigate the characteristics of geological techniques from soft clay containing geo-form beads and step cement dust. Likewise, we explore the possibility of planning a mixture of low-quality drill contents. To concentrate the soft clay effects on the liquid state and the compaction properties of the new filling, the test work was carried out in two mixed sets (A & B). Specific proportions are added to the mixture to investigate the effect on flow consistency, dry unit weight, unlimited compression quality, and sheer quality. The effect after testing directed to the material shows that the cement side step residues and excess sand castings can be used effectively to develop a flow filling material strategy that can be compressed on its own and can be stamped by it. The quality of compression from the non-geo-foam test mixture is in the range of 271.8 kPa to 1405.14 kPa in the CBPD, somewhere in the range of 3.99% to 17.98%. The attached file honors Geo-foam which collects a place in the range of 50 kPa to 20 kPa somewhere in the range of 0.32% to 1.35% in Geo-foam. The scrubbing point with geo-foam spreads is in the range of 0.36% to 1.40% somewhere in the range of 10 to 22 kPa in the CBPD.*

KEYWORDS: Geo-foam Beads; Bypass Cement Dust; Flowable Fill; Shear Strength

INTRODUCTION

EPS Geo-foam blocks are used in a wide range of geotechnical applications as a light weight fill. The primary function of Geofoam is to provide a lightweight void fill below a highway, bridge approach, embankment or parking lot [1]. EPS Geo-foam minimizes settlement on underground utilities. Geo-foam is also used in much broader applications, the major ones being as lightweight fill, green roof fill, compressible inclusions, thermal insulation, and (when appropriately formed) drainage. Expanded polystyrene (EPS) Geo-foam has been used as a geotechnical material since the 1960s. EPS Geo-foam is approximately 1% the weight of soil and less than 10% the weight of other lightweight fill alternatives. As lightweight fill, EPS Geo-foam reduces the loads imposed on adjacent and underlying soils and structures [3]. EPS Geo-

ISSN 2055-6578(Print), ISSN 2055-6586(online)

foam is not a general soil fill replacement material but is intended to solve engineering challenges. The use of EPS typically translates into benefits to construction schedules and lowers the overall cost of construction because it is easy to handle during construction, often without the need for special equipment, and is unaffected by occurring weather conditions [3-5]. EPS Geo-foam can be used to replace compressible soils or in place of heavy fill materials to prevent unacceptable loading on underlying soils and adjacent structures. The high compressive resistance of EPS Geo-foam makes it able to adequately support traffic loadings associated with secondary and interstate highways [5,6]. Also, using EPS Geo-foam eliminates the need for compaction and fill testing, reduces the construction time and minimizes impact to the existing roadway and adjacent structures and/or buried utilities [6-10].

Experimental Program

Material characteristics The soft clay was dried in the oven at 110 C. It is passing through sieve size of 0.25mm. Soft clay characteristics are listed in table 1.

Table 1: Properties of tested soft clay soil.

Soft clay properties	Value
Average liquid limit, %	48
Average plastic limit, %	26
Plasticity index, %	22
Soft clay type (A-line chart)	CI

Figure 1:Mixing the samples.

Mixture proportions

The experimental work was divided into two groups, each with the same size of 600cm3. Group A was divided into five subsamples without the use of Geo-foam and mixed with increasing percentages of CBPD (50g) for each sample and different percentages of water. In addition, the B group was divided into five sub-samples and mixed with increasing percentages of Geo-foam (5g) for each sample as well as different percentages of water with of water with stable weight of CBPD as shown in the following Tables 2-5.

Table 2

Group	Mix	Soft clay (gm)	CBPD (gm)	Geo-foam (gm)	Water (gm)
A	A1	1000	50	0	240
	A2	1000	100	0	250
	A3	1000	150	0	250
	A4	1000	200	0	260
	A5	1000	300	0	310

Table 3

Group	Mix	Soft Clay, %	CBPD (%)	Geo-foam (%)	water (%)
A	A1	77.52	3.88	0	18.6
	A2	74.07	7.41	0	18.52
	A3	71.43	10.71	0	17.86
	A4	68.49	13.7	0	17.81
	A5	62.11	18.63	0	19.25

Table 4

Group	Mix	Soft Clay (gm)	CBPD (gm)	Geo-foam (gm)	Water (gm)
B	B1	1000	200	5	340
	B2	1000	200	10	320
	B3	1000	200	15	400
	B4	1000	200	20	450
	B5	1000	200	25	640

Table 5.Grouping of tested mix samples.

ISSN 2055-6578(Print), ISSN 2055-6586(online)

Group	Mix	Soft Clay, %	CBPD (%)	Geo-foam (%)	water (%)
B	B1	64.72	12.94	0.32	22.01
	B2	65.36	13.07	0.65	20.92
	B3	61.92	12.38	0.93	24.77
	B4	59.88	11.98	1.2	26.95
	B5	53.62	10.72	1.34	34.32

Experimental Work and Results

Samples were mixed for groups A-B for different percentages of water as shown in Figure 1b. The consistency flow of the samples was measured for each sample. It is found that the flow consistency increased slightly for group B than for group

A. So, the flow consistency was measured in laboratory as listed in (Tables 6-7) for the two groups. Although the percentage of water present in the B samples, the effect of the presence of Geo foam beads than bypass cement dust on soil was clear as shown in Figure 2.

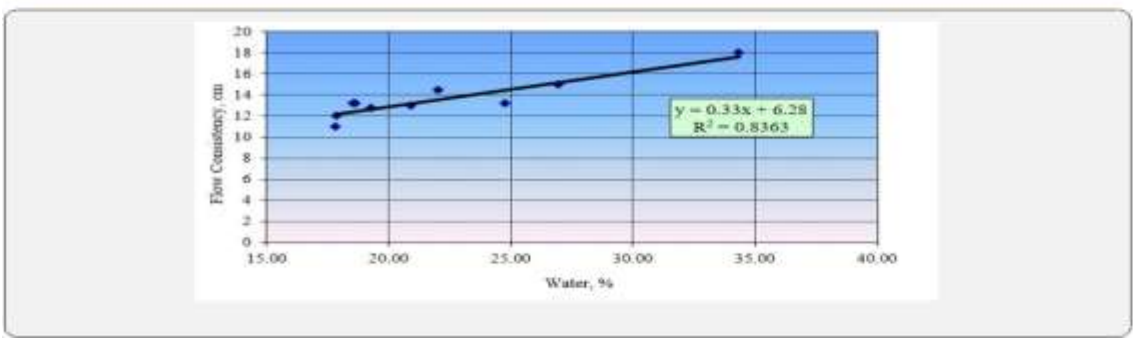

Figure 2:Flow consistency for group (B)

Table 6: Measurements of flow consistency (Group A)

Group	Mix	Water (gm)	Flow Consistency, cm
A	A1	240	13.25
	A2	250	13.25
	A3	250	12
	A4	260	11
	A5	310	12.75

ISSN 2055-6578(Print), ISSN 2055-6586(online)

Table 7: Measurements of flow consistency (Group B)

Group	Mix	Water (gm)	Flow Consistency, cm
B	B1	340	14.5
	B2	320	13
	B3	400	13.25
	B4	450	15
	B5	640	18

Unconfined compressive strength

Figure 3: Typical shear failure of mixtures.

The studied mixtures for each group were molded and hardened. Unconfined compressive strength was obtained by the Triaxial test for the studied mixtures as shown in Figures 3. It was found that with the increase of cement bypass dust, the unconfined compressive strength increased significantly and especially for the samples (A4 - A5) compared to a slight increase in the values of the strain% as shown in Figure 4. Also, compressive strength values are also stabilized with increasing mixing rates in cement bypass dust from approximately 14 to18% as shown in Figure 5. This shows the significant effect of cement bypass dust on compressive strength of studied samples.

ISSN 2055-6578(Print), ISSN 2055-6586(online)

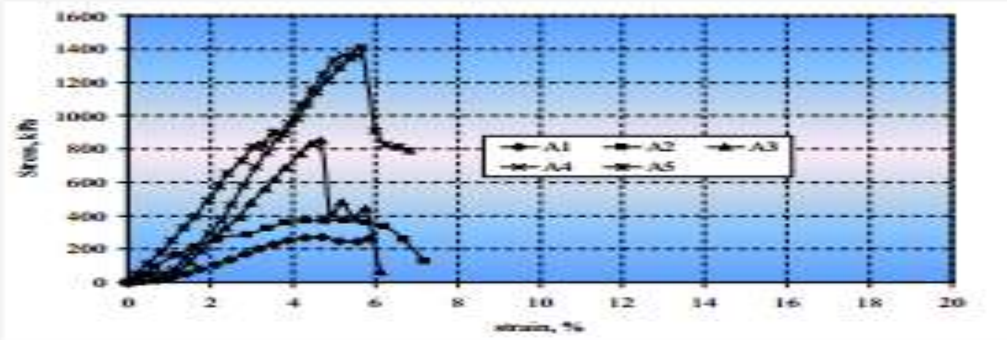

Figure 4: Typical stress-strain curve for group (A) samples.

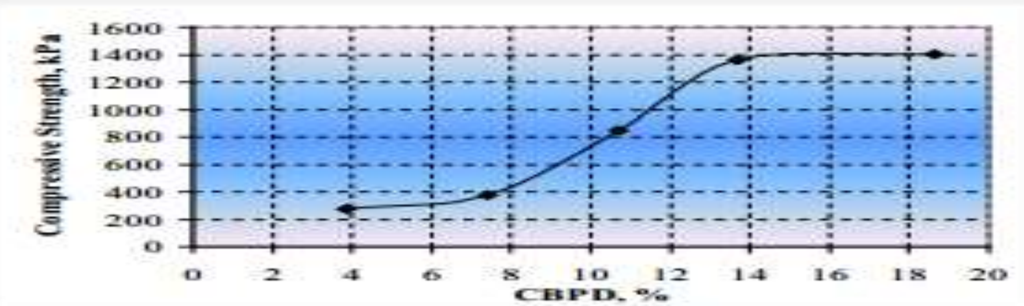

Figure 5: Effect of cement bypass dust on compressive strength.

Shear strength

Shear box test was carried out on the studied samples. The samples were loaded with increasing stresses (50-100-150kPa). and the shear stresses were calculated versus horizontal displacement (mm). We took samples (A4-B4) for examples as shown in Figures 6 -7. Shear strength parameters were obtained from direct shear test and it is concluded that CBPD affected in the cohesion of the group A samples as shown in Figure 8. On the contrary, angle of internal friction was increased significantly when increasing the ratio of Geo-foam beads for group B samples as shown in Figure 9 [10-16].

ISSN 2055-6578(Print), ISSN 2055-6586(online)

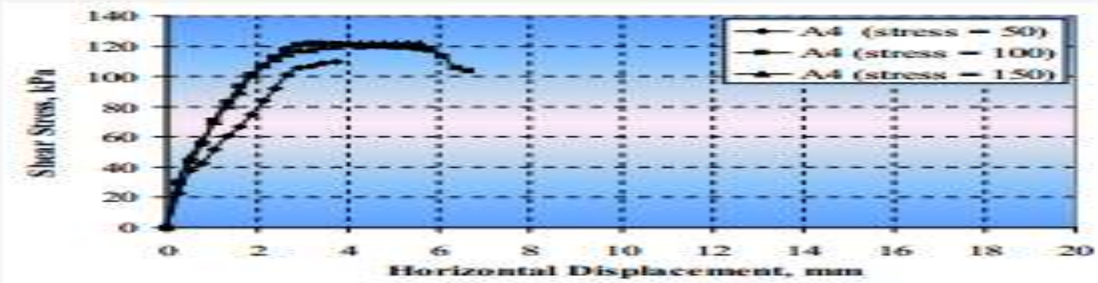

Figure 6: Shear strength versus horizontal displacement for (A4).

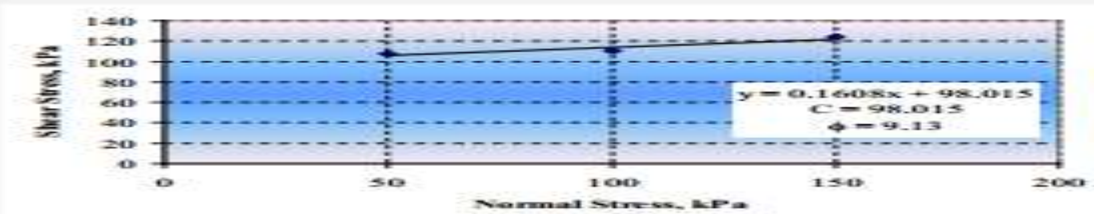

Figure 7:Shear strength parameters for sample (A4).

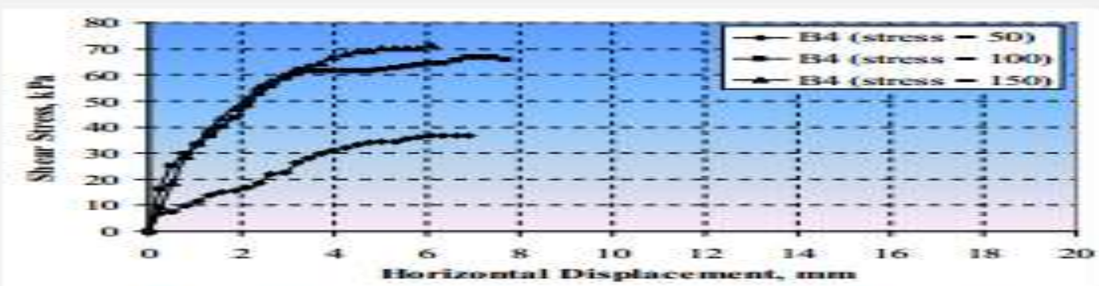

Figure 8: Shear strength versus horizontal displacement for (B4).

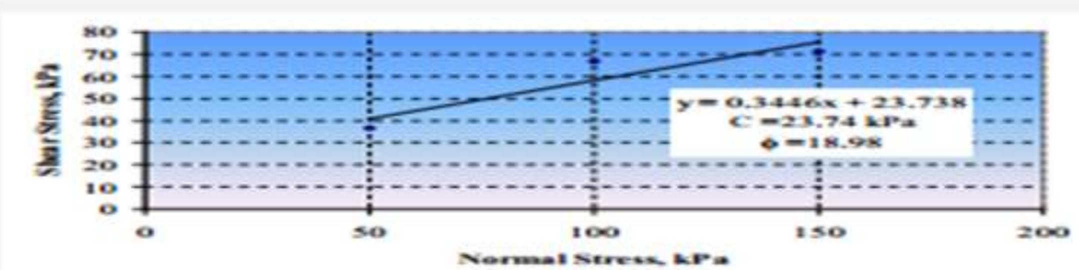

Figure 9: Shear strength parameters for sample (B4).

ISSN 2055-6578(Print), ISSN 2055-6586(online)

CONCLUSION

This paper presented an experimental study of various samples of soft clay mixed with different percentages of Geo foam beads and cement bypass dust. The following conclusions may be drawn:

A. The results of test conducted on the materials illustrated that, cement bypass dust and excess foundry sand

can be successfully used to procedure self-compaction, self-leveling excavatable flowable fill material.

B. The dry unit weight of the studied mixtures for group without Geo-foam ranged between 1.40 and 1.6 gm/cm3 at CBPD between 3.88% and 18.63%.

C. The dry unit weight of the studied mixtures for group with Geo-foam ranged between 0.65 and 1.20 gm/cm3 at Geo-foam between 0.32% and 1.35%.

D. The unconfined compressive strength of the studied mixtures without Geo-foam ranged between 271.8kPa and 1405.14kPa at CBPD between 3.88% and 18.63%.

E. The unconfined compressive strength of the studied mixtures with Geo-foam ranged between 230kPa and 120kPa at Geo-foam between 0.32% and 1.35%.

F. The Cohesion values for group without Geo-foam with ranged between 62kPa and 105kPa at CBPD between 3.88% and 18.63%.

G. The Cohesion values for group with Geo-foam with ranged between 50kPa and 20kPa at Geo-foam between 0.32% and 1.35%.

H. The friction angle of group without Geo-foam with anged between 30 and 11 at CBPD between 3.88% and 18.63%.

I. The friction angle of group with Geo-foam with ranged between 10 and 22 at CBPD between 0.32% and 1.35%.

References

1. Baiyan ZA, Fartani MN, Sabban NA (1995) Soil Modification by Cement Kiln Dust. Journal of Materials in Civil Engineering 7: 218-222.
2. ACI Comittee 229 (1999) Controlled Low-Strength Materials (CLSM). Report 229 R, American Concrete Institute, Farmington Hills, Mich,USA.
3. Bagdadee, A.H"Power Quality Analysis by the Ripple Technique" Published http://dx.doi.org/10.21839/jaar.2017.v2i4.74http://www.phoenixpub.org/journals/index.php/jaar

ISSN 2055-6578(Print), ISSN 2055-6586(online)

ISSN 2519-9412 / © 2017 Phoenix Research Publisher Journal of Applied and Advanced Research 2017, 2(4): 227–234

4. Bagdadee A.H, "Imitation intellect Techniques Implement for Improving Power Quality in Supply Network Published in IEEE International conference on Signal Processing, Communication, Power and Embedded System (SCOPES)-2016

5. A.H Bagdadee "To reduce impact of the variation of power from renewable energy by using super capacitor in Smart grid" Published by World Scientific and Engineering Academy and Society in WSEAS TRANSACTIONS on POWER SYSTEMS Vol.11 2016,USA.

6. A.HBagdadee, 'Rural Electrification Through Micro-grid in Bangladesh' (Paper ID: UCU77-J1) published by Oxford Academic Studies Press (OASP) in Engineering Sciences and Technology Journal (ESTJ). Vol. 10 Issue 5. ISSN: 1465-2382, 2015.UK

7. Amam Hossain Bagdadee , Md. Bayezid Islam "TO IMPROVE POWER FAILURE ANDPROTECT SUSTAINABILITY OF THE ENVIRONMENT IN BANGLADESH BY THERENEWABLE ENERGY" Published by European Centre for Research Training andDevelopment UK in International Journal of Energy and Environmental Research Vol.3, No.1, pp.29-42, ISSN: 2055-0200,March 2015.UK

8. A.HBagdadee ,Nazib Sobhan "Developing model of control stratagem with variable speed drive by synchronous speed in micro-Hydro plant" Published in International Journal of Power and Renewable Energy Systems (IJPRES)Vol.2,2015PP.88-100 ISSN 2374-376X.USA

9. Amam Hossain Bagdadee," ASSESSMENT OF PV OPERATION IN BANGLADESH Published by European Centre for Research Training andDevelopment UK in International Journal of Energy and Environmental Research Vol.2, No.1, ISSN: 2055-0200,March 2014.UK

10. Bagdadee.H "Status and Reform towards Development Energy Sector of Bangladesh"Published in European Journal of Advances in Engineering and Technology, Vol. 2(2): 24-28 ISSN: 2394 - 658X,2015.India

11. A.HossainBagdadee,Abu Salman ShaikatPROPERTY OF ANCILLARY SERVICE MARKETS ON FREQUENCY CONTROL PERFORMANCE OF POWER SYSTEMSPublished by European Centre for Research Training and Development UK inInternational Journal of Engineering and Advance Technology Studies Vol.2, No.3, ISSN: 2053-5791,2014.UK

12. A.H Bagdadee, Sheikh Aminur Rahaman ASSESSMENT OF CLIMATE CHANGE WITH ENERGY EXPANSION FOR DEVELOPING COUNTRIES Published by European Centre for Research Training and Development UK, in International Journal of Energy and Environmental Research Vol.3, No.2 ISSN 2055-0200,UK

13. A. HBagdadee,Rural Electrification with Renewable Energy Based Village Grids in Bangladesh .Published inInternational Journal of Scientific & Engineering Research, Volume 5, Issue 10, 1080ISSN 2229-5518,2014,India

14. Bagdadee,'Using A Battery Storage Wind / PV Hybrid Power Supply System Based Stand-Alone PSO To Determine The Most Appropriate "Published in American Journal of Engineering Research (AJER)e-ISSN : 2320-0847 p-ISSN : 2320-0936Volume-03, Issue-08,2014,USA

15. AmamBagdadee, "POWER SYSTEM ANALYSIS OF LOAD FLOWIN RADIAL DISTRIBUTION NETWORK" Published in International Journal of Scientific & Engineering Research, Volume 5, Issue 10, 1080ISSN 2229-5518,2014.India

16. Bagdadee A.H, "Soft Power Factor Modification Using Static VAR Compensator on Dynamic Load" Published in International Journal of Novel Research in Electrical and Mechanical Engineering Vol. 1, Issue 1, ISSN:2394-9678,2014,India