International Journal of Research in Engineering, Science and Management
Volume-2, Issue-6, June-2019
www.ijresm.com | ISSN (Online): 2581-5792

Fiber Reinforced Clay Liner

Princy Mathew
Student, Department of Civil Engineering, Cochin College of Engineering and Technology, Valanchery, India

***Abstract*: Permeability is one of the most important properties of sand-bentonite mixture which is used as a liner material at the waste disposal site, and needs to be understood for settlement analysis. When bentonite comes in contact with water, its swells and exhibits a lower value of hydrolic conductivity. However due to desiccation of bentonite, it shrinks and the hydraulic conductivity increases significantly. This is the general problem of compacted clay. Now a days a geo-synthetic clay liner (GCL) with equivalent performance may be used in place of a compacted clay liner. Furthermore, synthetic fiber generally used to reduce the shrinkage of clays. However, no studies have been carried out on fiber reinforced sand-bentonite mixture with geo-synthetic clay liner (GCL) inclusion. In order to check the influence of GCL and glass fiber on these parameters, such as swelling potential, swelling pressure, compression index, hydraulic conductivity, co-efficient of consolidation and unconfined compressive strength of the mixture. Bentonite-sand mixtures, mixed with fiber. Test result shows that hydraulic conductivity is reduced significantly with interaction of GCL then slightly increased with addition of glass fiber. It has also observed that compression index and swelling pressure reduced with addition of glass fiber. Swelling pressure was more for GCL inclusion. Compression index (cc) is found to be increased for GCL inclusion. Co-efficient of consolidation (cv) is found to be increased with the increased in consolidating pressure, indicating the mixtures gets consolidated at a higher rate under a higher overburden pressure. Unconfined compression strength decreased with addition of GCL due to effect of structural integrity of continuous soil column or predetermined failure plain has to be created automatically by inclusion of GCL. This behavior is confirmed that all the failure observed where GCL placed. Furthermore, UCS enhanced with inclusion of nylon fiber. Therefore, SB40+GCL+ 1% fiber composite is optimum combination which have to be used for landfill liners.**

***Keywords*: Geo-synthetic clay liner, nylon fiber, Sand-clay mix**

1. Introduction

The important of landfill throughout world increases and need of engineered waste dumps is necessary. But nowadays landfills become a serious environment pollution factor by the emission of toxic gases to atmosphere and migration of leachate produced from the decomposition of waste dumps. Landfills are lined on the bottom and sides with natural and synthetic barrier to contain and collect liquids (leachate) and prevent waste to escape to the environment. Compacted clays soils have traditionally been used as liners of hydraulic conductivity, typically in the range of 10-6-10-7 cm/s. Clayey soil liners are suitable when temperature and moisture fluctuations are minimal, however; when temperature and moisture fluctuations are high, they form cracks . Even though geomembranes have been point out as the best alternative for liners, they are out of reach of most underdeveloped countries for their high price and the need for trained personnel for installation. Then, for most underdeveloped countries there is a need for a landfill liner that is natural, locally available, and that can be installed in an inexpensive way, and in compliance with the environmental regulations. Because of low permeability and high adsorption capacity, bentonite can be used with clay as landfill liner material. This combination provides a natural, easily available efficient and economical alternative to all landfill liners and it can be adopted by all developing countries like India. Bentonite can increase the plasticity index of clayey soil. When liquid interact with clay minerals, the properties which are increased and hydraulic conductivity tend to decrease. The hydraulic conductivity of liner material is less than or equal to 1x10-7 cm/sec. The low conductivity will be gained adequate strength and minimum shrinkage. In present study, suitability of clay and Bentonite as landfill barrier is tested. To, limit the sweeling of clay and bentonite, it was added with 0.25% waste flex fibers of aspect ratio 6. The characteristics of this combination is determined with different percentages of bentonites to clay.

2. Objective

In this Atterberg's limit test, compaction test, Hydrometer analysis, variable head permeability test is conducted. The liquid limit was found using Casagrande's method because of the higher silt Content of the mixes. Plastic limit was found out by making threads of 3mm diameter that begin to crack. Compaction is an important parameter controlling the hydraulic properties of the soil liner materials. Soils compacted at water contents dry of optimum tend to have a relatively high hydraulic conductivity, whereas soils compacted at a water content wet of optimum tend to have a lower hydraulic conductivity. Compaction tests were carried out to access the optimum moisture content and maximum dry density of all the mixes by standard proctor test. Permeability is a measure of the ease in which water can flow through a soil volume. To conduct test first compact the soil into the mould at a given dry density and moisture content by a suitable device or find the moisture content by oven drying method.

3. Methodology

As per the standards prescribed by Environmental Protection Agency the material for compacted clay liners should necessarily satisfy the following norms for the co-efficient of

permeability/hydraulic conductivity, plasticity index, minimum fines content, and maximum gravel content. Obviously, only clayey soils will satisfy the above conditions. As per the current practice, kaolinite, quicklime, fly ash enhanced by natural clay is the most popular liner material. In the present study the feasibility of landfill liners using natural clay with addition of kaolinite, quicklime, fly ash has-been studied. This chapter deals with the different materials used in the study and the methods of different experiments done to assess the suitability of different mixes.

Select suitable site for designing clay liner. four types of materials are used, such as kaolinite, quicklime, fly ash and natural clay. Then create clay liner with geomembrane and it is used for safety and avoid leakage. The various methods used to characterize some important geotechnical properties of natural clay and kaolinite, quicklime and fly ash. Natural clay and kaolinite, quicklime, fly ash and natural clay mixes were allowed to hydrate for at least 24 hours prior to all the tests. The tests conducted for checking the properties of clay are Atterberg's limit test, compaction test, hydrometer analysis and variable head permeability test.

4. Conclusion

Tests were carried out to study the effect of polypropylene fiber on the geotechnical behaviour of various sand-bentonite mixtures amended with a layer of GCL. Fibers of 10 mm length in the proportion of 0.5% and 1% were added to the samples. The data shows that the swelling pressure and the swelling potential of the mixtures increased due to the addition of a layer of GCL to the mixtures. However, with the inclusion of the fiber the swelling pressure and swelling potential decreased significantly. The results of the hydraulic conductivity test showed that with the inclusion of the GCL, the hydraulic conductivity of the mixtures decreased significantly. However, when the mixture with layer of GCL was reinforced with fiber, the hydraulic conductivity increased. The hydraulic conductivity value was increased with an increase in the fiber content in the mixture and its effect was more pronounced for the mixture with a higher amount of bentonite content. The compression index of the mixtures with GCL was decreased marginally due to the inclusion of fiber. Coefficient of volume change (mv) of soil decreased with inclusion of glass fibres in mixture. Settlement was restricted by inclusion of fiber. t90 decreased with application of fiber. cv increased with the increase in the consolidating pressure. However, there was significant increase in the unconfined compressive strength of the mixture due the addition of fiber

References

[1] Aqeel, A. 2016. Investigation of expansive soils in Obhor Sabkha, Jeddah-Saudi Arabia. Arabian Journal of Geosciences 9, 314, 1–14.
[2] Wyoming Office of Homeland Security, 2016. Wyoming State Mitigation Plan 2016 – 2021. Wyoming Office of Homeland Security, Cheyenne, WY, 324p. http://wyohomelandsecurity.state.wy.us/mitigationplanning/Final_Wyoming-StateMitigation-plan_012516.pdf
[3] Seco, A., Ramirez, F., Miqueleiz, L., Garcia, B. 2011. Stabilization of expansive soils for use in construction. Applied Clay Science 51, 3, 348–352.
[4] Perez-Rea, M., Ayala-Ibarra, T., Castano, V.M. 2015. Prediction of final settlements of buildings constructed on expansive soils. International Journal of Engineering and Technology 4, 3, 424–431.
[5] Nagaraj, H., Munnas, M., Sridharan, A. 2010. Swelling behavior of expansive soils. International Journal of Geotechnical Engineering 4, 1, 99–110.
[6] Zumrawi, M.M.E. 2000. Performance and design of expansive soils as road subgrade. PhD Thesis, Chang'an University, Xi'an.
[7] Shi, B., Chen, S., Han, H., Zheng, C. 2014. Expansive soil crack depth under cumulative damage. The Scientific World Journal, Article ID 498437, 9p.
[8] Elkady, T.Y. 2016. The effect of curing conditions on the unconfined compression strength of lime-treated expansive soils. Road Materials and Pavement Design 17, 1, 52–69.
[9] Komonweeraket, K., Cetin, B., Aydilek, A., Benson, C., Edil, T. 2015. Geochemical analysis of leached elements from fly ash stabilized soils. Journal of Geotechnical and Geoenvironmental Engineering, 141, 2015.
[10] Akinwumi, I.I. 2014. Soil modification by the application of steel slag. Periodica Polytechnica Civil Engineering 58, 4, 371–377.
[11] Anggraini, V., Huat, B.B.K., Asadi, A., Nahazanan, H. 2015. Relationship between the compressive and tensile strengths of lime-treated clay containing coconut fibres. Acta Geotechnica Slovenica 12, 1, 49–57.
[12] Akinwumi, I.I., Booth, C.A. 2015. Experimental insights of using waste marble fines to modify Detail (Regular, 9), 2015.