

Effect of Date Palm Fiber on the Engineering Properties of Expansive Jamshoro Shale

Prih Laila¹, Dr Aneel Kumar¹, Dr. Rizwan Ali Memon¹

¹Department of Civil Engineering, Mehran-UET, Jamshoro, Sindh, Pakistan

Abstract: Construction of structures on soft soil is troublesome because of their weak nature and having so many problems just like High volumetric change, low compressibility as well as low strength. This type of soil must be upgrade with better material before its use for the construction of various projects such as construction of roads, buildings, dams, airports etc. Soil reinforcement is an effective technique to enhance the engineering properties of various geotechnical works. In present time, there are so many materials for the reinforcement that are found to be an effective source of improving the geotechnical properties of soil Geofibers are one of them. The geonatural fibers are consider as an attractive reinforcement material as compare to geosynthetic fibers due to its multiple applications and cost efficiency. Hence, the feasible health effect can be minimizing by using geonatural fibers. The fibers can be obtained from so many waste products and the utilization of waste can assist to resolve the issue of waste disposal otherwise so much amount of landfills can be generating from these wastes. In this research, the date palm fiber which is naturally available material in most of Asian countries is used to enrich the engineering properties of Shale. To evaluate the effect of fiber on the properties of shale, the date palm fiber is mixed in soil with different percentages 1%, 2%, 4%, 6%, 8% & 10% by weight of air dry shale to check the effect of fiber on the shear strength parameters, moisture density relationship, consolidation parameters. Thus it can be said that the Date Palm fiber showed superior results to enhance the properties of shale.

Keywords: Date Palm fiber; Geo fibers; Consolidation Parameters; Geo reinforcement.

I. INTRODUCTION

In the most specified and common sense, the main issue during construction is “GROUND” (i.e. soil or rock) performing differently than anticipated. Soil is very complicated material. It is not just a combination of particles of fine minerals but also contains water, air, organic matters and many types of living organism. Due to the capacity of dealing with forces, soil possess its own scientific importance. As we know that soil is very aged construction and engineering material. It plays very important role in the foundation of the structure as it is the construction material in every geotechnical/civil engineering projects. Soil and various other materials are good in compression but poor in tension. In Present construction practice in agriculture, civil, environment, mining and other engineering projects, there are several materials are found to enhance the properties of soil (Stiffness, strength, compressibility, permeability etc.). Thus a soil embedded with tension resisting materials can improve the overall performance of weak soils therefore reinforcement of soil is considered as constructive and well-grounded technique such as strength, stability in several applications, containing foundations, retaining walls, pavements, slopes, embankments. [1]. Expansive soils either fine grained or decomposed rocks shows large volume change due to the moisture content. When it is subjected to the environmental & seasonal variation the Shrinkage & swelling behavior takes place near ground surface [2][3]. Construction of civil engineering projects as well as residential buildings on expansive soil is considered to be very unsafe because this type of soils affected by cycles of wetting & drying, including swelling & shrinkage behavior below foundation of building, as results cracking to non-structural as well as structural members of those structures. The cost of structural damage due to swelling and shrinkage in UK considered to be £400 million, in USA \$15 billion and millions of dollars worldwide [4]. Soil reinforcement with fibers has been a topic of discussion and research for a long period of time. Such constructions in which soil reinforced with natural or synthetic fiber is known to have existed in the fourth & fifth millennium B.C. [5] This concept helps to enhance the properties of soil just as their strength and bearing capacity. This idea was first given by Henry Vidal [6] in which he said that the shear resistance of the medium increases by the introduction of reinforcing elements in soil mass. Now a day this technique of soil reinforcement is proved to be very attractive & effective method due to its easily availability and cost effectiveness. [7]

Reinforcing elements such as, membranes, strips, rods and sheets are typical traditional soil improvement methods but the use of naturally available materials such as, coir, jute, bamboo, sisal and papyrus as reinforcement material in soil is currently very popular and these are widely used in so many Asian countries such as, Pakistan, India, Iraq, Saudi Arab etc. [8] However, very limited knowledge has been reported on reinforcement of soil with randomly distributed date palm fibers. The main aim of using natural material is that they are economical and cheaply available materials they do not generate any type of disposal issue in the environment. The rural economy can be effectively increased by the use of natural material. Similarly, the date palm fiber has so many advantages and can be used effectively for erosion control, enhancing the overall performance of embankment, increase the bearing capacity of soil etc. When the fibers mixed with soil it shows the improvement in strength & stiffness such type of improvements in soil properties plays important role in deformation requirements and short term stability [9].

II. MATERIALS & METHODS

A. Soil

The soil used in this study is “Shale” collected from Mehran University of Engineering & Technology Jamshoro. Shale and other soils derived from them are considered as very problematic materials because of their ability to absorb and release huge quantity of water. When these type of soils become saturated they swell and shrink when dry out. Buildings, roads, and other type of structures constructed on these soils can be harmed and weakened by the motion and the forces of volume change. The most common cause of damage in foundation is due to the Expansive soils.

Soil Properties	Values
L.L	55.1
P.L	34.9
P.I	20.2
Specific Gravity	2.60
Opt. moisture content	15.25
Dry density	1.78
Soil group	A-7-6

B. Date Palm Leaf Fiber

The date palm tree, which forming several stems from single root, is member of palm tree family (phoenix dactylifera) is naturally available in Middle East, Canary Islands, North Africa, California(USA), Pakistan and India. There are above 100 million palm trees present in the world and each tree can grow for more than 100 years [10]. Date palm leaves are used for making several products such as baskets, fans, screens, mats, walking sticks, brooms etc. Also popular for making huts.

III. EXPERIMENTAL PROGRAM

In this research dried and crushed date palm fiber have been used with the size of 1mm to achieve randomly distributed soil sample. The soil and fiber were mixed well until distributed adequately. fiber with different percentages (1%, 2%,4%, 6%,8%,10%) were added with the unreinforced Jamshoro shale, in order to evaluate the effect of each percentage on soil properties.

A. Compaction Test

The modified proctor test was performed in order to evaluate the maximum dry density and optimum moisture content of natural soil as well as soil reinforced with date palm fiber.

B. Direct Shear Test

The series of direct shear tests were conducted with the help of shear box. In order to evaluate the effective angle of shear strength (ϕ) and cohesion (c) for reinforced as well as unreinforced soil samples compacted at their maximum dry densities and optimum moistures contents.

C. Consolidation Test

To assess the effect of Date Palm fiber on the compressibility and swelling characteristics, consolidation and swell tests were conducted with standard consolidation apparatus. The tests were conducted on fiber reinforced moist specimens compacted to attain the maximum dry density.

IV. RESULTS

The effect of different percentages of date palm fiber on dry unit wt. of soil is shown in figure1. The reduction in average unit wt. of soil solids shown in figure2.

When each fiber content increases, the dry density decreases. It is because of decrease the average unit weight of solids in mixture of soil and fiber. On the other side OMC increases with increment in fiber contents due to increment in voids of soil skeleton when % of fiber increases [11].

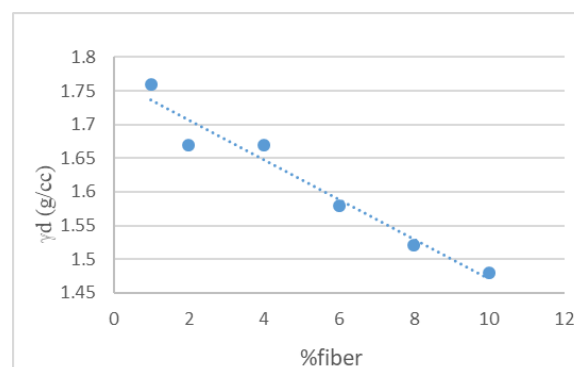


Fig. 1: The relation between dry unit wt. with increasing fiber content of the soil samples

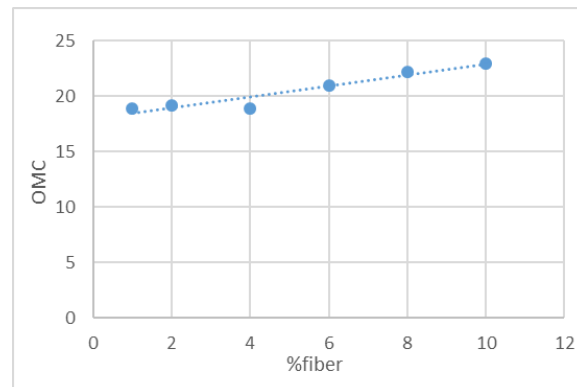


Fig. 2: The relationship between OMC with increasing fiber content

V. CONCLUSION

This study presents experimental outcome of the strength and stiffness response to the soil reinforced with randomly distributed date palm fiber. As per discussion and results, some conclusion can be drawn. Based on laboratory experiments carried out to study the impact of randomly distributed date palm fiber as reinforcement material on the strength of natural soil, it decreases the dry density of soil because of low specific gravity and unit wt. of date palm fiber. Due to the increment in percentage of fiber, the shear stress as well as cohesion of soil improved. Furthermore, Stiffness of soil, enhance significantly because of fiber inclusion. Hence, the instant settlement of soil can be decreased by including fibers in the soil.

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