USE OF NATURAL FIBERS FOR THE REINFORCEMENT OF SOIL MASS THROUGH ARTIFICIAL REPLICATION

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Abstract
Use of shredded palm leaf for improving soil property is advantageous. Because palm leaves are cheap, easily available, eco-friendly and biodegradable. This paper investigates the stabilizing effect of shredded palm leaf on soil properties and to investigate the property and behaviour of shredded palm leaf in sandy-silty soil reinforcement. Previously work has been done for improvement of sandy-silty soil using palm fibre and investigation of resultant strength and ductility behaviour of randomly distributed palm fibre in the use of silty-sandy soil has been carried out. Here we investigate the property and behaviour of shredded palm leaf in sandy-silty soil reinforcement. Various research have been done for stabilization of soil using different materials like rice husk, fly ash, coconut coir fibres, multiwall carbon nanaotubes e.t.c. Palm leaf is cheaper than above materials and easily available in any region of India and Indian subcontinent. The Indian palm trees are generally of “Borassus flabelliform” species. The palm leaves were shredded to different sizes keeping L/D ratio 2.5 and 3 and are mixed with soil by various percentage of dry weight of soil. The tests we conduct are compaction test, California Bearing Ratio Test (CBR) and unconfined compressive strength test with and without mixing of shredded palm leaf with soil.

Keywords:-California Bearing Ratio, Unconfined Compressive strength test, Compaction test, Shredded palm leaf, Sandy-silty soil.

I. INTRODUCTION
The increasing growth of urban and metropolitan areas over the world demands construction in low lands and coastal regions, in many cases geologically characterized by poor geotechnical properties (low strength and high compressibility). This is a major issue for many transportation and geotechnical applications. To overcome these difficulties, it is usual to adopt ground improve techniques, being soil stabilization one of the techniques that have been used with success in practice. Soil stabilization is referred to as a procedure in which a special soil is proportioned /added/removed, or a cementing material, or other chemical material is added to a natural soil material to improve one or more of its property. The stabilizing material s include cement, lime, bitumen/asphalt, polymers, and other chemical materials. The requirement of stabilization is adequate
strength. In case of cohesion-less soil the adequate strength can be achieved by providing confinement or by adding soil with a cementing/binding agent. In case of cohesive soil, the strength can be achieved by drying, making the soil moisture resistant, and increasing cohesion with a cementing agent, and adding frictional properties.

II. BACKGROUND

There have been many research papers published on fibres reinforced soil. Al khanbashi et al.[1] added polymers to increase the unconfined compression strength and decrease the permeability of desert sand. Kaniraj and Havanagi (2014) found that cement-fly ash fibre reinforcement results in increase in the shear strength. Consoli et al. [15] adopted stabilization of desert sands using cement and cement dust. Al-Aghbari et al.(145) adopted reinforcement of uniformly fine sandy soil using polyethylene terephthalate fibre obtained from waste plastic bottles) and cement to improve the soil property. They found that use of fibre reinforcement enhanced the ultimate strength of cemented and uncemented soil. Maher and Ho (1994) stated that rise in strength and toughness of kaloinite fibre composite is a function of length of fibre, fibre content and water content. Dhariwal and Ashok (2003) performed studies on California Bearing Ratio values of fly ash mixed with jute fibre and non-woven geo fibres. Maher and grey (20) and Al-Rafeai (1) stated that strength of reinforced sand rises with rise in ratio, fibre content and soil fibre surface friction. In this paper we are going to investigate the behavior of sandy soil mixed with shredded palm leaf of different size (l/d ratio of 2.5 and 3).

III. METHODOLOGY

Materials used

a. Soil Characteristics

The soil used in this investigation was taken from coast of brahmani river of angul city India. Characteristics of soil given in the following Table 1

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand zone</td>
<td>III</td>
</tr>
<tr>
<td>Sand content</td>
<td>82.6%</td>
</tr>
<tr>
<td>Silt content</td>
<td>12.8%</td>
</tr>
<tr>
<td>Clay content</td>
<td>4.6%</td>
</tr>
<tr>
<td>Maximum dry density</td>
<td>17.70 Kn/m³</td>
</tr>
<tr>
<td>Optimum moisture content</td>
<td>10.35%</td>
</tr>
<tr>
<td>Specific gravity</td>
<td>2.59%</td>
</tr>
<tr>
<td>Plasticity</td>
<td>Np</td>
</tr>
</tbody>
</table>

Shredded palm leaf
In India generally palm trees are belong to “Borassus flabellifer” species. Palm leaves were collected from coastal area of odisha. Then the leaves were dried under the atmospheric temperature. After drying, the leaves were shredded to desirable size. Figure 1 shows the picture of shredded palm leaves.

Fig. 1: Picture of Shredded palm leaf

Preparation of sample
To study the effect of palm leaf on sandy soils, the leaves were cut into different sizes having L/D ratio 2.5 and 3 and were mixed with soil in varying proportions.

The test conducted were
(i) Compaction test
(ii) California bearing ratio test
(a) Soaked
(b) Un soaked
(iii) Unconfined compression test

IV. COMPACTION TEST

The compaction tests were performed in accordance with ASTM D 1557. The compaction curves of sandy soil with and without inclusion of shredded palm leaves were obtained. The percentages of palm leaves added to the soil were 0.35% and 0.45% of dry unit weight of soil. The maximum dry density and optimum moisture content of sandy soil with or without inclusion of shredded palm leaves were obtained from compaction curve. The results show that with increase in inclusion palm leaf content the optimum moisture content increases and maximum dry density decreases. The decrease in maximum dry density may be due to less specific gravity of palm leaves comparing to the soil grains. The rise in optimum moisture content may be due to high water absorption capacity of the palm leaves. The results of the compaction tests shown in the figures.

Maximum dry density and optimum moisture content of the soil. California bearing ratio tests were done to examine the influence of shredded palm leaf on the soil medium. Tests were carried out on specimens with inclusion of palm leaf of 1.25%, 1.75% and 2%. The samples were compacted as per the ASTM D 1557 standards. The samples were compacted in five layers with optimum moisture content of 10.35%. The CBR tests were carried out in both soaked and un soaked condition. The results of CBR tests are shown in the following figures.

V. CBR TEST

The CBR tests were performed in accordance with ASTM D 1883. The tests were performed at

![Fig. 3: Un-reinforced and reinforced Un-soaked CBR](image)

![Fig. 4: Un-reinforced and reinforced soaked CBR](image)
Unconfined compression tests were carried out on a cylindrical specimen at maximum dry density and optimum moisture content. The UCS tests were performed according to ASTM D 2166. Here we added fly ash to the sandy soil. Fly ash we added was 40% of dry weight of sandy soil. Then the UCS tests were carried out with and without mixing of palm leaf in fly ash-sandy soil. The results of the UCS tests shown in the following figures.

The inclusion of shredded palm leaf had a significant influence on the engineering behaviour of sandy soil. The following are the major conclusion of engineering behavior of palm leaf reinforced sandy soil.

1. The moisture content and the dry density relationship of the soil greatly affected due to addition of shredded palm leaf. The maximum dry density decreases and optimum moisture content increases.
2. With increase in L/D ratio of shredded palm leaf and palm leaf inclusion, the ductility increased.
3. The CBR value of the soil slightly increased in both unsoaked and soaked condition with increase in content of shredded palm leaf and L/D ratio.
4. The results suggested that the use of shredded palm leaf reinforcement proved to beneficial to change the properties of sandy soil.
5. The use of shredded palm leaf in fly ash mixed sandy soil, increases the ductility characteristics of the sandy soil.

VII. Conclusion
From the above discussion, it is found that the use of the shredded palm leaves will solve many problems of transportation engineers as well as geotechnical engineer in near future.

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References