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# Soil Stabilization Using Banana Fibre and Disposable Face Masks

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***Abstract*: Soil has been used as a construction material from time immortal. Being poor in mechanical properties, it has become challenges to civil engineers to improve its properties depending upon the requirement which varies from site to site. Soil stabilization is a technique to refine and improve the engineering properties of soils such as mechanical strength, permeability, compressibility, durability and plasticity. In this paper focus is made on the improvement of engineering properties of soil by using banana fiber in addition of disposable face masks. Banana fiber is treated with surgical face masks to enhance the engineering properties in case of pavement and earthen slopes. The aim of the present investigation is to determine the banana fibre-mask combination in the process of soil stabilization. In this project mechanical extraction method is used. Different tests performed in this study are Specific Gravity, Liquid limit, Plastic limit, Shrinkage Limit, Standard Proctor Compaction Test, direct Shear Test and Unconfined Compression Test. The optimum value of banana fibre is taken as 10% and the various percentages of masks is added with fibre such as 0.5%, 1% and 1.5% and their tests results were compared and discussed.**

***Keywords*: Soil, Stabilization, Banana fibre, Face mask, Corona.**

## 1. Introduction

Soil is the most vital source for construction in every aspect. Not all soil is suitable for the purpose of construction as it is available in nature. Some soils like black cotton soil are not suitable in its natural form. Being poor in mechanical properties, it has been putting challenges to civil engineers to improve its properties depending upon the requirement which varies from site to site. Black cotton soil swells in the presence of water and shrinks during dry climate. In such cases, to fill in the voids and stabilize the soil, soil stabilizers are used. Soil stabilizer is any material that is used to modify the physical and chemical properties of the soil for better construction. Banana fiber is a naturally occurring material and easily available. During the current corona situation, the number of disposable masks being used is increasing to keep ourselves safe from the virus. On the other hand, these disposable face masks are a huge threat and the waste masks are getting accumulated. In this project banana fiber is used as a soil stabilizer and disposable surgical face mask is used as an additive. The banana fiber and disposable masks when mixed with soil, binds the soil particles together by interlocking mechanisms as one unit. In this present study the percentage of banana fiber is kept as optimum and different percentages of surgical disposable face mask are added to soil and tested.

## 2. Objectives

- To Study the properties of soil
- To improve the characteristics of soil by adding stabilizers.
- To increase the shear strength by decreasing the compressibility of the soil.
- To use banana fibre as a stabilizer and disposable face masks as an additive
- To study the soil properties after the addition of stabilizers.

## 3. Materials Used

### *A. Soil*

- Black cotton soil is a highly clayey soil.
- The black colour in Black cotton soil (BC soil) is due to the presence of titanium oxide in small concentration.
- Black Cotton soil is expansive soil which expands when it contacts with water. This is the major reason of failure of black cotton soil strata. Therefore, it is called "ABSTRACT EXPANSIVE SOIL."
- The black cotton soil is characterized by high shrinkage and swelling properties.
- Due to high swelling and shrinkage characteristics, the black cotton soil has been a big issue to highway and other civil engineering specializations.
- Therefore, there is a need to stabilize black cotton soil.

### *B. Banana Fibre*

- Banana fiber is a natural fiber with high strength, which can be blended easily.
- Banana fiber is a lignocellulosic fiber, obtained from the pseudo-stem of banana plant with relatively good mechanical properties.
- Natural fibers possess several advantages over synthetic fibers such as low density, appropriate stiffness and mechanical properties and also high disposability and renewability. Also, they are recyclable and biodegradable.

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- Banana fibre is used as a stabilizer in this project.

*C. Disposable Face Mask*

- The material most commonly used to make surgical masks is polypropylene, either 20 or 25 grams per square meter (gsm) in density.
- Melt-blown fabric is created through a process that melts down plastic and blows it out in strands.
- The same process is used to create spun-bond fabric, which is also used in face masks worn by healthcare workers.
- Disposable face mask is used as an additive in the soil stabilization process.

## 4. Methodology

The properties of the soil are determined by performing laboratory tests that include

- Specific Gravity
- Sieve Analysis
- Atterberg Limits
- Standard Proctor Compaction Test
- Direct Shear Test
- Unconfined Compression Test

The percentage of banana fibre was kept as optimum (0.4%) and the addition of disposable face masks were done in varying proportions (0.5% ,1% ,1.5%).

## 5. Results and Discussion

*A. General*

Through material investigation and experimental investigation, the various properties of the Black cotton soil were checked and the results of these tests were analyzed with existing standard results. The following are the various test results obtained.

*B. Properties of Black Cotton Soil*

Table 1
Properties of Black Cotton Soil

| S. No. | Description | Results |
|---|---|---|
| 1 | Specific Gravity | 2.38 |
| 2 | Shrinkage Limit | 81.04% |
| 3 | Optimum Moisture ContentOMC% | 4% |
| 4 | Minimum Dry Density, MDD(g/cc) | 14.25g/cc |
| 5 | Unconfined Compression Strength (Kg/cm²) | 0.854 |
| 6 | Standard Proctor Compaction | 10.66 |

*C. Graphical Representation of the Results*

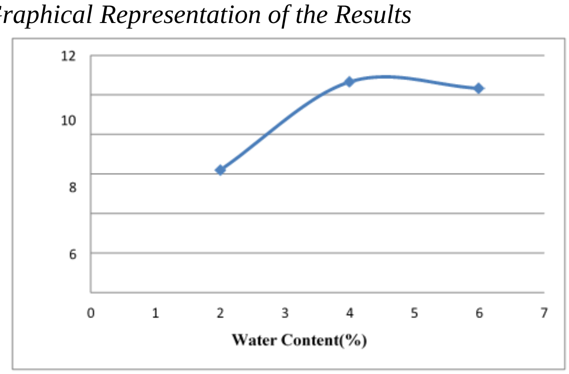


Fig. 1. SPCT for Black Cotton Soil

The above graph shows that the value of dry density increases at a water content percentage of 2% and decreases steadily with an increase in every addition of 2% of water content for black cotton soil.

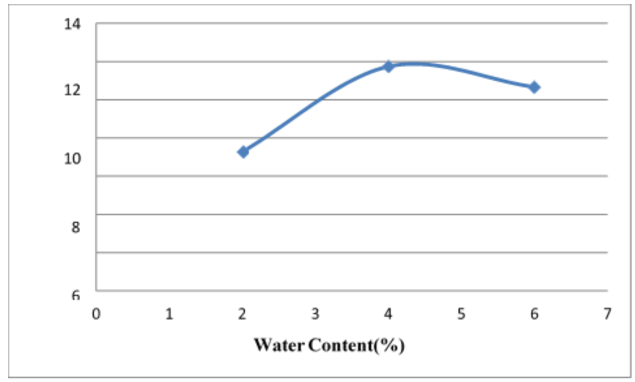


Fig. 2. SPCT for BCS with 0.5% Mask

The above graph depicts that the value of dry density increases rapidly and decreases gradually with increase in every 2% of water content for black cotton soil and 0.5% mask.

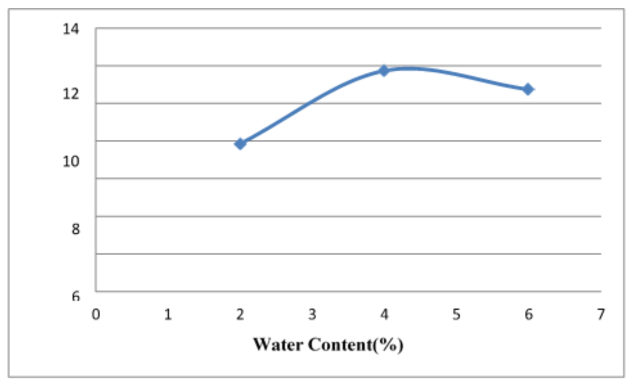


Fig. 3. SPCT for BCS with 1% Face Mask

From the graph, it can be interpreted that the value of dry density increases at 4% water content and gradually decreases at 6% water content for black cotton soil and 1% mask.

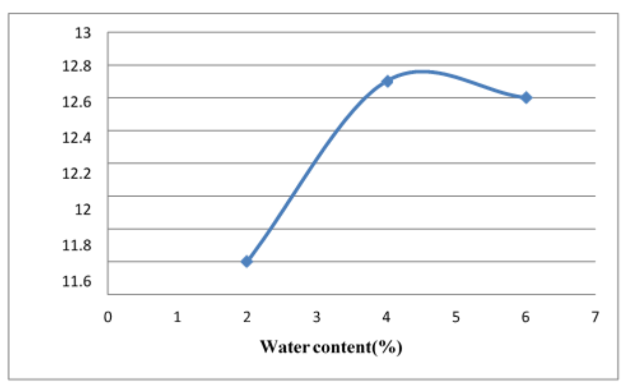


Fig. 4. Standard Proctor Curve on Soil with Mask and 0.4% Banana Fibre

From the above graphs, it can be depicted that the dry density values keep increasing for every addition of mask. The value of dry density increases drastically and decreases with increase in water content for black cotton soil mask and 0.4% banana fibre.

This shows how well mask and banana fibre can be used to stabilize the soil.

### *D. Comparison of SPCT Results of Black Cotton Soil After Infiltration with Mask and Fibre*

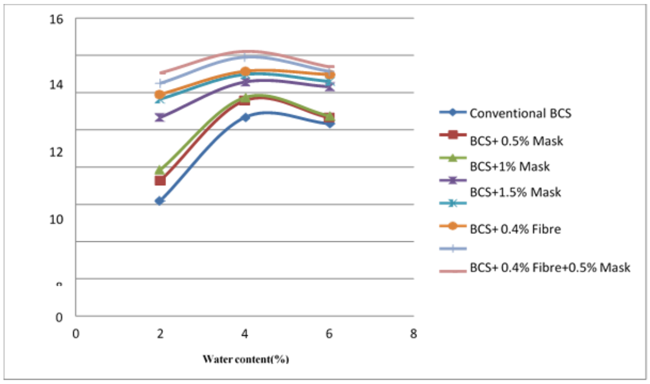


Fig. 5. Comparison Graph-SPCT for BCS

From the above graph it can be interpreted that usage of mask with black cotton soil enables strength in the soil. The addition of banana fibre and masks help to increase the soil strength and stability. Therefore, banana fibre and masks act as a very good stabilizing agent.

## 6. Conclusion

This work evaluated the effect of Black Cotton soil after incorporating of 0.4% of Banana Fibre with addition of varying percentage of 0.5%, 1%, and 1.5% of face mask was added to enhance the strength characteristics. Based on the test results the following conclusions has been drawn.

- From the Standard Proctor compaction test it has been observed that the OMC & MDD of parent soil were 4% & 10.66g/cc respectively.
- In the case of BCS when mixed with 0.4% of Banana fibre and 1.5% of face mask, the MDD is 14.2g/cc.
- The maximum Dry density shows the decreasing trend with the increase percentage of face mask in the soil mixture. From the results It is clear that as minimum Optimum Moisture content increases as per the inverse relationship between MDD and OMC.
- From the UCCS test conducted for the same samples, the strength of sample shows increasing tendency with addition of varying percentage of face mask for conventional Black cotton soil strength obtained 0.977 $Kg/cm^2$.
- For face mask mixture the strength obtained 10.66, 11.22, 12.56 for percentage of 0.5%, 1% and 1.5% respectively.
- For Banana fibre mixture the strength obtained 0.916 and again the addition 1.5% of face mask with Banana fibre give a strength of 0.811 the strength shows a drastic increase.
- In the above observation we come to conclusion that the face mask and Banana fibre used in the combination with Black cotton soil upholds certain remarkable properties which enables it to be used economically for improvement of Black cotton soil.
- Since Banana fibre is a waste product, usage of the same reduces the environmental pollution and replaces the effect of chemical stabilizers in soil.

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