

# Study About Swelling Behavior of Black Cotton Soil with RBI GRADE-81 And Single Use Face Mask

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## ABSTRACT

Most of the area in Maharashtra state is the agriculture land. Now a days the deficiency of land for construction so use of requirement of agricultural zone for construction of MIDC, factories, Public Buildings etc. So, needs to improve properties of Black cotton soil. Black cotton soil is good for agricultural purpose but dangerous for construction of point of view in the region of black cotton soil (or expansive soil) swell-shrink behavior risky for structure. From pandemic situation use of COVID - 19 single use face mask generated lots of medical waste to reduce the environmental risk reuse of waste facemask as geotextile nonwoven material. Use of RBI grade 81 is one of good stabilizer for different types of soil.

In this research, to study the effect on black cotton soil by adding waste of single use face mask and replacing RBI - grade 81 with different percentages of combinations. Experimental work of properties of soil of Free Swell Index with percentages varying Between 2 to 8% of RBI - grade 81 replacement and addition of 0.2 % to 0.8% waste single COVID-19 face mask. Evaluation of Comparative study results can indicate improvements in properties of Black cotton soil.

**Keyword :** - Black cotton soil, single use face Mask, RBI Grade - 81, Swelling Behavior, Free Swell Index

## 1. Introduction

For construction of any structure, first of all, the designer requires the data about soil classification, characteristics and its behavior in different situations/conditions. It is most necessary when the soil is expansive soil or Black Cotton soil because their swells-shrink behavior. From mineralogical analysis, rich proportion of montmorillonite is found in Black cotton soil. High percentage of montmorillonite renders high degree of expansiveness. These property results cracks in soil without any warning. These cracks may sometimes extent to severe limit like ½” wide and 12” deep. So building to be founded on this soil may suffer severe damage with the change of atmospheric conditions. Black cotton soils are inorganic clays of medium to high compressibility and form a major soil group in India. They are characterized by high shrinkage and swelling properties. This Black cotton soils occurs mostly in the central and western parts and covers approximately 20% of the total area of India. Because of its high swelling and shrinkage characteristics, the Black cotton soil (BC soils) has been a challenge to the highway engineers. The Black cotton soil is very hard when dry, but loses its strength completely when in wet condition. As a result of wetting and drying process, vertical movement takes place in the soil mass. All these movements lead to failure of pavement, in

the form of settlement, heavy depression, cracking and unevenness. In such situations, improvement of soil properties has been widely used for resolving the site condition.

Therefore, we decided to use this face mask in black cotton soil to evaluate the properties of Black cotton soil with the help of RBI grade 81 material.

In this project the strength parameters of the black cotton soil is examined when it mixed with face mask and RBI grade 81 material at different proportion of mixing. Basic soil sample test are conducted to find the Engineering properties of the soil then conducted for soil mixed with face mask and RBI grade 81 material at different proportion. The most important of this test are to determine the correct proportion of mixing which gives the optimum strength to the soil and it will be takes as standard mix and can be used for highway project and buildings.

### 1.1 Soil Properties:

- 1) It is suitable for the cultivation of cotton and is also known as black soil.
- 2) This soil is formed of incredibly fine clayey material and is well-known for its moisture-holding capacity.
- 3) They formulate deep cracks during the hot climate which enables the adequate aeration of the soil.
- 4) These soils are sticky when moist and tough to work on.

### 1.2 Objective

1. To comparative study the properties of BC soil with different percentage of combinations.
2. To study the Swelling Behavior of black cotton soil by reusing Covid-19 single use face mask and replacement of RBI grade 81 in black cotton soil.

## 2. Litratue Review

**Sidali Denine (2010)** • She suggested show that the geotextile reinforcement improves the cohesion strength of the reinforced soil. Here non-woven geotextile is used for reinforcement. The addition of reinforcement layer continuously increases the shear strength of the soil

**Siavash Kouravand, Mohammad Boveiri (2007)** • Reviewed the stabilization of soil and different waste materials used for it. From the review it had been observed that mostly used materials were cement, sand, lime, fly ash. they will be use effectively for expansive soils for the applications of lower layers of road pavement, fill material, dike material, and reclamation material. Agricultural waste like rice husk ash with combination of cement and lime are often used. they need found contribution of fiber in increasing strength.

**Priyank Goyal, Ashutosh ShankerTrivedi and Manoj Sharma** .present in his paper is an attempt to study the effectiveness of coconut fibre (coir) to control swelling properties of black cotton soil along with an impact on its strength characteristics and dry density. The test results show that in presence of 2% coir fibre, the shrinkage limit is increases by 7.52% to 12.62%. Increase in compressive strength was observed from 1.09 to 1.32 kg per sq-cm.

**Aparna, P.K. Jain, and RakeshKumar.** In this paper presents the result of an experimental study conducted for evaluating the effect of size of the sand column on swelling of expansive soil. The sand columns of diameters 25mm, 37.5mm and 50mm were made in black cotton soil test beds in a cylindrical mould of diameter 100mm. The test beds were prepared at different water contents (14, 18, 22, 26,30,36,40 and 44% by weight of dry soil) keeping the dry density of the soil as constant. The soil with sand column was submerged and the swelling of the composite material was observed. The test results show that the presence of sand column in the expansive black cotton soil reduces the swelling.

**Chayan Gupta, Ravi Kumar (2015)** • When the black cotton soil comes in contact of water, it causes structure damage and also creates many problems. The replacement of finer particle of black cotton soil with coarser particle of waste materials used alter the gradation of it and the composite acts as a well graded material. Further the addition of these hazardous waste materials i.e.fly ash and marble dust in the river sand stabilized black cotton soil improved

the various geotechnical properties of black cotton soil. Also, the final composite allows its application in many construction fields beneficially and also leads to a safe and effective disposal technique of waste materials.

### 3. Materials

#### A] Black cotton soil :-

- Black cotton soil is a clayey soil. They are of variable thickness, density under layered by black sticky material known as “Black soil”.
- It swells, shrinks enormously due to present of fine and dust clay particles. Hence black cotton soil must be treated by using suitable admixtures to compact it.
- The Black cotton soil has a high percentage of clay. Chemically black cotton soils consist of lime, iron, magnesium, alumina and potash but they lack in nitrogen, phosphorus and organic matter. Because of their capacity to hold water, they are suitable for the cultivation of cotton. hence the name black cotton soil.
- Particular construction technology has been acquired traditionally in most of the places where such type of soil is found, yet, cracks are identified in several structures as sufficient precautions are not carried out during the construction and maintenance period of the buildings.
- Black cotton soil also contains large amounts of organic matter which helps to improve the overall fertility and structure of the ground. In addition to being useful for farming purposes, black cotton soil can be used for landscaping projects due to its resistance to erosion and moisture retention.



**Fig.1** Black Cotton Soil

#### B] RBI Grade-81:-

- RBI Grade-81 is an advanced soil stabiliser that re-engineers the in-situ soil and increases its strength and load bearing capacity. It is patented worldwide and in India, and is the only Stabiliser that is registered as a “Soil Stabiliser” in its country of origin.
- In a world where connectivity is paramount, and resources are increasingly constrained, Soil Stabilisation is the perfect solution to construct world-class roads that are better, stronger, cheaper and environmentally friendly.
- RBI Grade-81 was developed in South Africa to construct roads and highways capable of supporting loads from heavy machinery in critical areas. The technology was subsequently bought over privately and developed and optimized even further. It has since been used in the construction of all kinds of roads, highways, airstrips, helipads, high altitude roads, forest roads and other pavements worldwide for more than twenty years.
- RBI Grade 81 meets the requirement for a well-proven, reliable and very cost-effective method by creating a strong and irreversible impermeable layer resistant to adverse climatic conditions, from very high

temperatures to permafrost conditions, and accommodating all vehicular loads. RBI Grade 81 is environmentally friendly and emphasises the use of recycled material, recognizing the lack of readily available resources.



**Fig.2 RBI Grade-81**

**C] Face Mask [Non-Woven Geotextile Material]**

- Nonwoven fabric is a fabric-like material made from staple fibre (short) and long fibres (continuous long), bonded together by chemical, mechanical, heat or solvent treatment.
- The term is used in the textile manufacturing industry to denote fabrics, such as felt, which are neither woven nor knitted. Some non-woven materials lack sufficient strength unless densified or reinforced by a backing. In recent years, non-woven have become an alternative to polyurethane foam.



**Fig.3 Face Mask [Non-Woven Geotextile Material]**

**4. Laboratory Tests on Soils, Face mask, RBI Grade-81 & Their Mixtures:**

Soil, RBI Grade-81 & Face mask mixtures were prepared for Experimental investigation by mixing 2,4,6 and 8% of RBI Grade-81 & 0.2,0.4,0.6 and 0.8% of Face mask (by weight). All these mixtures were tested in the laboratory as per procedure described in respective IS codes for properties and Free swell Index.



**Free Swell Index:** The increase in volume as a percentage of initial volume of soil is referred as free swelling index of soil. IS; 2720 Part 40-1985.

#### 4. Test Results and Discussion

**Free Swell Index: -**

**Table 1: -B.C Soil + RBI Grade-81**

| SR NO | Materials                 | Result in D.F.S(%) | Potential   |
|-------|---------------------------|--------------------|-------------|
| 1     | B.C Soil                  | 100                | Very high   |
| 2     | B.C Soil+ 2% RBI Grade-81 | 80                 | Very high   |
| 3     | B.C Soil+ 4% RBI Grade-81 | 90.90              | Very high   |
| 4     | B.C Soil+ 6% RBI Grade-81 | 50                 | <b>High</b> |
| 5     | B.C Soil+ 8% RBI Grade-81 | 60                 | Very high   |

**Conclusion:-** The given soil sample is High swelling potential.

**Table 2 :-B.C Soil+ Face mask**

| SR NO | Materials                | Result in D.F.S(%) | Potential   |
|-------|--------------------------|--------------------|-------------|
| 1     | B.C Soil+ 0.2% Face mask | 80                 | Very high   |
| 2     | B.C Soil+ 0.4% Face mask | 100                | Very high   |
| 3     | B.C Soil+ 0.6% Face mask | 63.63              | Very high   |
| 4     | B.C Soil+ 0.8% Face mask | 36.36              | <b>High</b> |

**Conclusion:-** The given soil sample is High swelling potential

**Table 3 :-B.C Soil + RBI Grade + Face mask**

| SR NO | Materials                             | Result in D.F.S(%) | Potential       |
|-------|---------------------------------------|--------------------|-----------------|
| 1     | B.C Soil + 2% RBI Grade-81+ 0.2% Face | 20                 | <b>Moderate</b> |

|   |  |       |           |
|---|--|-------|-----------|
|   | mask   |       |           |
| 2 | B.C Soil + 4% RBI<br>Grade-81+ 0.4% Face<br>mask | 63    | Very high |
| 3 | B.C Soil + 6% RBI<br>Grade-81+ 0.6% Face<br>mask | 41.66 | High      |
| 4 | B.C Soil + 8% RBI<br>Grade-81+ 0.8% Face<br>mask | 23.07 | Moderate  |

**Conclusion:-** The given soil sample is Moderate swelling potential

Swelling potential of soil is described as low, medium or high, depending on values of these parameters as shown in the table below.:-

|                                  |     |          |       |           |
|----------------------------------|-----|----------|-------|-----------|
| <b>Free swell index swelling</b> | <20 | 20-35    | 35-50 | >50       |
| <b>Potential</b>                 | Low | Moderate | High  | Very High |

#### 4. CONCLUSIONS

1. On the basis of experimental investigations, it was observed that the properties of Black cotton soil can be improved by the use of Face mask, RBI Grade-81 Some outcomes are as listed below:
2. On addition of Face mask, RBI Grade-81 in black cotton soil, a free swell index decrease which indicates controls the swelling behaviour of soil. Hence minimise the risk of failure.
3. The mixture of above all three samples indicates the lowest potential value of materials.
4. it is observed that free swell index values of the soil have decreased with increase in RBI Grade -81 & Face mask at specific proportion.

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