

# AN EXPERIMENTAL STUDY ON BLACK COTTON SOIL TREATED WITH RENOLITH AND GGBS

Prof. A.Pandurang<sup>1</sup>, Dr.Vageesha S. Mathada<sup>2</sup>, Prof. Sharankumar<sup>3</sup>, Deone shital<sup>4</sup>

<sup>1,2,3</sup>Professor, BKIT College of Engineering Bhalki, India.

<sup>4</sup>PG Student, Dept. of Civil Engineering, BKIT College of Engineering, Bhalki, India.

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**Abstract** – As we know Expansive soil is major group of soil in India. Now a day's Civil Engineering play important role in growth and development of countries. This study investigation reports gives the replacement of black cotton soil by various percentage of GGBS (i.e. 5% 10% 15%) with the (5% 7.5% 10% 12.5%) of Renolith by weight of GGBS is replaced in different proportion to the BC Soil. From every 10% replacement of Renolith by weight of GGBS, CBR and UCS value increases gradually beyond that limit it will start to decreases. So the main purpose of doing this investigate on is to improve the properties of soil by doing various laboratory tests such as CBR Test, UCS Test, Compaction Test, Atterberg Limit Test. In general we face the problems in construction during rainy season due to presence of montmorillonite mineral in clayey soil. Thus in order to reduce several problems soil is treated with above chemical polymer to give additional strength to soil, avoid excessive swelling, more flexibility and quick construction time with long duration of life to the pavement.

**Key Words:** Black Cotton Soil, Renolith, GGBS replacement of BC Soil by GGBS and Renolith, water, etc.

## 1. INTRODUCTION

The main characteristic of expansive soil is swelling, shrinkage and this type of soil occurs mainly in western and central part of India. As we know the properties of black cotton soil which is highly plastic or clayey in nature due to presence of montmorillonite mineral which reduce the strength of soil when soil comes in contact with water. So it has been challenge to highway engineers during rainy season. In dry season it show cracks after drying. Which result in to unevenness of pavement i.e. failure of the pavement.

The soil that is utilized in the current research study has been attained from Bhalki Taluka, Bidar district. The soil obtained is of Black cotton soil. The soil was originally collected in the form of lumps excavated from an approximate depth of 1.0 m from level of lower surface. Among all the type of soil particularly Black-cotton soils contain high plasticity and high Clay content with swelling property due to this it is a big challenge for highway engineers while constructing the road pavement work. In order to get solution the soil is treated with GGBS and Renolith to give additional strength to the soil.

Construction of road made by this chemical does not undergo cracking along with this it also improve the load bearing capacity of pavement and flexibility. This paper deals with the evaluation of strength criteria of soil to be used for structural construction such as building, bridges, pavement etc.

## 2. OBJECTIVES

The main objective of this paper is replacement of black cotton soil by stabilizing agent Renolith and GGBS to examine following.

- To check the variations in the strength of black cotton soil due to reduction in the cohesion by the addition of Renolith polymer.
- To check the geotechnical properties of black cotton soil when replaced with Renolith and GGBS.
- To avoid formation of road cracking after rainy season when surface get dried.

Properties	Result
Specific gravity	2.0
Optimum moisture content	21%
Maximum dry density	1.48g/cc
CBR	18.466KN/m <sup>2</sup>

- To minimize the sub-grade problems specially when the sub-grade is constructed from clayey soil.

## 3. MATERIAL USED

### 3.1 RENOLITH

Renolith is the locally produced liquid additive obtained from the waste synthetic chemical product. This is non-toxic, economic and non-poisonous. It is mainly available in the area of Mumbai. The main purpose of Renolith is to improving the properties of soil. Following are the properties of Renolith.

Specific gravity	1-2
Appearance	White
State present	Liquid

### 3.2 GGBS

It is named as ground granulated blast furnace slag, which is waste product obtained from steel content and iron content which include silicates and aluminates. It is type of non-metal material. Main source of this material is steel industries. The quantity of GGBS produced per year is 7.8 million ton. The chemical composition of GGBS is given below

- Calcium oxide = 30 to 45 %
- Silicon dioxide = 30 to 38 %
- Aluminum Oxide = 15 to 25 %
- Ferrous Oxide = 0.5 to 2 %
- Specific gravity = 2.9



GGBS

### 3.3 BLACK COTTON SOIL

For this project soil is collected from Taluka Bhalki, Dist Bidar Karnataka which is locally available.

### 4. EXPERIMENTAL INVESTIGATION.

This study investigation reports gives the replacement of black cotton soil by various percentage of GGBS (i.e. 5% 10% 15%) with the (5% 7.5% 10% 12.5%) of Renolith by weight of GGBS is replaced in different proportion to the BC Soil.

### 5.0 RESULT

#### 5.1 Variation in OMC of BC soil with Varying Percentages of GGBS and Renolith

Renolith by % of GGBS	GGBS by % weight of black cotton soil		
	5	10	15
5	17.5	16	16.5
7.5	17	16	17
10	20	16.5	18
12.5	17.5	15	16

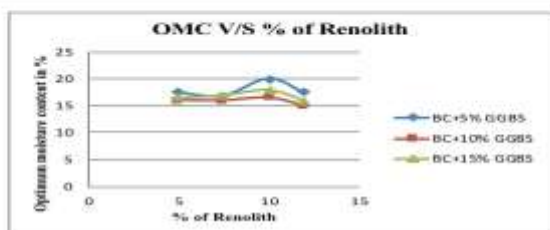


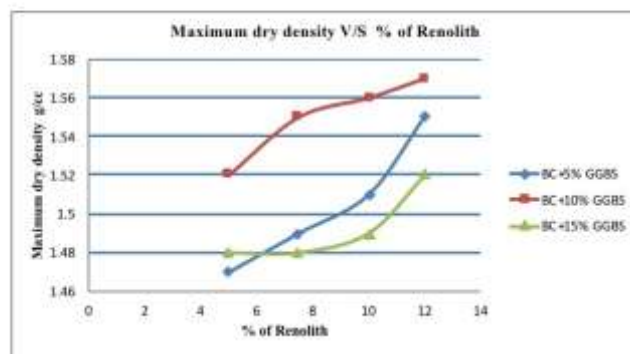
Fig. 5.1 OMC of BC Soil with Varying Percentages of GGBS and Renolith

### Result:

The above graph represents the variation in OMC with respect to different proportion of GGBS and Renolith. In the above graph OMC value increases with respect Increase in amount of replacement of GGBS.

Table 5.2 Variation in MDD (g/cc) with Different Amount of GGBS and Renolith

Renolith by % of GGBS	GGBS by % weight of black cotton soil		
	5	10	15
5	1.470	1.520	1.480
7.5	1.490	1.550	1.480
10	1.510	1.560	1.490
12.5	1.550	1.570	1.520



### Result:

The above graph represents the variation in MDD with respect to different proportion of GGBS and Renolith. In the above graph MDD value increases with respect Increase in amount of replacement of GGBS

Table 5.3 Variation in UCS (kN/m<sup>2</sup>) of BC Soil with GGBS & Renolith

Renolith by % of GGBS	GGBS by % weight of black cotton soil		
	5	10	15
5	72.97	102.79	113.87
7.5	78.18	113.87	124.22
10	87.99	119.05	136.46
12.5	82.82	114.67	125.96

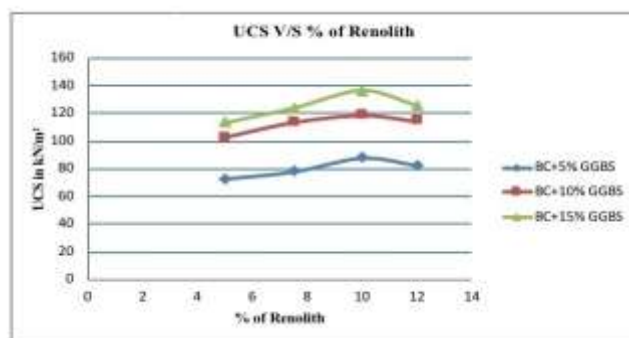


Fig. 5.3 Variation in UCS of BC Soil with Varying Percentages of GGBS and Renolith

**Result:**

The above graph represents the variation in UCC with respect to different proportion of GGBS and Renolith. In the above graph shear resistance capacity of treated BC soil increases with increase in dosage of GGBS up to 12.5 of Renolith content than the value decreases.

**Table 5.4 Variation in CBR Value of Black Cotton Soil with Varying Percentages of GGBS and Renolith**

Renolith by % of GGBS	GGBS by % weight of black cotton soil		
	5	10	15
5	5.37	5.70	7.39
7.5	7.72	10.07	10.74
10	9.73	12.76	14.77
12.5	8.72	12.08	13.76

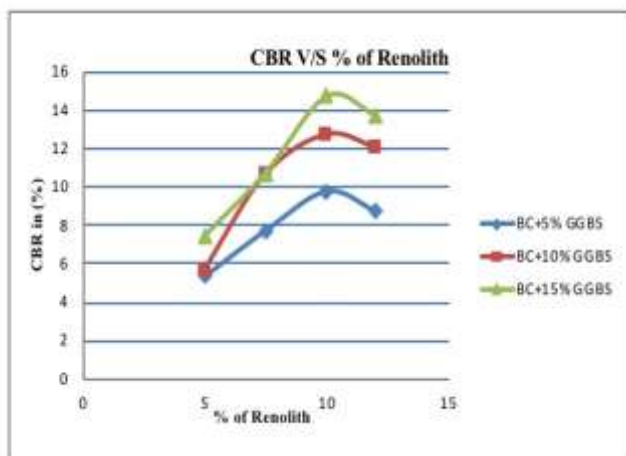


Fig. 5.4 CBR of BC Soil with Different Amount of GGBS and Renolith

**Result:**

The above graph represents the variation in CBR with respect to different proportion of GGBS and Renolith. In the above graph CBR value increases with respect increase in amount of replacement of GGBS up to 12.5 of Renolith content, then the value decreases.

**6. CONCLUSIONS**

The following conclusions may be drawn from the this study

1. Black cotton soil is stabilized by GGBS and Renolith.
2. As the black cotton soil is replaced by various percentages of GGBS, we come to know that CBR and UCC value has increased by adding the amount of GGBS and OMC and MDD value decreases with adding the amount of GGBS.

3. As percentage of additives (5, 10, and 15 % of replacement of GGBS by weight of black cotton soil with the 5, 7.5, 10 and 12.5% of replacement of Renolith by weight of GGBS) is replaced in different proportion to the BC soil. For every replacement of GGBS to the BC soil, 10% of replacement of Renolith by weight of GGBS, CBR and UCC value increases gradually beyond that limit both CBR and UCC value decreases.
4. MDD and OMC increases up to 10% of replacement of Renolith, beyond that limit both values decreases.
5. Stabilization of BC Soil with the help of GGBS and Renolith, test results have found that there is gradual increase in the CBR and UCC. Hence the load resisting capacity of black cotton soil increases so, we can reduce the pavement thickness.

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