Investigations On Properties of Black Cotton Soil Using Marble Dust & Banana Fiber For Flexible Pavement

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Abstract - The safe disposal of hazardous and non- hazardous waste becomes a problematic for the civil engineers. This is because only few states are able to dump these wastes emanating from industries safely. This Work presents a research on safe disposition of waste such as Marble Dust with Banana Fiber. So, efforts have been made using marble dust and banana fiber in this research to revamp the quality of the soil. Present study the effects of marble dust (MD) on soil properties such as liquid limit (LL), plastic limit (PL), compaction characteristics and California Bearing Ratio (CBR) on black cotton soil. Previous study conducting on biological materials for improvement of properties of black cotton soil is lacking effect on properties of soil. Marble Dust (MD) material & Banana fiber was used to enhance the properties of natural soil used for subgrade material in pavement. In view of its properties to stabilization of soil study was under taken. Due to Swelling and shrinkage properties of black cotton soil most of the roads are damage to cracks.

INTRODUCTION

Soil is the indispensable element of this nature. It is attached to everyone in one or another way. All the basic amenities of life, whether it is concerned with food, clothes and house, have been fulfilled by the soil .Without the soil it is just next to impossible to think about life on this earth. The word „soil" is derived from the Latin word solium which according to Webster's dictionary means the upper layer of the earth that may be dug or plowed; specifically, the loose surface material of earth in which plant grows. The term soil in soil engineering is defined as an unconsolidated material, composed of solid particles produced by disintegration of rocks.

OBJECTIVES

The objectives of the research are outlined below:

- To determine the Geotechnical properties of Natural soil, Stabilized with different percentages (5, 10, 15, 20, 25 & 30) of Marble dust With 0.25% of banana fiber for the construction of Flexible Pavement.

METHODOLOGY

- Following steps were taken to conduct the study.

1. Selection of Sample
2. Preparation of Sample
3. Various test such as LL,PL,PI,OMC&MDD and CBR where conducted varying the percentage of Marble Dust with banana fiber.

Table 1 – Steps carried out for the experimental work showing different combinations of materials and the tests conducted

Material	Tests conducted
Natural	Grain size Analysis- (mechanical Method), Specific Gravity Consistency Indices (L.L. , P.L. , P.I.) Compaction Test (Light Compaction) CBR Test (Soaked & Un-soaked)
Natural Soil + 05 % Marble dust + 0.25% Banana Fiber	
Natural Soil + 10 % Marble dust+ 0.25% Banana Fiber	
Natural Soil + 15 % Marble dust+ 0.25% Banana Fiber	
Natural Soil + 20 % Marble dust+ 0.25%Banana Fiber	
Natural Soil + 25 % Marble dust+ 0.25% Banana Fiber	
Natural Soil + 30 % Marble dust+ 0.25% Banana Fiber	

The different materials used in the present investigation are described as follows:

Black Cotton Soil

Soil is an accumulation or deposit of earth material, derived naturally from the disintegration of rocks or decay of vegetation that can be excavated readily with power equipment in the field or disintegrated by gentle mechanical means in the laboratory. The supporting soil beneath pavement and its special under courses is called sub grade. Undisturbed soil beneath the pavement is called natural sub grade. Compacted sub grade is the soil compacted by controlled movement of heavy compactors.

The soil used in this investigation is expansive soil; one type of most problematic soil for sub grade constructions is

used in this research Work which is locally available Soil.

Fig. 4.1 Black Cotton Soil

MARBLE DUST

Marble is a non-foliated metamorphic rock composed of re-crystallized carbonate minerals, most commonly calcite or dolomite. Geologists use the term "marble" to refer to metamorphosed limestone; however, stonemasons use the term more broadly to encompass un-metamorphosed lime-stone. Marble is commonly used for sculpture and as a building material.

Marble dust is generated as a waste during the cutting and polishing of the marble. The amount of the marble dust generated is very substantial being in the range of 5-6 million tons per annum. The heaps of this waste material sac-quire large land areas and remain scattered all around, spoiling the aesthetic of the entire region and have affected the tourism and industrial potential of the states. The hazardous dumping practices in Rajasthan thus pose a severe threat on the environment, ecosystem and health of the people. While marble blocks are cut by gang saws, water is used as a coolant. The blade thickness of the saws is about 5 mm and normally the blocks are cut in 20mm thick sheets. Therefore, out of every 25mm thickness of marble block, 5mm are converted into powder while cutting. This powder flows along with the water as marble slurry. Thus, nearly 20 % of the total weight of the marble processed results into marble slurry. The marble slurry has nearly 35%-45% water content. The total waste generation from mining to finished product is about 50 % of mineral mined.

Some of effects of the marble slurry may be listed as under :

- The waste is indestructible.
- The sites which can be used as dumping ground are limited and gives repulsive dirty look.
- Erosion of top fertile soil cover.
- Contamination of the rivers and other water bodies there by adversely affecting irrigation and drinking water resources.
- Contamination of air.
- Public outcry due to general losses.

Marble dust was obtained from local marble industry. White marble dust waste was obtained from the industry.

Fig. 4.2 Marble dust

Chemical Composition and classification

Chemical composition Versus in Marble Dust

Chemical Composition	Chemical %
SiO2	6.20 %
Fe2O3	0.80 %
Al2O3	4.80 %
CaO	30.10 %

EFFECT ON ENVIRONMENT

The marble slurry imposes serious threats to eco-system, physical, chemical and biological components of environment open cast mining, marble processing, solid waste generation and its disposal, trading and transport of marble blocks, slabs and irregular marble pieces (khandas) and art and craft work are important activities in Makrana mining area. Quarrying is by conventional rope and bucket method and the quarries run along the strike and dip of marble bands. Large scale land transformations, unscientific mining, un-segregated waste land degradation, ponding and flooding of water, visual impact, loss of aesthetics, pollution, health and safety hazards, damps, incompatible land uses and improper waste disposal have caused :

1. When dumped on land, it adversely affects the productivity of land due to decreased porosity, water absorption, water percolation etc.
2. When dried, the fine particles (size is less than 363 micron) become air borne and cause severe air pollution.
3. Apart from occupational health problems, it also

affects machinery and instruments installed in industrial areas. Slurry dumped areas can not support any vegetation and remain degraded.

4. During rainy season, the slurry is carried away to rivers, drains, roads and water bodies affecting quality of water, reducing storage capacities and damaging aquatic life.
5. Due to long term deposition on land the finer particles block flow regime of aquifers thus seriously affecting underground water availability.
6. The heaps of slurry remain scattered all round the industrial estate are an eye sore and spoil aesthetics of entire region. Subsequently tourism and industrial potential of the state is adversely affected

BANANA FIBER

Banana fiber is used because it is available easily in local villages. Uniform length of fibers was obtained by cutting machine. Salient physical and mechanical properties of banana fiber were determined in their natural form.

PROPERTIES OF BANANA FIBER

- Density (kg/m3) – 1350
- Moisture content (%) - 11
- Tensile strength (M Pa) - 56
- Elongation at Break (%) - 2.6
- Young's modulus (M Pa) – 3.5

Fig 1.4. Banana Fiber

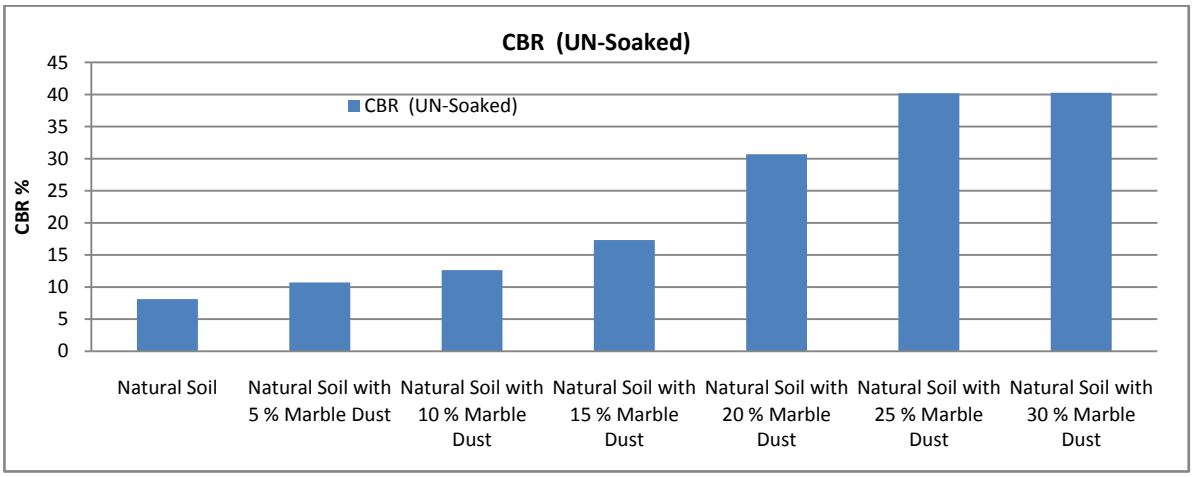

Fig.1 Shows Un-Soaked CBR Natural Soil with varying % of Marble Dust with 0.25% Banana Fiber

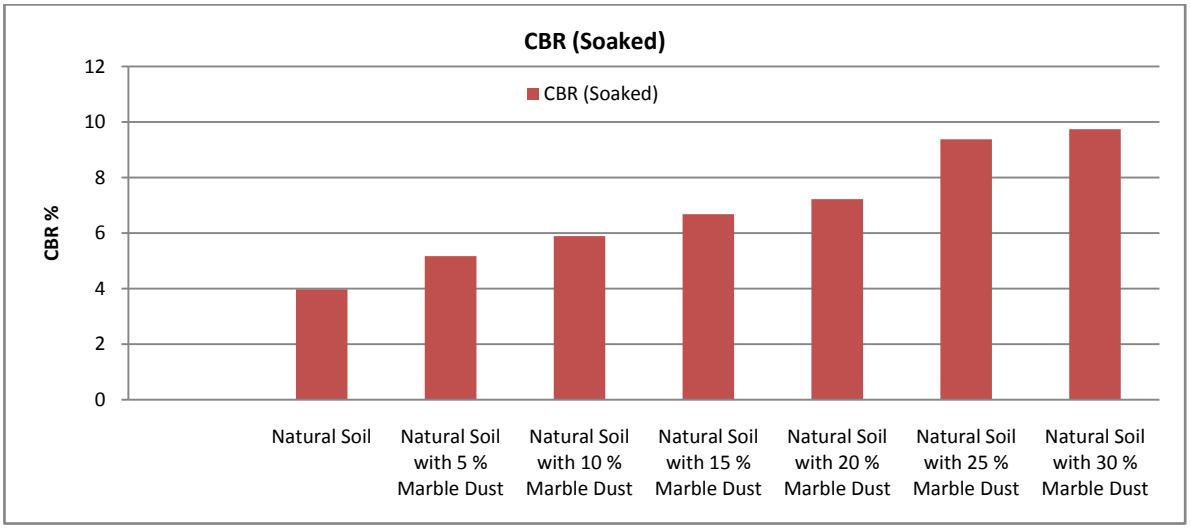

Fig.2 Shows Soaked CBR Natural Soil with varying % of Marble Dust with 0.25% Banana Fiber

RESULT

California Bearing Ratio (CBR) Test:-

California Bearing Ratio (CBR) tests were carried out to determine the CBR Value for sub- grade soil and for the soil stabilized with varying percentages of Marble Dust.

The CBR Tests were conducted on Black cotton soil, Black cotton soil treated with varying percentages of Marble Dust ranges from 5% to 30%with 0.25% of Banana Fiber.

CONCLUSION

- The mixing of Marble Dust with 0.25% of banana fiber has pronounced effect on compaction characteristics also. In Compaction Test, the MDD value of raw soil is achieved as 1.86 gm/cc at OMC of 13.65 %. It got increased to 1.95 gm/cc at OMC of 12.55 % on 25 % addition of Marble Dust with Fiber.
- The soaked CBR value of the raw soil is 3.9 % and after mixing of Marble Dust with 0.25% of banana fiber in the soil, there is remarkable change in CBR value. The addition of 30 % Marble Dust with 0.25% of banana fiber increased the CBR value from 3.9 % to 9.8 %.

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