

## Study of Black Cotton Soil

Akash Koli<sup>1</sup>, Ganesh Kudu<sup>2</sup>, Omkar Loke<sup>3</sup>, Nilesh Mestry<sup>4</sup>

Department of Civil Engineering, Mumbai University, Mumbai - 400055

**Abstract**— Black cotton soil has the tendency to swell or shrink depending on its moisture content. Due to such characteristics of soil, the structures constructed over this may develop some cracks in due course of time. It is there for essential to stabilize such soils, prior to any construction work carried out on this to improve its engineering properties. At present, waste materials like bottom ash and cement waste dust are in abundance at various parts of our country. These wastes disposal is a great problem for our society. Various tests are carried out on the soil samples with and without stabilizing material at different percentages and compared together to obtain optimum percentage of admixture added to soil. This paper deals with a feasibility study carried out to find the suitability of using waste material i.e. bottom ash or cement waste dust as stabilizing material for improving the engineering properties of black cotton soil and make it suitable for construction work.

**Keyword**-Black cotton soil, cement dust waste, bottom ash.

### I. INTRODUCTION

Black soils, locally called regur or black cotton soils, and internationally known as 'tropical black earths' or 'tropical chernozem' have been developed by the weathering of the lava. The color of these soils varies from deep black to light black and chestnut. These soils have clay texture, average clay content being 50% and the range being 40-50%. This soil present in major parts of Maharashtra, western Madhya Pradesh, Gujarat, Andhra Pradesh, Karnataka, Rajasthan, Tamil Nadu and Uttar Pradesh.

Black cotton soil deposits in India are very useful for farmers but problematic to civil engineers due to its high swelling and shrinkage properties. When black cotton soil comes in contact with water it gets swell and dries out it get shrink. because of montmorillonite mineral it is high swelling and shrinkage in nature and the structures constructed on these soils experience cracks, making it unsuitable for construction. Hence there is a need for improving black cotton soil to suite as foundation material.

Various researchers, for the past few decades, had tried to stabilise black cotton soil using lime for improving its shrinkage and swelling characteristics. Addition of bottom ash and cement dust improves the overall performance of soil. So we are testing the different proportion of admixture to be added to soil and to get its optimum quantity for soil.

### II. OBJECTIVES

After identification of problem and setting the objective of research following specific objective are framed to study the utilisation of bottom ash and cement dust for effective stabilisation of black cotton soil. To study the effect of bottom ash and cement dust on properties of black cotton soil. To cast the various trial mixes with varying percentage of bottom ash and cement dust. To compare trial mixes with conventional soil sample with each other. To select the optimum percentage of stabilises to be mixed with soil sample to produce maximum strength. To study the variation of Liquid Limit, Plastic Limit, Plasticity Index, Dry density, OMC, CBR (Soaked) of clayey soil with and without bottom ash and cement dust with different aspect ratio.

### III. MATERIALS

#### 3.1 Black cotton soil:-

Black cotton soils also called Regur soils and internationally known as 'tropical black earths' or 'tropical chernozems'. These soils are made up of volcanic rocks and lava-flow. Black cotton soil is one of major soil deposits in India. This soil shares 15% of all types of soil in India. It is concentrated over Deccan Lava Tract, which includes major parts of Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh, Karnataka, Rajasthan, Tamil Nadu and Uttar Pradesh. Black cotton soil is rich in calcium, potassium and magnesium but has poor nitrogen content. Crops like cotton, tobacco, chilly, oil seeds, jowar, ragi and maize grow well in it.

Soil exhibit high rate of swelling and shrinkage when exposed to changes in moisture content and hence have been found to be most troublesome from engineering consideration. As such soil has very low bearing capacity, it forms a very poor foundation material for road construction. Soaked laboratory CBR values of Black Cotton soils are generally found in the range of 2 to 4%. The foundations are provided for construction purpose in black cotton or any expansive soil is Under reamed pile. which is most suitable type foundation for black cotton soil. Black cotton soil is not suitable for foundation because it swells excessively when wet and it shrinks excessively when dry. So it is not suitable because of its property to undergo a volumetric change due to variation of moisture content.

### 3.2 Bottom ash:-

Bottom ash is the coarse, granular, incombustible by-product of coal combustion that is collected from the bottom of furnaces. Most bottom ash is produced at coal-fired power plants. When pulverized coal is burned in a bottom boiler, most of the unburned material is caught in the flue gas and captured as fly ash. Only about 10-20% of this ash is bottom ash. This ash is dark grey in colour, and is about the size of sand. This ash is collected in a water-filled hopper at the bottom of the furnace and removed by high-pressure water jets. It is deposited in a collection pond and stored for disposal or later use after recycling. It exists in massive quantities. Although the total coal ash generation varies from year to year, (depending on the amount and ash content of the coal burned) the amount of coal ash has been increasing since 1996. About 30% of bottom ash is re-purposed and recycled in a variety of ways. Most recycled bottom ash is used for snow and ice control, as a road base, structural fill material, or a raw feed material for some cements. Bottom ash can also be added into hot asphalt, however, it is a fairly fine powder and has a low durability. Because of this there is usually a sifting process to collect the larger particles when used in asphalt.

Bottom ash is part of the non-combustible residue of combustion in a furnace or incinerator. In an industrial context, it has traditionally referred to coal combustion and comprises traces of combustibles embedded in forming clinkers and sticking to hot side walls of a coal-burning furnace during its operation. The portion of the ash that escapes up the chimney or stack is, however, referred to as fly ash. The clinkers fall by themselves into the bottom hopper of a coal-burning furnace and are cooled. The above portion of the ash is referred to as bottom ash too. Additionally, modern municipal waste incinerators try in reducing the production of dioxins by incinerating at 850 to 950 (degrees Celsius) for at least two seconds forming bottom ash as byproduct.

### 3.3 Black cotton soil + Cement waste dust:-

Black cotton soil has very less bearing capacity and high swelling and shrinkage characteristics. Due to these characteristics it is very poor material for foundation of any structure. By adding cement dust in BC soil can improve some characteristics of the soil. It is waste material from the cement manufacturing industries, Properties differ slightly from cement. The natural behavior of the cement exhibits in cement dust also. By adding cement dust in BC soil has some satisfying results in laboratory. The chemical content in cement dust is pretty much similar as cement. The content of (SiO<sub>2</sub>) helps to bind the particles of black cotton soil and improve the plasticity characteristics of BC soil.

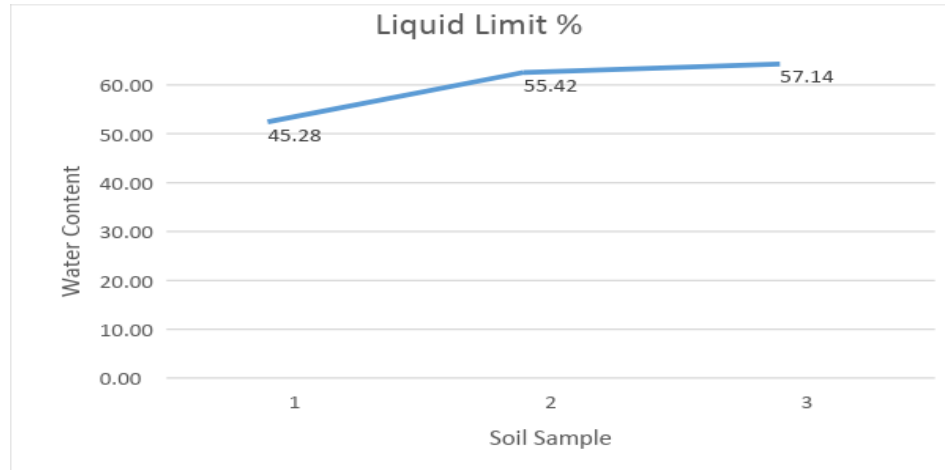
## IV. TESTS

Test introduction Sample of Black cotton is dried in oven and then sieved from 425 micron sieve. Then various tests are performed to determine the results.

The sample of black cotton soil is tested with different tests in order to determine its characteristics. Consistency limit test such as plastic limit, liquid limit are conducted on soil. These tests conducted on soil result to provide liquid limit, plastic limit and plasticity index. Liquid limit test is carried out according to IS standard (IS 2720 part 5) Plastic limit test is carried out according to IS standard (IS 2720 part 5).

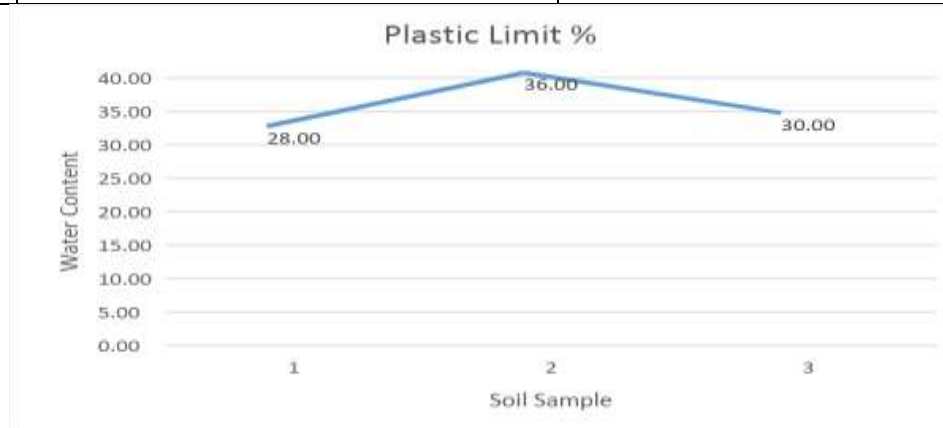
Sr. No.	Soil sample	Liquid Limit (%)
1	1	45.28
2	2	55.42
3	3	57.14

Plastic limit test is carried out according to IS standard (IS2720 part 5).



4.1.1 Liquid Limit

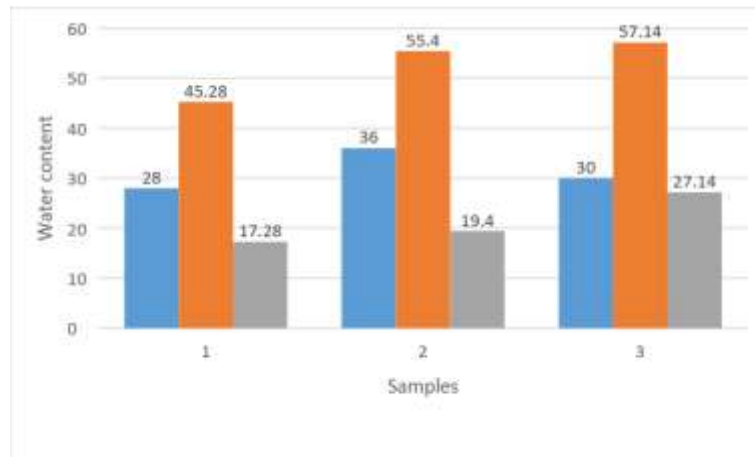
Sr. No.	Soil sample	Plastic Limit (%)
1	1	28
2	2	36
3	3	30



4.1.2 Plastic Limit

Sr. No.	Soil sample	Plasticity Index(%)
1	1	17.28
2	2	19.42
3	3	27.14

4.1.3 Plasticity index



#### 4.1.4 Plasticity index, Plastic limit, Liquid limit

### V. OVERVIEW ON RESEARCH

Black cotton soil has the tendency to swell and shrink depending on its moisture content. Due to the unusual characteristic of the soil make it difficult to construction. So it is necessary to strengthened and stabilized the soil. The main objective is to strengthening of the black cotton soil by addition of bottom ash and cement waste dust. After strengthening of the black cotton soil it can be used for the construction of the pavement works.

After study of literature review many admixture are obtain which can applied to stabilize the soil sample. By using bottom ash and cement dust both in different composition on black cotton soil can be gives most satisfactory result for strengthening of black cotton soil.

Various tests like Plastic limit, Liquid limit and Shrinkage limit were performed on the soil samples. On the basis of this the results obtain are plastic limit as a 31.33%, liquid limit as a 59% and shrinkage limit as a 6%. So it suggest that soil has ability to become saturated at lower water content. Also the range of plasticity over the water content is large. At present, waste materials like bottom ash and cement waste dust are in abundance at various parts of our country and it can be used as an admixture for stabilization.

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