

Black Cotton Soil Modification by the Application of Waste Material- Steel Plant Slag

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Abstract: *The main objective of this experimental study is to improve the properties of the black cotton soil by adding steel slag problematic soil (Black cotton soil) is too weak and does not have required stability for any kind of construction works. In foundation as well as in pavements, sub grade layer lays below the base course or surface course. To improves the strength of sub grade soil, by improving its engineering properties BC soil, In the present study, stabilization of sub grade soil by using slag is used to develop the strength of sub grade soil. The aim of this study is to examine the swelling property and optimum proportion of the stabilizer, which enhance the strength and stability of soil which is appropriately suitable for pavements. An experimental study has been made to use slag for improving the strength of black cotton. The aim of this study is to improve the engineering properties of expansive soil using steel slag and utilization of industrial waste. The samples were prepared, bymixing the percentage of steel slag and expansive soil as 10%, 20%, 30%, and 40% by the dry weight. Standard proctor test, unconfined compressive strength, liquid limit and plastic limit tests are performed to analysis compressive strength, Maximum dry density (MDD) and optimum moisture content (OMC) of soil mixture.*

Keywords: Black Cotton Soil, Steel slag, Stabilization, etc.

I. INTRODUCTION

Due to land limitations and increase in population, peoples are utilizing every available land for construction. The behavior of soil at any location is not same due to anisotropic nature. Sometimes poor soil is encountered during construction. When a project is to be carried out in difficult foundation condition, the possible alternate solutions are, avoid the particular sites, design the planned structure accordingly, use pile foundation which transmit the total load to hard strata, removed and replace the foundation soil and attempt to modify the existing ground, out of these alternate solutions the modification of existing ground than all alternative solutions is found to be economical and therefore modification of existing soil i.e. soil stabilization is one of the cheaper and easily implementable solution. Soil stabilization is a process of improving the properties of soil. It is extremely cost effective method of converting poor quality soil into hard impermeable medium.

II. OBJECTIVE

- To improve the engineering property of black cotton soil.
- To study the effect of slag on black cotton soil
- To use the stabilize soil in pavement and railway embankment.

III. METHODOLOGY

Based on the complete analysis of literature the foremost Problems prevailing with Black Cotton (BC) soil are Swelling, shrinkage and heaving characteristics. Generally, BC soil swells when water content present within the soil mass and shrinks on drying 79. These soils are characterized by intrinsic swelling and shrinkage, Due to the presence of montmorillonite mineral in BC soils, soil shows swelling characteristics which exhibits volume change and properties under different loading with respect to the water content. Due to the inbuilt swelling nature of the BC soil, the structure which constructed on such soils will undergo differential settlements and appears cracks in buildings or

sometimes it leads total distractions of the entire structure For this reason, an effort has been made in this analysis for effective utilization of PVC powder and crushed glass to modify and improve the geotechnical properties of Black cotton soil and to study the consequence of these additives on Geotechnical properties of Black cotton soil treated with optimum percentage of SLAG A variety of materials are used in geotechnical engineering field, properties of these materials differ from place to place due to this Complete categorization of these materials in terms of their vital properties will be very much useful in understanding soil

response under different loading and changes in stress levels with fluctuated environmental conditions. In the present investigation concentrated on basic parameters of which influence the engineering properties and the following tests were conducted for the study of b.c. soil

- 1) Free Swell Index
- 2) Specific gravity
- 3) Liquid limit
- 4) Plastic Limit

IV. CHARACTERISTIC OF BLACK COTTON SOIL

Natural black cotton soil was obtained from Wardha district in 1.5m from the natural ground. The soil was dark grey to black in color with high clay content and high compressibility. This soil has a property of high moisture tenacity and develop crack in summer.

Generally, lands with black cotton soil are fertile and very good for agriculture, horticulture sericulture and aquaculture. Expansive soil are the problem of civil engineers in general and for geo technical engineers in particular Clay is made up of tiny particles less than 0.002mm in diameter these soils are considered to be fine textured, clay is basically a catch all for a family of minerals that are heavy, sticky and dense.

PROPERTIES OF SOIL	VALUES
Liquid limit	30
Plastic limit	24
Plasticity Index	6
Free swell index	71
OMC	8
MDD	1.89
CBR	5.04

V. MATERIAL USED

1) 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. Compacted sub grade is the soil compacted by controlled movement of heavy compactors. Undisturbed soil beneath the pavement is called natural sub grade.

The desirable properties of sub grade soil as a

- highway
- material are
- Stability
- Incompressibility
- Permanency of strength
- Good drainage, and
- Ease of compaction

2) STEEL SLAG

Slag is a by-product of smelting ores and used metals. Broadly, it can be classified as ferrous, ferroalloy or non-ferrous/base metals. Within these general categories, slag can be further categorized by their precursor and processing conditions

VI. PHYSICAL PROPERTY

Property	Value
Specific Gravity >	3.2 - 3.6
Unit Weight, kg/m ³ (lb/ft ³)	1600 - 1920 (100 - 120)
Absorption	up to 3%

VII. CHEMICAL PROPERTIES

Constituent	Composition (%)
Coo	40 - 52
SiO ₂	10 - 19
Foe	10 - 40 (70 - 80% Foe, 20 - 30% Fe ₂ O ₃)
Môn	5 - 8
Go	5 - 10
Al ₂ O ₃	1 - 3
P ₂ O ₅	0.5 - 1
S	< 0.1
Metallic Fe	0.5 - 10

VIII. MECHANICAL PROPERTIES

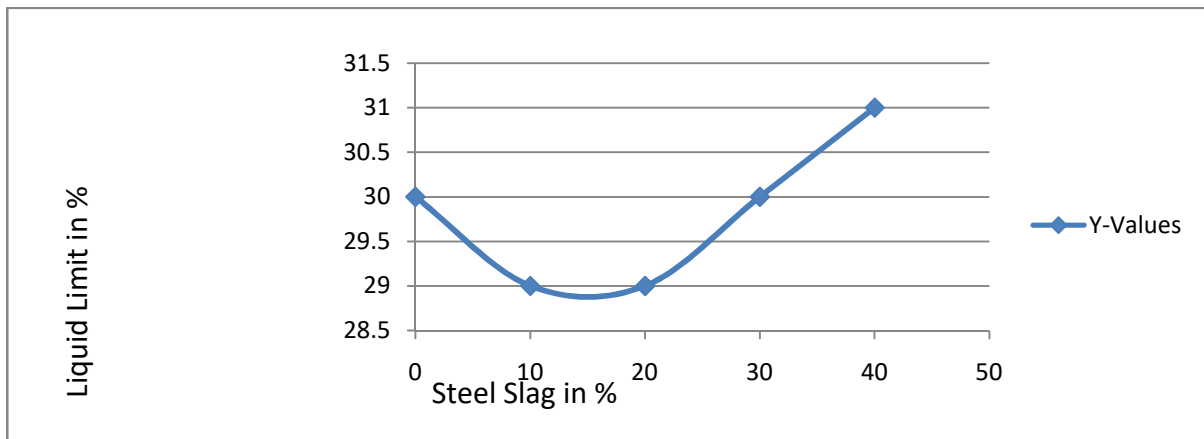
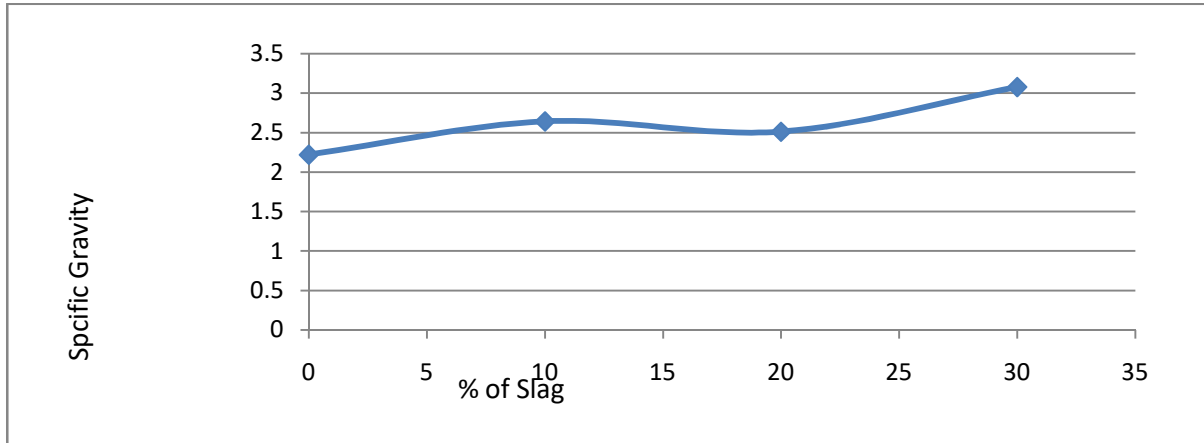
Property	Value
Los Angeles Abrasion (ASTM C131), %	20 - 25
Sodium Sulphate Soundness Loss (ASTM C88), %	<12
Angle of Internal Friction	40° - 50°
Hardness (measured by Mohr's scale of mineral hardness)*	6 - 7
California Bearing Ratio (CBR), % top size 19 mm (3/4 inch)**	up to 300
* Hardness of dolomite measured on same scale is 3 to 4.	
** Typical CBR value for crushed limestone is 100%.	

IX. RESULT AND CONCLUSION

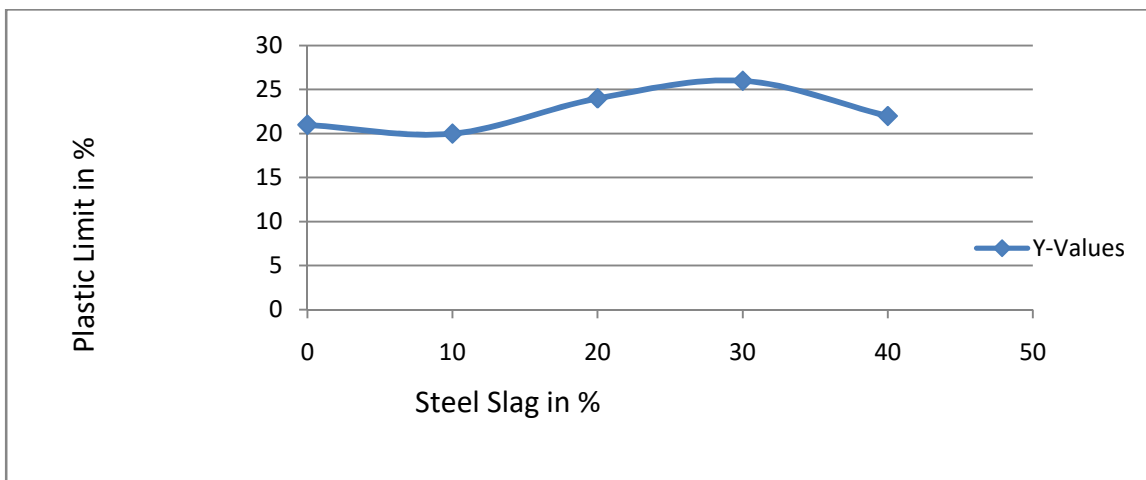
BC soil generally having property in its nature due to the presence water content. Because of this volume gets increased/ decreased with respect to the presence of moisture content. Due to this the strength or bearing capacity of black cotton soils may get increase or decreases according to the moisture levels in soils. India has large tracks of the expansive soil and many researchers doing their research on. expansive soil properties to meet the requirements.

Result Of Specific Gravity

SOIL	Specific Gravity
B.C Soil	2.22
BC Soil+10% slag	2.64
BC Soil+20%slag	2.51
BC Soil+30%slag	3.057



Plastic Limit



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