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Potential of Industrial waste zinc slag to stabilize weak soil.

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Abstract: The rapid growth of industrialization generates a large quantity of waste. Along with iron production, large amount of iron slag is generated. This waste of slag can be mixed with the soil as stabilizer to improve the strength of the soil and soil behaviour. Many areas in our country there is most of Black cotton soil is available. Black cotton soil is very poor in strength and highly compressible and has extremely low bearing capacity. The admixture iron slag added in the soil to improve soil behaviour and its strength. The tests performed for testing geotechnical properties are water content test, specific gravity test, sieve analysis test, liquid limit test, and plastic limit test. These tests are showed the results of iron slag improve the geotechnical properties of the soil samples and these waste material iron slag is useful for our black cotton soil.

I. INTRODUCTION

Black cotton soil is very favorable for the cultivation of cotton. It is called black cotton soil because it is black in color formed by the presence of titaniferous magnetite. Black cotton soils have montmorillonite clay mineral which shows swelling and shrinkage behavior on wetting and drying. The black cotton soils are highly compressible and have extremely low bearing capacity. We can see the cracks in many lands having black soil; this is because during the dry season they form the crack for circulation of air. Though it is very good soil for cultivation but it problematic soil for civil engineering work due to its swelling and shrinkage property In this research an approach is made towards the way of improvement in the various geotechnical properties of black cotton soil such as index properties, swelling characteristics and strength characteristics by blending it waste material.

The environmental problems are very common in India due to generation of industrial by products. Due to industrialization enormous by products are produced and to utilize these by products is the main challenge faced in India. Iron slag is one of the industrial by product from the iron and steel making industries. The history of the use of iron slag a long way. Considering the specificity of physical and chemical properties of iron slag This study show that using iron slag with black cotton soil in different percentage i.e5%,10%,15% resulted in plasticity index of soil. The strength of soil increase rapidly with increase the iron slag content and the optimum value P.I is obtained at 15%The result confirm that the use of iron slag overcome the pollution in the environment. The result shows that the iron slag added to the black cotton soil had greater strength.

II. LITERATURE REVIEW

The physical properties of Iron slag according to National Slag Association (NSA) Environmental Science& Technology [5] are angular shape, generally well-graded material, has a high degree of internal friction angle and high shear strength. Iron slag has high bulk specific gravity and usually less than 3% water absorption as well as dry unit weight 1600 – 1920 kg/m3, National Slag Association (NSA) Environmental Science& Technology. According to Proctor, the slag particle size is generally larger than silt or clay, which has an upper size 0.075 mm, and smaller than gravel which has a lower limit of 2 to 5 mm. The mechanical properties of Iron slag include good abrasion resistance, good soundness characteristics, and high bearing strength, Zumrawi and Khalill. Due to these mechanical properties Iron slag can be used as soil stabilization product in construction projects

The use of Iron slag has been established in a number of applications in the construction industry. Slag can be applied as a material in cement, as road base course material due to large bearing capacity and excellent in wear resistance as aggregate material for the asphalt concrete mixture as fine and coarse aggregates increment concrete mixture as improvement weak soil due to high angle of internal friction and high particle density.

III. MATERIALS USED

- **Soil:** Expansive black cotton soil collected from Vaishali Nagar, Nagpur. The properties of the expansive clay used in this investigation are given below:

Table: 1

Properties	**Soil**
Grain size distribution	425 micron
Specific gravity	1.56
Liquid limit	49.85%
Plastic limit	32.12%
Plasticity Index	17.73%

- **IRON SLAG:** Industrial waste product approx 5 kgs.

IV. TESTS CONDUCTED

Iron Slag in addition to the mixture, 5% of Iron Slag was also added to the soil mixture by weight. The percentage of Soil was maintained at a constant 5% by weight of the expansive soil sample, whereas the mixture of Iron Slag was increased in multiple percentages of 5% to obtain test samples on which tests were carried out and their properties studied. The proportions of Iron Slag used along with the soil in the study are 5%, 10%, 15% respectively. The following Tests were performed in order to check the properties of the expansive soil.

• **Liquid limit**

The liquid limit (LL) is conceptually defined as the water content at which the behavior of a clayey soil changes from the plastic state to the liquid state. However, the transition from plastic to liquid behavior is gradual over a range of water contents, and the shear strength of the soil is not actually zero at the liquid limit. We have taken magnesium sulphate by 10 % by the weight of soil.

Result: the liquid limit of soil comes out to be 51% with standard field soil.

• **Plastic limit**

All the tests were conducted in the controlled conditions as per the standard procedures given in the respective codes of Indian Standard.

V. RESULTS AND DISCUSSION

- **Liquid Limit:** The liquid limit (LL) is often conceptually defined as the water content at which the behaviour of a clayey soil changes from plastic to liquid.
- **Plastic Limit:** The plastic limit (PL) is defined as the water moisture content at which a thread of soil with 3.2mm diameter begins to crumble.

Table: 2

S.No.	Sample	Liquid Limit	Plastic Limit	Plasticity Index
1	Only Black cotton soil	49.14%	32.12%	17.73%
2	Soil Sample+ 5% Iron Slag	44.8%	30.59%	14.21%
3	Soil Sample + 10% Iron Slag	36.81%	25.25%	10.93%
4	Soil Sample + 15% Iron Slag	32.04%	23.29%	8.75%

From the above it shows that the Plasticity Index (PI) decreases with increase in the Iron slag content from 5% to 15%.

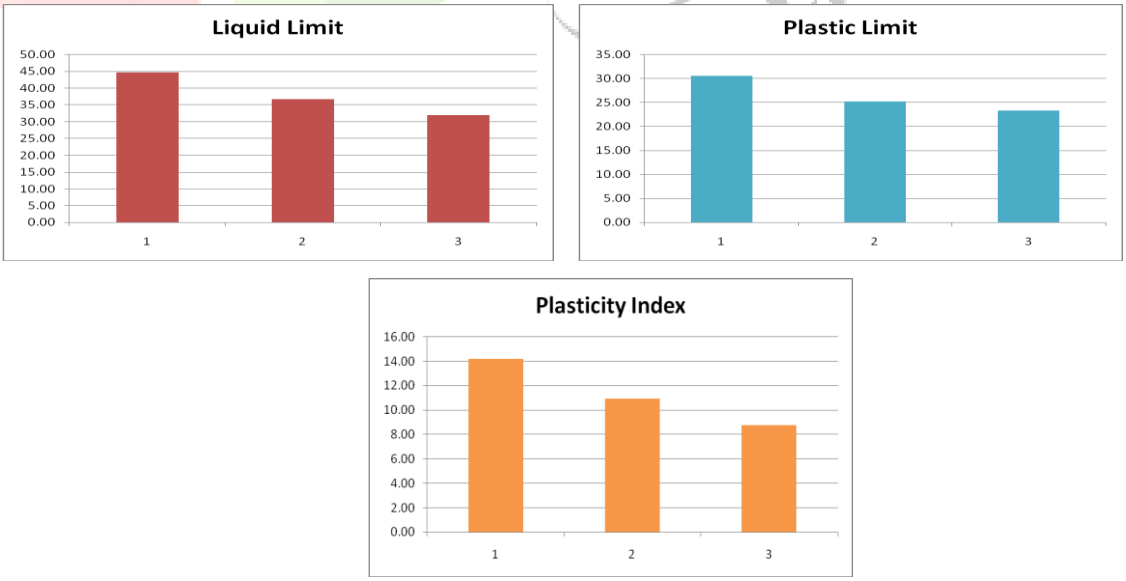
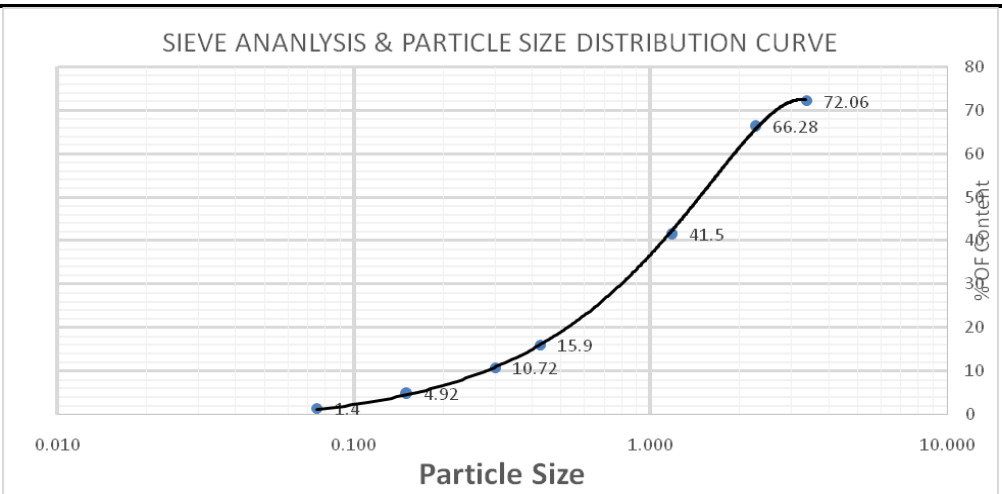


FIGURE 1. Graph representing Combine Liquid limit, Plastic limit and Plasticity Index of Potassium Chloride additive.



Cu = 0.63, Cc = 6.2

FIGURE 2. Graph representing Sieve analysis curve.

From graph it is seen that the soil is well graded soil.

VI. CONCLUSION

From the result it is clear that & addition of iron slag in expansive soil is possible and knows positive results with respect to improving Plasticity of soil. By using of iron slag resulted increase of plastic limits and decreases in Plasticity Index. The plasticity Index decreased from 17.73 to 8.75 of interacted soil sample us 17.73 which reduces gradually. The Plasticity Index from 17.73 to 8.75.

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