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# Soil Stabilization Study by using Steel Slag

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**ABSTRACT**

The growing needs for fully furnished highways in the developed countries has led engineers to search for the durable cost effective measure for roadway construction. The basic necessity for suitable base course for roads is an important aspect in construction. The paper aims at utilizing the common waste materials for the improvement of roads. One such material that was analyzed in the paper for the execution of road work is the steel slag which is furnished in tones in the steel factories across the country. The use of the material is found to have improved the sub grade properties of soil to a good extent.

## I. INTRODUCTION

Soil is a base structure which simply supports the shape from beneath and distributes the weight correctly. Stabilization of expansive soil has been done by addition of different types of materials like Cement, Lime, and Bitumen. Nowadays, the usage of waste materials for soil stabilization has become popular by considering environment and economy. Waste materials like Wood Ash, Steel Slag, rice husk ash, Silica Fume, Quarry Dust, Fly Ash have been used to improve the properties of expansive soils. Iron is the second most metallic element in the earth's crust and accounts for 5.6% of the lithosphere. It is becoming more attractive to reuse and recycle industrial wastes rather than disposing them off. Steel slag, a by-product of the conversion of iron to steel, is one of the industrial wastes having a large percentage still being disposed off in landfills and on dumpsites.

Past years, steel slag was not attractive because of the availability of large amount of blast furnace slag, which is considered more stable for direct use as a construction material than steel slag.

In the study, expansive soil is replaced with different proportions of Waste Iron slag and various tests are carried out to find the specific gravity, Atterberg limits, maximum dry density and California bearing ratio Values.

## II. MATERIALS

### 1. Soil

The soil sample chosen is the under construction highway stretch near police line Panchkula on NH 73, the stretch is the part of highway program from Panchkula to Saharanpur. The sub grade samples taken from the area were analyzed in the laboratory of Hindustan College of engineering and technology in Dusarka, Ambala situated on the same highway.

Table1:-Properties of soil sample

| | |
|---|---|
| Specific gravity | 2.47 |
| Liquid limit | 45.2 |
| Plastic limit | 34.94 |
| Plasticity index | 9.32 |
| Maximum dry density | 1.51 |
| Optimum moisture content | 19.26 |
| CBR | 7 |

### 2. Steel slag

The steel slag is collected from H.M Steel Ltd. Located Trilokpur road kala amb, himachal Pradesh.

Table2:-Chemical composition of steel slag

| Constituents | Composition(%) |
|---|---|
| CaO | 40-50 |
| FeO | 20-30 |
| $SiO_2$ | 10-20 |
| MgO | 5-10 |
| MnO | 5-8 |
| $Al_2O_3$ | 1-3 |
| $P_2O_5$ | 0.5-1 |
| S | <0.1 |

## III. RESEARCH METHODOLOGY

### 1. Specific gravity:-

The specific gravity of solid debris (G) is described as the ratio of the mass of a given amount of solids to the mass of an same amount of water at 4˚c. The gravity of solids at a particular point can be determine with the aid of pycnometer approach or density bottle method.

The pycnometer is used for determining the specific gravity of soil debris of both first-class grained and coarse grained soils. The willpower of particular gravity of soil will help within the calculation of void ratio, degree of saturation and unique soil properties.The fundamental measuring system on this check is pycnometer. A pycnometer is a jar made of glass about a litre capacity and fitted with a conical cap of

brass by means of a screw-type cover. The cap has a small hole of 6mm diameter at its apex. A rubber washer is placed between the cap and the jar to prevent leakage. There is a mark on the cap and also on the jar. The cap is screwed down to the same mark such that the volume of the pycnometer used in calculations remains constant.

**2. Liquid limit:-**

Liquid limit is defined as the minimum water content at which soil is in liquid stage of consistency or behave like a liquid or have tendency to flow. At liquid limit soil passes from liquid stage of consistency to plastic stage of consistency or visa-versa. For determination of liquid limit it is define as minimum water at which the standard groove part of soil cut of standard dimension flow together by the distance of half inch (12mm) under the impact of 25 blows in the device.

The liquid limit is determined in the laboratory either by Casagrande's apparatus or cone penetration method.

**3. Plastic limit:-**

Plastic limit is the water content below which the soil stops behaving as a plastic material. It starts to collapse while rolled right into a thread of soil of 3mm diameter. At this water content material , the soil loses its plasticity and passes to a semi-solid state. For determination of the plastic restriction of a soil, it is air-dried and sieved through a 425µ IS sieve.

**4. Plasticity Index:-**

Plasticity index is the range of water content over which the soil remains in the plastic state. It is equal to the difference between the liquid and plastic limit. Thus,

$$I_p = w_l - w_p$$

When either $w_l$ or $w_p$ cannot be determined, the soil is non-plastic (NP). When the plastic limit is greater than the liquid limit, the plasticity index is reported as zero (and not negative).

**5. Standard Proctor Test:-**

To determine the amount of compaction and the water content required in the subject , compaction checks are achieved on the same soil within the laboratory. The take a look at provide a relationship among the water content and the dry density. The water content at which the maximum dry density is attained is received from the relationships supplied by way of the checks.

**6. California bearing ratio test**

California bearing ratio (CBR) check is a sort of take a look at evolved by way of the California division of highways in1929. The take a look at is used for evaluating the suitability of subgrade and the material used in sub-base and base course. The take a look at effects have been correlated with the thickness of the diverse substances required for flexible pavements.The test may be conducted on a prepared specimen in a mould or on the soil in-situ condition.

## IV. AIM OF THIS STUDY

The study topic "analysis of soil stabilization of subgrade by using steel slag" by conducting the various tests. It has the following objectives under consideration

- To study the existing characteristic of the road.
- To determine the the specific gravity , consistency limits of the present soil.
- To determine the strength of the soil by using standard proctor test and CBR test.
- To look out the strength characteristics for various percentage of steel slag.
- To improve the engineering properties like bearing capacity of the soil.

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