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Stabilization of Soil by Using Iron Slag

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Abstract—*The main objective of this project work is to examine the effect when addition of 0%, 3%, 6%, 9%, 12% iron slag in the sandy soil for stabilization of soil and to determine its convenience, so this can be used in the construction of embankment, road and structural fills. The iron slag is possessed from Jaipur Steel Plant and the soil is taken from the ground field of Panchyawala, Jaipur for assessing its appropriateness as a development material for different geotechnical works. Its various properties are to be tested i.e. consistency, compaction properties and strength parameter. In this project, how the addition of iron slag effects the soil properties is examined and is collated with that of the simple soil. The whole testing was organized in 2 stages. In the previous stage, by performing Hydrometer analysis, Light compaction test and UCS test the study of physical engineering properties of the soil samples is done. In the another stage of the testing, sandy soil in which 0%, 3%, 6%, 9%, and 12% of iron slag as percentage of dry weight of soil is added.*

1. INTRODUCTION

Adjustment of soil in a more extensive sense is the alteration of the properties of a soil is enhancing its building execution. Primarily soil adjustment is extensively utilized as a part of the street development, asphalt and establishment development. After adding the iron slag in the soil there is improvement in the soil's engineering properties i.e. volume stability, strength, and durability as compared with the virgin soil sample. Soil stabilization occurs after a longer time period of curing which affect the various properties of soil. The effects of iron slag stabilization are usually measured after the period of 3-7 days. A soil sample in which iron slag is added, the changes in its properties may lead to stabilization. When appropriate contribution of iron slag is added to the soil, then soil is stablized.As stabilization is much different than the modification as strength increases. When 10% of iron slag is added to the soil then there is increase in the strength afterlong period of time. This Soil is usually found in warm temperature and in the areas where presence of mixed forest or deciduous is observed.

Generally, it is on the alluvial deposits on which the brown layer is resting, which overlayer the thin organic and inorganic mineral layer. Soil is gettable in many states of India. Soil is mostly found in Jaipur, Jalor, Bikaner, Jodhpur, Jaisalamer, Ganganagar, Barmer, Sirohi, Pali, Jhunjhunu, Sikar, Bhilwara, districts (Rajasthan).

The Iron slag is a waste by product produced by the iron or steel plants which can be utilized in the construction material for road, pavement, railway ballast, landfills etc.

2. OBJECTIVE OF THIS PROJECT

The aim of this project is follows;

- The engineering properties of soil sample, which are required for the construction of roads or pavement, is to be determined with the virgin soil as well as iron slag sample.
- Identification of best result i.e. ratio at which iron slag and virgin soil together giving maximum result.
- Effect of iron slag content on the properties of soil i.e. index properties, volume stability, persistence, Atterberg limit (i.e. liquid limit, swelling index) of sandy soil and iron slag mixture.

3. MATERIALS USED

3.1 Iron Slag

Iron Slag is the glass-like by product left finished after a coveted metal has been isolated from its crude metal. Slag is typically a blend of oxides of metals and dioxide of silicon. In any case, sulfides of metals and essential metals can be found in the slag. Iron slag is the co-product from the lessening of iron metals to deliver liquid iron and liquid slag. Press slag is utilized as a part of numerous fields where its exceptional attributes can be put to powerful use. It is stony waste issue isolated from metals amid the purifying metal. Press Slag is utilized everywhere throughout the world in street and railroad development and for building, and has numerous focal points over regular shake.

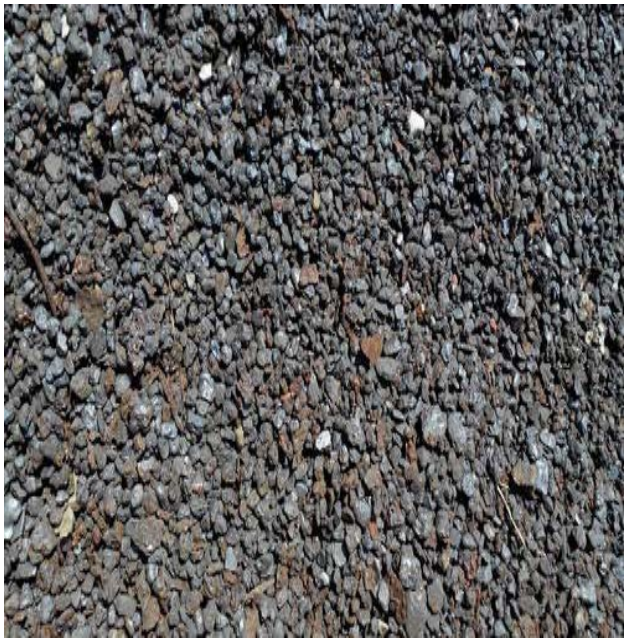


Figure 1: Iron Slag

3.2 Sandy Soil

Sandy soils are granular soils that contain little shake and mineral particles. The surface of sandy soils is typically abrasive. This dirt feels course whether it is dry or wet. Sandy soils are the consequence of the weathering and breaking down of an assortment of rocks, for example, stone, limestone and quartz. This sort of soil is anything but difficult to develop be that as it may, since it takes into account more waste than required, it is critical to water it consistently, particularly amid summer days. As sandy soils don't enable the water to pool around the roots, they are a decent decision for plants that tend to experience the ill effects of root rot.

Fig. 1 Sandy soil

4. METHODOLOGY

4.1 Liquid limit

As far as possible is most normally perform of the Atterberg Limits alongside as far as possible. These 2 tests are utilized globally to group soil. As far possible is characterize the dampness content at which soil start to act as a fluid and soil starts to stream. The fluid restrain is decide in the lab as the dampness content at which the two sides of a depression formed in soil come all the while and touch a separation of 2 inch after 25 blows. It is extremely dubious to motivate this to happen esteem precisely, we will perform the test over and over until the point when the score closes 1/2 inch with more than 25 blows. We can plot these outcomes as no of blow versus dampness content and add the dampness content at 25 blows from the chart.

4.2 Consolidation Test

Consolidation is a procedure by which the expulsion of water from the soil is done by applying the external load on it. ... In the Classical Method, which is created by Terzaghi, soils are tried with an odometer test to decide their pressure list. This can be utilized to anticipate the measure of solidification.

Apply an underlying setting burden to give a weight of 5 (2.5 for delicate soils) to the get together so that there is no swelling. Permit the setting burden to remain till there is no adjustment in the dial measure perusing or for 24 hours.

4.3 Free Swelling Index

Free swell index is the expansion in volume of soil within 24 hours with no outer restriction when subjected to submergence with water and lamp fuel.

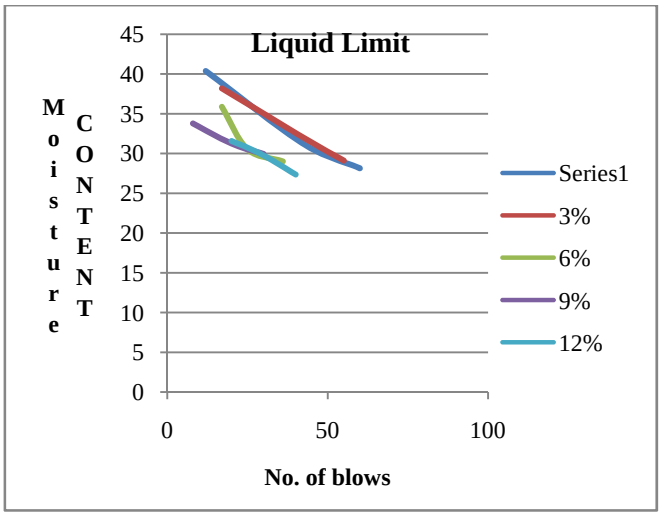
4.4 California bearing ratio (CBR): The California bearing ratio (CBR) test is an empirical penetration test, evolved for the empirical method of flexible pavement design. This test has been standardised by the Bureau of Indian Standards (BIS) and has been recommended for evaluation of sub grade soil by the Indian Roads Congress (IRC). The CBR test is carried out in the laboratory on soil specimens compacted to desired density and soaked in water. This test is also carried out to evaluate the strength of other flexible pavement component materials.

4.5 Permeability

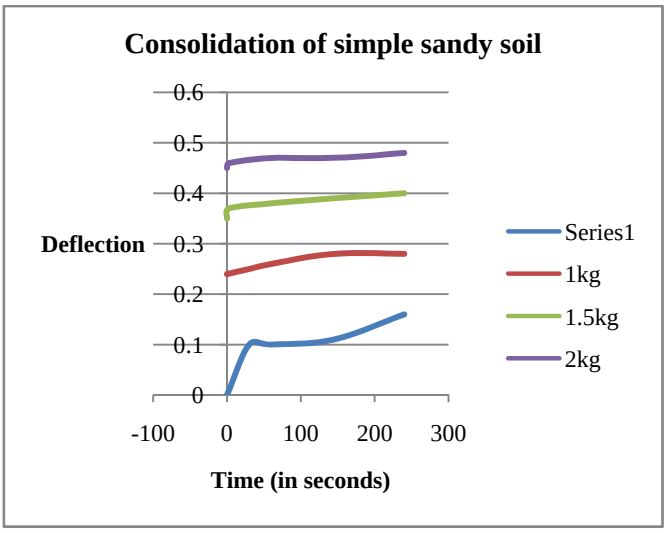
The permeability is rate of flow of water under bedded condition through a limit crisscross area perpendicular to the direction of flow through a permeable medium under the hydraulic gradient & under temperature conditions.

TABLE 1 Engineering Property of Sandy Soil

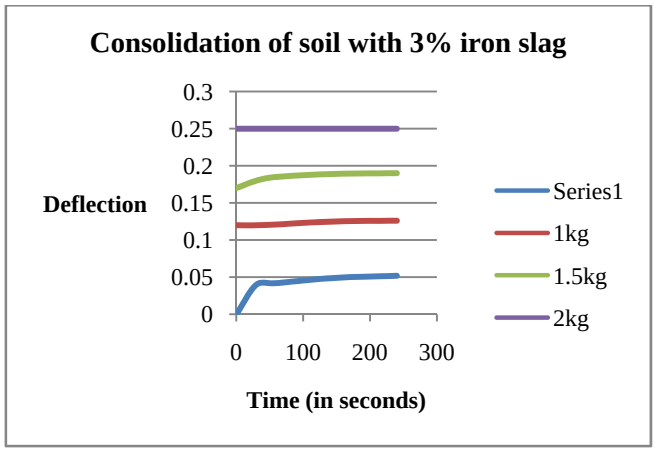
Liquid limit	35.47%
Free swelling index	13.79%
Permeability Constant	2.12
Specific gravity	2.64
Moisture content	11.15%



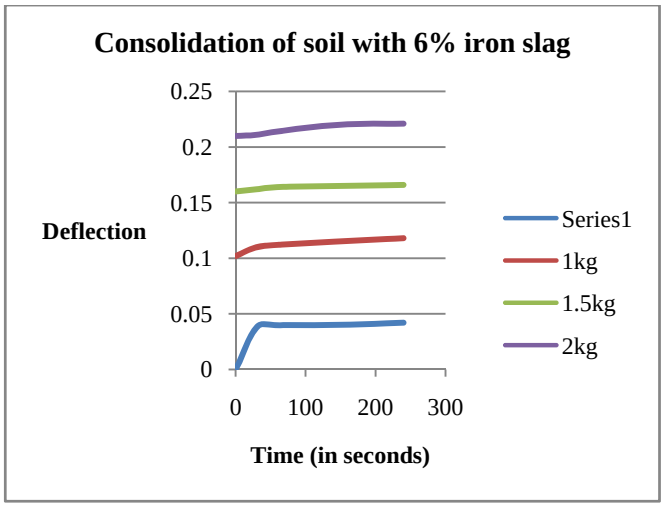
Graph 1 : Liquid limit



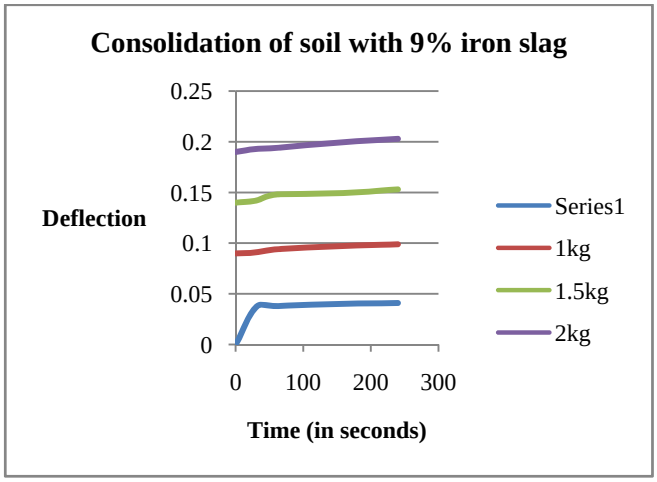
Graph 2(a): Consolidation



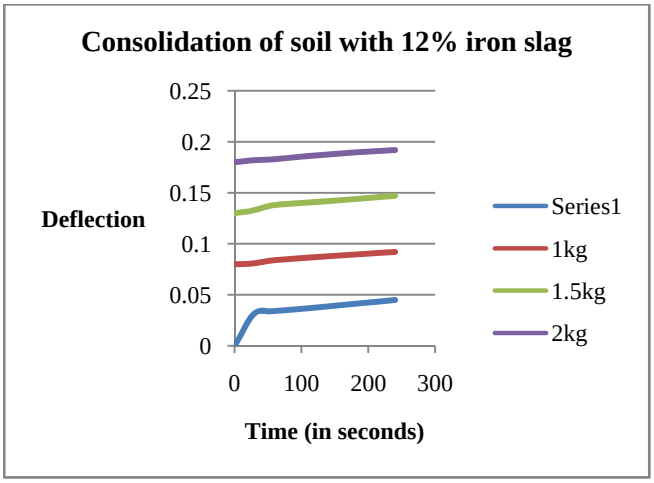
Graph 2(b): Consolidation



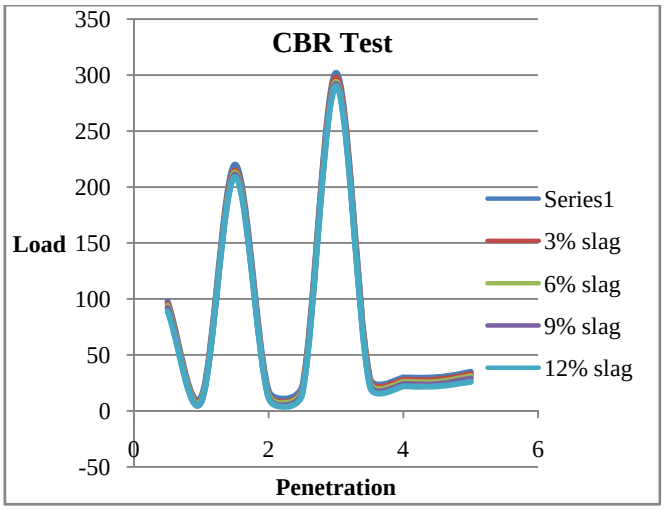
Graph 2(c): Consolidation



Graph 2(d): Consolidation



Graph 2(e): Consolidation



Graph 3: CBR test

4.6 Variation of Free Swelling Index, Liquid limit & Permeability test After Adding 3%, 6%, 9%, 12% Iron slag

Property	%	Property	%	Property	%
Liquid limit for soil sample	35.47 %	Free swelling index for sandy Soil	13.79 %	Permeability for sandy soil sample	2.12
Liquid limit for soil + 3%Iron Slag	32.38 %	Free swelling index for sandy Soil+3%(IS)	10.34 %	Permeability for sandy soil sample +3% iron slag	1.91
Liquid limit for soil + 6%Iron Slag	30.53 %	Free swelling index for sandy Soil+6% (IS)	8.6%	Permeability for sandy soil sample +6% iron slag	1.86
Liquid limit for soil + 9%Iron Slag	30.05 %	Free swelling index for sandy Soil+9% (IS)	6.89%	Permeability for sandy soil sample +9% iron slag	1.77
Liquid limit for soil + 12%(IS)	29.11 %	Free swelling index for sandy Soil+12% (IS)	5.17%	Permeability for sandy soil sample +12% iron slag	1.71

5. RESULTS AND DISCUSSION

5.1 Liquid Limit

As far as possible test is resolved for plasticity index. in as far as possible test included diverse % of impact iron slag then as far as possible is decreases, so that there is decrease in the plasticity.

5.2 Consolidation test

The expansion of water of the soil sample with different % (0%, 3%, 6%, 9, and 12%) of iron slag added in it is determined in different curing period as far as possible is decreases.

5.3 FREE SWELLING INDEX

In free swelling index test, swelling index is determined. In the test free swelling index, iron slag is added in the different % then there is a decrease in the swelling index.

6. CONCLUSION

This investigation has focused on the impact of Iron Slag stabilizer on building properties specifically the swelling and quality properties of a very far reaching soil. In view of the examination discoveries, the accompanying conclusions are drawn:

The basic properties of the soil studied were determined, clay content 86%; liquid limit 35.47%; permeability 89.81%; free swell index 13.79%;. The soil is classified as high expansive clay.

As far as possible reductions with an expansion in Iron Slag content. Expansion of Iron Slag to the far reaching soil is causing around 9.5% diminishment in as far as possible incentive at 3% of Iron Slag.

Free swell list is altogether diminished as Iron Slag increments. At 3% Iron Slag, the free swell record of the dirt is diminished and the decrease watched is very nearly 33.36%.

Permeability decreases with the increase in Iron slag content. At 3% Iron Slag, the permeability of the soil is decreased and reduction observed is almost 11.34%.

Expansion of Iron Slag has significant impact on compaction qualities of the balanced out soil. An expansion in Iron Slag content prompts a huge increment in most extreme go thickness away to 10% Iron Slag and past this rate.

Encourage expansion of Iron Slag is causing steady decline in MDD, while a significant abatement in OMC is seen with expanding level of Iron Slag. Along these lines, an ideal estimation of Iron Slag might be taken as 10% as for compaction parameters.

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