



Experimental Investigation of Improvement of Soil using Ground Granulated Blast Furnace Slag

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Abstract:

Soil is one of the nature's most abundant construction materials. Almost all type of construction is built with or upon the soil. If the foundation is not enough good the whole structure will face failure such as cracks. Therefore the foundation is normally replaced with stronger soil material so as to improve the strength but this is not economical. In this project the strength of soil is increased conducted by GGBS instead of replacing with stronger soil. The field test is added to the 15% of the GGBS. The properties of the soil is determined by conducting soil tests such as Nature moisture content tests, sieve analysis, liquid limit, plastic limit, free swell, standard Proctor compaction, unconfined compression test and. The results obtained are then compared with the soil treated with 5%, 10%, 15%, 20%, and 25% of GGBS.

Keywords: GGBS, Atterberg limit's, unconfined compressive strength.

1. INTRODUCTION

The foundation is very important and has to be strong enough to support the entire structure. In order for the foundation to be strong, the soil around it plays a very critical role. So we need to have proper knowledge about their properties and factors which affect their behavior to work with soil.

The process of soil stabilization helps to achieve the required properties in a soil needed for the type of construction work. In the thesis, the strength of the soil is improved by using GGBS. GGBS is a mixture of water. The different percentage of GGBS using in the soil. The laboratory test is mixture of GGBS is 5%, 10%, 15%, 20%, 25% .

The field test using in the GGBS is 15% The properties of soil are determined by using conducting sieve analysis, plastic limit, liquid limit, specific gravity and shrinkage limit. The strength of soil is determined by modified proctor compaction test and California bearing ratio tests and the results are compared with the soil after treated with GGBS

2. MATERIAL USED

2.1 Ground granulated blast furnace slag

It is most suitable for the increasing the strength of the soil . To control the swell shrink characteristics caused by moisture changes and durability To increase the resistance to a erosion, weathering. it is a quenching molten iron slag from a blast furnace in water or steam to produce a glassy granular product that is then dried and a fine powder. it is lower viscosity of water use of significantly reduce the risk of damage caused by alkali silica reaction provide higher resistance the risk of reinforcement corrosion and provides higher resistance to attack by sulfate and other chemicals



3. EXPERIMENTAL WORK

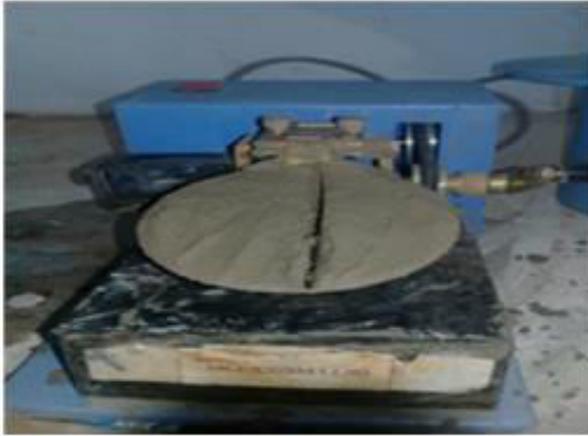
In this project have conducted various experiment to find stabilization of soil using GGBS. The various test are conducted to find the stabilization of soil on ASTM procedure are listed below

- 3.1 Liquid limit
- 3.2 plastic limit
- 3.3 sieve analysis
- 3.4 Nature moisture content
- 3.5 Differential free swell
- 3.6 specific gravity
- 3.7 standard proctor compaction
- 3.8 unconfined compressive strength

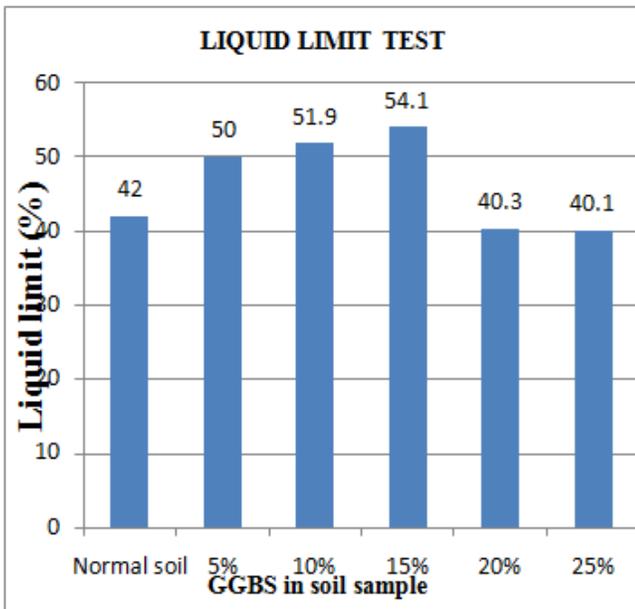
3.1 Liquid limit

Liquid limit is defined as the moisture content at which soil is begins to behave as a liquid limit material and begins to flow.

Different soils have vary liquid limits also once must use the plastic limit to determine its plasticity index



S.NO	SAMPLE	LIQUID LIMIT(%)
1	Normal soil	42
2	Soil with 5% GGBS	50
3	Soil with 10% GGBS	51.9
4	Soil with 15% GGBS	54.1
5	Soil with 20% GGBS	40.3
6	Soil with 25%GGBS	40.1

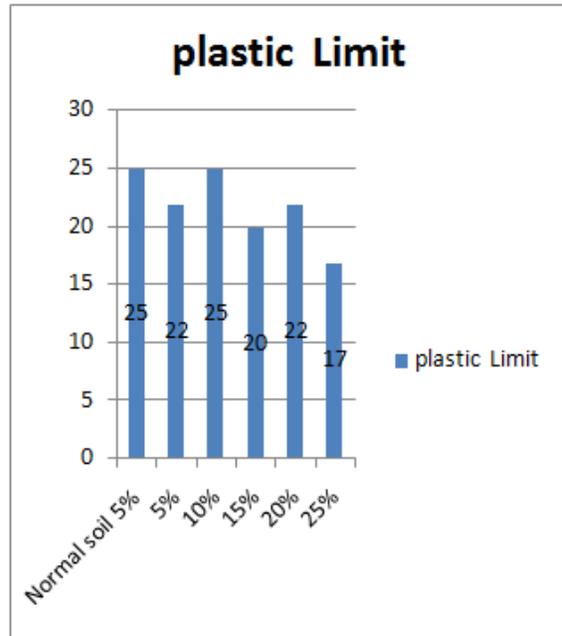


3.2 Plastic limit

It is defined as the projectst moisture content and expressed as a percentage of the oven dried soil at rolled in to the threads one-eighth inch in a diameter without soil breaking in to pieces.



S.NO	Sample	Plastic limit(%)
1	Normal soil	25
2	Soil with 5% GGBS	22
3	Soil with 10% GGBS	25
4	Soil with 15% GGBS	20
5	Soil with 20% GGBS	22
6	Soil with 25% GGBS	17



3.3 sieve analysis

A sieve analysis is a practice or procedure used asses the practice size distribution of a granular material



3.4 Nature moisture content

The soil moisture content is the amount of water which can be removed when soil sample is dried at the temperature of 105°C moisture content present usually expressed as a percentage of the dry mass.

calculation

Weight of the container = 44 gms
 Weight of the container + wet soil = 144gms
 Weight of the container + dry soil = 124 gms
 Weight of dry soil = 80 gms
 Weight of water = 20 gms

$$W = [(w_2 - w_3) / (w_3 - w_1)] \times 100$$

$$= [(144 - 124) / (124 - 44)] \times 100$$

$$= (20 / 80) \times 100$$

$$= 25\%$$

The nature moisture content is 25%

3.5 Differential free swell test

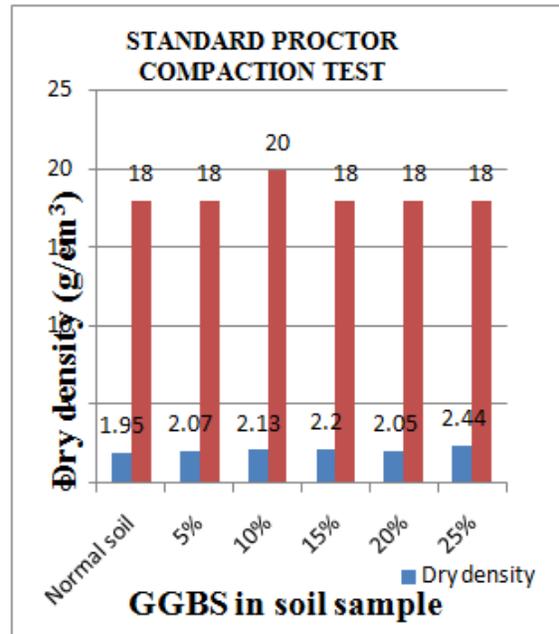


The free swell index of clay for untreated soil is found to be 50%. So degree of expansion is very high.

3.6 Standard proctor compaction

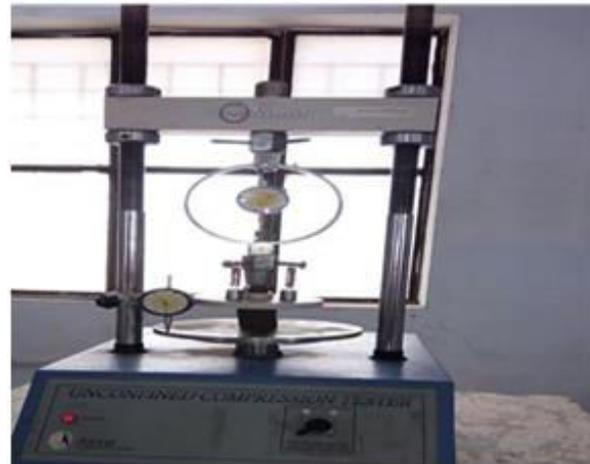


S.NO	SAMPLE	MAXMIMUM DRY DENSITY(g/cm ³)	OMC
1	Normal soil	1.95	18
2	Soil with 5%GGBS	2.07	18
3	Soil with 10% GGBS	2.13	20
4	Soil with 15% GGBS	2.20	18
5	Soil with 20%GGBS	2.05	18
6	Soil with 25% GGBS	2.44	18

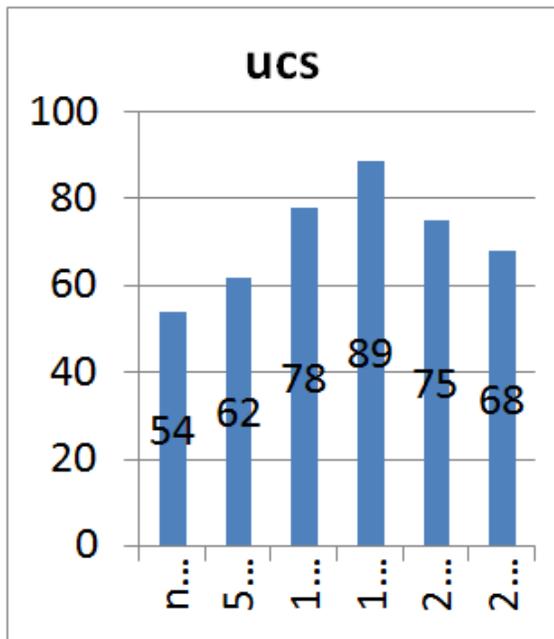


3.7 Unconfined compressive strength

This test is to determine the shear parameters of the soil. The primary purpose of this test is to determine the unconfined compressive strength, The unconfined strength and cohesive strength is obtained by conducting Unconfined Compressive Strength

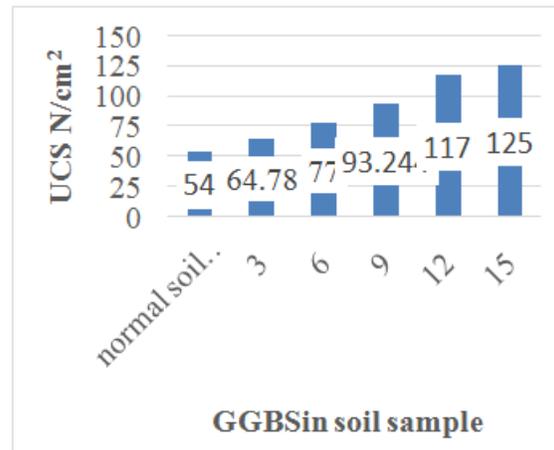


s.no	Sample	Unconfined compressive strength(N/cm ²)
1	Normal soil	54
2	Normal soil with 5% GGBS	62
3	Normal soil with 10% GGBS	78
4	Normal soil with 15% GGBS	89
5	Normal soil with 20% GGBS	75
6	Normal soil with 25% GGBS	68



3.8.2 unconfined compressive strength

s.no	sample	Ucs(N/cm ²)
1	Normal soil	54
2	3 days	65.78
3	6 days	77
4	9 days	93.27
5	12 days	117
6	15 days	125
7	18 days	133

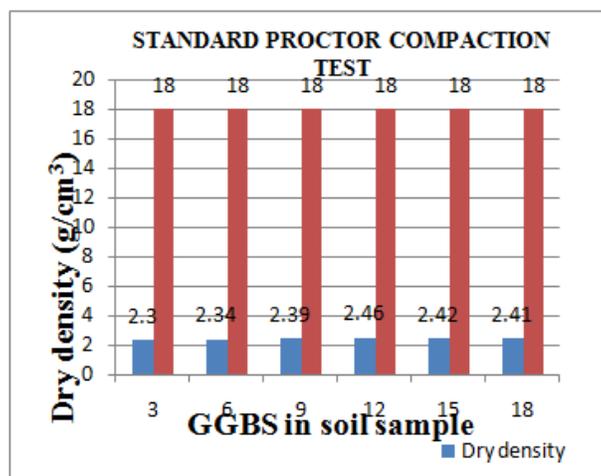


3.8 field test

The amount of soil moisture or water content held in the soil after excess water has drained away and the rate of the downward movement has decreased. The field capacity is characteristic by measuring water content after wetting a soil profile covering it and monitoring the change soil moisture in the profile. When the rate of change of water content is relatively small is indicative of when drainage ceases and is called field capacity.

3.8.1 standard proctor compaction

s.no	Sample	Max dry density	Omc
1	3 days	2.3	18
2	6 days	2.34	18
3	9 days	2.39	18
4	12 days	2.46	18
5	15 days	2.42	18
6	18 days	2.41	18



4. CONCLUSION

This study made a comprehensive examination of the effectiveness of soils on the performance of GGBS. The characteristics of soil sample were known from the tests conducted and the similar tests are conducted for the soil sample mixed with four different proportions of GGBS (5%,10%, 15%,20%,25%). Test result indicate that with the increase of GGBS in the soil sample till 15% proportion ratio the soil strength is increased and after certain percentages (20% and 25%) its getting decrease. The results are shown that the strength of the soil is good when 15 % GGBS is added. The field test are 15% GGBS is added . the strength increased in 12days and the (15 and 18 days) are the strength is decreased.

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