

Stabilization of Black Cotton Soil of Atali Village Using Groundnut Shell Powder

Pratik V. Shah¹, Pavasiya Dishant², Harshil R. Bhavsar³

Asst. Professor, Dept. of Civil Engineering, R. N. G. Patel Institute of Technology-Isroli, Surat, Gujarat, India¹

Pursuing B. E., Birla Vishvakarma Mahavidyalaya Engineering College, Anand, Gujarat, India,²

Lecture, J. H. Desai Polytechnic-Palsana, Surat, Gujarat, India³

ABSTRACT: Soil stabilizing is a very old technique and the best way to improve the soil properties which are weak. And in that too the black cotton soil is very poor in carrying the load. These study aims to evaluate the use of Groundnut Shell Powder (GSP) as a soil stabilizing agent for Black Cotton Soil. The groundnut shell are easily available as well as it is economical. The GSP was added as 2%, 4%, 6%, 8%, and 10%. The testing was carried out on normal soil as well as the after % addition of the GSP, various physical and mechanical properties of the soil were determined as per Indian Standard 2720. The result shows that there is a decrease in the UCS value and also the value of unsoaked CBR. BThe optimum dosage for the GSP was found to be 10%. The stabilized soil with 10% GSP can be used for the sub grade as it is having the higher value of CBR and UCS compared to other dosage of GSP and is having low value of FSI.

KEYWORDS: Soil Stabilization, Groundnut Shell Ash, Black cotton soil, UCS, FSI and unsoaked CBR.

ABBREVIATIONS:

CBR	= California Bearing Ratio	FSI	= Free Swell Index
GSP	= Groundnut Shell Powder	LL	= Liquid Limit
MDD	= Maximum Dry Density	OMC	= Optimum Moisture Content
PL	= Plastic Limit	SL	= Shrinkage Limit
UCS	= Unconfined Compressive Strength		

I. INTRODUCTION

For any construction work, the foundation is the most important. As well as the foundation soil should be strong enough to carry the load. The soil is the basic material which is widely used for the construction purpose. Quality of road depends upon the foundation. And in south Gujarat region we can find most probably black cotton soil which is good for the agriculture purpose but very poor to be used as a construction material. Because it is having very low bearing capacity and very high swelling. And while using for the road construction it is very poor material. So to improve the property of black cotton soil stabilization is the best way. It helps in improving the mechanical and physical properties of the soil, e.g:

- Strength - to carry the load coming over it without any deformation,
- Volume stability - to control its volume change property i.e. sometimes the soil swells and sometimes shrinks,
- Durability - there is increase in resisting the weathering and traffic loading.
- It helps in reducing the pavement thickness and it's construction cost.

For soil stabilizing there are many methods like chemical, cement, lime, bitumen stabilization etc. Some of the waste materials which can be used for stabilization are groundnut shell powder, glass powder, rubber crum, fly ash, quarry dust, municipal waste, egg shell powder etc.

II. MATERIAL USED

Expansive Soil

Various black cotton soil from Gujarat region were available for study purpose like Olpad Region from Surat, Monpar Region from Saurashtra and from Atali Village near Dahej Region, all the selected regions were from the Gujarat State. And we have selected the Atali Village soil for stabilization purpose as it was having more swelling properties

compared to the other region soil. The soil was collected from 0.5 m depth after cleaning up the surface. And the soil was having lumps and a natural moisture content of 9%. The soil was having a FSI of 90% which is expansive in nature. From its liquid limit of 49% and plastic limit of 26%, the soil was classified into CH type as per the IS : 1498.

Groundnut Shell Powder (GSP)

For this study we have selected the agricultural waste and in that to groundnut shell powder to stabilize the soil. The groundnut shell was obtained from an oil mill named Lakhani Mini Oil Mill situated in Sayan in Gujarat. Than groundnut shell were burned to make it in the powder form at the college campus only. The GSP was carefully sieved through 0.075 mm to remove unwanted materials.

Groundnut Shell Powder Properties

A sample of the ash was analysed for its oxide composition; the results are summarized in Table 1.

Table -1: Oxides content of black cotton soil and GSP-

Oxides	Groundnut Shell Ash (%)	Black cotton soil (%)
CaO	10.91	-
SiO ₂	33.36	31.01
Al ₂ O ₃	6.73	16.19
Fe ₂ O ₃	2.16	4.74
Mn ₂ O ₃	4.72	-
TiO ₂	-	1.34
Na ₂ O + K ₂ O	25.38	-
MgO	4.72	-
-SO ₃	6.40	-
CO ₃	6.02	-

THE MIX PROPORTION

The soil was mixed with GSP in different proportions. The proportions were at an interval of 2% i.e. 0%, 2%, 4%, 6%, 8%, and 10%.

III. EXPERIMENTAL WORK

The experimental work was carried out as the per the Indian Standard 2720 for finding out the various parameters described below. And the experiments were done in the Bhumi Research Laboratory, Surat.

First the various physical properties were done like Grain Size Analysis (IS - 2702 Part - 4), Specific Gravity (IS - 2720 Part - 3), Liquid Limit and Plastic Limit (IS 2720 - Part - 5), Standard Proctor Test (IS - 2720 Part - 7) was carried out to find the MDD and OMC on various mix proportion described above. Than the California Bearing Ratio (IS - 2720 Part - 16) and Unconfined Compressive Strength (IS - 2720 Part - 10) were tested on MDD and OMC obtained for different proportions. The unsoaked CBR testing were done.

Table -2: Properties of black cotton soil + % GSP

% GSP	0	2	4	6	8	10
LL (%)	49	50.78	51.92	59.43	62.76	89.3
PL (%)	26	27.35	26.66	26.4	27.13	27.41
SL (%)	20.79	27.37	27.16	26.01	25.72	22.11
MDD (gm/cc)	1.46	1.49	1.51	1.46	1.48	1.49
OMC (%)	19.51	17.1	15.18	25	18.08	17.9
UCS (kg/cm ²)	3.34	3.8	3.86	2.79	2.24	2.99
CBR (%)	11.44	10.51	10.54	7.5	14.52	11.23
FSI (%)	90	88.88	63.63	54.54	41.66	25

IV. RESULTS & CONCLUSIONS

After adding the GSP in the black cotton soil, the index properties like liquid limit was increased whereas plastic limit remain constant. And there is nominal reduction in the shrinkage limit. The research was stop at the 10% replacement of soil due to increase in the liquid limit of the soil.

From the research we can conclude the following points:

- The result indicates that at 4% of GSP + Soil there is increase in the value of UCS as well as of CBR.
- There is increase in the value of Liquid Limit by 82.25% on adding the GSP.
- The results of Free Swell Index (FSI) shows that there is a drastic reduction in its volume change from 90% to 25%.
- The reduction in the FSI was by 72.22%.
- The optimum dosage for the GSP was found to be 4% for using the stabilized soil as a foundation material in construction because it has the highest value of UCS but the FSI is 63.63% therefore the soil cannot be used because it is having value greater than 50%.
- The optimum dosage for the GSP was found to be 4% for using the stabilized soil as a foundation material for flexible pavement because it has the highest value of CBR.
- And at 10% dosage of GSP it was found that the value of UCS and CBR get reduced to 2.99 kg/cm² and 8.45% respectively. The value are lower than the original value of the black cotton soil but the FSI is very low which is 25% compared to the other dosages.
- For 10% dosage of GSP there is almost same amount of reduction in the value of UCS and CBR i.e. 10.48% from the original value.

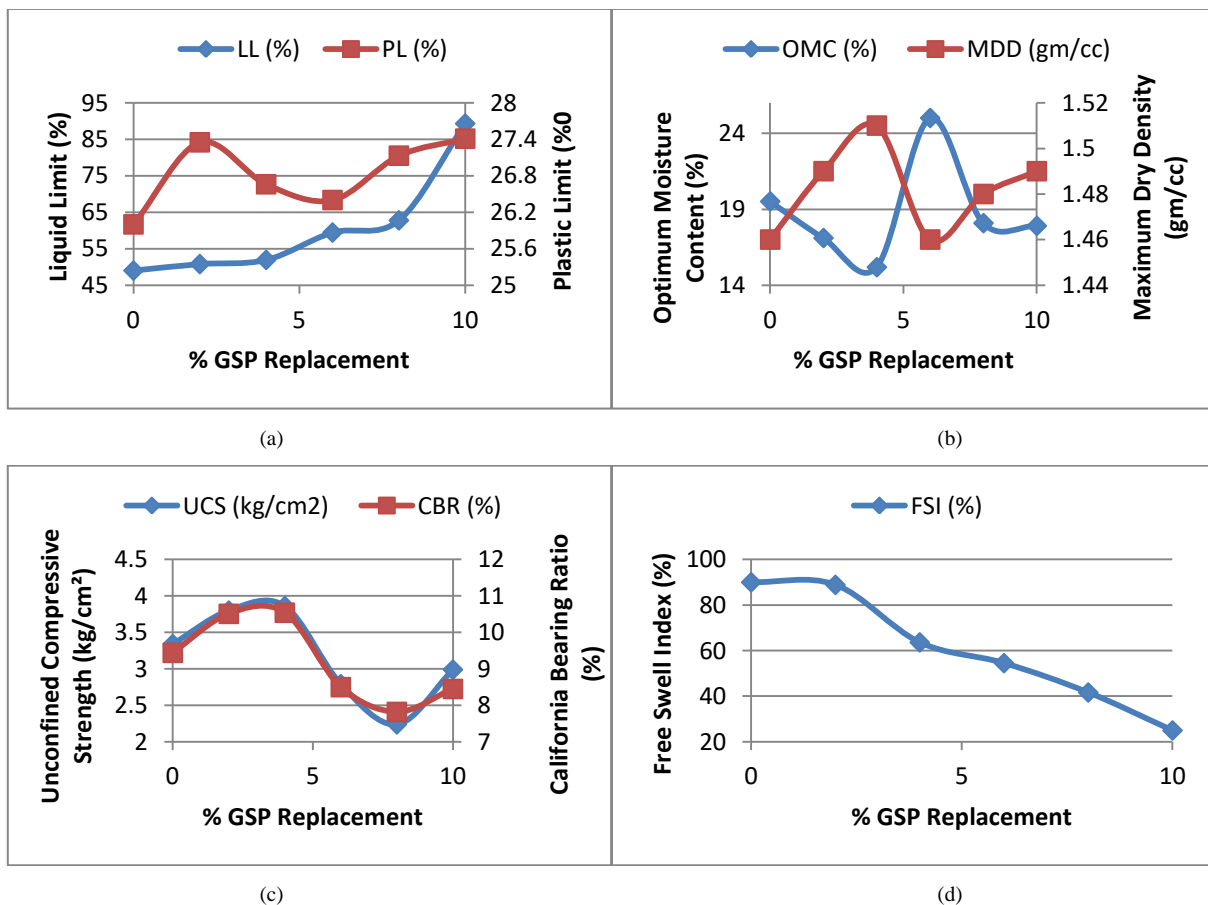


Fig. 1 Variation of (a) Liquid Limit & Plastic Limit (b) Maximum Dry Density & Optimum Moisture Content (c) California Bearing Ratio & Unconfined Compressive Strength (d) FSI all with % GSP Replacement



REFERENCES

1. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain. 2005. Soil Mechanics And Foundations. Delhi - 110002: Laxmi Publications (P) Ltd.
2. I. S. 2720 (Part - 16) : 1987. "Laboratory determination of CBR."
3. I. S. 2720 (Part - 3) : 1980 Sec/2. "Determination of specific gravity of fine-grained soil."
4. I. S. 2720 (Part - 4) : 1985. "Determination of Grain size analysis."
5. I. S. 2720 (Part - 40) : 1977. "Determination of free swell index of soils."
6. I. S. 2720 (Part - 5) : 1985. "Determination of Liquid and Plastic Limit."
7. I. S. 2720 (Part - 7) : 1980. "Determination of water content - dry density relation using light compaction."
8. I. S. 2720 (Part -10) : 1991. "Determination of Unconfined compressive strength."
9. N. V. Gajera and K. R. Thanki. 2015. "Stabilization analysis of black cotton soil by using Groundnut shell ash." International Journal for Innovative Research in Science and Technology 2:158-162.