

Stabilization of Black Cotton Soil of Delad Region Using Iron Dust

Pratik V. Shah¹, Harshil R. Bhavsar²

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

Lecturer, J. H. Desai Polytechnic-Palsana, Surat, Gujarat, India²

ABSTRACT: Generally Soil Stabilization is done for the improving the soil properties to with stand the load coming over it. In these study we have used iron dust as a soil stabilizing agent for Black Cotton Soil. The iron dust was added as partial replacement of the soil in 3% i.e. 0%, 03%, 06%, 09%, 12%. The testing was carried out on soil as well as the after % addition of the iron dust, various physical and mechanical properties of the soil were determined as per Indian Standard 2720. The optimum dosage for the iron dust was found to be 9%. The stabilized soil with 9% iron dust can be used for the sub grade as it is having the higher value of CBR and UCS compared to other dosage of iron dust which is having low value of FSI.

KEYWORDS: Soil Stabilization, Iron dust, 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 land-based structure, the foundation is very important. It has to be strong to support the entire structure. Good road network is the basic requirement for the overall development of an area, city, state or country. The black cotton soil was collected from the Delad village of Surat region. The soil stabilization is a solution to improve the index property as well as the mechanical properties of the soil. Conventionally the lime and cement are used for the stabilization purpose, but nowadays many waste alternatives are used for the stabilization of soil or to improve the properties of black cotton soil. Few waste materials are quarry dust, fly ash, ground nutshell powder, municipal waste, egg shell powder etc. The south Gujarat region is mostly covered with the black cotton soil and it is available in large amount.

BLACK COTTON SOIL

The black cotton soil has very low bearing capacity and high shrinkage and swelling properties. Due to these distinctive properties it is a very poor foundation material to be used in road construction. And to improve the physical and mechanical property of black cotton soil stabilization is the best alternative.

II. MATERIAL USED

SOIL

The various black cotton soil from Gujarat region was studied and from that Atali Village near Dahej Region of Gujarat was selected as it was having more swelling properties compared to the other region soil.

IRON DUST

The Iron Dust used for the study was taken from the Dahej, Gujarat. The Iron Dust was carefully sieved through 0.075 mm to remove unwanted materials.

IRON DUST PROPERTIES

A sample of the Iron Dust was analyzed for its oxide composition and properties are show in table - 1.



Table – 1: Oxides properties of Iron Dust and Black Cotton Soil

Oxides	Iron Dust (%)	Black cotton soil (%)
CaO	6.12	-
SiO ₂	1.30	41.01
Al ₂ O ₃	-	15.45
FeO	22.19	-
Fe ₂ O ₃	-	4.45
TiO ₂	-	0.79
MgO	0.24	-
Fe	62.53	-

THE MIX PROPORTIONS

The soil was mixed with iron dust in different proportions. The proportions was at an interval of 3% i.e. 0%, 3%, 6%, 9%, and 12%.

III. EXPERIMENTAL WORK

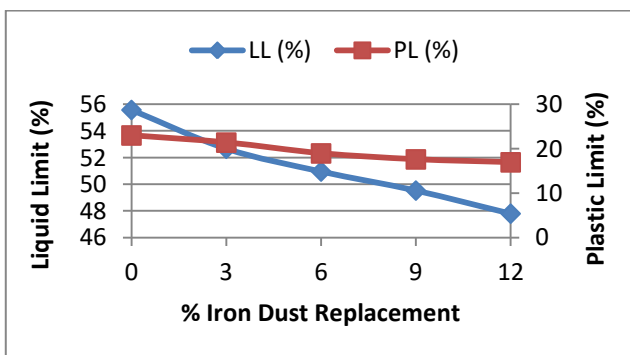
The testing was done as per Indian Standard for various physical and mechanical properties of the soil and soil + iron dust. The iron dust was added in 3%, 6%, 9% and 12%. The purpose of this study was to improve the strength as well as the bearing capacity of the black cotton soil.

IV. RESULTS & CONCLUSION

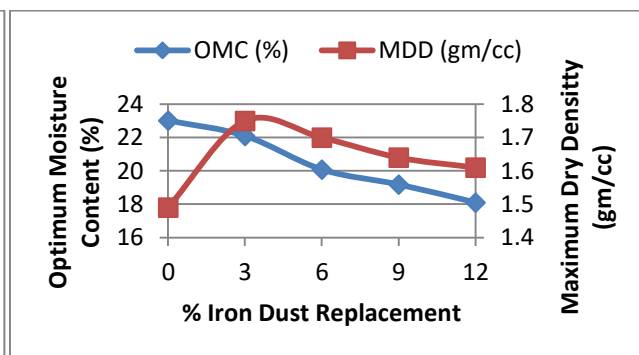
After adding the iron dust in the black cotton soil, the index properties were increased as well as the mechanical property of the soil. Following table shows the result of the soil stabilize with iron dust. As the iron dust proportions increases there is decrease in the FSI of the soil.

Table – 2 Properties of Soil with % Iron Dust Replacement

% Iron Dust	0	3	6	9	12
LL (%)	55.58	52.67	50.96	49.53	47.8
PL (%)	23	21.39	18.96	17.61	16.95
MDD (gm/cc)	1.49	1.75	1.7	1.64	1.61
OMC (%)	23.02	22.1	20.08	19.18	18.1
UCS (kg/cm ²)	2.08	5.1	1.38	3.46	2.59
CBR (%)	7.5	14.28	7.17	12.62	11.26
FSI (%)	70	50	40	35	20



(a)



(b)

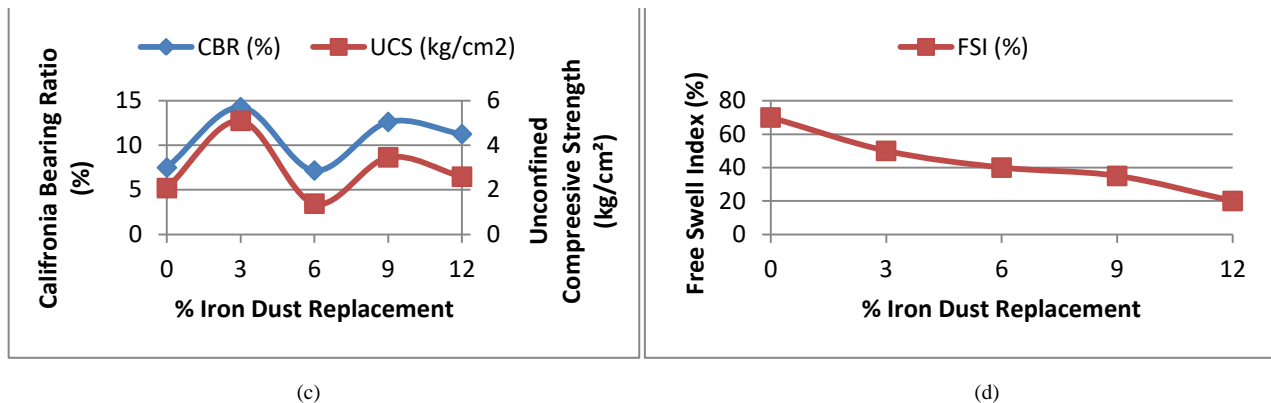


Fig. 1 Variation of (a) Liquid Limit & Plastic Limit (b) Maximum Dry Density & Optimum Moisture Content (c) California Bearing Ratio & Unconfined Compressive Strength (d) FSI all with % Iron Dust replacement

- There is decrease in the liquid limit on adding the iron dust by 14.00%.
- The results indicates that when iron dust is added by 3% there is highest value of UCS and CBR, but the value of FSI is 50% so it can't be used.
- There is also reduction in the moisture content of the soil on adding the iron dust by 21.37%.
- The results of Free Swell Index (FSI) shows that there is a drastic reduction in its volume change from 70% to 20%.
- The optimum dosage for the iron dust was found to be 9%. The stabilized soil with 9% iron dust can be used for the sub grade as it is having the higher value of CBR and UCS compared to other dosage of iron dust which is having low value of FSI.

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