Black Cotton Soil Stabilization using Plastic and Glass Fibres

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Abstract: Soil stabilization is the process which enhances the properties of soil by mixing of different admixtures in various proportions. Stabilization increases the load bearing capacity of soil by mixing of glass and plastic fibre in different percentage in expansive soils. In this paper, effect of mixed plastic and glass fibre in varying proportion on Mass Dry Density (MDD), Optimum Moisture Content (OMC), specific gravity and California Bearing Ratio (CBR) on Black Cotton Soil has been discussed. The percentage of plastic and glass fibre by dry weight of soil was taken as 5%, 10% and 20% and plastic fibre was mixed with glass at 6% constantly. By using the above test on the black cotton soil the compressive strength and and its property is increased by using plastic fibre and glass as an admixture.

Keywords: plastic granules, glass, specific gravity, ultimate, bearing strength, CBR, OMC, MDD.

I. INTRODUCTION

The growth of the population has created a need for better and economic operation which requires having good proper condition of soil. They have to be maintained so that comfort and safety are provided to the soil. Cost effective construction are very important for economical growth in any country. There is an urgent need to identify new construction materials to improve the soil in construction industry. Commonly used materials are fast depleting and this has led to an increase in the cost performance in construction industry. Hence, the search for new materials and improved techniques to process the local materials has received an increased impetus. When poor quality soil is available at the construction site, the best option is to modify the properties of the soil so that it meets the pavement design requirements. This has led to the development of soil stabilization techniques.

Stabilization is the process which improves the properties of the soil using the various methods. Soil stabilization can stabilize the chemical properties and physical properties of expansive soil. Black cotton soil is a low bearing strength soil and. In black cotton soil clay and sand particles percentages are maximum. In 1938, at California a device introduced which is used to determine the bearing ratio for determining the mechanical strength of the soil.

Nowadays, Waste utilization is an important challenge for project construction team. Construction project involves huge amount of waste materials, by mixing of these waste materials may reduce environmental waste product and increases the properties of material. This research presents the effect of glass and plastic granules inclusion on Engineering properties of black cotton soil. Plastic waste and glass waste is used each year in the construction of roadway and embankment and to improve the soil at construction sites.

The mixing of randomly oriented glass and plastic granules to soil sample may be considered same as other admixtures used to stabilize soil.

II.MATERIAL DESCRIPTION

2.1 Soil

The soil for this experiment was adopted from the site near Chinor tehsil, Gwalior district, India. The material was extracted from 90cm from the ground surface. The properties of soil can be classified as:-

Table: I Index Properties of soil

Property	Value
Natural Moisture Content (%)	9.69
Particle size distribution	
Sand (%)	12.7
Silt (%)	68.2
Clay (%)	19.1
Specific gravity	2.42

Liquid Limit (%) Plastic Limit (%) Plasticity Index (%)	43 36 11
OMC (%) MDD (g/cm^3)	17.30 1.45
CBR unsoaked (%)	13.25
CBR soaked(%)	0.45
Unconfinedcompressive strength	0.72
Free swell index	39
Ultimate bearing strength	763.5

2.2 plastic fibre waste

Plastic fibre for this experiment was taken from the Gwalior district, India. Plastic fibre was constantly mixed with soil samples in 5%, 10% and 20 % and with glass was taken at 6% consistent of the dry weight of soil.

Plastic waste, a part of waste by – product of plastics, was collected from the waste plastic from the different sites in Gwalior division.

The specific gravity of plastic waste was obtained as 0.12 and the average length of plastic waste present in it was 12mm.

Fig. 1 Plastic Powder

II. TABLE PROPERTIES OF PLASTIC WASTE

Physical Properties of Plastic waste	
Abbreviation	Polyethylene
Density (g.cm^3)	1.3 – 1.4
Usage temperature	115-125^{o}C
Specific gravity	1.56
Mechanical	Relatively low tensile
properties	Strength at yield and surface hardness, high viscosity, soft to rigid.

III. TABLE PROPERTIES OF PLASTIC WASTE

Chemical Properties of Plastic Waste	
Lignin	45.84%
Cellulose	43.44%
Hemi –Cellulose	0.25%

Pectin's and related Compound	3.0%
Water soluble	5.25%
Ash	2.22%

2.3 Glass waste

Commercially available glass has been used in the present investigation. It is available as a concentrated powder form and is to be diluted with water in specified proportion before mixing with the soil. The manufacturer's information available for this product is presented in Table IV.

IV. TABLE PROPERTIES OF GLASS

Physical/Chemical Characteristics	
Compression resistance	800-1000Mpa
Density	2500 Kg/m^3
Modulus of elasticity	70000Mpa
Hardness	5.5 mosh Hardness
Bending strength	45Mpa

III. EXPERIMENTAL ANALYSIS

In this paper, the experimental analysis has undertaken to investigate the index properties of soil specimen, specific gravity, standard proctor compaction test, California bearing ratio. The soil from site is dried and hand sorted to remove the pebbles and vegetative matter if any and is further dried and pulverized and sieved through a sieve of 4.75mm to eliminate gravel fraction if any .The dried and sieved soil is store in air tight container and is ready to be used for stabilization plastic fibre and glass waste.

Table: V OMC & MDD Results of Different Mixes

MIX	**OMC (%)**	**MDD(g/cc)**
Soil+6%Plastic fibre+5% glass	18.15	1.53
Soil+6%Plastic fibre+10% glass	17.75	1.64
Soil+6%Plastic fibre+20% glass	16.30	1.68

The soil samples are prepared and are then mixed with various proportion of glass and 6% plastic with constant proportion. The percentages of admixtures content varied with **6% plastic with 5% glass fiber**; **6% plastic with 10% glass fibre** ; **6% plastic with 20% glass fiber**. The admixture content is taken by weight of soil taken and after mixing the admixture is leave for three days for poring and then the tests are conducted on that soil following results are obtained:-

Table: VI CBR Result of Different Mix

MIX	**CBR (%) Unsoake**	**CBR SOAKED**
Soil+6%Plastic fibre+5% glass	13.45	1.3
Soil+6%Plastic fibre+10% glass	17.18	1.5
Soil+6%Plastic fibre+20% glass	19.56	1.6

Table: VII Specific Gravity and unconfined compressive strength Result of Different Mix

MIX	Unconfined compressive strength	Specific gravity
Soil+6%Plastic fibre+5% glass	3.68	2.49
Soil+6%Plastic fibre+10% glass	3.79	2.58
Soil+6%Plastic fibre+20% glass	3.58	2.67

IV. Graphical Analysis of CBR, Specific Gravity, unconfined compressive strength and OMC, MDD.

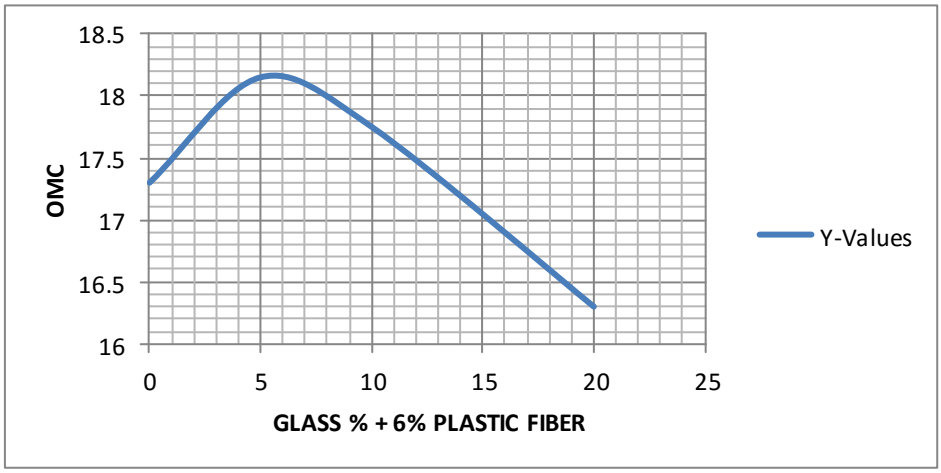

Fig.1 Variation of OMC of soil mixing with Plastic and glass

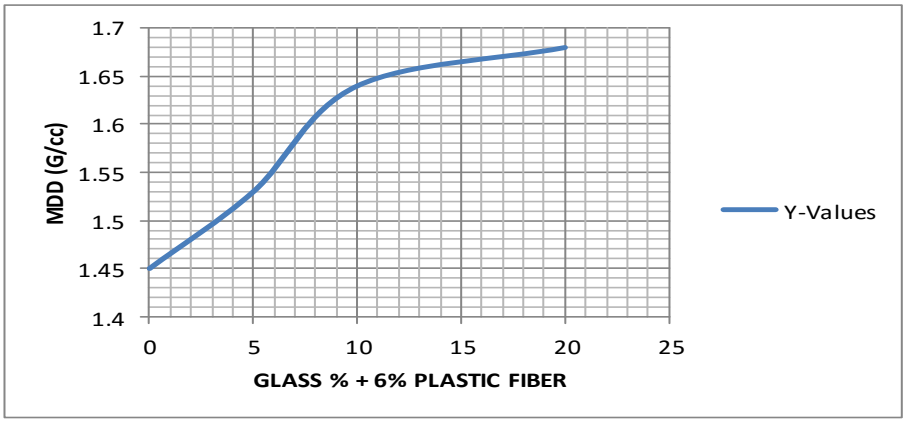

Fig.2 Variation of MDD of soil mixing with Plastic and glass

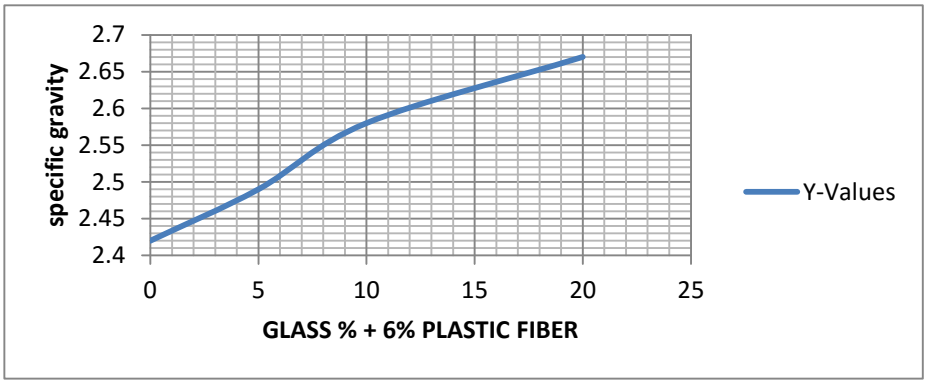

Fig.3 Variation of specific gravity of soil mixing with Plastic and glass

The specific gravity of soil increases to 2.67 from 2.42 with the increase in percentage of glass from 0% to 20%.

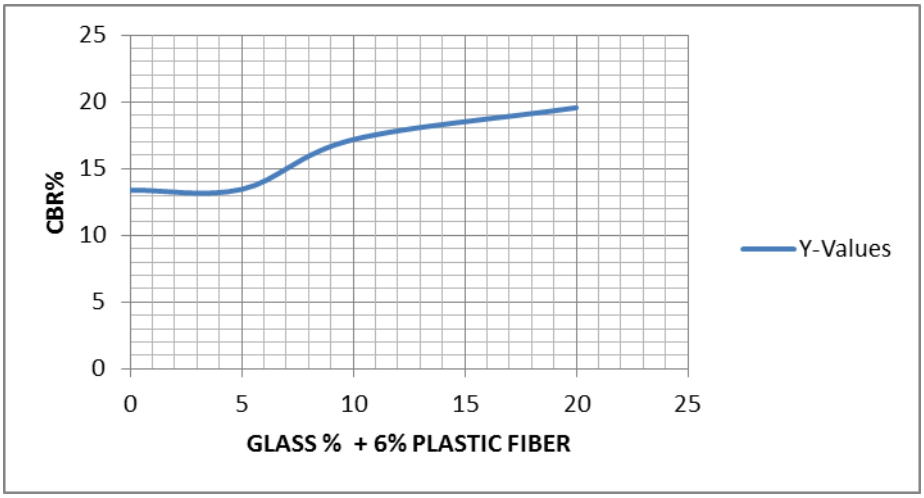

Fig.4 Variation of CBR value of soil mixing with Plastic and glass

Fig.4 shows the variation of CBR value with different percentages of glass and plastic. The CBR of soil 17.18 increases to 13.39 with the increases percentage of glass 0% to 20%.

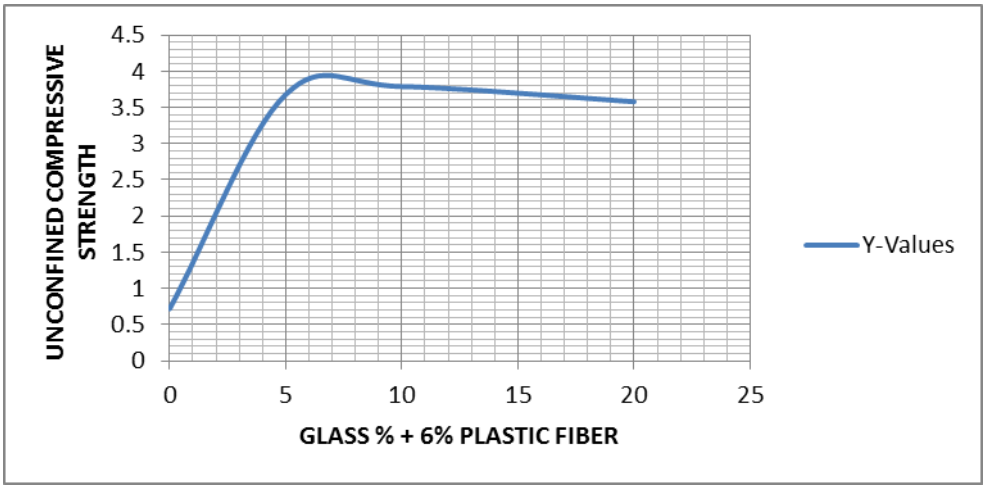

Fig.5 Variation of unconfined compressive strength value of soil mixing with Plastic and glass

Table VIII all the properties of black cotton soil after stabilization

PROPERTIES	PROPERTIES AFTER STABILIZATION									
	NATURAL	GLASS			PLASTIC FIBER			GLASS+PLASTIC FIBER		
		5%	10%	20%	5%	10%	20%	5%+6%	10%+6%	20%+6%
MAXIMUM DRY DENSITY	1.45	1.28	1.46	1.48	1.61	1.75	1.78	1.53	1.64	1.68
OPTIMUM MOISTURE CONTENT	17.%	16.9	16.1	15.26	19.15	18.54	17.29	18.15	17.75	16.30
FREE SWELL INDEX	39	29	26	22	27	25	23	26	24	21
UNCONFINED COMPRESSIVE STRENGTH	0.72KG/CM2	3.86	3.88	3.96	3.75	3.77	3.88	3.68	3.79	3.58
CBR UNSOAKED	13.39%	12.48	16.32	24.48	13.56	18.39	26.46	13.45	17.18	19.56
CBR SOAKED	0.45%	1.4	1.6	1.7	1.1	1.3	1.6	1.3	1.5	1.6
ULTIMATE BEARING STRENGTH	763.5KN/M2	1412.5	1456.6	1458.5	1423.5	1425.6	1427.7	1423.5	1430.9	1432.5
SPECIFIC GRAVITY TEST	2.42gm/cm2	2.35	2.36	2.39	2.51	2.55	2.57	2.49	2.58	2.67

V. CONCLUSIONS

1. Adding 20% of glass and plastic fibre is a effective in decreasing optimum moisture content (OMC) of soil which is decreasing quantity of water required during compaction.
2. Mixing of soil with glass and plastic fibre is a effective in increasing MDD of soil.
3. There is a great effect on specific gravity of soil on mixing plastic and glass fibre with them.
4. Mixing of soil with glass and plastic fibre is also found to improve its CBR.

VI.REFERENCES

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