

Stabilization of Black Cotton Soil by Using Stone Dust and Plastic Glass Strips

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ABSTRACT: The main objective of this study is to investigate the use of waste stone dust and plastic glass strips in geotechnical applications and to evaluate the effects of stone dust and plastic glass strips on optimum moisture content (OMC) and maximum dry density (MDD). Also the effect on CBR value in unsoaked condition. These solid wastes are day by day increasing in India, which is not environmental friendly hence they have to be recycled. Thus, a review is presented to make use of those wastes in soil stabilization. The results obtained with varying percentage of stone dust (5%, 10%, 15%, etc) and plastic glass strips (0.5%, 1%, 1.5%, etc).

KEYWORDS: Soil stabilization, CBR, OMC, MDD.

I. INTRODUCTION

Black cotton soils are inorganic clay of medium to high compressibility and form a major soil group of India. The black colour in black cotton soil is due to the presence of Titanium oxide in small concentration. The Black cotton soil has a percentage of clay which is predominantly montmorillonite structures and black or blackish grey in colour. They are characterized by high shrinkage, low bearing capacity and swelling properties. Because of these properties, the Black cotton soil has been challenge to the high way engineers. Black cotton soils are very hard when it dry but loses its strength completely when it wet condition. Soft clays, expensive soils, weak soils, sand and organic deposits are unsuitable for all construction work due to bare engineering properties.

Soil stabilization improves the engineering properties of soils and thus making it more stable. It is essential when the soil accessible for construction is not suitable for the anticipated purpose. The term stabilization is generally restricted to the process alter the soil material itself for improvement of its properties a solid wastes or chemicals are added to a natural soil for the purpose of stabilization. The use of by-product materials to improve the soil properties varies with economic, environmental and technical points. In this study, the waste stone dust and plastic glass strips are used to stabilization the black cotton soil.

II. RELATED WORK

Jaswinder Singh et al. [1] studied on Review on Improvement of Engineering Properties of soil Using Waste Plastic Bottles Strips and he has trying to find the best and the economical material for the soil stabilization including the virgin and waste materials of any kind which could be useful for the purpose. Y. Ramakrishna Reddy et al [2] studied on Stabilization of Soil by using Waste Fiber Material. The main objective of his study is to investigate the use of waste fiber materials in geotechnical applications and to evaluate the effects of waste polypropylene fibers on shear strength of unsaturated soil by carrying out direct shear tests and unconfined compression tests on two different soil samples. The results obtained are compared for the two samples and inferences are drawn towards the usability and effectiveness of fiber reinforcement as a replacement for deep foundation or raft foundation, as a cost effective approach. Naman Agarwal et al [3] studied on design of stone dust stabilized road and he found that the geotechnical characteristics of the soil were studied by conducting laboratory tests such as compaction test, California bearing ratio test, specific

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gravity, unconfined compression strength test, direct shear test and consistency limit test. Abeer Sabri Bshara et al [4] studied on effect of stone dust on geotechnical properties of poor soil and found that the main objectives of is study were to develop strategy for improving poor soil for road construction and to develop a model for estimating CBR value. Devashish kushwahi et al [5] studied on Review Study of soil behaviour mix with waste Plastic Infrastructure is a major sector that propels overall development of Indian economy. The foundation is very important for any structure and it has to be strong enough to support the entire structure. For foundation to be strong the soil around it plays a very important role. Expansive soils like black cotton soil always create problems in foundation. The problems are swelling, shrinkage and unequal settlement. Plastic wastes have become one of the major problems of the world.

III. METHODOLOGY

Sample Collection

Black Cotton Soil

Soil is the principal material for the construction of embankment and subgrade of highways. The design and performance of the pavement, particularly the flexible pavement, depends on the type of subgrade soil and its properties. Some of the essential laboratory tests were carried out to determine the engineering properties i.e. index properties, atterbargo limits, compaction and strength characteristics of the soils. Laboratory tests were carried out as per relevant IS codes.



Fig. No. 1

Fig. No.1 shows the black cotton soil used in the present study is locally available soil taken from bead by pass, Aurangabad. The material was excavated from 1m below the ground surface.

Stone Dust

Index properties of the stone dust were determined as per IS codes. It was randomly mixed with soil samples in 5%, 10%, 15%, 20% & 25% of the dry weight of soil.

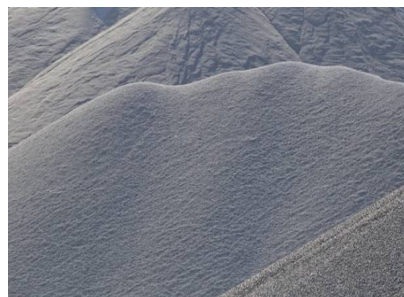


Fig. No. 2

Stone dust for the present work was obtained from stone crusher located at Aurangabad, Maharashtra, India. The stone dust used in soil which is passing though 90 micron IS sieve.

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Plastic Waste

Fig, No.2 shows the disposal of waste plastic bottles causes environmental pollution, it's a sustainable waste. Plastic can be recycled or reuse i.e. reprocessing this plastic wastes makes the useful products. Such waste of plastic is used as additives for stabilized soil.



Fig. No. 3

Fig. No. shows Waste plastic glass, which are of uniformed size and shape collected from function hall, soda shops, etc. the glass were cut 1cm x 1.5cm in dimension i.e. aspect ratio 1:1.5. Plastic is a non-renewable source and bio-degradable.

Experimental Work

Consistency Limits

Soil consistency is the strength with which soil materials are held together or the resistance of soils to deformation and rupture. Soil consistency is measured for wet, moist and dry soil samples. For wet soils, it is expressed as both stickiness and plasticity, as defined below. Soil consistency may be estimated in the field using simple tests or may be measured more accurately in the laboratory.

Liquid Limit

The liquid limit is defined as the moisture content at which soil begins to behave as a liquid material and begins to flow. The liquid limit is determined in the lab as the moisture content at which the two sides of a groove formed in soil come together and touch for a distance of 2 inch after 25 blows.

Plastic Limit

The plastic limit of a soil is the water content of the soil below which it ceases to be plastic. It begins to crumble when rolled into threads of 3mm diameter.

Standard Proctor Test

In geotechnical engineering, soil compaction is the process in which a stress applied to a soil causes densification as air is displaced from the pores between the soil grains. It is an instantaneous process and always takes place in partially saturated soil. The Proctor compaction test is a laboratory method of experimentally determining the optimal moisture content at which a given soil type will become most dense and achieve its maximum dry density.

CBR Test (California Bearing Ratio Test)

California Bearing Ratio (CBR) is defined as the ratio expressed in percentage of force per unit area required penetrating a soil mass with a circular plunger of 50 mm diameter at the rate of 1.25 mm/min to that required for corresponding penetration in a standard material. Tests are performed out on natural or compacted soils in water soaked or unsoaked conditions and the results so obtained are compared with the curves of standard test.

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IV. EXPERIMENTAL RESULTS

The materials which are considered are soil and plastic with chemical composition of poly propylene. Tests are conducted to determine different properties of soil sample collected and results are tabulated and presented in Table 1.

Table No. 1 Properties of soil

Sr. No.	Laboratory Test	Result
1	Atterberg Limits	
	Liquid Limit	66.00%
	Plastic Limit	30.02%
	Plasticity Index	35.98 %
2	Modified Proctor Test	
	Optimum moisture Content (OMC)	19.90 %
	Maximum dry Density (MDD)	1.16 gm/cc
3	California Bearing Ratio Test, CBR	4.31%

Stone dust which pass through 90 μ and plastic glass strips are added to the Black Cotton Soil in percentages of 5, 10, 15, 20 and 0.5, 1.0, 1.5, 2.0 respectively. The standard proctor test has been conducted on the sample and graphs obtained are shown below in Figures4 to 8

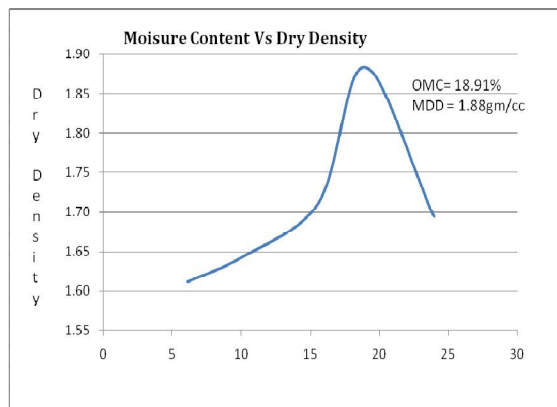


Fig. No. 4

Fig. No. 4 shows compaction curve of standard proctor test of combination of black cotton soil, 5% of stone dust and 0.5% of plastic glass strips by weight of soil. The optimum moisture content is decreases and dry density is increases. The optimum moisture content is 18.91% and dry density is 1.88 gm/cc.

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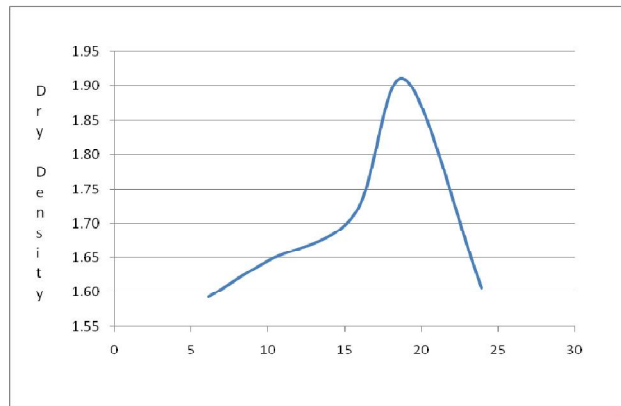


Fig. No. 5

Fig. No. 5 shows compaction curve of standard proctor test of combination of black cotton soil, 10% of stone dust and 1.0% of plastic glass strips by weight of soil. The optimum moisture content is decreases and dry density is increases. The optimum moisture content is 18.87% and dry density is 1.91 gm/cc.

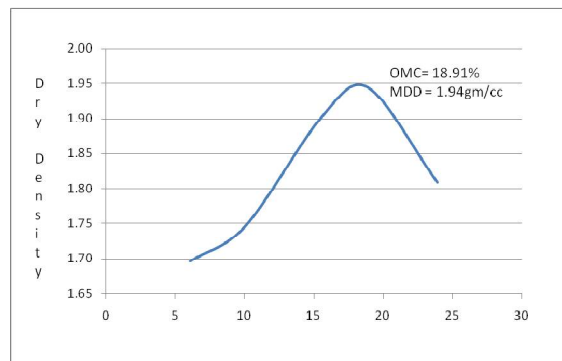


Fig. No. 6

Fig. No. 6 shows compaction curve of standard proctor test of combination of black cotton soil, 15% of stone dust and 1.5% of plastic glass strips by weight of soil. The optimum moisture content is decreases and dry density is increases. The optimum moisture content is 18.79% and dry density is 1.94 gm/cc.

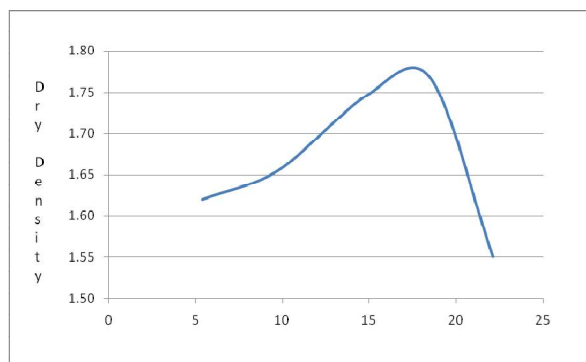


Fig. No. 7

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Fig. No. 7 shows compaction curve of standard proctor test of combination of black cotton soil, 20% of stone dust and 2.0% of plastic glass strips by weight of soil. The optimum moisture content is decreases and dry density is decreases. The optimum moisture content is 18.51% and dry density is 1.77 gm/cc.

Material	CBR Value (%)
Plain Soil	4.32
soil+ 5% Stone Dust + 0.5% Plastic Strip	5.1
soil+ 10% Stone Dust + 1.0% Plastic Strip	7.32
soil+ 15% Stone Dust + 1.5% Plastic Strip	9.25
soil+ 20% Stone Dust + 2.0% Plastic Strip	7.92

Similarly, California Bearing Ratio (CBR) Test was conducted to obtain the CBR Value on the samples with Stone dust which pass through 90 μ and plastic glass strips are added to the Black Cotton Soil in percentages of 5, 10, 15, 20 and 0.5, 1.0, 1.5, 2.0 respectively. The results obtained are presented as follow in Table No 2.

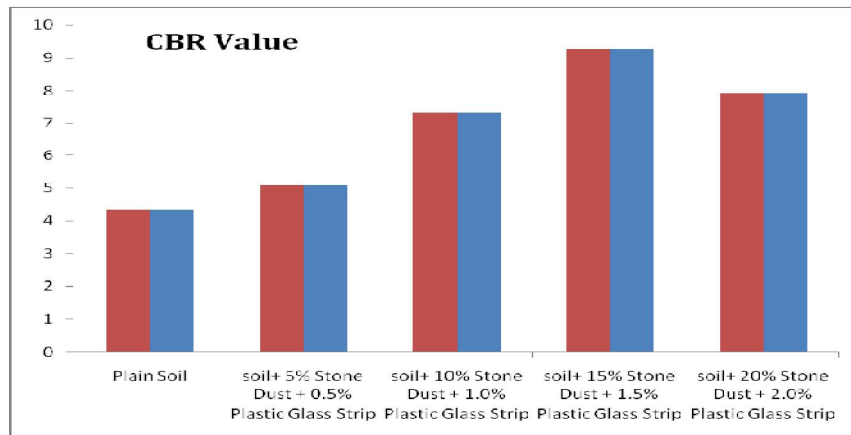


Fig. No. 8 CBR Valve Graph

Fig. No. 8 shows the graphical representation result of CBR valve in unsoaked condition with the variation of mixing stone dust and plastic glass strip. The optimum parentage of mixing stabilizing agent is 15% stone dust and 1.5% plastic glass strips by weight. The CBR value is increase from 4.32% to 9.25 and further decreasing.

V. CONCLUSION

Utilization of plastic disposal glass is enormously increasing day by day. This has an adverse effect in nature and it is not possible to restrict its uses. In this regard, the disposal of the plastic disposal glass without causing any ecological hazards has become a real challenge to the present society. Thus, using plastic as a soil stabilizer is an economical and gainful usage because there is lack of good quality soil for various constructions. Similarly stone dust is waste product which is generated from stone crusher plant.

In the present study, the improved CBR value of the soil is due to the addition of stone dust and plastic strips. Stone dust and plastic strip can be utilized as one of the material that can be used as a soil stabilizing agent but the proper proportion of plastic must be there, which helps in increasing the CBR value of the soil.

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It can be concluded that CBR percentage goes on increasing up to 15% of stone dust and 1.5% plastic strips content in the soil and there on it decreases with increase in stone dust and plastic strips. Hence, we can say that 15% stone dust and 1.5 % plastic strips content is the optimum content of material in the soil.

The maximum dry density (MDD) of soil is increasing with addition stone dust and plastic strips with soil and the optimum moisture content (OMC) is decreasing with addition of stone dust and plastic strips.

The maximum dry density is 1.94 gm/cc and optimum moisture content 18.91% at 15% stone dust and 1.5% plastic strip. This is the optimum percentage of addition of material. Further addition of stone dust and plastic strip the maximum dry density decrease and optimum moisture content is increases.

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