

Stabilization of Black Cotton Soil Using Plastics

R. Jayaram ¹, Chethan Kumar N T ², Meheboob Pasha³, Mohammed Waseem Akram⁴, Gangadhara B M⁵,
Shaima Khathija Ismail⁶

Department Civil Engineering

¹ Professor, S C E M, Mangaluru.

²Assistant Professor, S C E M, Mangaluru.

^{3,4,5,6}Research Students, S C E M, Mangaluru.

Abstract- Soil is basic for many engineering structures such as buildings, embankments, foundation structures, retaining walls etc. The existing black cotton soil at a particular location Western parts of India covering Gujarat, Karnataka, Andhra Pradesh, Tamilnadu and some parts of Madhya Pradesh may not be suitable for construction due to poor soil bearing capacity. These type of weak soils create many problems and it is a challenging task for civil engineers to overcome this problems. Hence it is necessary for improving the engineering properties of the weak in black cotton soils.

Keywords- Black Cotton Soil, Plastics,

I. INTRODUCTION

BLACK COTTON SOIL

Black cotton soils are very fertile soils good for agriculture purposes and they are not good for road or construction of foundation. The Black cotton soils are expansive clays with high potential for shrinking or swelling as a result of changing moisture content.

Due to intensive shrink-swell processes, surface cracks resulting in openings during dry seasons. These openings are usually more than 50mm wide and several millimeters deep.

Cracks disappear during wet season but an uneven soil surface stays as a result of irregular swelling and heaving. The black cotton soils have low strength and are susceptible to excessive volume changes, making their use for construction purposes very difficult. Instability of these black cotton soils cause more damage to structures. and other natural hazard, unless proper black cotton soil stabilization performed.

In India, black cotton soil covers around 50% of the aggregate area zone in the world and covers a range of around 0.8 million sq. km area. It is largely found in Southern and Western parts of India covering Gujarat, Karnataka, Andhra Pradesh, tamilnadu and some parts of Madhya Pradesh. These soils are also found in River valley of Tapi, Godavari and Krishna. Shows the areas in which black cotton soil is available

in India. shows the distribution of black cotton soil in India. From the data available USA, USSR, and European countries are having nearly 80% of black cotton soil and hence geotechnical engineering is fully developed by these countries scientist the total area covered by black cotton soil is 250 million hectares.

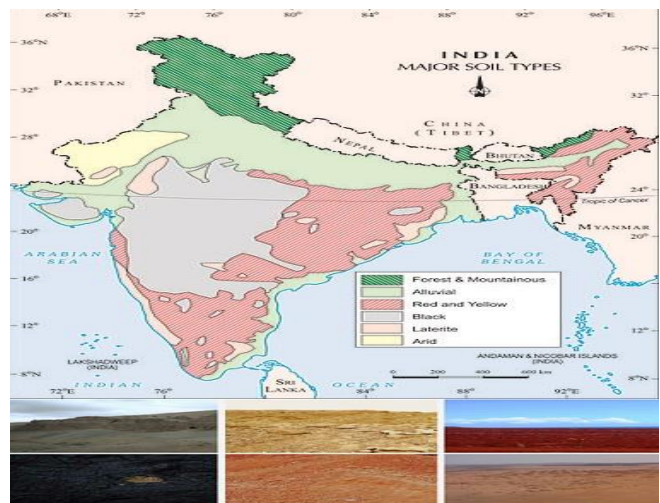


Fig.1.1: Lithomargic Clay Soil in the Field

Table 1.1: distribution of black cotton soil in world

Country	Total area covered (million hectares)	Area covered %
Australia	70.5	28
India	60	24
Sudan	40	16
Chad	16.5	7
Ethiopia	10	4

Black cotton soil is causes various problems to the engineering structures such as buildings, embankment, rocks and dam structures because of their tendency to swell during wet season and shrink during dry season. Black cotton soil has high water content capacity and swells significantly when the soil comes in contact with water due to the presence of minerals called montmorillonite. Black cotton soil is also called expansive soil. shows the crack developed in black cotton soil

after drying condition and swelling of soil due to contact with water. Black cotton soil develops differential damages in the form of cracking, undulation, differential settlements in the embankments, buildings, pavement sub grade etc.



Fig1.2: Crack developed in black cotton soil after drying condition and swelling of soil due contact with water.

SOIL STABILIZATION

Stabilization is a process of altering or improving the engineering properties of black cotton Soil. stabilization includes improving properties like bearing capacity of soil, shearing resistance, durable (weak resistance), reduction in swelling potential and other desirable characteristics improve the black cotton soil.

There are two types in soil stabilization such as

- Mechanical stabilization
- Chemical stabilization

Mechanical soil stabilization is a process of compaction or the introduction of plastics and other non-biodegradable reinforcement to the weak soil. This practice does not require chemical change of the soil but it is common for both mechanical and chemical stabilization. Mechanical stabilization is the densification of soil by expelling the air from soil voids without much change of water content. This method

of stabilization occurs in cohesive soil and maximum compaction occurs with optimum moisture content.

Chemical stabilization is a method to improve the engineering properties of soil by adding chemicals or additives. There are different types of chemicals such as plastics, lime, fly ash, bitumen cement, stone dust, solid waste etc., Additives reacts with the soil to change the chemical properties of soil and thereby increases the engineering properties of the soil.

II. OBJECTIVES

The main objectives of the research are to investigate the properties of the black cotton soil with plastics The objectives of the study are as follows:

1. To study the basic properties of Black Cotton Soil.
2. To study the strength behavior of block cotton soil with 0%, 0.25%, 0.5%, 0.75%, 1% of plastics
3. To determine the optimum addition of waste plastic to block cotton soil.
4. To study the strength gain due to addition of 0.25%, 0.5%, 0.75% and 1% of plastics to the block cotton soil in order to analysis the optimum percentage of plastic to derive maximum strength, and to minimize the shrinkage and swelling potential, of black cotton clay.

III. MATERIALS AND METHODOLOGY

All the materials used in the experimental investigation were locally available. The materials in the experimental research include black cotton soil. Stone dust and polypropylene fiber.

Materials Used in The Experimental Study

Soil

Soil is a basic for many engineering structure, it can resist and carry the load come from structure. Black cotton soil is problematic to the engineering structure such as buildings, embankment, rocks and dam structures, because of their tendency to swelling during wet season and shrinkage during dry season. Black cotton soil has high water contents holding capacity and swells significantly when soils come in contact with water. Black cotton soil is also called expansive soil. The Black cotton soil was collected from Raichur District, devadurga Taluk by open excavation from a depth of 0.5m below natural ground level. Table 3.1 shows the properties of black cotton soil. Figure 3.1 shows the black cotton used in the

investigation, collected from Raichur, district Devadurga, taluk, Karnataka state.



Fig. 3.1: Black Cotton Soil Used In the Investigation.

Plastic

Which is commonly used for shopping bags, storage and marketing for various purposes due to its most advantage character of less volume and weight. Most of these plastic are specifically made for spot use, having short life span and are being discarded immediately after use. The few reasons cited above, it is very important that we find ways to re-utilize these plastic wastes. Therefore, the investigation and attempt has been made to demonstrate the potential of reclaimed plastic wastes as soil reinforcement for improving the sub grade soils. The study will describe series of tests carried out to initially understand the types of soil and its properties. Then CBR test was carried out with varying percentage of plastic strips with proportions mixed uniformly with the soil. The results obtained from the tests will be presented and discussed. The waste plastic were collected from nearby disposal sites and made into strips of different aspect ratios. The waste plastic strips to be added to the soil were considered a part of the solid fraction in the void solid matrix of the soil. The content of the strip is defined herein as the ratio of weight of strips to the weight of dry soil. The tests were conducted at various strip contents of 0.0%, 0.25%, 0.5%, 0.75% and 1%.

IV. RESULT & DISCUSSIONS

The main objective of this study was to investigate the stabilization of black cotton soil using waste plastics. The addition of plastics to the black cotton soil was varied from 0.25% to 1% at an increment of 0.25%. Details of the results are shown below.

1. Specific gravity of black cotton soil, test results	
Specific Gravity (G)	= 2.9
2. Grain size distribution of soil results	
1. % Gravel	= 3.7%

2. % Sand = 92.95%
3. % silt = 3.45%
3. Liquid limit test results
1. Liquid limit (water content corresponding to 25 no blows) $W_L = 54\%$
2. Flow index $I_f = 5.868\%$
3. Plasticity index = 33.1% 4. Toughness index = 5.64
4, Plastic Limit test results
1) Plasticity limit of soil sample. $W_p = 20.9$
2) Plasticity index of soil sample $I_p = 33.1\%$
5. Permeability test results
Discharge (Q) = $\frac{V}{T} = \frac{240}{60} = 4 \text{ cm}^3$
Co-efficient of permeability = $\frac{Q \times L}{A \times L} = \frac{4 \times 12.5}{78.53 \times 121} = 5.2619 \times 10^{-3} \text{ Cm/sec}$
6. Direct shear test results
Slope = 0.019865
Cohesive (C) = 0.070191

CBR test results

Sample Description	MDD gm/cc	OMC (%)	CBR (%)	Shear Strength of Soil kg/cm ²
Soil	1.611	16	2.08	0.0919
soil with 0.25% plastic	1.621	12	2.4	0.150
soil with 0.5% plastic	1.625	20	2.84	0.269
Soil with 0.75% plastic	1.633	12	2.77	0.441
soil with 1% plastic	1.469	16	2.66	0.361

V. CONCLUSION

- ❖ In the present study, the improved dry density value of the soil is due to the addition of plastic strips.
- ❖ The plastics are added in the soil for 0.25%, 0.5%, 0.75% and 1%. The maximum dry density of soil is obtained when 0.75% of plastic is added and 12% is optimum moisture content.
- ❖ shear strength of soil was found to be increased for 0.75% of plastics.
- ❖ In the present study, the improved CBR value of the soil is due to the addition of plastic strips. Plastic 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 of the soil.

- ❖ It can be concluded that CBR percentage goes on increasing up to 2.84% plastic content in the soil and thereon it decreases with increase in plastic content. Hence, we can say that 2.84% plastic content is the optimum content of plastic waste in the soil.
- ❖ Attempts have been made to test the Black cotton soil with Terrazyme stabilization, and results are satisfactory with both tests.

REFERENCES

- [1] Chethan Kumar N T, Ramyashree, Prashanth, “Analysis on Performance of Terrazyme Stabilized Soil by Using KENPAVE Software” Vol : 06, Issue : 10, Oct 2016.
- [2] Dr.Mallijarjuna ,Ms. T. Bindu, “Soil stabilization using plastics” VOLUME;05 Issue :05/May -2016.
- [3] Jasmine Verghese Kalliyath , Jenny Pavl, “Soil stabilization using plastic fibers” Volume 2/ Issue 12/June 2016.
- [4] K Shyam Cchamberlin, Megnath Neoponey issie “Soil stabilization of soil by using plastics wastes” , Volume 2 (March 2002)