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Performance Of Soil Reinforced Using Plastic Strips and Flyash

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Abstract*—For the construction of any kind structure resting on weak soil, there are many available methods used to improve the bearing capacity & reduce the settlement of such soil. One of these methods is using reinforcement.In case of geotechnical engineering the idea of inserting plastic fiber material in a soil mass in ordered to improve its mechanical behaviour has become a very popular. The concept of earth reinforcement is an ancient technique. These reinforcement resist tensile stress develop within the soil mass there by restricting shear failure. Reinforcement interacts with the soil through friction & adhesion. The practicing engineers are employing these technique for stabilization of thin soil layers, repairing failed slopes, soil strengthened around the footing & earth retaining structures. The inclusion of randomly distributed plastic fiber increases strength parameter of the soil as in case of reinforced concrete construction. Reinforced soil is a construction material that consist of soil fill Strengthened by a variety of tensile inclusions ranging from polymeric materials to relative stiff, high strength metallic inclusions. This tensile inclusion comes in many forms ranging from plastic fibers. The soil & reinforcing element will interact by means of frictional resistance. Appropriate selection of the re-use of different types of plastic fibers generated which as become one of the major challenges for the environmental issues in many countries. Waste such as plastic fiber mixed with soil behave similar to fiber reinforced soil & several researchers' technique of using plastic fiber to enhanced the strength of soil.*Keywords—construction; Pre-engineered;sustainable; innovative touch; quality control speed**

I. INTRODUCTION

The behavior of expansive soil is very uncertain when it is subjected to moisture changes. These changes pose considerably challenged for civil engineering during construction activities specially while constructing foundation. The strength of soil changes when water occupies spaces in the voids of soil. General recognizable of this effect are excessive compression of soil, collapsing behavior, high impermeability, high swelling capacity & low shear strength. These undesirable characteristics make the black cotton soil unfit for construction purposes. Hence they needs stabilize before they can be put to use. Through black cotton soil has unfavorable characteristics for infrastructural developments, they are useful as agents of particular environmental protection & waste such as plastic fiber. Soil reinforcement under taking for wide range of ground improvement scheme in geotechnical engineering applications that applications that include back fill for earth retaining structures, repair of failed slope, landfill limner & covers, stabilization thin layer of soil. The principle of soil reinforcement first develop by Henri vidal in 1966 involves introducing tensile resisting material into the soil to enhance the strength properties so as to improve soil stability, increase bearing capacity & reduce lateral deformation. The waste material are abundant but are by & beneficial in a sustainable geotechnical material stream. The need to find alternative uses for reclaimed plastic accessible reinforcing material for soil in geotechnical engineering from the basis of the . This research specifically explored to possible of re-using plastic fiber made as soil reinforcement material by undertaking a testing to investigate the random effect of inclusions of plastic fiber on engineering strength properties of soil.

The rising demands of ample & electrical energy coal reserve in India have found in the construction of many coal-fired power plants. Most of the power plants which are constructed or have been proposed are also coal-fired plants. Therefore, the production of the power plant waste ash has also under inflation. They use pulverized coal of much ash content (45%) & create bottom ash and flyash. The part of the ash which is classified as flyash and constitutes about 30-60% of total ash liberated with flue gases which is carried through Electrostatic Precipitators. Since, coal is supplied from 22 different coal mines of Bihar, the chemical properties also vary to a great extent. With the rising use of low-grade coal which contain high ash, the premium production of flyash is about 100 million tones. Much of the ash generated from the power plant is disposed off in the vicinity of the power plant as the waste material capturing several hectares of valuable land. Developed and developing countries all over the world have many flyash resources. Amount of flyash available in developed and developing countries is causing disposal problems and environmental problem. The huge utilization of flyash has become very essential in view of its high production and decreasing of disposal sites, The uses in geotech applications such as subgrade/soil improvement, structural fills, land reclamation etc, it has the capability for huge utilization. The flyash is being used as a constructional material in most civil project, but its use as a general fill has a long past. When we used in the construction of highways. Design life as well as the maintenance cost of highways may get affected. Flyash is now being use in most countries for stabilization of soil for the construction of roads and runway bases.\

Sivankumar Babu and Vasudevan [1] show that the use of coir fiber as random reinforcement material in the case of clayey soil increases the strength & stiffness properties & attributed the improved behavior to the reinforcing effect of fibers. The author have presented a simple method to quantity the degree of improvement obtained by reinforcing sand with randomly distributed coir fibers, in terms of the strength and stiffness of the coir-reinforced soil. Further, the analytical models available in the literature for obtaining the degree of improvement due to synthetic fibers have been examined with respect to experimental data in coir fiber reinforced soil samples. The technique of soil improvement using coir fibers and products has several advantages.

- The ability of the fibers to absorb water and degrade with time are the principal properties that give them an edge over synthetic material.
- In countries where the availability and cost of synthetic and metallic reinforcing materials are major constraints, reinforced soil systems using natural materials such as coir have tremendous application potential.
- Coir is reputed to be among the strongest and most durable of all natural materials. Because of coir‟s high lignin content, it degrades much more slowly than other natural materials in an earth context.

II. MATERIALS USED

There are two materials are used for investigation:

1. Black Cotton Soil

Soil is the indispensable element of this nature. It is attached to everyone in one or another way. All the basic amenities of life, whether it is concern with food cloth & house, have been fulfilled by the soil. Without the soil it is just next t impossible t think about life on this earth. The word soil is derived from the Latin word "Solium" which is according to Webster‟s dictionary means the upper layer of the earth that may be dug or ploughed the term soil in soil engineering is defined as "unconsolidated Material, composed of solid particles by disintegration of rocks. Black cotton soil sample were collected form construction project at Nagpur from ground with depth of 1 m. The disturbed sample was then sealed in plastic bag of cement to avoid loss of moisture during transportation. The soil was oven dried at 105^{o}Cbefore putting it for test[2]. The properties of soil were found by performing different basic experiments as shown in Table1.

2. Plastic Fiber

Plastics are considered as one of the important invention which has remarkable assistant in different aspect of life whether it might be in scientific field or others. Due to omnipotent scope of plastic other different materials such as plastic fiber are being replaced with it which was used for different purposes like packing purposes, used by restaurant & all. It has omnipotent used in today's context but the use of plastic & its effect in the environment has made the use of plastic has to be limited by now otherwise there would be harshly circumstance that human & environment has to face in near future. Disposal of waste is complicated and expensive. There are a number of Government agencies and volumes of regulations governing the proper disposal of waste. Severe penalties can be levied against individual and organizations as a whole should waste be discarded improperly.

Table 1: Properties of Black Cotton Soil

Sr. No.	PROPERTIES	VALUE
1	Specific gravity	2.09
2	Liquid limit	40.13%
3	Plastic limit	26.60%
4	Shrinkage limit	11.20%
5	Optimum moisture content (OMC)	17.70%
6	Maximum Dry Density (MDD	1.58gm/cc

Properties of PlasticFiber

A) PHYSICAL PROPERTIES:

Strength: Plastic fiber has good tenacity & the strength is not loss with age. Plastic fiber has high strength to weight ratio. It is one of the lightest fiber is at the same time also one of the strongest. The strength of plastic fiber is lost when wet fiber has excellent abrasion resistance.

Elasticity: Fiber has a good elasticity which makes it much suitable for the apparel purposes. The excellent elasticity would mean that the plastic fiber materials return to their original length & shreds the wrinkles or creases. Plastic fiber like other fiber has its own limit of elasticity. If stretch to much it will not completely recover its shape the high elongation & excellent elastic recovery of plastic fiber contributes to the outstanding performance in hosiery.

Resilience: Plastic fiber have excellent resilience. Plastic fiber retain their smooth appearance that usual daily activities can be removed easily.

Heat Conductivity: The heat conductivity of the plastic fiber very depending upon the construction, the type of plastic used in the construction etc. for instant the plastic fiber used in the open construction. In a closed or tight construction the air circulation through fiber is limited. The heat & moisture of the body will not readily pass the construction which makes the wearer fill very warm. Such fibers are good for winter apparel such as wind breakers but are not suitable for summer garment.

Absorbency: Plastic fibre has low absorbency of the fiber tends to be advantageous & also disadvantageous. The main advantage of plastic fiber is low absorbency is that the water remains on the surface of the fiber & runs of the smooth fiber & hence dried quickly. This property makes the plastic fiver suitable for rain coat & shower curtains. Plastic fiber has low absorbency disadvantage in that fiber feels clammy & uncomfortable in warm, humid weather.

Cleanliness & wash ability: Plastic fiber are easy care garments. Plastic fiber are smooth, non-absorbent & dry quickly. Dirt doesn't cling to this smooth fiber, which can be washed easily or can be even cleaned by using a damp cloth. They easily pick up color [3].

B) CHEMICAL PROPERTIES:

Shrinkage: Plastic fibres retain their shape & appearance after stretching. It has good stability & does not shrink.

Resistance to insects: Plastic fiber is resistance t moths & fungi.

Reaction to alkalis: Plastic fiber has excellent resistance to alkalis but the frequent & prolongs exposures to alkalis will weaken to plastic fiber.

Reaction to acids: Plastic fiber is less resilient to the action of acids & is damaged by strong acid [3].

Fig. 1 Plastic Strips

III. TEST PEFORMED

1. Sieve Analysis

The sieve size analysis is the process of determining the proportion by weight of different sizes of particles present in the given soil. Take adequate quantity of the representative sample and thoroughly break up the lump by means of a rubber pestle in mortar bur not breaking the individual grains. Then dry in air or sun. In wet weather, use sample maintained at 70oC weight the sample & record its weight correct to 0.1% of the weight of the sample. Separate the sample by sieving into two parts, via:- Retaining on 2mm sieve and Passing through 2mm sieve.

Here analysis is done for the fraction above 2mm only. Record the weight of fraction retained o 2mm sieve accurate to 0.1% of its total weight. Separate the various fractions by successive sieving through sieve of 100mm, 63mm, 20mm, 6.3mm, 4.75mm, & 2mm. While sieving, agitate the sieves so that the material rolls in irregular motion. Record the weight of material retained on each sieve correct to the 0.1% of its total weight. Then calculate the percentage of each fraction of the weight of total sample taken initially for analysis [4].

$$Cu = \frac{D_{60}}{D_{10}} \; ; \; CC = \frac{(D_{30})^2}{D_{60} \times D_{10}}$$

Fig. 2 Sieve Shaker

2. Moisture Content

The moisture content of soil in an important paramet affecting its behavior. Moisture content is a ratio expressed as a percentage of the weight of water in a given soil mass to the weight of soil solid particles under the specified testing condition. Clean & dry container with lid or dish. Weight accurately & determine the weight of the empty container provided along with lids. Let it be W1. Take about 20 to 25 gm. of the given weight of soil in a container & determine the weight again. Let it be W2. Keeps the container containing the wet soil in an oven. Set at 105^0C. The drying should be done in constant weight. The container should be open, but the lid also be kept along with container. After complete drying, cool it in desiccators to room temperature& weight. Let it be W3.

Moisture content (W) (%)

$$= \frac{\text{Weight of water}}{\text{Weight of soil solids}} \times 100$$

$$= \frac{\text{Weight loss during drying}}{\text{Oven dry weight of soil}} \times 100$$

$$= \frac{(W_2 - W_3)}{(W_3 - W_1)} \times 100$$

Fig. 3 Oven

3. Specific Gravity

The specific gravity of a soil is the ratio of weight in air of a given volume of soil particular at a stated temperature to the weight of an equal volume of distilled water under the same condition.Sieve the dry field sample through 4.75mm sieve. Oven dry the soil to constant weight at 105^0C to 110^0C & cool it I desiccators. Record the weight of empty Pycnometer used (W1).Weight the Pycnometer with oven dry soil (W2). Fill distilled water to half full level in the Pycnometer and mix the thoroughly with glass rod. Add more water & stir it. Replace the screw top & fill the Pycnometer flush with hole in the conical cap. Dry the Pycnometer form outside, and find the weight (W3).Empty the Pycnometer, clean it thoroughly & fill it with distilled water, to hole of the conical cap and find the weight (W1). Repeat above steps for the two more determination of specific gravity [5].

$$SpecificGravity = \frac{(\text{W2} - \text{W1})}{(\text{W2} - \text{W1}) - (\text{W3} - \text{W4})}$$

Fig. 4. Pycnometer

4. Atterberg's Limit

4.1 Liquid Limit Test

Liquid limit is the water content at which a part of soil cut by groove of standard dimensions will flow together for a distance of 12.5mm under the impact of 25 blows in a standard liquid limit apparatus.

4.2Plastic Limit Test

Plastic limit is the water content at which the soil begins to crumble when rolled into thread of approximately 3mm diameter.

4.3 Shrinkage Limit Test

Shrinkage limit is the maximum water content at which the reduction of water content will not cause decrease volume of soil mass [6].

These limits along with results of mechanical analysis help in Identification & classification of soil. They also give idea about other properties of soils, such shear strength, permeability etc. on the basis of which their suitability for the proposed work can be determined.

Fig. 5. Casagrande Apparatus

5 Standard Protector Test

Standard proctor test is to determine the relationship between the moisture content and the dry density of a soil for a specified comp active effort. Different methods are used for compact soil in the field. These test is developed by R.R Proctor in 1933, therefore the test is known as {Proctor test} [7].

Fig.6. Standard Proctor Test

6. California Bearing Ratio Test (CBR)

It is the ratio of the force per unit area required to penetrate a soil mass with a circular plunger of 50mm of diameter at the rate of 1.25mm per minute to the required for corresponding penetration in standard materials. The ratio is usually determined for penetration of 2.5mm & 5mm.

Table 2. Standard Load used in CBR Test

Penetration Depth (mm)	Unit Standard load (Kg/cm^2)	Total Standard Load (Kg.)
2.5mm	70	1370
5.0mm	105	2055
7.5mm	134	2603
10.0mm	162	3180
12.5mm	183	3600

IV. RESULT AND DISCUSSION

1. Sieve Analysis

Expansive soils are the main cause of damages to many civil engineering structures such as spread footings, roads, highways, airport runways, and earth dams constructed with dispersive soils. Stabilization by chemical additives, pre-wetting, squeezing control, overloading, water content prevention are general ground improvement methods that are used to mitigate swelling problems. There has been a growing interest in recent years in the influence of chemical modification of soils which upgrades and enhances the engineering properties. The transformation of soil index properties by adding chemicals such as soils including the cementation of the soil particles. Especially use of fly ash admixture has proved to have a great potential as an economical method for improving the geotechnical properties of expansive soils cement, fly ash, lime, or combination of these,often alter the physical and chemical properties of expansive soils.

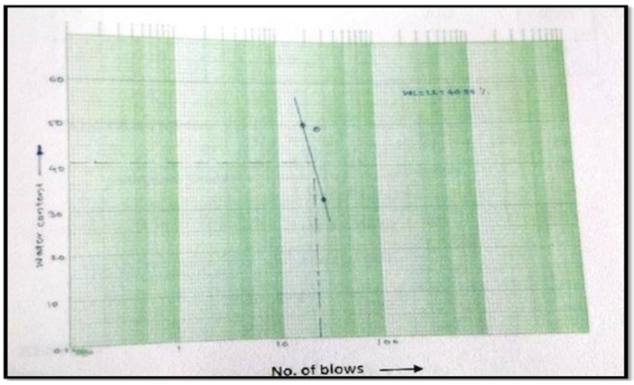

Fig. 7. Sieve Analysis

2. Atterberg's Limit

2.1 Liquid Limit

The average liquid limit from the above graph is 40.96 %.

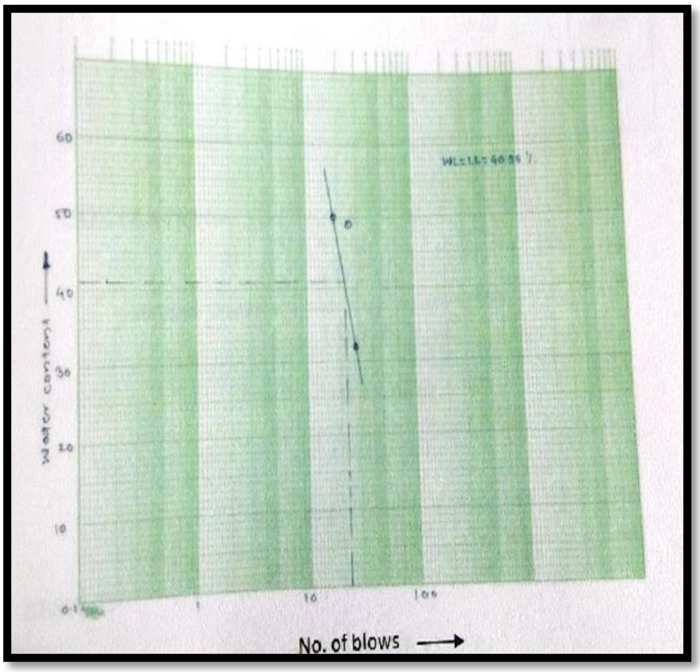

Fig. 8. Liquid Limit

2.2Plastic Limit

The average plastic limit of sample is 49%.

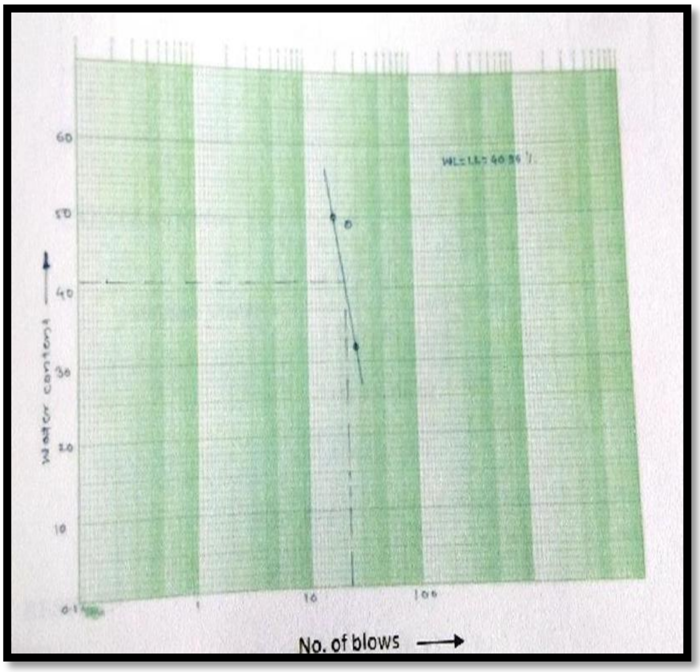

Fig. 9. Plastic Limit

2.3 Shrinkage Limit

From the Table 3, shrinkage limit is found to be 16.70%.

Table 3: Observation of Shrinkage Limit

Sr. No.	Dish No.	Weight of Empty Dish, W1 (gm)	WeightOfShrinkagedish +weight ofSoil(W2)(gm.)	Weight Of Shrinkage dish + weight of Dry Soil (W2) (gm.)	Volumeofmercuryto fillthe dish	Originalvolumeof soil, V1 (cc)	Volumeofmercurydisplacedby soil, (cc)	Finalvolumeof drysoil pat, V2 (cc)	Shrinkagelimit(%)
1	1	71.9	116.70	104.48	23.98	23.97	19.85	19.85	16.70

3. Standard Proctor Test:

From the Fig. 10,MDD = 1.58 gm /cc, OMC = 17.7 %

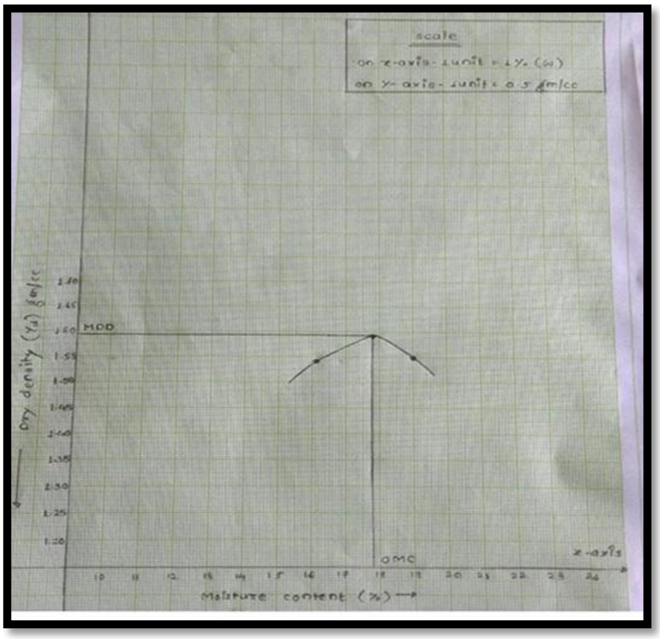

Fig. 10. Standard proctor test

4. California Bearing Ratio Test (CBR)

From Fig. 4, CBR value is 1.79 %

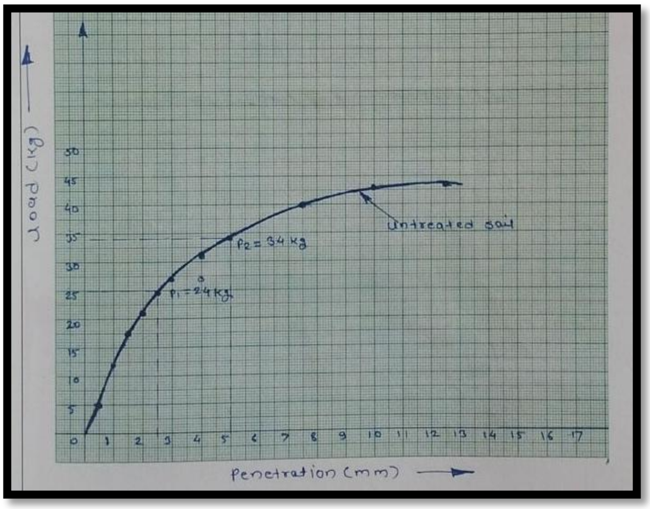

Fig. 11. California Bearing Ratio Test

V. CONCLUSION

The present investigation was undertaken to study the improvement. In the engineering behavior of expansive soil by stabilizing with plastic fiber. The preliminary test was first conducted on untreated expansive soil & then the soil was stabilized with plastic fiber in different percentage.The laboratory investigation has been carried out in order to evaluate the effect of inclusion of plastic fiber with expansive soil on the compaction& strength characteristics of soil.Based upon the laboratory investigation carried out by treating the expansive soil with plastic fiber, the following conclusion are arrived:

1. The CBR value of expansive soil is enhanced by the inclusion of plastic fiber on soil.

2. The CBR value initially increases with percentage of plastic fiber up to an extend but decrease with further increase in percentages of plastic fiber.

3. The maximum CBR value was found at 1% of plastic fiber proportion.

4. Based upon the study it was concluded that proportion 1% of plastic fiber is the best combination of soil.

5. Fiber content having maximum CBR value.

6. Hence this proportion may be used in building construction in foundation & also road embankments.

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13. Hence this proportion may be used in the building construction in foundation & also road embankments.

14. The CBR value of fiber reinforced soil is increases with the increasing percent of fiber up to 1% & then decreases.

15. Based on finding soil an plastic fiber could be used as alternative reinforcement materials in place of conventionally used reinforcing.

16. The disposal of plastic fiber is a big problem in thermal industries; soil stabilization is one of the bestmethods for the effective & economical disposal of plastic fiber.

17. The aimof CBRtest ofsoil mixedwith plastic fiber to bring down the cost of constructionof buildingsin foundation, roads and achieved the goal of research.

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