iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** III **Month of publication:** March 2018

DOI: http://doi.org/10.22214/ijraset.2018.3261

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue III, March 2018- Available at www.ijraset.com

Influence of Plastic Waste Strips on Engineering Behaviour of Soils

B. Kumari[1], CH. Damodar Naidu[2]
M-Tech Student[1], Assistant Professor[2],Department of Civil Engineering, Gokul Group of Institutions, Bobbili, Vizianagaram, A.P, India

Abstract:** Rapid improvements in the engineering world have influence a lifestyle of human beings in utmost extends but day to day activities of mankind are augmenting risk in the environment in the same proportion. Plastic wastes have become one of the major problems for the world. The harmful gas which is being produced by this agent leads to tremendous health related problems. So, effective engineering implementation of this has become one of the challenging jobs for engineers. Engineer are seeking for astute implementation of these wastes in ample amount and implementing these wastes in Soil stabilization helps to reduce the risk of natural destruction which is caused due to rainfall or other aspect and also it aid in reducing the waste in an ample amount. Plastic is considered as one of the major pollutant of environment as it would not decay or can't be destroyed so implementing this for some good purpose helps to reduce its effect also. This implies that stabilization using waste plastic strips is an economic method where use of waste materials as plastic and other cheaply available material of plastic can be used which is found accessibly. This paper reflects that plastic wastes can be used in stabilization of soil which is concluded from various tests conducted on fiber reinforced soil with varying fiber content and different aspect ratio and profound analysis of their results depicts that it can be used in the fields. Therefore, it is of utmost importance considering the design and construction methodology to maintain and improve the performance of such pavements. In this paper, different means of plastic waste as shopping bags and other plastic material which is locally available are used so as a reinforcement to perform the CBR studies while mixing with soil for improving engineering performance of sub grade soil. In this the Plastic strips which are collected for stabilization of soil were mixed randomly with the soil. With this a series of California Bearing Ratio (CBR) tests were carried out randomly reinforced soil in which the percentage of plastic strips with varying percentage of plastic strips with different lengths and proportions were carried on. And the results and conclusion were summed up which shows that use of plastic in soil in an appropriate amount really aids in improving the strength of soil and also helps in modification of soil properties which might be in term of strength of sub grade soil

The amount of wastes has increased year by year and the disposal becomes a serious problem. Particularly, recycling ratio of the plastic wastes in life and industry is low and many of them have been reclaimed for the reason of unsuitable ones for incineration. It is necessary to utilize the wastes effectively with technical development in each field.This study presents a simple way of recycling plastic waste in the field of civil engineering as reinforcing material. Reinforced soil construction is an efficient and reliable technique for improving the strength and stability of soils. The technique is used in a variety of applications, ranging from retaining structures and embankments to subgrade stabilization beneath footings and pavements.

This paper describes an experimental study on mixing plastic waste pieces with two types of soil (clayey soil and sandy soil) at different mixing ratios (0,2,4,6,8)%by weight respectively. For the two types of soils, the shear strength parameters (cohesion value and angle of internal friction) of reinforced and unreinforced samples were investigated by the direct shear test. In addition, a series of compaction tests were performed on clayey soil mixed with different percentages of waste pieces. It was found that, there is significant improvement in the strength of soils due to increase in internal friction. The percentage of increase in the angle of internal friction for sandy soil is slightly more than that in clayey soil, but there is no significant increase in cohesion for the two types of soils. Also, it was concluded that the plastic pieces decreases the maximum dry density of the soil due to their low specific gravity and decreases the optimum moisture content.

***Keywords:** Plastic waste strips , Highly compressible clayey soils, Sandy soils, Un-confined compressive strength*

I. INTRODUCTION

Due to rapid growth in population and developmental activities, suitable grounds for constructions are depleting day by day. This situation leads to take unsuitable grounds for constructions by improving the properties of these soils. Soil Stabilization is one of the best methods to improve the properties of soil. Inclusion of plastic waste strips comes in the category of Reinforced Earth technology of soil stabilization. Reinforced Earth structures have provided effective structural solutions at significant cost savings and have been accepted as standard practice by civil engineering authorities worldwide. Several reinforcing materials are available in market like steel rods, steel plates, steel strips , Steel Panels, Geosynthetics etc.,. But usage of plastic is an economic method to reinforce soils since it is cheap and easily available.

and Sitar (1989) conducted experiments with sand reinforced with fibres to observe the deformation pattern and to quantify the width of shear zone in sand. The results showed that deformation pattern of reinforcement was found curve- linear and symmetric about the centre of the shear zone. Maher and Gray (1990) carried out triaxial compression tests on sand reinforced with discrete, randomly distributed fibres and observed the influence of various fibre properties on soil behavior. Using the experimental results they have proposed a force equilibrium model based on statistical analysis for randomly distributed discrete fibre reinforced sand. Ranjan et al. (1996) examined distinct relationships between the grain size of given soils and the fiber-bond strength. He found that the finer sand size particles had significantly greater fiber-bond strengths, thus they were less likely to fail by conditions of slippage than the coarser grained soils. Silts, being even smaller than fine-grained sands, might then be expected to achieve a stronger bond with fibers. T. Yetimoglu et al. (2004) studied the load–penetration behavior of randomly distributed fiber-reinforced sand fills overlying soft clay subgrade by performing laboratory CBR tests. They determined the effect of fiber reinforcement content on bearing capacity, stiffness and ductility of the fiber-reinforced sand–soft clay system. The test results indicated that adding fiber inclusions in sand fill resulted in an appreciable increase in the peak piston load and it increased with an increase in fiber content. They also reported that the initial stiffness of load–penetration curves was not significantly affected by fiber reinforcement and increasing fiber reinforcement content could increase the brittleness of the fiber-reinforced sand fill–soft clay system providing higher loss of post-peak strength. They found that the effect of the fiber reinforcement on the load–penetration behavior of the system is similar to that of geotextile reinforcement.

Fauziah Ahmad et al (2009). conducted triaxial compression tests to evaluate the response of randomly distributed fibre on the strength of reinforced silty sand. In this study, oil palm empty fruit bunch (OPEFB) fibre was mixed with silty sand soil to investigate the increase of shear strength during triaxial compression. The specimens were tested under drained and undrained conditions with 0.25% and 0.5% content of OPEFB fibres of different lengths (i.e. 15mm, 30mm and 45mm). In addition, OPEFB fibres coated with acrylic butadiene styrene thermoplastic were tested to determine the effect of coating on reinforcement. Inclusion of randomly distributed discrete fibres significantly improved the shear strength of silty sand. Coated OPEFB fibres increased the shear strength of silty sand much more compared to uncoated fibres. Coating fibres increases interface friction between fibre and soil particles by increasing the surface area. Reinforced silty sand containing 0.5% coated fibres of 30mm length exhibited approximately 25% increase in friction angle and 35% in cohesion under undrained loading conditions compared to those of unreinforced silty sand. The results indicate that the shear strength parameters of the soil-fibre mixture (i.e. Ø' and C') can be improved significantly. Nilo Cesar Consoli et al. (2008) observed the engineering properties and triaxial behavior of polypropylene fiber-reinforced/non-reinforced cemented/uncemented specimens of Osorio uniform sand. He prepared cemented sand specimens with cement contents varying from 0% to 10% by weight of dry sand and cured for seven days. He has taken fiber length and diameter as 24 mm and 0.023 mm, respectively, in the contents of 0%and 0.5% by weight of dry sand–cement mixture. Test results indicated that the addition of cement to sand increases stiffness, peak strength and brittleness. Both cement and fiber insertions affect dramatically the stress–dilatancy behavior of the sand. The fiber reinforcement increases peak strength just up to a certain cement content (up to about 5% in the present study), increases ultimate strength, decreases stiffness and changes the cemented sand brittle behavior to a more ductile one. He showed that the triaxial peak strength increase due to fiber inclusion is more effective for smaller amounts of cement, while the increase in ultimate strength is more efficacious when fiber is added to sand improved with higher cement contents. Peak strength envelopes indicate that the friction angle is about 46^0 for fiber-reinforced specimens containing up to 7% cement content, reaching 51.5^0 for higher cement contents. He reported that the Cohesion intercept is drastically affected due to fiber addition to all cement contents, increasing for cement contents up to 4% and reducing for higher cement contents. Sivakumar Babu et al. (2007) presented the results based on numerical analysis of stress strain response of fiber reinforced sand. Numerical simulation results indicate that the presence of random reinforcing material in soils make the stress concentration more diffused and restricts the shear band formation. Numerical simulation results also indicate that pull-out resistance of fibers governs the stress strain response of random-reinforced soil. In the present study, an attempt is made to reuse the plastic waste to improve the strength and CBR values of clayey soils.

II. MATERIALS AND PROPERTIES

Materials used in the present study are two types of clayey soils with different plasticity characteristics and plastic waste strips

A. Soils

In the present study effect of plastic strips on cohesive soils with different plasticity is considered. Two types of soils used are (a) highly compressible clay (CH) and (b) sandy clay (SC). The basic properties of the soils are given below.

1) *Highly Compressible Clay:* The first soil used in the present study is black cotton soil. These soils are residual deposits formed from basalt or trap rocks. Black cotton soils are clays with high plasticity and this plasticity is due to the presence of the clay mineral montmorillonite. These soils have high shrinkage and swelling characteristics. The shearing strength of the soils is extremely low. The soils are highly compressible and have low bearing capacity. This soil is abundantly available in and around Warangal, A.P. The basic properties of the soil are given in Table 1

TABLE 1 PROPERTIES OF HIGHLY COMPRESSIBLE CLAY

Parameters	Values
Specific Gravity	2.6
Liquid Limit (%)	62
Plastic Limit (%)	19
Shrinkage Limit (%)	10
Plasticity Index PI (%)	43
Gravel (%)	4
Sand (%)	26
Silt (%)	30
Clay (%)	40
Classification	CH
Maximum dry density, MDD(g/mm^3)	1.7
Optimum moisture content, OMC (%)	20
Unconfined Compressive Strength(kg/cm^2)	2.92
Cohesion (kg/cm^2)	1.46
Compression Index(C_C)	0.27
Coefficient of consolidation(C_V)	5.23×10^{-4}
Coefficient of Permeability(k)	2.4×10^{-8}

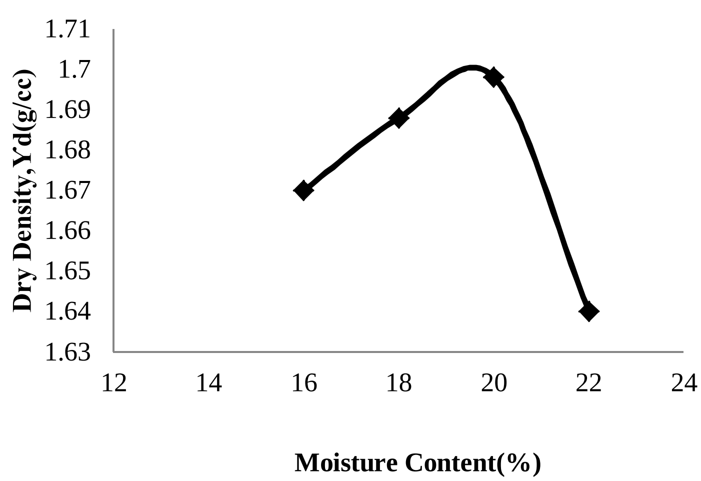


Fig2.1 Compaction Curve of Highly Compressible Clay

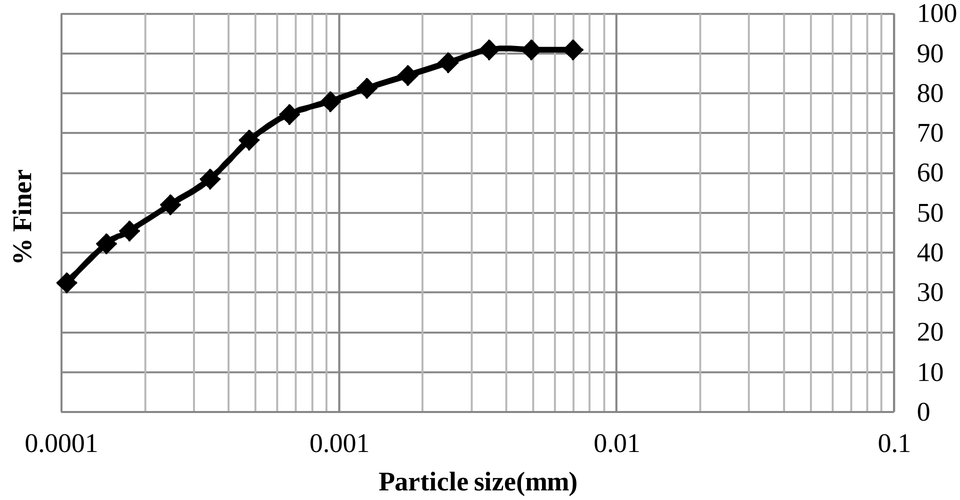


Fig.2.2 Hydrometer Analysis Graph for CH soil

B. Sandy Clay

The second soil used in this study is Red Soil. Red soils are Lateritic soils. Lateritic soils are Residual soils, formed by decomposition of rock, removal of bases and silica, and accumulation of iron oxide and aluminum oxide. These soils are generally red/pink in color due to the presence of iron oxide. These soils are soft and can be cut with a chisel when wet and harden with time. These soils, especially those which contain iron oxide, have relatively high specific gravity. Lateritic soil is procured from the NIT Warangal campus. The basic properties of the soil are given in Table 2.

Table 2 Properties of Sandy Clay

Parameters	Values
Specific Gravity	2.67
Liquid Limit (%)	59
Plastic Limit (%)	26
Plasticity Index PI (%)	33
Gravel (%)	24
Sand (%)	46
Silt (%)	8
Clay (%)	22
Classification	SC
Maximum dry density, MDD(g/mm^3)	1.93
Optimum moisture content, OMC (%)	11
Unconfined Compressive Strength(kg/cm^2)	2.4
Cohesion (kg/cm^2)	1.2

C. Plastics

In the present study, an attempt is made to reutilise these disposable plastic glasses to improve the engineering properties of soils. Plastics used in this study are collected from coffee day express, NIT Warangal. These disposable plastic glasses are cut into small strips and mixed in those soils and their properties are evaluated. Figs 2.3(a) and (b) shows the collected disposable plastic glasses and plastic strips that are made from plastic glasses. The basic properties of the plastic glass strips are given in Table 3.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue III, March 2018- Available at www.ijraset.com

Table 3 Basic properties of plastic waste strips

Parameters	Properties
Resin type	Polypropylene
Aspect ratio	3
Thickness	10μ
Specific Gravity	0.91
Length × Breadth(UCS)	5mm × 15mm
Length × Breadth(CBR)	8mm × 24mm

Fig2.3 (a) Disposable plastic glasses (b) Plastic Strips

The collected disposable glasses are smooth in texture and the resin type used for manufacturing these glasses is polypropylene. As these glasses are smooth, the surface of the glasses is made rough by needle punching for creating friction. Then these punched sheets are made into small strips i.e., 5mm×15mm for preparing UCS samples and 8mm × 24mm for preparing CBR specimens. This variation in length and breadth of strips is because of variation in size of specimens which are made in 38mm × 76 mm mould for UCS tests and 15cm × 17.5cm mould for CBR tests.

III.EXPERIMENTAL METHODOLOGY

This section deals with the experimental procedures of tests conducted on fiber reinforced soil in detail. Unconfined Compression test and California Bearing Ratio test have conducted on soils of both high plastic and low plastic clays after mixing with plastics to determine the strength and CBR values. The experimental procedures of Unconfined Compression test and California Bearing Ratio test are discussed below. Samples are prepared by mixing different percentages (0.25%, 0.5% and 1.0% to the dry weight of soil) of plastic strips into soils. Mixing of plastic strips into soil should be done carefully that these strips should be distributed uniformly in the soil. As the fibers tended to lump together, it required considerable care and time to separate them to obtain an even distribution of the fibers in the mixture. All of the mixing is done manually and proper care is taken to prepare homogeneous mixture.

A. *Unconfined compression test*

The Unconfined Compressive Strength (q_u) is the axial stress at which the cylindrical specimen of a cohesive soil fails in compression or at 15% of strain. This is a special form of a triaxial test in which the confining pressure is zero. The unconfined compression test gives the undrained shear strength of the soil in a simple and quick way. Figure 3.4 (a) and (b) shows the soil mixed with plastic strips and the specimen prepared for UCS test.

$$q_u = P/A$$

Where q_u = Unconfined Compression Strength

P = Load at which the specimen fails in compression, kg

A = Corrected area of the specimen, cm^2.

Fig 3.1 (a) Plastic waste strips mixed soil (b) Sample prepared with plastic waste mixed soil

Plastic glasses are made into small strips of length 12mm and width 4mm. These strips are mixed at different percentages i.e., 0.25%, 0.5% and 1.0% in both high plastic clay and low plastic clay and specimens are prepared at OMC and MDD in a mold with a length of 76 mm and an inner diameter of 38 mm. Each mold contains the same volume of mixture such that the density of all tested samples is approximately the same. The soil samples are extracted from the moulds after compaction and these samples are kept under compression testing machine to test them. Figs 3.1(a) and (b) are showing soil mixed with plastic waste strips and the sample prepared with that soil. The load at which these samples fail under compression gives Unconfined Compression Strength. The UCS tests are conducted in accordance with the ASTM D5102-09 (ASTM 2009b).

B. California bearing Ratio Test

The California Bearing Ratio test is conducted for evaluating the suitability of the sub grade and materials used in sub-base and base of a flexible pavement. It was developed by the California Department of Transportation. CBR is defined as the ratio of force per unit area required to penetrate a soil mass with a circular plunger of 50mm diameter at the rate of 1.25mm/min to that required for corresponding penetration of a standard material. The ratio is usually determined for penetrations of 2.5mm and 5mm and the greater value is used for the design of flexible pavement. Generally, the CBR for 2.5mm penetration is high and taken for design. But if the CBR for 5.0mm is more, the test is repeated and the results are constantly unchanged, then the value for 5.0mm penetration is used for design. The load corresponding to 2.5mm and 5.0mm penetration values are taken from load-penetration curve.

$$\text{CBR Value} = (\text{Test load}/\text{Standard load}) \times 100$$

Standard load is defined as the load obtained from the test on crushed stone which has a CBR Value = 100%.The Table 4 gives the standard loads adopted for different penetrations for the standard material with a C.B.R. value of 100%. CBR mould and the compacted plastic waste reinforced soil are shown in Figure 3.1 (a) and (b).

Table 4 Standard Loads for different Penetrations

Penetration (mm)	Standard Load(kg)
2.5	1344
5.0	2016
7.5	2580
10.0	3120
12.5	3532

Fig 3.2(a) CBR Mould (b) Compacted Plastic waste strips mixed soil in CBR mould

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue III, March 2018- Available at www.ijraset.com

This test is conducted on specimens mixed with different percentages (0%, 0.25%, 0 .5% and 1.0% to the dry weight of the soils) of plastics and on two different plasticity characteristics of clays. The specimens are prepared in a cylindrical mould of 150 mm-diameter and 175-mm height and compacted in three layers at its MDD and OMC based on the standard Proctor compaction. CBR mould and the compacted plastic waste reinforced soil are shown in Fig 3.2(a) and (b). The tests were conducted in accordance with ASTM D1883-07 (ASTM 2007). The mould is kept under CBR testing machine and the load corresponding to the 2.5mm and 5.0mm are taken from load-penetration curve to determine the CBR Values. Soaked CBR tests are also conducted for examining the performance of plastic waste mixed soil when it is in its worst condition. After compacting the plastic waste mixed soil in CBR mould, the soil specimen is kept submerged in water for about 4 days. The specimen is covered with surcharge mass to simulate the effect of overlying material. After 96 hours of submergence of specimen, it is taken out and tested to determine the soaked CBR Value.

IV. RESULTS AND DISCUSSION

A. Results Of Unconfined Compression Test

1) *Highly Compressible Clay:* The UCS of plain soil is 2.93 kg/cm^2 and after adding of 0.25% of plastics UCS value is increased to 3.35 kg/cm^2 and again after adding of 0.5% of plastics, the UCS Value is again increased to 3.70 kg/cm^2 and then the UCS value is decreased to 2.60 kg/cm^2 when 1.0% plastic is added. The Unconfined Strength of plain soil is increased to 26.2% when it is mixed with plastic waste strips. Table 4.1 gives the information about the percentage increase in UCS values and Cohesion of the soil.

Table 5 UCS, % increase in UCS and Cohesion values at 0.0%, 0.25%, 0.5% and 1.0% of the CH soil samples

S. No	% of Plastics	UCS Values Kg/cm^2	% Increase in UCS Values	Cohesion(C_u) Kg/cm^2
1	0.0	2.93	-	1.46
2	0.25	3.35	14.5	1.67
3	0.5	3.70	26.2	1.84
4	1.0	2.60	-	1.30

Results showed that Unconfined Compression strength is increased due to addition of different percentages (0.0%, 0.25%, 0.5% and 1.0%) of plastic waste in highly compressible soil. Figures 4.1, 4.2 and 4.3 show the plot of compressive stress vs strain, percentage increase in UCS values vs percentage of plastics and Cohesion vs percentage of plastics .

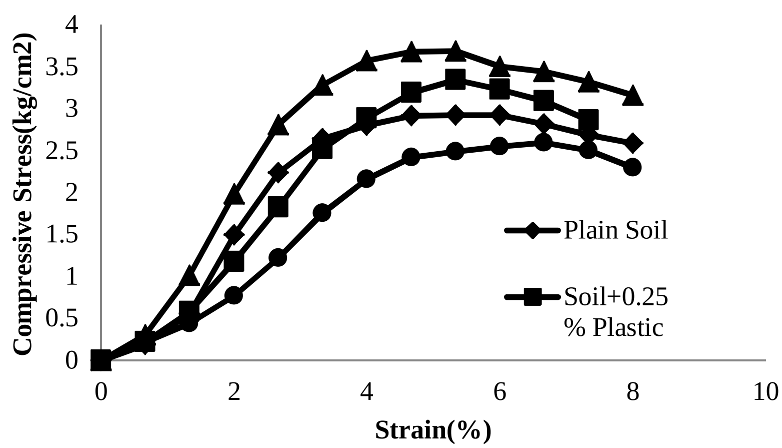


Fig 4.1 Relationship between Compressive Stress vs Strain of plain CH soil and soil with 0.25%, 0.5% and 1.0% plastic waste content

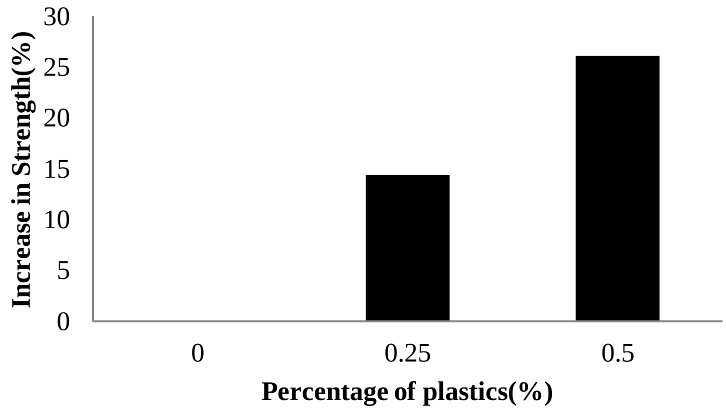


Fig 4.2 Increase in Strength of plastic waste reinforced soil over plain CH soil

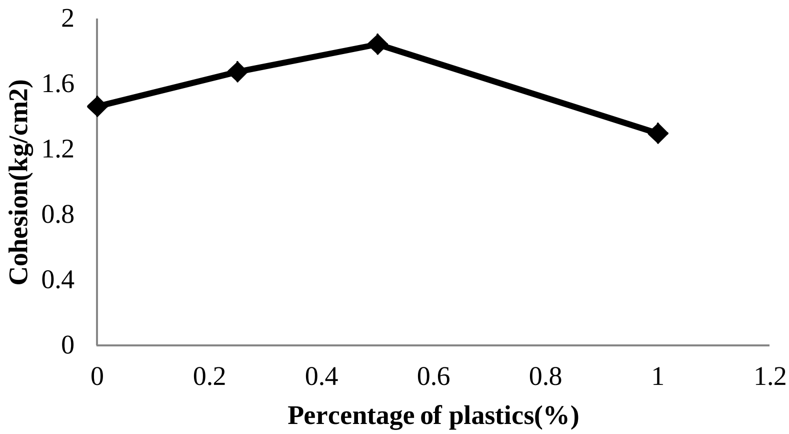


Fig 4.3 Variations in Cohesion of CH soil with 0.0%, 0.25%, 0.5% and 1.0% of plastic waste strips

B. Sandy Clay

The UCS of plain soil is 2.41 kg/cm^2 and after adding of 0.25% of plastics UCS value is increased to 3.03 kg/cm^2 and again after adding of 0.5% of plastics, the UCS Value is again increased to 3.46 kg/cm^2 and then the UCS value is decreased to 2.93 kg/cm^2 when 1.0% plastic is added. The plain soil strength is increased to 28.85% after reinforcing it with plastic waste strips. Table 4.2 gives the information about the percentage increase of UCS values and Cohesion of the soil.

Table 6 UCS, % increase in UCS and Cohesion values at 0.0%, 0.25%, 0.5% and 1.0% of the SC soil samples

S. No	% of Plastics	UCS Values Kg/cm^2	% Increase in UCS Values	Cohesion(C_u) Kg/cm^2
1	0.0	2.53	-	1.20
2	0.25	3.03	19.76	1.51
3	0.5	3.26	28.85	1.73
4	1.0	2.93	15.81	1.46

The results showed that Unconfined Compression strength of Sandy Clay is also increased by the addition of different percentages (0.0%, 0.25%, 0.5% and 1.0%) of plastic waste. Figures 4.4, 4.5 and 4.6 plotted between Compressive stress and strain, % increase in UCS values and % of plastics and Cohesion and % of plastics are presented below.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue III, March 2018- Available at www.ijraset.com

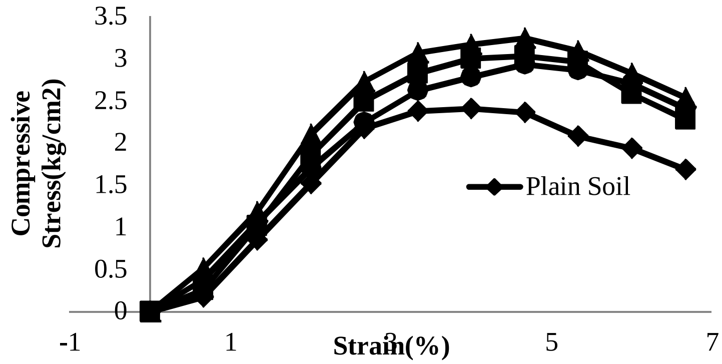


Fig 4.4 Relationship between Compressive Stress vs Strain of plain SC soil and soil with 0.25%, 0.5% and 1.0% plastic waste content

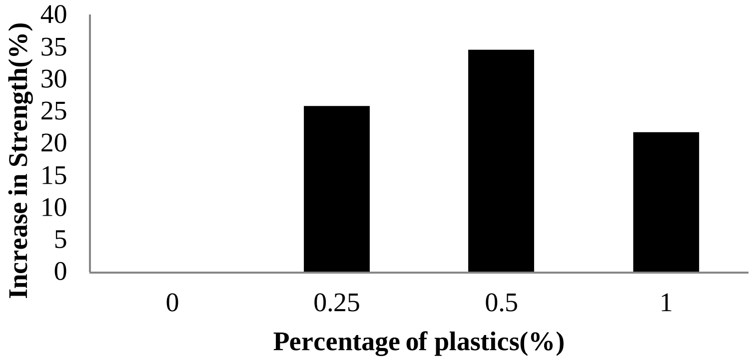


Fig 4.5 Increase in Strength of plastic waste reinforced soil over plain SC soil

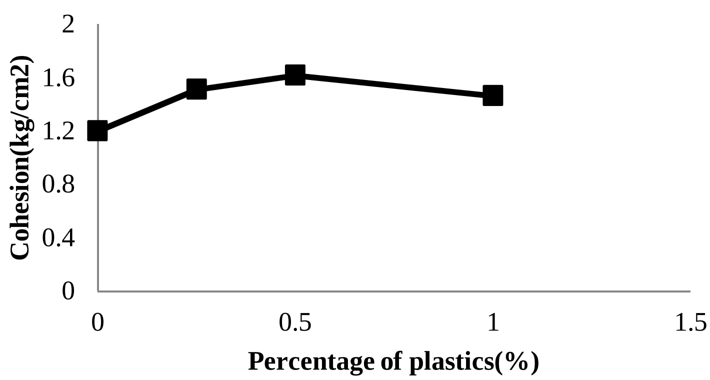


Fig 4.6 Variations in Cohesion of SC soil with 0.0%, 0.25%, 0.5% and 1.0% of plastic waste strips

The Unconfined Compression Strength is increased for both high plastic and low plastic clays when they are added with different percentage of plastic waste strips. The increase of Unconfined Strength of plastic waste mixed soils is increased till 0.5% of plastics and then the strength of both soils is reduced at 1.0% of plastic content. The improvement in strength is due to the addition of plastic strips. With increase in fiber content there is increase in the interface area between the fiber and soil particles. The increased contact area increases the friction between soil and fibers. The friction between the fiber and soil particles increases which renders it difficult for soil particles that surround fibers to change in position from one point to another and thereby improves the bonding force between soil particles, i.e., cohesion of the soil (A.S.Muntohar,2013). Moreover, when local cracks appear in the soil, fibers across the cracks will take on the tension in the soil with fiber/soil friction, which effectively impedes further development of cracks and improves the resistance of soil to the force applied. Tang et al. (2007) noted the ability of the fibers to prevent further cracks as a bridge effect of fiber inclusion. The decrease in strength is due to the loss of integrity between soil and plastic waste strips. This loss of integrity is due to addition of a large amount of the fiber. Addition of large amount of fibers will cause a slippage and decrease the friction between soil and fiber.

C. Results Of California Bearing Ratio Tests

The CBR tests are performed according to the procedure as mentioned in above chapter. The results of CBR tests are showing that there is appreciable increase in CBR values when soils are mixed with different percentages (0.0%, 0.25%, 0.5% and 1.0%) of plastic waste strips. This test is performed on both unsoaked and soaked conditions for plastic waste fiber reinforced soils.

1) *Unsoaked CBR Test:* The unsoaked CBR value of plain soil is 5.47. The CBR value of 0.25% plastic waste strips reinforced soil is increased to 6.01. The CBR value is 6.84 when the soil is mixed with 0.5% of plastic waste strips and it is increased to 7.46 when the soil is mixed with 1.0% of plastic waste strips. The results are presented in the below Table 4.3. The percentage increase in CBR values is increasing with the increase in percentage of plastic waste strips. The CBR value of plain soil is increased to 32.72% when it is reinforced with 1.0% plastic strips.

Table 7 CBR and % increase in CBR values of CH soil with 0.0%, 0.25%, 0.5% and 1.0% plastic waste content

S.No	% Plastics	CBR Values	% increase in CBR Values
1	0.0	5.47	0.0
2	0.25	6.01	9.96
3	0.5	6.84	26.05
4	1.0	7.26	32.72

The graph is plotted between load and penetration of reinforced soil with different percentage of plastic strips. The load-penetration graph and the graph showing increase in CBR values with respect to percentage of increase in plastic strips are given in figures 4.7 and 4.8.

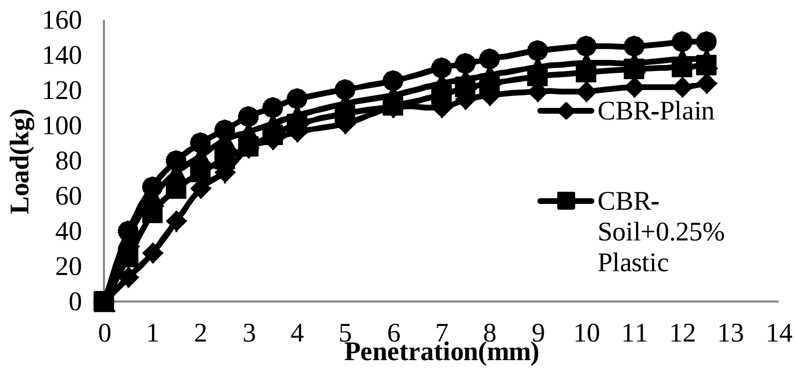


Fig 4.7 Relationship between Load vs Penetration of CH with 0.0%, 0.25%, 0.5% and 1.0% plastic waste content

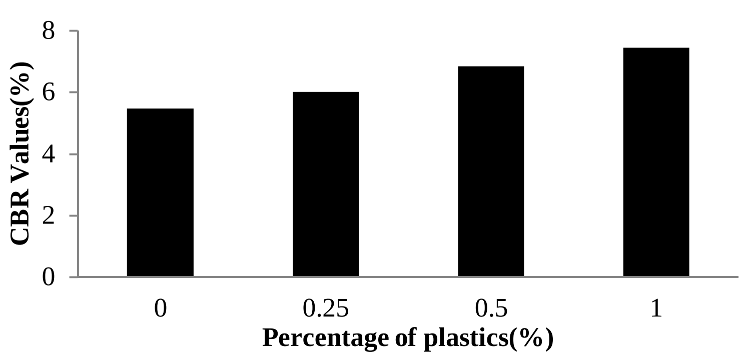


Fig 4.8 Percentage increase in CBR values of CH soil with the increase in percentage of plastic waste content

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue III, March 2018- Available at www.ijraset.com

2) *Sandy Clay:* The unsoaked CBR value of plain soil is 13.7. The CBR value of 0.25% plastic waste strips reinforced soil is increased to 15.06. The CBR value is 16.43 when the soil is mixed with 0.5% of plastic waste strips and it is increased to 17.80 when the soil is mixed with 1.0% of plastic waste strips. The CBR value of plain soil is increased to nearly 30% after mixing it with 1.0% of plastic waste strips. Results of CBR values and % increase in CBR values are given in Table 8.

Table 8 CBR values and % increase in CBR values of SC soil with 0.0%, 0.25%, 0.5% and 1.0% percentage of plastic waste strips

S.No	% Plastics	CBR Values	% increase in CBR Values
1	0.0	13.7	0
2	0.25	15.06	9.92
3	0.5	16.43	19.92
4	1.0	17.8	29.92

The graph is plotted between load and penetration to show the variation of penetration resistance of reinforced soil with different percentage of plastic strips against plain soil. Fig 4.9 is showing the relationship between plain soil and soil with different percentages of plastic waste strips. Fig 4.10 is showing increase in CBR values with respect to percentage of increase in plastic strips are given below.

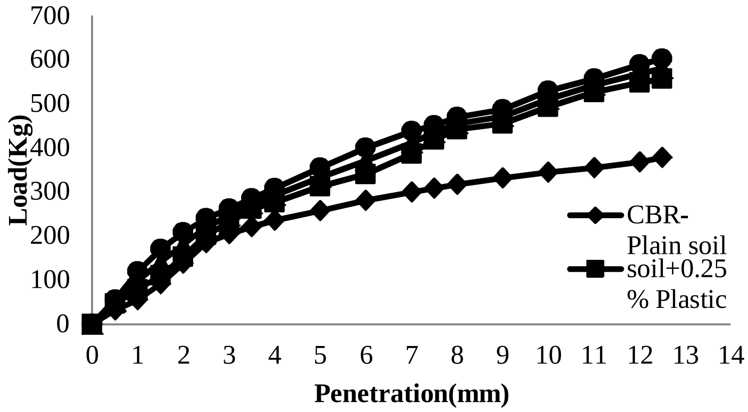


Fig 4.9 Relationship between Load vs Penetration of SC and SC with 0.0%, 0.25%, 0.5% and 1.0% plastic waste content

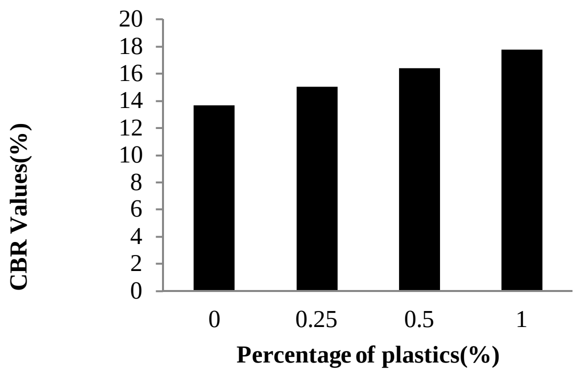


Fig 4.10 Relationship between % increase in CBR values of SC soil with the increase in % of plastic waste content

3) *Highly Compressible Clay:* The soaked CBR value of plain soil is 1.34 and it is increased to 2.23 when the soil is mixed with 0.25% of plastic strips. After adding of 0.5% of plastic strips, the soaked CBR value is 2.98. The soaked CBR value is showing maximum at 1.0% of plastic strips and the value is 3.27. Increased in soaked CBR values of CH soil with increase in percentage of plastic waste content is shown in Table 4.5.

Table 9 Increase in soaked CBR values of CH soil with increase in percentage of plastic waste content

S.No	**% of Plastics**	**CBR Values**
1	0.0	1.34
2	0.25	2.23
3	0.5	2.98
4	1.0	3.27

The results showed that the soaked CBR values are increased with the increase in percentage of plastic waste strips The load vs penetration and CBR values vs % of plastics graphs are plotted and they are presented below.

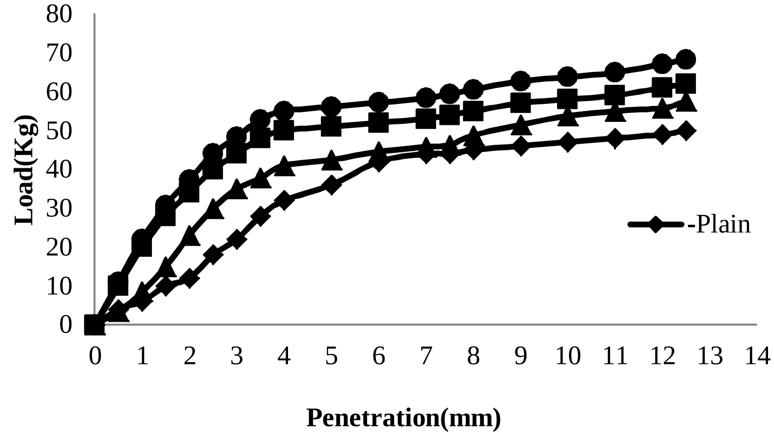


Fig 4.11 Relationship between Load vs Penetration of CH and CH with 0.0%, 0.25%, 0.5% and 1.0% plastic waste content

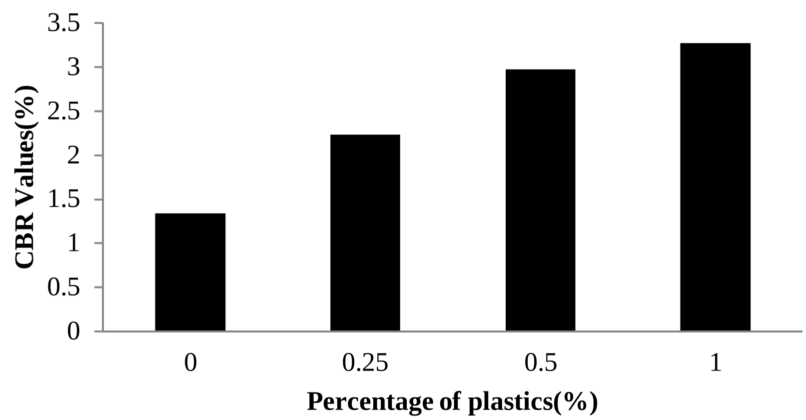


Fig 4.12 Percentage increase in CBR values of CH soil with the increase in % of plastic waste content

Table 10 Increase in soaked CBR values of SC soil with increase in percentage of plastic waste content

S.No	% of Plastics	CBR Values
1	0.0	2.25
2	0.25	2.73
3	0.5	2.89
4	1.0	3.05

Figures 4.13 and 4.14 show the load vs. penetration and CBR values vs. % of plastics graphs.

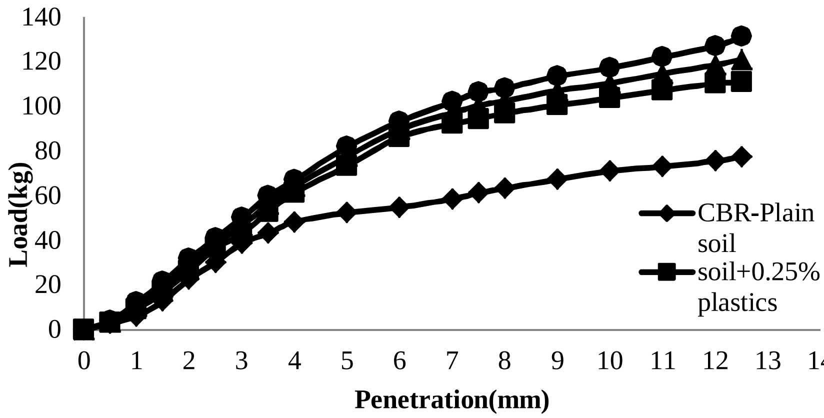


Fig 4.13 Relationship between Load vs Penetration of SC and SC with 0.0%, 0.25%, 0.5% and 1.0% plastic waste content

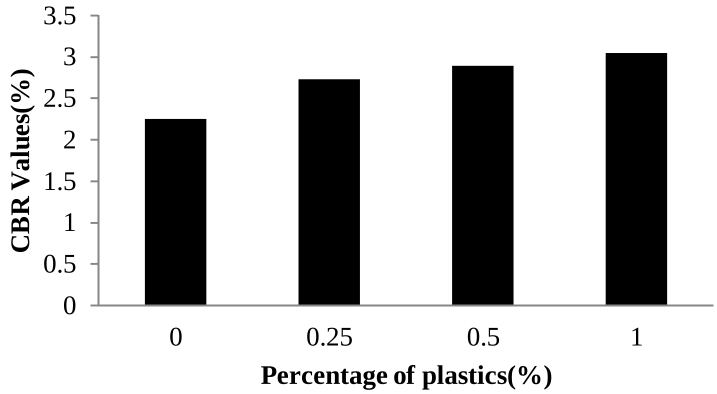


Fig 4.14 Percentage increase in CBR values of SC soil with the increase in % of plastic waste content

The CBR values for both high plastic and low plastic clays are increased with the increase in plastic waste content. This increase in CBR values are attributed to the resistance offered by the strips present in the soil. Generally the plunger penetrates into the soil when the specimen is subjected to loading. But in case of plastic waste reinforced soil, the strips present in soil do not allow the plunger to penetrate into the soil so that the fiber reinforced soil can take more load than plain soil. The penetration resistance of the soil is increased due to the inclusion of plastic waste strips.

V. CONCLUSIONS

A series of UCS tests and CBR tests are conducted on high plastic and low plastic clays with different percentages of plastic strips. The conclusions made from the present study are given below.

A. The Unconfined Compressive Strength for both high plastic and low plastic clays is increased due to inclusion of plastic waste strips. The strength of both soils is increased till the addition of 0.5% of plastic waste strips. After adding 1.0% plastic strips the strength of both soils is reduced. This reduction in strength is due to loss of integrity in soil-fiber system and slippage between fibers.

B. The percentage increase in strength of highly compressible clay is 26.2 and for sandy clay the strength increased is 28.85%. This is attributed to the increase in friction between soils and plastic waste fibers

C. The California Bearing Ratio values are increasing with the increase in percentage of plastic waste strips for both the soils. The CBR values for both high plastic and low plastic clays are increased for both soaked and unsoaked CBR test

D. The percentage increase in CBR values are 32% and 30% for black cotton soil and red soil respectively. This is attributed to the increase in penetration resistance of the plastic waste fiber reinforced soil.

REFERENCES

[1] Javeriya Siddiqui and Govind Pandey (2013), "A Review of Plastic Waste Management Strategies", International Research Journal of Environmental Sciences, Vol. 2(12), 84-88.

[2] Shewbridge.S.E and Sitar.N (1989), "Deformation characteristics of reinforced sand in direct Shear", J. Geotech. Eng. ASCE 115 (8), 1134–1147.

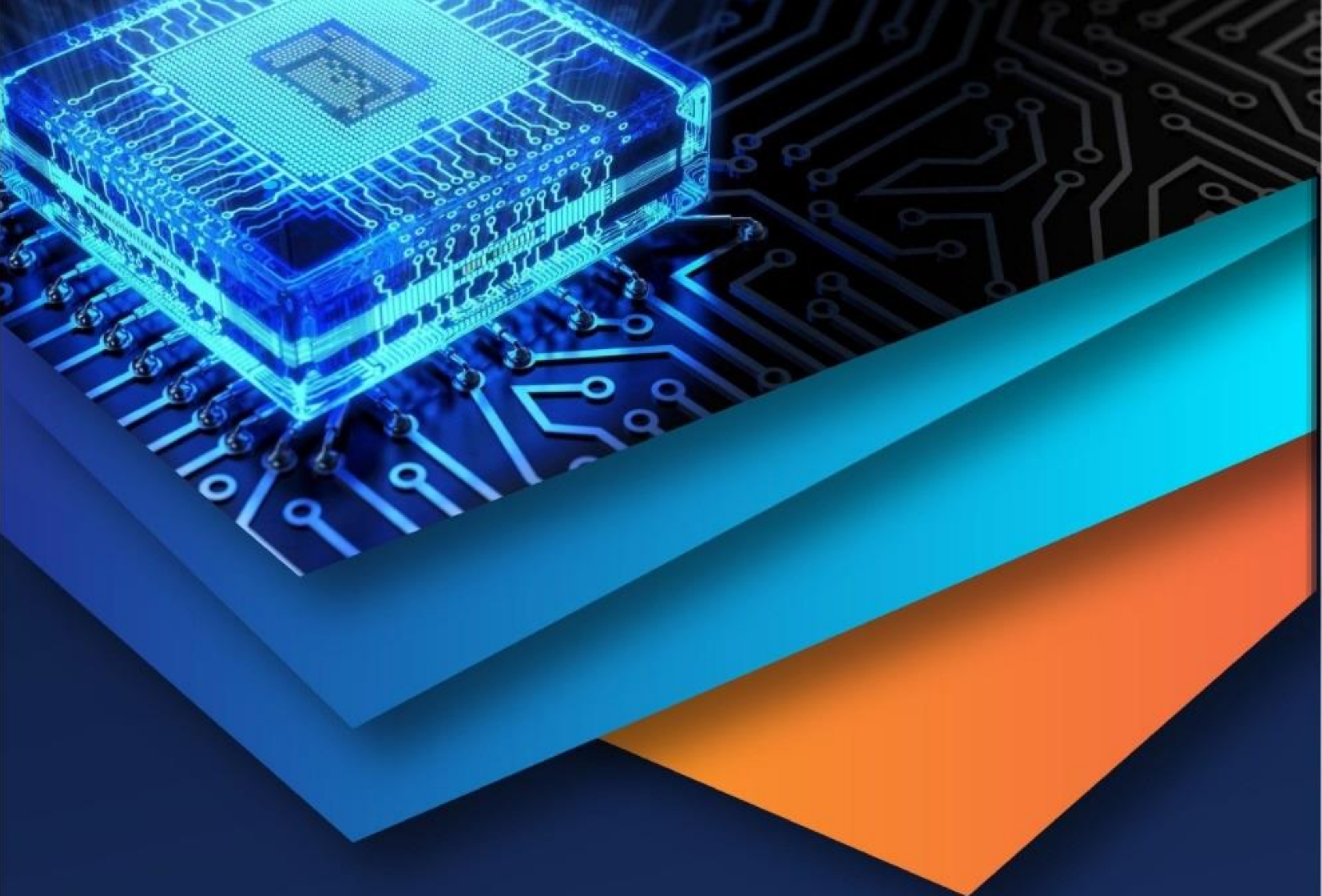
[3] Sivakumar Babu.G.L, Reddy.K.R, and Chouskey.S.K (2010a), "Constitutive Model for Municipal Solid Waste Incorporating Mechanical Creep and Biodegradation-Induced Compression", Waste Management Journal, (30) 11-22.

[4] Sivakumar Babu.G.L., Reddy.K.R., Chouskey.S.K., and Kulkarni.H (2010b), "Prediction of Long-term Municipal Solid Waste Landfill Settlement Using Constitutive Model", Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management, ASCE. vol.14 (2), 139-150.

[5] Sivakumar Babu.G.L., and Chouksey.S.K (2010), "Model Analysis of fiber reinforced clayey soil", Geomechanics and Geoengineering Journal, Taylor & Francis, Vol. 5(4), 277- 285.

[6] Sivakumar Babu.G.L., Vasudevan.A.K. (2008a), "Strength and stiffness response of coir reinforced tropical soils", J. Mater. Civ. Eng. ASCE 20 (9), 571–577.

[7] Sivakumar Babu.G.L., Vasudevan.A.K. (2008b), "Use of coir fibers for improving the engineering properties of expansive soils", J. Nat. Fibers 5 (1), 61–75.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429