Utilization of Waste Bottle Plastic Strips and Crusher Dust, Flyash as a Soil Stabilizer in Construction of Flexible Pavements

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***Abstract*: Economic growth and industrialization generates huge quantities of waste materials and needs thousands of hectares of land for the disposal which creates environmental pollution. Flyash and crusher dust come under this category. Utilization of these materials into bulk quantities in civil engineering structures can provide an alternative to natural soils and disposal problems. In this connection an attempt is made for the utilization of crusher dust and flyash in Geotechnical engineering applications. Tests like compaction, strength, CBR were performed on mixes prepared from crusher dust and flyash by varying their percentages with respect to each other. From the test results it is identified that high strength values in terms of CBR (14) and angle of shearing resistance (40) by maintaining high dry densities. It is also identified that by achieving of high strength values against shear these crusher dust- flyash mixes can be used as sub-grade and fill material. Therefore 20 -40% of flyash added to crusher dust can give better results to suit as sub-grade, fill materials in constructional activities.**

The design of the flexible pavement layers to be laid over the sub grade soil so the estimation of sub grade strength and traffic volume to be carried. The designs of the various layers of pavement are dependent on the sub grade soil strength over which they are going to be laid. Sub grade strength is expressed in the terms of CBR value. Weaker sub grade causes high amount of failures on surface of Flexible Pavement like Pot holes, various types of cracks and rut depth which is supposed to reduce ride quality of vehicles

In this study, we are making the use of solid waste is used in the construction of pavements and reducing the waste for land fill and making utilization of raw material in the embankments of pavements and also making the soil improvement by stabilization process. Therefore, the present study will focus on literature work related to the field of soil improvement and solid waste related problems. Here an attempt has been made to lime stabilization of black cotton (BC) soil with various percentage i.e 0%, 2%, 4%, 6% of waste Plastic bottle strips and study the engineering properties of soils MDD, OMC, Compaction, including CBR at different percentages plastic strips

***Index Terms*: Environmental Pollution, Flyash, Geotechnical Engineering, Flexible Pavements, Soil Stabilizer, Black Cotton**

I. INTRODUCTION

A. *Introduction*:

Industrial wastes like flyash, pondash, GGBFS, crusher dust, slag etc collectively touches 200MT annually. These huge quantities require lot of cultivable and useful land for their disposal. To reduce their impact on natural ground these have been under the utilization process in the field of civil engineering as bricks, road material, cement and other applications. Their utilization in bulk quantities to suit as construction and foundation material and to meet certain specifications similar to natural construction material like stones, sands, gravel soils etc. Civil engineering structures require large quantities of the above said material for their completion. Some materials are durable and some of them have been continuously deforming when contacted with water.

Now-a-days industrial wastes have been gaining their prominence to be used as civil engineering material as an individual or mixed with natural soils or stones or admixture to suit as construction materials. Several thinkers have been in the field of research on the utilization in various parts of civil engineering. Geotechnical engineering is a promising area for the utilization in the areas of road construction material and other geotechnical material. The current sustainable approach is to reduce, recycle and reuse. Where it does not address properly the total waste which pollutes the nature and environment. There are several products which are manufactured from plastic according to growth of usage of plastic products these plastic products classifies in to plastic as follow:

1. Polyethylene Terephthalate (PET),
2. High-Density Polyethylene (HDPE),
3. Polyvinyl Chloride (PVC)
4. Polypropylene (PP),
5. Low-Density Polyethylene
6. Polystyrene (PS), and
7. Others (like polyester, polyamides, and polycarbonate).

various use of plastic are packaging, furniture, automotive, agriculture, sport, electrical and electronics goods, health and safety, building and construction, and consumer and household appliances which Increase the uasge plastic products which makes increase in plastic waste, It has became a challenge to waste management authorities.

B. Objectives of Present Study:

The main objective of the present study is utilization of Plastic bottles in certain quantities when mechanically stabilized with Crushed dust and their mixes can be used as reinforcement

- To know the geotechnical Characterization of Crusher dust
- To know the Compaction characteristics of Crusher dust and Plastic strips at various percentages
- Suitability of the stabilized Crusher dust and Flyash mixes as Sub-grade, fill material in road construction.
- To know the discuss environmental impact when soil is reinforced with waste bottle plastic strips.
- To improve shear strength and reduce the compressibility of soil
- To improve load carrying capacity of soil
- Using plastic strips and lime as a stabilizer which increases shear tensile strength and CBR value of the soil.

C. Scope of Present Study:

In the present study Crusher dust and Plastic waste were collected from crushing stone plants of Srikakulam and NTPC, Vishakhapatnam and Scrap yards respectively. These soils were tested for Geotechnical Characteristics such as Gradation, Plasticity, Compaction, Seepage and CBR etc. To study the performance of Crusher dust - Flyash mixes various percentages of Flyash was added to the Crusher dust and studied their plasticity and strength characteristics. Based on Liquid Limit, Plasticity Index, Angle of Shearing resistance, Coefficient of Permeability and CBR the stabilized Crusher dust with Flyash were checked as sub-grade and fill materials in accordance with MORTH specification.

II. ROAD NETWORK, PAVEMENTS AND FLYASH

A. Road Network:

India has a road network of 4,236,000 kilometers (2,632,000 mi) in 2011, the third largest road network in the world. India has 0.66 km of roads per every square kilometer of land. The quantitative density of India's road network is similar to that of the United States (0.65) and far higher than that of China (0.16) or Brazil (0.20). However, qualitatively India's roads are a mix of modern highways and narrow, unpaved roads, and are undergoing drastic improvement. As of 2008, 49 per cent – about 2.1 million kilometers – of Indian roads were paved.

Adjusted for its large population, India has less than 4 kilometers of roads per 1000 people, including all its paved and unpaved roads. In terms of quality, all season, 4 or more lane highways, India has less than 0.07 kilometers of highways per 1000 people, as of 2010. These are some of the lowest road and highway densities in the world. For context, United States has 21 kilometers of roads per 1000 people, while France about 15 kilometers per 1000 people – predominantly paved and high quality in both cases. In terms of all season, 4 or more lane highways, developed countries such as United States and France have a highway density per 1000 people that is over 15 times as India.

India in its past did not allocate enough resources to build or maintain its road network. This has changed since 1995, with major efforts currently underway to modernize the country's road infrastructure. India has planned to spend approximately US $70 Billion by 2013 to modernize its highway network. The rate of new highway construction across India has accelerated in recent years. As of October 2011, the country was adding 11 kilometers of new highways, on average, every day. The expected pace of project initiations and completion suggests that India would add about 600 kilometers of modern highway per month, on average, through 2014.

Since 1995, the authority has privatized road network development in India, and delivered by December 2011, over 70,000 kilometers of National Highways, of which 16,500 kilometers are 4-lane or 6-lane modern highways. In this chapter looks at previous journals of different researchers on this subject matter. It presents an overview of plastics, PET, fibre-reinforced soil, and case studies of fibre-reinforced soils. More over here it was discussed that behavior of soil-waste bottle plastic strips composite and potential applications of soil reinforced with waste bottle plastic strips in pavement construction. Lastly, a summary and conclusions discussed in this chapter are listed.

B. Types of Pavements:

The pavement carries the wheel loads and transfer the load stresses through a wider area on the soil sub-grade below. Thus, the stresses transferred to the sub-grade soil through the pavement layers are considerably lower than the contact pressure or compressive stresses under the wheel load on the pavement surface. The reduction in the wheel load stress due to the pavement depends both on its thickness and the characteristics of the pavement layers. A pavement layer is considered more effective or superior, if it is able to distribute the wheel load stress through a larger area per unit depth of the layer. However, there will be a small amount of temporary deformation even on a good pavement surface when heavy wheel loads are applied. One of the objectives of a well designed and constructed pavement is therefore to keep this elastic deformation of the pavement within the permissible limits, so that the pavement can sustain a large number of repeated load applications during the design life.

1. Types of Pavement Structure:

Based on the structural behavior, pavements are generally classified into two categories

- Flexible pavements.
- Rigid pavements.
- Semi Rigid pavements.

C. Components of Flexible Pavements:

A typical flexible pavement consists of four components

- Soil sub-grade.
- Sub base course.

- Base course.
- Surface course.

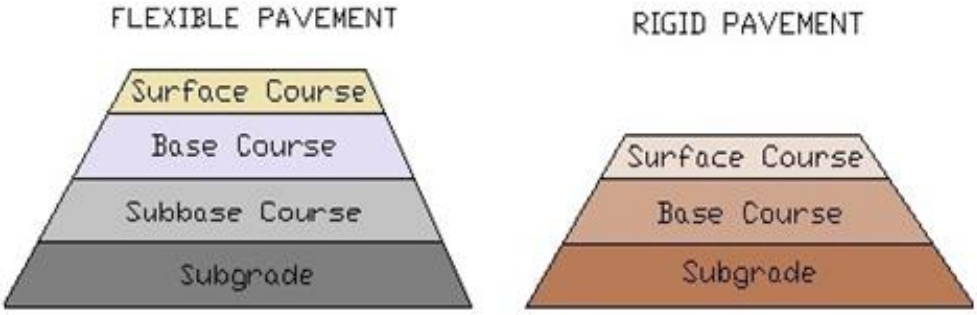


Figure. 1 Components of Pavements.

The flexible pavement layers transmit the vertical or compressive stresses to the lower layers by grain to grain transfer through the points of contact in the granular structure. A well compacted granular structure consisting of strong graded aggregate (interlocked aggregate structure with or without binder materials) can transfer the compressive stresses through a wider area and thus forms a good flexible pavement layer. The load spreading ability of this layer therefore depends on the type of the materials and the mix design factors. Bituminous concrete is one of the best flexible pavement layer materials. Other materials which fall under the group are, all granular materials with or without bituminous binder, granular base and sub-base course materials like the Water Bound Macadam, crushed aggregate, gravel, soil-aggregate mixes etc. The vertical compressive stress is maximum on the pavement surface directly under the wheel load and is equal to the contact pressure under the wheel. Due to the ability to distribute the stresses to a larger area in the shape of a truncated cone, the stresses get decreased at the lower layers. Therefore by taking full advantage of the stress distribution characteristics of the flexible pavement, the layer system concept was developed. According to this, the flexible pavement may be constructed in a number of layers and the top layer has to be the strongest as the highest compressive stresses are to be sustained by this layer, in addition to the wear and tear due to the traffic. The lower layers have to take up only lesser magnitudes of stresses and there is no direct wearing action due to traffic loads, therefore inferior materials with lower cost can be used in the lower layers. The lowest layer is the prepared surface consisting of the local soil itself, called the sub grade. Typical cross section of a flexible pavement structure is shown in Fig 3.1 this consists of a wearing surface at the top, below which is the base course followed by the sub base course and the lowest layer consists of the soil sub grade which has the lowest stability among the four typical flexible pavement components. Each of the flexible pavement layers above the sub grade, viz. sub-base, base course and the surface course may consist of one or more number of layers of the same or slightly different materials and specifications.

D. Functions of Pavement Components:

1. Soil Sub-grade and its Evaluation:

The soil sub-grade is a layer of natural soil prepared to receive the layers of pavement materials placed over it. The loads on the pavement are ultimately received by the soil sub-grade for dispersion to the earth mass. It is essential that at no time, the soil sub-grade is overstressed. It means that the pressure transmitted on the top of the sub-grade is within the allowable limit, not to cause excessive stress condition or to deform the same beyond the elastic limit. Therefore it is desirable that at least top 50 cm layer of the sub-grade soil is well compacted under controlled conditions of optimum moisture content and maximum dry density. It is necessary to evaluate the strength properties of the soil sub-grade. This helps the designer to adopt the suitable values of the strength parameter for design purposes and in case this supporting layer does not come up to the expectations, the same is treated or stabilized to suit the requirements. Many tests are known for measuring the strength properties of the sub grades. Mostly the test is empirical and is useful for their correlation in the design. Some of the tests have been

The common strength tests for the evaluation of soil sub-grade are:

- California bearing ratio test.
- California resistance value test.
- Triaxial compression test.
- Plate bearing test.

E. Typical Flexible Pavement Failures:

Following are some of the typical flexible pavement failures:

- Alligator (map) cracking.
- Consolidation of pavement layers.
- Shear failure.
- Longitudinal cracking.
- Frost heaving.
- Lack of binding (keying) to the lower course.
- Reflection cracking.
- Formation of waves and corrugation.

1. Alligator (Map) Cracking:

Fig 2.8 shows the general pattern of alligator or map cracking of the bituminous surfacing. This is the most common type of failure and occurs due to relative movement of pavement layer materials. This may be caused by the repeated application of heavy wheel loads resulting in fatigue failure or due to the moisture variations resulting in swelling and shrinkage of sub-grade and other pavement materials. Localized weakness in the underlying base course would also cause a cracking of the surface course in this pattern.

Figure 2 Map Cracking

2. Consolidation of pavement Layers:

Formation of ruts is mainly attributed to the consolidation of one or more layers of pavement. The repeated application of loads along the same wheel path cause cumulative deformation resulting in consolidation deformation or longitudinal ruts. Shallow ruts the surfacing course can also be due to wearing along the wheel path. Depending upon the depth- and width of ruts, it can be estimated whether the consolidation deformation has been caused in the sub-grade or in subsequent layers. A typical section of the pavement surface showing such failure is given in Fig 2.9.

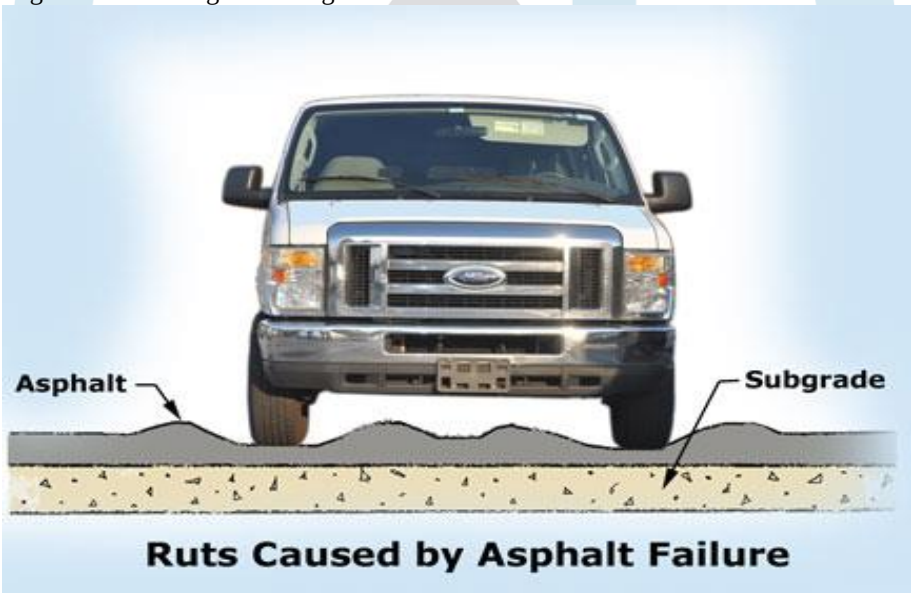


Figure 3 Formation of Ruts

3. Shear Failure & Cracking:

Shear failures are associated with the inherent weakness of the pavement mixtures, the shearing resistance being low due to inadequate stability or excessively heavy loading. The shear failure causes upheaval of pavement materials by forming a fracture or cracking. Fig 2.10 is a typical section showing this type of failure.

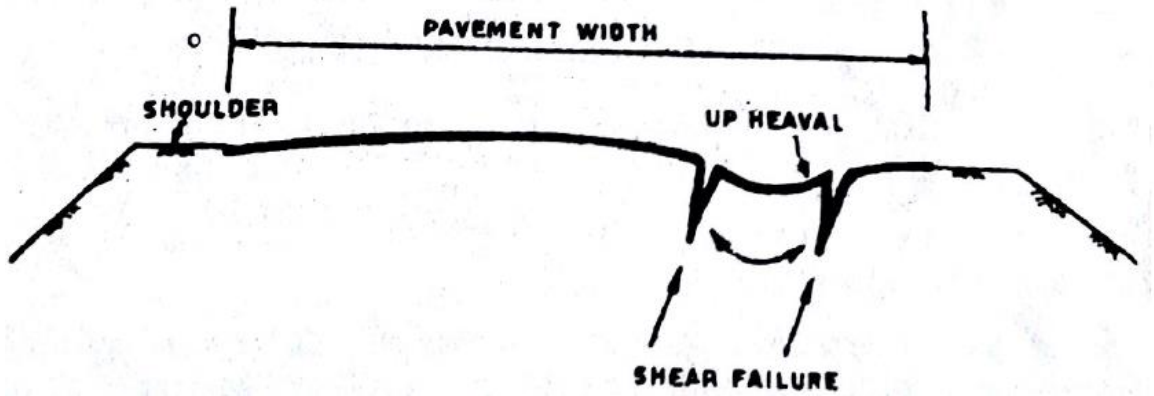


Figure 4 Shear Failure Cracking

4. Longitudinal Cracking:

Due to frost action and differential volume changes in sub-grade longitudinal cracking is caused in pavement traversing through the full pavement thickness. Settlement of fill and sliding of side slopes also would cause this type of failure.

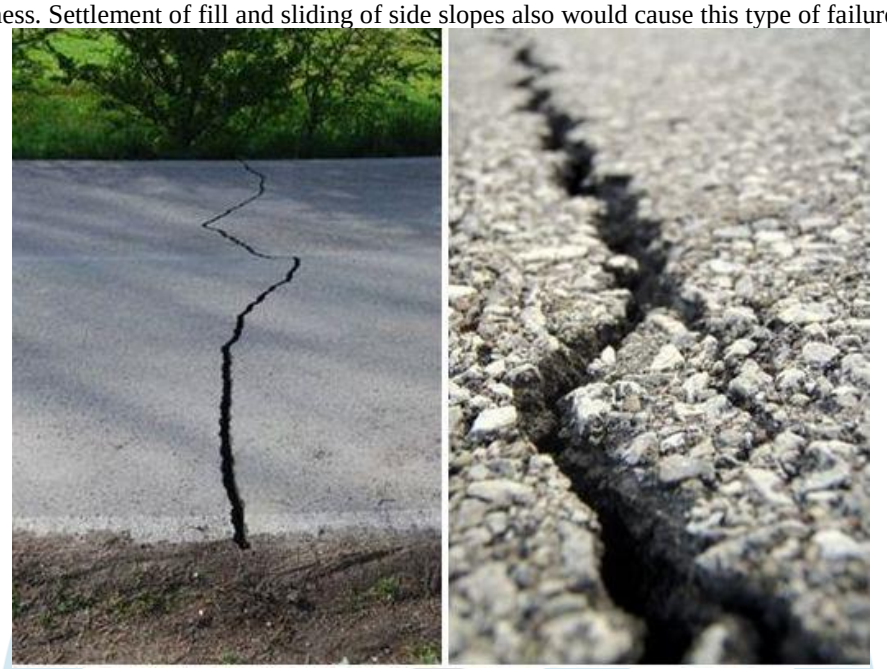


Figure 5 Longitudinal Cracking

5. Typical Expected Component Layers Failures in Flexible Pavements and Their Remedial Measures:

- Failure in sub grade.
- Failure in base course.
- Failure in wearing course.

F. Flyash:

1. Production of Flyash:

According to National Thermal Power Corporation (NTPC), coal is used for approximately 62.3 % of electric power generation in India, oil and gas accounts for 10.2%, hydro's share is 24.1%, nuclear, wind, and other contribute remaining 3.4%. The quality of coal depends upon its rank and grade. The coal rank arranged in an ascending order of carbon contents: Lignite, sub-bituminous coal, bituminous coal, anthracite. Indian coal is of mostly sub-bituminous rank, followed by bituminous and lignite (brown coal). The ash content in Indian coal ranges from 35% to 50%. The coal properties including calorific values differ depending upon the colliery. The calorific value of the Indian coal (15 MJ/kg) is less than the normal range 21 to 33 MJ/Kg.

2. Flyash can be supplied in four forms*:*

Dry: This is currently the most commonly used method of supplying Flyash. Dry Flyash is handled in a similar manner to Portland cement. Storage is in sealed silos with the associated filtration and desiccation equipment, or in bags.

Conditioned: In this method, water is added to the Flyash to facilitate compaction and handling. The amount of water added being determined by the end use of the Flyash. Conditioned Flyash is widely used in aerated concrete blocks, grout and specialist fill applications.

Stockpiled: Conditioned Flyash not sold immediately is stockpiled and used at a later date. The moisture content of stockpiled ash is typically 10 to 15%. This is used mainly in large fill and bulk grouting applications.

Lagoon: Some power stations pump Flyash as slurry to large lagoons. These are drained and when the moisture content of deposited Flyash has reached a safe level may be recovered. Because of the nature of the disposal technique, the moisture content can vary from around 5% to over 30%. Lagoon Flyash can be used in similar applications to stockpiled conditioned Flyash.

3. Types of Flyashes:

Two classes of Flyashes are defined by ASTM C618: Class F Flyash and Class C Flyash. The chief difference between these classes is the amount of calcium, silica, alumina, and iron content in the ash. The chemical properties of the Flyash are largely influenced by the chemical content of the coal burned (i.e., anthracite, bituminous, and lignite).

4. Environmental Concern:

Environmentally safe disposal of such a huge quantity of Flyash involves lot of expenditure and land. Flyash if not disposed of in an environmentally safe manner may also create lot of environmental hazard. Flyash may cause serious lung diseases silicosis, fibroses of lungs, bronchitis, pneumonitis etc. (Kumar, 1996).Flyash may even contain toxic element like lead, arsenic, barium, cadmium, mercury, selenium etc. (Tonny, 1978; Sahu, 1996; Thakre, 1996 and Sen. et al. 1996). Water leaching out of Flyash may carry away these toxic elements and may cause high levels of ground and surface water contamination. Due to its alkaline nature, Flyash increase the pH value of soil which is generally in the range of 6 to 7 to a value greater than 8.5.

- Arsenic – Poison
- Barium – Soft silvery - white metal
- Cadmium – Soft bluish – white metal (nuclear energy)
- Selenium – Selenium is produced as a byproduct in the refining during copper Production.

III. METHODOLOGY

A. Introduction:

In this chapter a brief description of the experimental procedures adopted in this investigation and the methodology adopted during the course of the study are briefly presented.

B. Material Used:

The materials used in this investigation are:

- Crusher dust
- Flyash(Partially)
- Plastic Waste
- Black Cotton Soil

C. Laboratory Testing:

1. Properties of Materail:

The following tests were conducted on the soil. The index and engineering properties of soil were determined.

1. Grain size analysis confirming (IS: 2720-part 4, 1985)
2. Consistency limits or Atterberg's Limits using Uppals method confirming (IS: 2720-part 5, 1985)
3. Compaction test confirming (IS: 2720- Part 8: 1983)
4. California bearing ratio test confirming (IS: 2720- Part 16: 1987)

a. Grain Size Analysis: (IS: 2720- part 4, 1985)

Sieve analysis was carried out using a set of standard I.S.Sieves. The sample was oven dried and placed on the top of the sieve set and shaken by hand. The fine fraction that passed through 75 micron sieve was taken and hydrometer analysis was carried out in 1000 ml for using the required quantuty of sodium Hexametaphosphate as dispersing agent. The test was carried out according to IS: 2720- part 4, 1985.

A known quantity of oven dried sample has taken in a set of dieves i.e., 4.75mm, 2.36, 1.18 mm, 600 µ, 425µ, 300µ, 150µ, 75µ arranged in an ascending order and shake for 10 minutes to 15 minutes on a sieve shaker. The weight retained on each sieve has obtained and their corresponding percentage finer has detrmined. Therefore from the graph plotted between percentage finer as Ordinate and Particle size (D in mm) as abcissa, mean particle size D_{10}, D_{15}, D_{30} , D_{50}, D_{60}, D_{85}, D_{90} are determined similarly the Coefficeint of Uniformity (C_u) and Coefficient of Curvature (C_c) also be determined.

Figure 6 Sieve Shaker

b. Consistency Limits (IS: 2720-part 5, 1985)

(I) **Liquid Limit**

The liquid limit test was conduted as per I.S:2720 (part - v)-1970. The test is conducted on soil after passing 425 micron I.S. Sieve using casagrande apparatus.

(II) **Plastic Limit**

The plastic limit test was coducted as per I.S:2720 (part - v)-1970.

c. Compaction: (IS: 2720- Part 8: 1983)

A known quantity of oven-dried sample of Crusher dust-flyash mixes with various percentages of water was mixed and transferred into CBR mould with a rammer of 4.89 kg, 5 layers and each layer subjected to 25 blows. For each set of results bulk unit weight, dry unit weight and corresponding water contents. A graph has been developed between water content and dry unit weights known as compaction curve. From the compaction curve, optimum moisture content and maximum dry density was obtained. The same procedure is repeated for various gradation mixes.

d. California Bearing Ratio Soaked (IS: 2720- Part 16: 1987)

The samples were prepared at their maxium dry densities, soaked for 4 days and tests were conducted as per I.S:2720 (part-xvi) 1987. The laboratory CBR apparatus consists of consists of a mould 150 mm diameter with a base plate and a collar, a loading frame with the cylindrical plunger of 50 mm diameter and dial gauges for measuring the expansion on soaking and the penetration values. Briefly the penetration tests consists of causing a cylindrical plunger of 50 mm diameter to penetrate a pavement component material at 1.25 mm/min. the load value to cause 2.5 mm and 5.0 mm penetration are recorded. These loads were expressed as percentage of standard load value at respective deformation levels to obtain CBR values. The standard load values obtained from

average of a large number of tests on crushed stones are 1370 and 2055 kg (70 and 105 kg/cm^2) respectively at 2.5 and 5.0 mm penetration.

Figure 7 CBR Apparatus

Two typical types of curves may be obtained. The normal curve is with convexity upwards as per specimen number 1 and loads corresponding to 2.5 and 5.0 mm penetration values are noted. Sometimes a curve with initial upward concavity is obtained, indicating the necessity of the correction as per specimen number 2. In this case, the corrected origin is established by drawing a tangent AC for steepest point on the curve. The load values corresponding top 2.5 and 5.0 mm penetration values from the corrected origin C are noted.

The causes for initial concavity of the load penetration curve calling for the correction in the origin are due to:

- The bottom surface of the plunger or the top surface of the soil specimen not being truly horizontal, with the result the plunger surface not being in fully contact with the top of the specimen initially.
- The top layer of specimen being too soft or irregular.

The CBR values are calculated using the relation

$$\text{CBR\%} \frac{[\text{Load (or pressure)sustained by the specimen at 2.5 or 5.0 mm penetration}]}{[\text{Load sustained by standard aggregates at the corresponding penetration levels }]}$$

Normally the CBR value at 2.5 mm penetration that is higher than that at 5.0 mm is reported as the CBR value of the material. However, if the CBR value obtained from the test at 5.0 mm penetration is higher than that at 2.5 mm, then the test is to be prepared for checking. If the check test again gives similar results, the higher value obtained at 5.0 mm penetration is reported as the CBR value. The average CBR value of three test specimens is reported to the first decimal place, as the CBR value of material. If the variation in the CBR value between the three specimens is more than the prescribed limits, tests should be repeated on additional three samples and the average CBR value of six specimens is accepted.

D. Direct Shear Test (IS: 2720- Part 17, 1986):

Samples of Crusher Dust and flyash are taken as oven dried and weighed as per the volume of Direct Shear mould. Now the sample is filled in three layers in the mould and compacted for 25 blows. Before placing the sample in Direct Shear mould, porous Shearing plates are kept perpendicularly facing their grooves at top and bottom of the sample. Entire set up is now kept in the container seating and a proving ring is attached and a surcharge load of 0.5, 1.0, 1.5 and 2.0 kg/cm^2 are kept simultaneously for samples at various water contents. Now a load is applied in the horizontal direction at a strain rate of 1.25mm/min and observed for shearing in the sample. This procedure is repeated for different normal pressures.

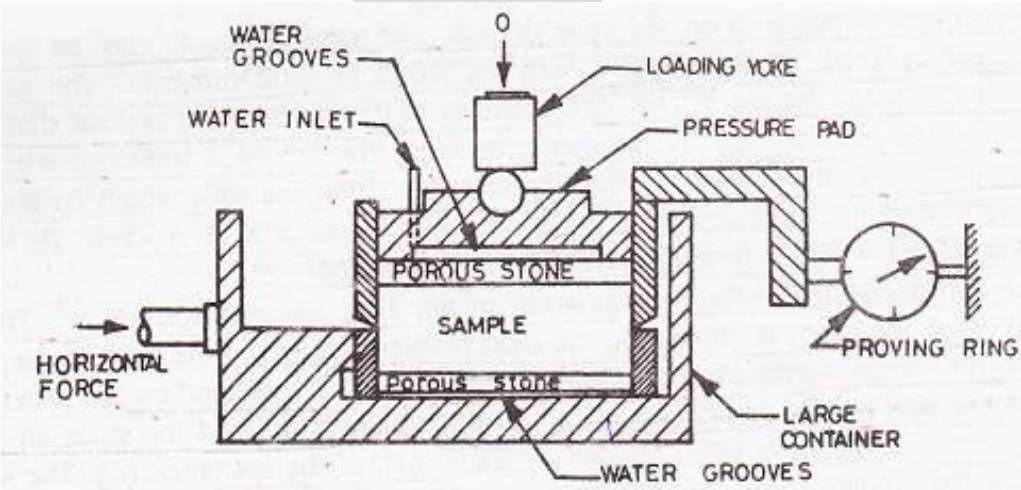


Figure 8. Cross sectional view of Direct Shear Apparatus

i. Coefficient of Permeability: Falling Head Permeability Test (IS: 2720- Part 17: 1986)

In the Falling Head Permeability test as per IS:2720- Part 17:1986, Crusher Dust and flyash samples for various locations is allotted to saturate 100% by allowing water through the entire sample grain to grain saturation at its Dry Density. At various heads the Coefficient of Permeability values are calculated using the given relation:

$K= (a.L/A.t) * In*(h_o/h_t)$

Where:

k = coefficient of permeability (cm/sec)

a = area of burette standpipe (cm^2)

L = length of specimen (cm)

A =area of specimen (cm^2)

t = elapsed time of test (sec)

h_0 = head at beginning (time =0) at test (cm)

h_t = head at end (time=t) of test (cm)

IV. RESULTS AND DISCUSSIONS

The tests are conducted in the laboratory of various experiments conducted as follows.

- STANDARD PROCTOR TEST (COMPACTION TEST)
- CBR TEST

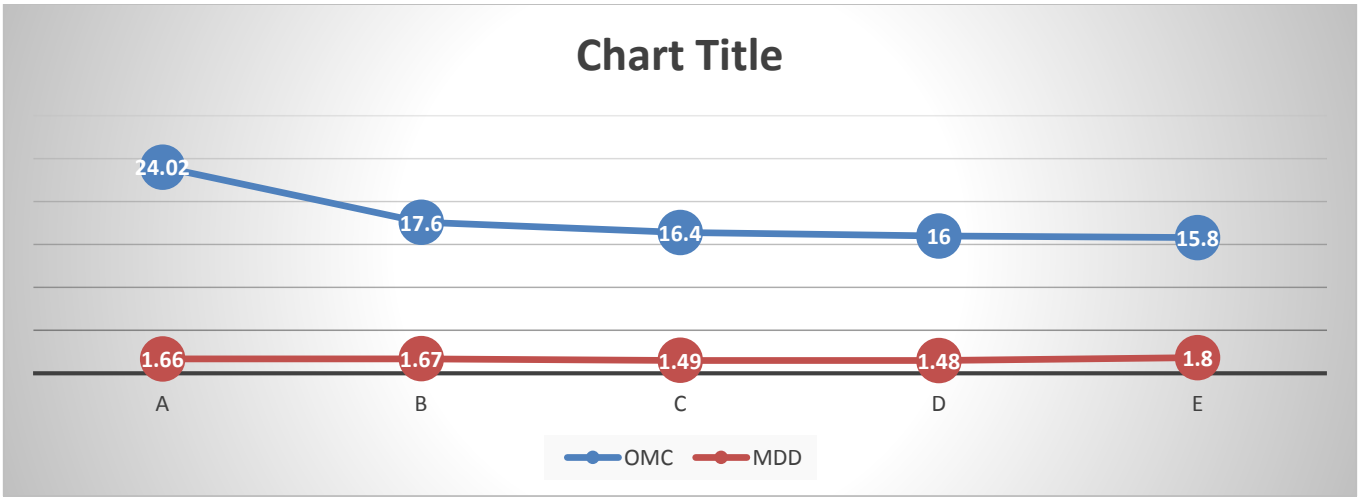
Table 1: CBR Values of various types of various soil

TYPE OF SOIL	PLASTICITY	RANGE OF CBR (%) VALUE
CLAY	CH	1.5 TO 2.5
	CL	15 TO 3.5
SILTY CLAY	CL	2.5 TO 6
SANDY CLAY	P2= 20	2.5 TO 8
	P1=10	2.5 TO 8 OR MORE
SILT		1 TO 2
SAND	POORLY GRADED	20
SAND	WELL GRADED	40
SANDY GRAVEL	WELL GRADED	60

Table 2 Determination of Compaction Characteristics, The tests were conducted on Compaction characteristics on BC soil. The effect of PLASTIC STRIPS on lime treated BC soil on the compaction characteristics were studied. The results and discussions are presented in the following sections.

Table 2: Compaction characteristics of Black Cotton Soil with optimum percentage of crusher dust mixture treated with various percentages of PLASTIC STRIPS

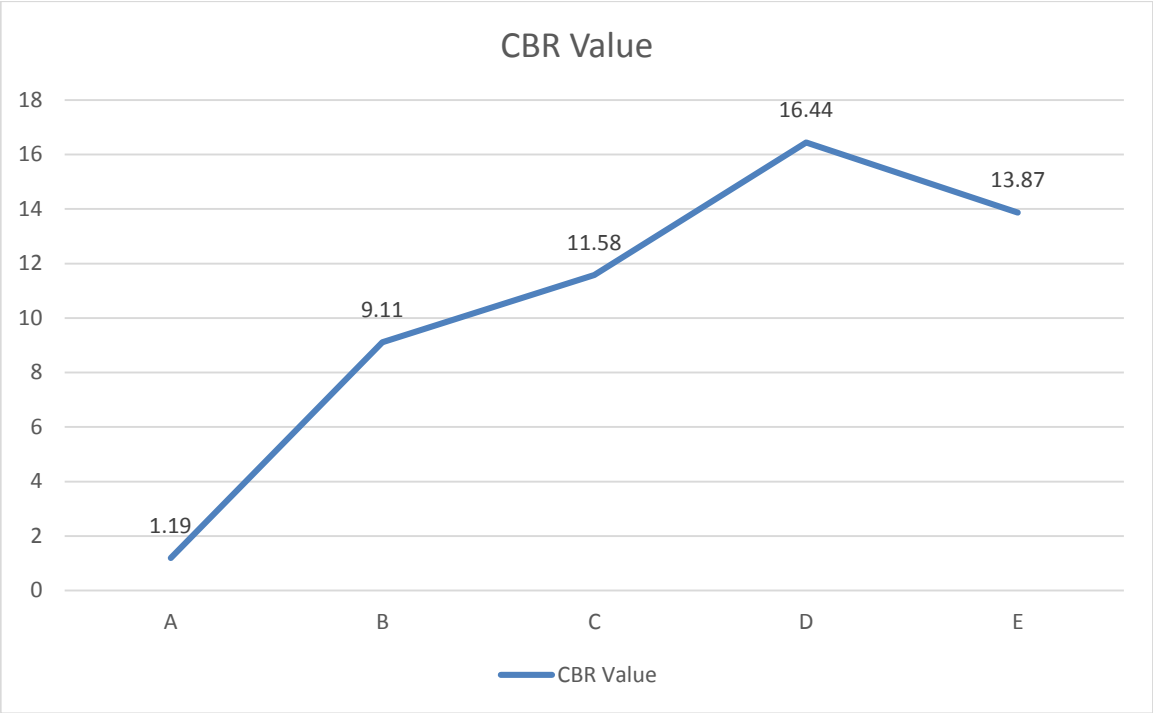
#	Description	OMC%	MDD%
A	BC Soil	24.02	1.66
B	BC Soil+5%Crusher Dust	17.6	1.67
C	BC Soil+5%crusher dust+2%PLASTIC STRIPS 16.40 1.49	16.40	1.49
D	BC Soil+5%crusher dust+4%PLASTIC STRIPS	16.00	1.48
E	BC Soil+5%Crusher Dust+6%PLASTIC STRIPS	1.580	1.80



GRAPH .1 : OMC & MDD of BC soil with plastic strips

Table 3: CBR VALUE Of Black Cotton Soil WITH LIME AND PLASTIC STRIPS

#	Samples	CBR VALUES
A	BC Soil	1.19
B	BC soil +5% Crusher dust	9.11
C	BC soil +5% Crusher dust+2%Plastic Strips	11.58
D	BC soil +5% Crusher dust+4%Plastic Strips	16.44
E	BC soil +5% Crusher dust+6%Plastic Strips	13.87



GRAPH.2: CBR values of soil with various % of plastic strips

V. CONCLUSION

In this study, the CBR value of the Black cotton soil is improved with addition optimum content of lime and waste bottle plastic strips in it. Now we can make use of plastic as soil stabilising agent for improving the properties expandable soils with proper proportion of plastic strips must be there, which helps in increasing the CBR of the soil. It can be concluded that CBR percentage of black cotton soil goes on increasing up to 4% plastic content in the soil and there on it decreases with increase in plastic content. Hence, we can say that 4% plastic and 5 % lime content is the optimum content of stabilizers used in stabilisation of the BC soil.

Future Scope

In future study test can be carried on black cotton soil or on different types of soil. The lime can be replaced by cement, marble polish waste Fly ash, sand and quarry dust. plastic can be ssreplaced by waste plastic powder, polythene covers. From the above materials, different proportions and combinations can be made which can be used for

ACKNOWLEDGMENT

I take pleasure in recording my sincere profound gratitude to my Project Supervisor **Dr N.C ANIL**, Associate Professor, Department of Civil Engineering, SITAM, for his valuable guidance, encouragement and constant supervision. It has great experience to work under his guidance for his encouragement and providing necessary facilities to complete this project so far. I am also thankful to my management for providing such pleasant environment. I am grateful to our Head of the Department **Mr. P.M.S.SATISH KUMAR**, Assistant Professor for his encouragement and providing necessary facilities to complete this project so far. I am also thankful to my management for providing such pleasant environment. I express my heart full thanks to **Mr. P.S.NAIDU,** Assistant Professor and PG In-charge, Department of Civil Engineering, SITAM without her cooperation the seminar would not have been completed successfully. I express my heart full thanks to **Dr. C.GHANSHYAM** Principal, SITAM, for his moral support in providing necessary infrastructure and equipment in the laboratory. I am also thankful to all the faculty members and supporting staff of the Civil Engineering Department SITAM, for their advice and support in successful completion of Project work. I also thanks my **2nd year M-Tech friends Ch. Srinivas, K. Vara Prasad, P. Lavanya Roopa, S**ITAM for their unconditional help and support without which this work would be a more difficult task. Finally I would like to thank all of my friends and parents for their support and encouragement in completing this project work successfully.

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