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RESEARCH ARTICLE

STUDY OF THE BEHAVIOUR OF CLAY SOIL MIXED WITH POLYTHENE STRIPS.

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Abstract

Soil is the basic earths toppest layer which support the structure and also the sub base and base course in the pavements. The existing soil at a particular location may not be suitable for the construction due to poor bearing capacity and higher compressibility or due to excessive swelling in case of expansive soils. The improvement of soil at a site is indispensable due to rising cost of the land. In that case the properties of soil can be improved by soil stabilization. soil stabilization a general term for any physical, chemical, biological, or combined method of changing a natural soil to meet an engineering purpose. Improvements include increasing the weight bearing capabilities and performance of in-situ subsoils, sands and other waste materials in order to strengthen road surfaces.

Introduction:-

Soil is the basic earths toppest layer which support the structure and also the sub base and base course in the pavements. The existing soil at a particular location may not be suitable for the construction due to poor bearing capacity and higher compressibility or due to excessive swelling in case of expansive soils. The improvement of soil at a site is indispensable due to rising cost of the land. In that case the properties of soil can be improved by soil stabilization. soil stabilization a general term for any physical, chemical, biological, or combined method of changing a natural soil to meet an engineering purpose. Improvements include increasing the weight bearing capabilities and performance of in-situ subsoils, sands, and other waste materials in order to strengthen road surfaces.

Stabilization in a broad sense incorporates the various methods employed for modifying the properties of a soil to improve its engineering performance. Stabilization is being used for a variety of engineering works, the most common application being in the construction of road and airfield pavements, where the main objective is to increase the strength or stability of soil and to reduce the construction cost by making best use of locally available materials. As a huge wastage of polybagsis available in world so it can be used as admixture for stabilization of clay. There is a great scope of stabilization of Clay with the admixture of Plastic Wastage for construction of pavements,airfields and helipads.The aim of present work is the beneficial and economical utilization of such wastages for improving properties of clay which is to be used as a base material for roads construction and proper foundation material for other types of super structures.

Utilization of plastic wastage for improvement of a soil is a sustainable and cost effective technique. Since plastic wastages can be easily available hence it was thought to be utilized as an admixture with which clay can be utilized

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as a low cost building material. On the other hand, the problem of the disposal of plastic wastage can be overcome by using it for stabilization of clay.

Material and test programme:-
This work is done for beneficial utilization of polythene strips and a mix proportion that can be mixed with clay as a best stabilizer with limited detrimental effects. The objective of the present study is to evaluate the use of clay as a construction material after stabilizing it with polythene strips as admixture. The laboratory investigation on clay stabilization with polythene strips as admixture was performed so that it becomes as a base material for road construction and proper foundation material for other types of super structures.

Clay Sample:-
This sample is collected from the Tal Chhapar Sanctuary. The sanctuary is named after Chhapar village which is located at 27°-50' North and 74°-25' East. It is a flat saline depression locally known as a "tal" that has a unique ecosystem in the heart of the Thar Desert. Perched at a height of 302 meters (990 feet) above sea level. Tal Chhaper Sanctuary, with almost flat tract and interspersed shallow low-lying areas, has open grassland with scattered Acacia and Prosopis trees.

Polythene Strips:-
Polyethylene is of low strength, hardness and rigidity, but has a high ductility and impact strength as well as low friction. It shows strong creep under persistent force, which can be reduced by addition of short fibres. It feels waxy when touched.For common commercial grades of medium and high density polyethylene the melting point is typically in the range 120 to 180°C (248 to 356°F). The melting point for average, commercial, low density polyethylene is typically 105 to 115°C (221 to 239°F). These temperatures vary strongly with the type of polyethylene. Polyethylene consists of nonpolar, saturated, high molecular weight hydrocarbons. Therefore, its chemical behaviour is similar to paraffin. The individual macromolecules are not covalently linked. Because of their symmetric molecular structure, they tend to crystallize, overall polyethylene is partially crystalline. Higher crystallinity increases density and mechanical and chemical stability.PE can become brittle when exposed to sunlight, carbon black is usually used as a UV stabilizer. Polyethylene burns slowly with a blue flame having a yellow tip and gives off an odour of paraffin (similar to candle flame). The material continues burning on removal of the flame source and produces a drip. Polyethylene cannot be imprinted or stuck together without pre-treatment. Polyethylene is a good electrical insulator.

Preparation Of Soil-Polythene Strips Mix:-
Plastic reinforced soils were prepared manually by hand mixing. Another thing to note is that for a specified particular percentage of plastic strip content, the plastic strips were mixed in the dry clay manually so that it get distributed throughout the sample. Then the water is added slowly. Sun dried soil after passing through 4.75 mm sieve was taken. Each test was conducted for all three dry densities of clay and bentonite.

Figure 1:- Mixing of small polythene strips mix in clay.

Test programme:-

The test programme included the preliminary tests for clay and mix compositions of clay with polythene strips. Following tests were carried out:

1. Standard proctor test
2. CBR Test

Test Results:-

Standard proctor test Results:-

The dry density and water content relationship was obtained from Standard Proctor Test. The OMC and Maximum Dry Density of the plain soil without plastic are obtained from the figure 2 as O.M.C is18 and M.D.D is 1.67gm/cc and also the other dry densities at water content 12 and 24 are 1.61gm/cc and 1.52gm/cc respectively.

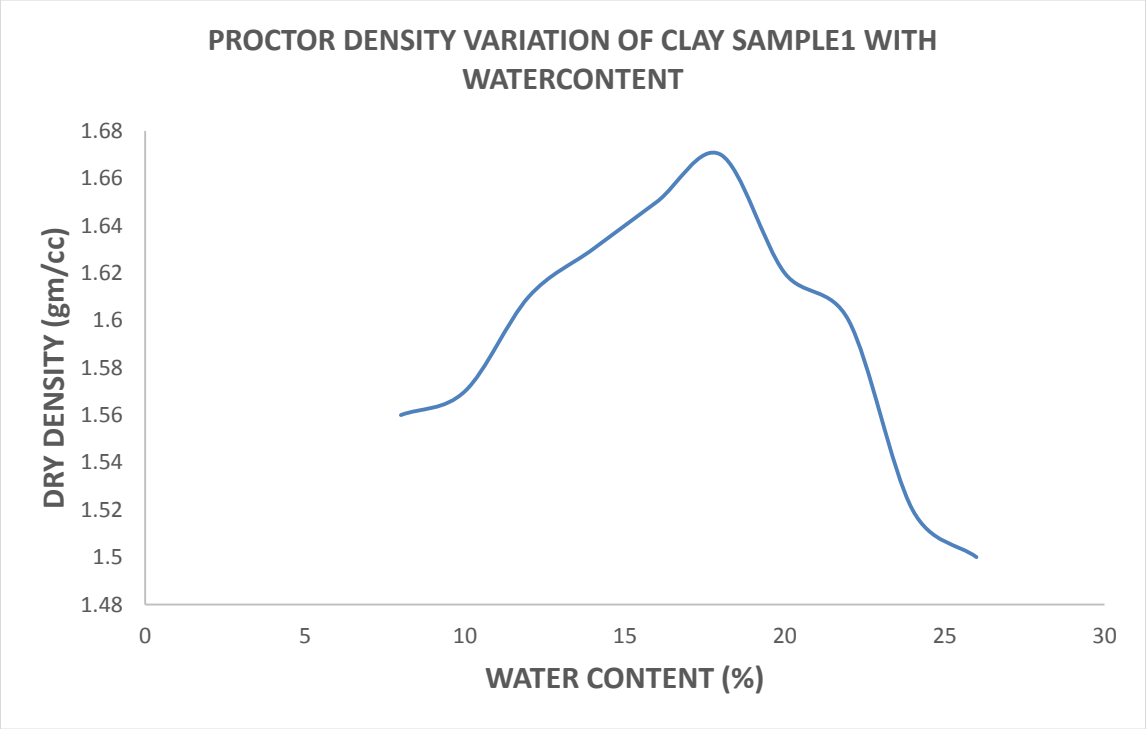


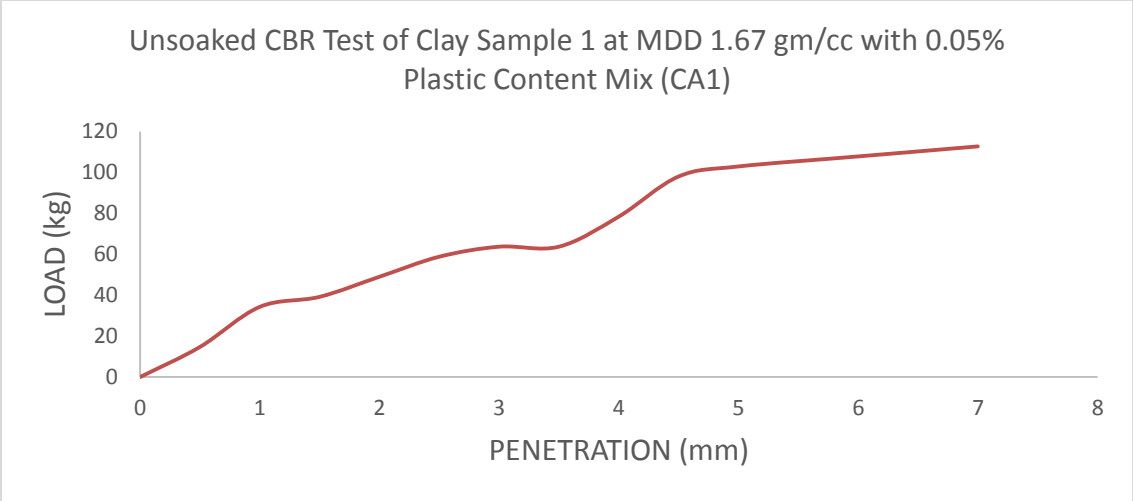
Figure 2:- Proctor Density Variation of Clay Sample with Water Content.

Cbr Test Results:-

Various unsoaked CBR test was conducted on sample. Rubber and plastic are mixed with clay in different percentages. There were six types of percentages were used. 0.05%, 0.075%, 0.25%, 0.50%, 0.75% and 1.0%. Rubber and plastic were mixed on the above mentioned percentages with clay and at different MDD the tests were conducted. MDD of 1.52 gm/cc, 1.61 gm/cc and 1.67 gm/cc were used for the experiments. Test results of Unsoaked CBR Test of Clay Sample at MDD 1.67 gm/cc with 0.05% Rubber Content Mix is as shown as tabular and graphical way. Similarly various other tests were done.

S. NO.	PENETRATION (mm)	DIAL READING	LOAD (kg)	% CBR VALUE
1	0	0	0	
2	0.5	3	14.7	
3	1	7	34.3	
4	1.5	8	39.2	
5	2	10	49	
6	2.5	12	58.8	4.291
7	3	13	63.7	
8	3.5	13	63.7	

9	4	16	78.4	
10	4.5	20	98	
11	5	21	102.9	5.007
12	6	22	107.8	
13	7	23	112.7	



The CBR values according to test results for unsoaked condition at MDD 1.67 gm/cc with plastic content 0.05%, 0.075%, 0.25%, 0.50%, 0.75% and 1.0% of the clay are 5.007, 5.245, 6.676, 5.007, 4.053 and 3.815 respectively. For mix composition at 1.61 gm/cc dry density with plastic content mix 0.05%, 0.075%, 0.25%, 0.50%, 0.75% and 1.0% of clay weight the CBR values in percentage are 4.291, 4.768, 5.484, 4.291, 3.815 and 3.815 respectively. For mix composition at 1.52 gm/cc dry density with plastic content 0.05%, 0.075%, 0.25%, 0.50%, 0.75% and 1.0% of the clay, CBR values in percentage are 4.768, 5.484, 6.199, 5.007, 5.007 and 4.768 respectively. According to test results it can be seen that on increment of dry density, the CBR value of the mix composition increases. On increasing the percentage of plastic content firstly the CBR value of the mix composition also increases and then starts to decrease for more percentage of plastic content. The maximum results have been obtained at low percentage of plastic content (0.25%) and minimum results at 1.0% plastic content for all the three dry densities. Hence it can be concluded that to use the mix compositions in base and sub base construction, the CBR values can be increased or decreased as needed. Comparative results for all the three dry densities 1.67 gm/cc, 1.61 gm/cc and 1.52 gm/cc have been shown in graph in figure 3 for un soaked conditions.

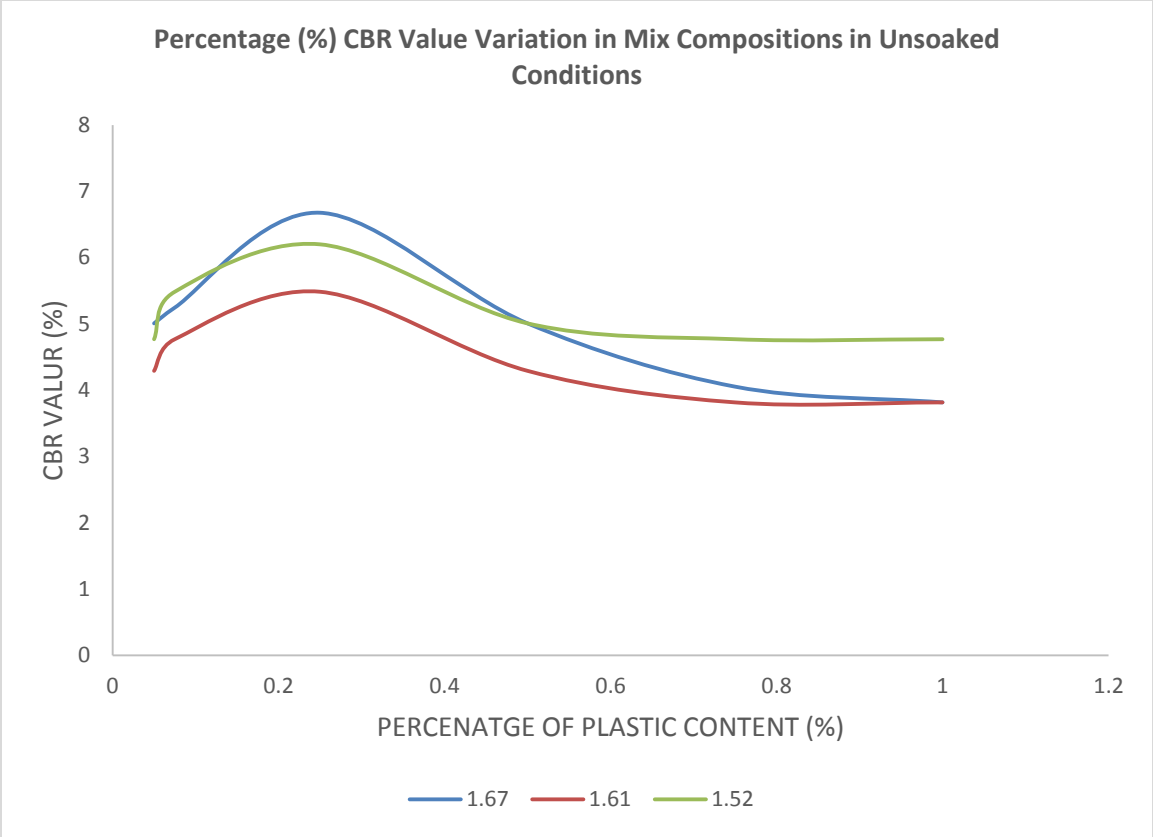


Figure 4:- Percentage (%) CBR Value Variation in Mix Compositions in Un soaked Conditions.

Conclusion:-

After analysis of the test results presented in the tables and figures of plotted graphs, the following conclusion are drawn regarding the performed experimental study:

1. The polythene strips waste usage in the investigation has the potential to reduce the environmental menace of plastic waste.
2. As the results indicates that the soil characteristics such as gradation, particle size, shape and plastic parameters such concentration in the specimen, strip size are affects the strength behavior of the polythene-reinforced soil.
3. The results indicate that the initial void ratio was higher for plain soil and as the polythene waste was added it being lower. As the percentage of polythenewaste increased in soil, the density of polythene waste being less, more voids were occupied with polythene waste and resulted in overall reduction of void ratio.
4. The study indicates that the Angle of internal friction (ϕ) increases with increase of percentage of polythene strips content in the mix composition. Less percentages of strip contents are giving optimum values. Those values for clay sample 1, clay sample2 at MDD are $16.45^{0"}$, 15.70^{0} respectively.
5. The values of friction angle increases as the dry density of clay increases. The increase in strength in soil is due to increase in friction between soil and polythene waste and development of tensile stress in the polythene.
6. Shear strength increases with increasing amounts of polythene strips up to 0.50% for clay sample 1, 0.075% for clay sample 2 by weight, beyond which the gain in strength is smaller. The smaller grain size provides greater contact area and better surface frictional resistance between clay and fibers.
7. The results of CBR test indicates that the proper mixing of polythene strips in soil with appropriate amount improved strength and deformation behavior of subgrade soil. It is appropriate to say that the reason behind the above conclusion is, the interaction between soil and strips which causes the resistance to penetration of the plunger resulting into higher % CBR Values.
8. The notable improvement properties that found are shear strength, ductility, toughness, isotropy in strength, % CBR Value etc. up to a limiting value referred to as the critical confining stress, failure occurs by frictional slipping of the reinforcement.

Suggestions for further studies:-

The results of this study suggest that strips cut from polythene may prove useful as soil reinforcement in highway and light-duty geotechnical applications. However, further study is needed to:

1. Optimize the size and shape of the strip.
2. Assess the durability and aging of the strips.
3. Mathematical modeling can be done so that improvement of subgrade of a road structure may be predicted from the properties of soil, and plastic content to be used in subgrade to help the practicing geotechnical engineers.
4. Determine the economic benefits that can be accrued through their use. Larger-scale tests should also be conducted to determine if boundary effects influence the test results.
5. polythene wastes can be used in varying shapes too, just like the soil gravel particles like angular, rounded, etc.
6. Waste hard plastics can be used in bricks or concrete but it has to be molded as required first.

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