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"Use of Plastic as Soil Stabilizer"

Wasim Ahmad Rather
Suhail Ahmad Bhat
The Supervision of Assistant Professor Mr. Sourav Kumar
Department of Civil Engineering ITS Engineering College
Greater Noida

ABSTRACT
Soil stabilization is a process which improves the physical properties of soil, such as increasing shear strength, Bearing capacity, etc. The foundation is very important for every structure & it has to be strongly enough to support the structure. Soils such as black cotton soil have always problem of swelling, shrinkage, & unequal settlement. Plastic waste is become one of the major problems for the world. So, recommended that use of plastic waste material for stabilization of soils and using plastic as soil stabilizer would decrease the problem of disposing plastic waste material & also reduce facing environmental problems. These reviews and researches on stabilization of soil using waste plastic material would improves its strength.

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I. INTRODUCTION

Soil forms the integral matrix of land separate during a variety of layers. Soil round the world square measure of assorted compositions and has varied physical, chemical and physiological properties that invariably comes into action once soil is subjected to external hundreds or pressure. a number of them could respond absolutely from engineering purpose of read and a few might not. Positive response are going to be thought of only the mass is stable against traditional and shear failures underneath hundreds. because of deficiency of land within the gift day the weak lands cannot be eliminated and should be place to use and thence the soil needs to create capable enough up-to-date the incomings hundreds and external pressure. so stabilization of soil is a very important task to be done before a construction is started. For this purpose variety of strategies may be used. we've got here thought of the usage of geo textiles and its effects on stabilising. Usage of geo textiles is desirable because it is accessible around USA extravagantly and additionally rock bottom rates. The management of this is often terribly restricted that has created several adverse effects. it's expected that out of total waste the plastic itself would be of around five-hitter, that could be a Brobdingnagian quantity which got to be addressed The work should be unitedly with the surroundings rather than doing the work against the surroundings therefore this is often vital task to form the items higher by mistreatment plastic for various uses for several years, road engineers have used additives such as lime, cement and cement oven mud to enhance the qualities of pronto obtainable native soils. Laboratory and field performance tests have confirmed that the addition of such additives will increase the strength and stability of such soils. However, the price of introducing these additives has additionally enlarged in recent years. This has opened the door wide for the event and introduction of other forms of soil additives like plastics, bamboo, liquid accelerator soil stabilizers etc. varied experiments square measure performed for endeavour the mechanical behaviour of a soil strengthened with the plastic strips. There square measure innovative uses of those materials for the many candidate waste materials in geotechnical and pavement applications. There is varied researches that square measure done on the premise of evaluating the compressive, split tensile and flexural strength characteristic of a cloth and additionally so as to see the effectiveness of recycled plastic strips that ensures in enhancing the toughness characteristics of the fabric. To use it as a good reinforcing material a dimensionless toughness index is additionally suggested. This may guarantee as a promising material for the choice materials for technology sectors. within the same means different things can also be enforced within which the plastic soil primarily based geo plastic materials may be created by heating and intermixture at the same time recycled plastic bottles with soil at a selected temperature to soften the thermoplastic materials so uniform amalgamate combine may be attended. This aid in porousness and strength results of open stratified aggregates stable with the strengthened one. Stabilization was coined on create something during a stable condition that itself could be a difficult task and improvement of something especially stabilization of soil by increasing the bearing quantitative relation of the soil with the help of the plastic material that is getting used up for the soil. Soil stabilization is that the method of fixing some soil properties by completely different strategies, mechanical or chemical so as to provide associate degree improved

soil material that has all the required engineering properties. it's going to even be outlined as improvement of stability or bearing power of the soil by the employment of controlled compaction, proportioning and/or the addition of appropriate admixture or stabilizers. Use of controlled compaction, proportioning and/or the addition of appropriate admixture or stabilizers. Soil stabilization could be a collective term for any physical, chemical, or biological technique or any combination of such methods.

Advantages of Plastic as a Soil Stabilizer:

1. It improves the strength of the soil, thus, increasing the soil bearing capacity.
2. It is a lot of economical each in terms of price and energy to extend.
3. Bearing capacity of the soil instead of going for deep foundation or raft foundation.
4. It offers more stability to the soil in slopes or other such places.
5. Sometimes soil stabilization is also stop soil erosion or formation of mud**,** which is extremely helpful particularly in dry and arid weather.
6. Stabilization is also done for soil water-proofing; this prevents the seepage in soil and hence helps the soil from losing its strength.
7. It helps in reducing the soil volume modification because of modification in temperature or wetness content.
8. Stabilization improves the workability and also durability of the soil.

Research Significance:

For many years, road engineers have used additives like lime, cement and cement oven dirt to boost the qualities of native soils. Laboratory and field performance tests have confirmed that the addition of such additives will increase the strength and stability of such soils. However, the price of introducing these additives has additionally inflated in recent years. This has opened the door wide for the event and introduction of other forms of soil additives like plastics, bamboo, liquid protein soil stabilizers etc. Soil stabilization victimization raw plastic bottles is an alternate technique for the development of subgrade soil of pavement. It will considerably enhance the properties of the soil utilized in the development of road infrastructure. Results embody a stronger and longer lasting road with inflated loading capability and reduced soil porousness. This new technique of soil stabilization may be effectively wont to meet the challenges of society, to cut back the quantities of waste, manufacturing helpful material from non-useful waste materials that cause the inspiration of property society. It may be effectively utilized in strengthening the soil for road embankments and in getting ready an appropriate base for the higher pavement structure. Since it will increase the bearing capability of soil significantly, the land use may be inflated. It will lower the building and maintenance prices whereas increasing the quality of its structure and surface. The promise that soil stabilization technology will really improve the mechanical qualities of street soil so stronger, a lot of sturdy roads may be designed has prompted national road ministries round the world to conduct in depth testing to verify that this new technology is actually efficient. The result's that this new advance in soil stabilization technology is more and more getting used in each constructing and improving/rehabilitating unsurfaced and sealed roads worldwide.

II. LITERATURE REVIEW

1. Soil Stabilization Using Waste Plastic Strips: Shiva Kumar K., Vidyaranya V., Shravan Bhardwaj., Prathibha K N and Yuvaraj C use the plastic strips as soil stabilizer. The stabilization can be done by usage of plastic strips. Plastic consumption is increasing day by day due to rapid growth in population and urbanization, recycling of these plastics is very less compared to its production and a large quantity of plastic is dumped in to landfills as waste.

2. Soil Stabilization by using plastic bottles: S.W. Thakare and S. K. Sonule, (2013) carried out various laboratory tests to investigate the effect of reinforcement of sandy soil with model plastic water bottle through model plate load tests. The study showed that the ultimate bearing capacity of footing increases with increasing the layer of plastic bottles as reinforcement. The increase in bearing capacity may be due to the additional confinement to the soil in the vicinity of footing similar to that in case of Geocell.The bearing capacity increases with the increase in width of reinforcement and number of layers. Thus, the use of plastic bottles as reinforcement was recommended to reduce the quantity of plastic waste which creates the disposal problems. Harish and Ashwini, H.M. (2016) studied the effect of plastic bottles strips as a stabilizer for two soil samples, red soil and black cotton soil. Red soil consists of 4 % gravel, 88% sand and 8% silt and clay and black cotton soil 2.6% gravel, 15.1 %sand and 82.3 % silt and 0.18 % of clay. They used plastic stripes in making the pavement and it was found that there was an increase in the strength of the soil. Authors conducted a CBR ratio test to find out MDD and OMC.

3. Soil stabilization with plastic granules :Mercy Joseph Powet*h et al*. (2014) investigated the effect of plastic granules on weak soil sample with plastic and without plastic granules in varying percentage. The

percentage of waste plastic was taken as 0.25%, 0.5 %, 0.75%.Maximum dry density was obtained when 0.25 % plastic was added and OMC was less than the soil without plastic for this percentage of soil. Further CBR value decreases when 0.25 % plastic is added but it was found to be increased for0.75 % of plastic. Authors also observed that for the same percentage of plastic, shear stress was maximum. Satyam Tiwari and Nisheet Tiwari (2016) investigated the effect of waste polypropylene fibre on shear strength of unsaturated soil sample.

4. Soil Stabilization with Cement: The soil stabilized with cement is known as soil cement. The cementing action is believed to be

Amount of cement required, in tones = (AHr/100) * (P/100-P)

the result of chemical reactions of cement with siliceous soil during hydration reaction. The important factors affecting the soil-cement are nature of soil content, conditions of mixing, compaction, curing and admixtures used**.** The appropriate amounts of cement needed for different types of soils may be as follows: Gravels - 5 to 10%, Sands - 7 to 12%, Silts - 12 to 15%, and Clays- 12 - 20% the quantity of cement for a compressive strength of 25 to 30 kg/cm^2 should normally be sufficient for tropical climate for soil stabilization. If the layer of soil having surface area of A (m^2), thickness H (cm) and dry density rd.(tones/m^3), has to be stabilized with p percentage of cement by weight on the basis of dry soil, cement mixture will be((100XP)/(1+P)) and, the amount of cement required for soil stabilization is given by Lime, calcium chloride, sodium carbonate, Sodium Sulphate and fly ash are some of the additives commonly used with cement for cement stabilization of soil.

5. Soil Stabilization with Slaked Lime: Slaked lime is very effective in treating heavy plastic clayey soils. Lime may be used alone or in combination with cement, bitumen or fly ash. Sandy soils can also be stabilized with these combinations. Lime has been mainly used for stabilizing the road bases and the subgrade. Lime changes the nature of the adsorbed layer and provides pozzolanic action. Plasticity index of highly plastic soils are reduced by the addition of lime with soil. There is an increase in the optimum water content and a decrease in the maximum compacted density and he strength and durability of soil increases normally 2 to 8% of lime may be required for coarse grained soils and 5 to 8% of lime may be required for plastic soils. The amount of fly ash as admixture may vary from 8 to 20% of the weight of the soil.

6. Soil Stabilization with Bitumen: Vikash Kumar Gautam, Devesh Jaysawal use bitumen as soil stabilizer. Asphalts and tars are bituminous materials which are used for stabilization of soil, generally for pavement construction. Bituminous materials when added to a soil, it imparts both cohesion and reduced water absorption. Depending upon the above actions and the nature of soils, bitumen stabilization is classified in following four types:

- Sand Bitumen
- Stabilization soil
- Bitumen Stabilization
- Water proofed mechanical stabilization
- Oiled Stabilization

7 .**Stabilization of Black Cotton Soil using Lime and Geogrid:** Sujitkawade et al., studied the effect of Lime and geogrid on the properties of the soil. Their main objectives was to determine the properties of the soil before and after the addition of lime and geogrid to it. The different tests they conducted were natural moisture content determination, specific gravity, Atterbergs limits, Compaction test, Compressive Strength test. After studying and conducting the entire above test, the optimum lime content was found to be 15% and they concluded that there was a substantial increase in the compressive strength of the soil.

8 .**Soil Stabilization using Plastic:** Dr. Babitharani.H, Ashwini D G, Pavan Siva kumar.Ch, Dimple Bahri, Koushik.B, Sindhu Shankar use the plastic in soil as stabilizer. On the basis of present experimental study, the following conclusions were drawn,

·Based on direct shear test on soil sample, with fibre reinforcement of 0.05%, 0.15% and 0.25%, the increase in cohesion was found to be 50%, 34.6%, and 22.4%, 3.9% and 6.1% respectively. The increase in the internal angle of friction (φ) was found to be 10%, 3.9% and 6.1% respectively.

· Since the net increase in the value of c and φ were observed to be 100%, from 0.02kg/cm2 to 0.04kg/cm2 and 20%, from 35 to 42 degrees net increment respectively, for such soil, randomly distributed polypropylene fibre reinforcement is recommended.

· The result from the UCS test for soil sample are also similar, for reinforcement of 0.05%, 0.15% and 0.25%, the increase in UCS from the initial value are 35.31%, 1.1% and 8.8% respectively. This increment is substantial and applying it for soil sample is effective.

· Overall it can be concluded that fibre reinforced soil can be considered to be good ground improvement technique specially in engineering projects on weak soil where it can act as a substitute to deep/raft foundations, reducing the cost as well as energy.

Plastic Used

Acrylonitrile butadiene styrene: Acrylonitrile butadiene styrene (ABS) (chemical formula (C8H8) x· (C4H6) y· (C3H3N) z is a common thermoplastic polymer.

- **Acrylonitrile:** It is a synthetic monomer produced from propylene and ammonia. This component contributes to ABS chemical resistance & heat stability.
- **Butadiene:** It is produced as a by-product of ethylene production from steam crackers. This component delivers toughness & impact strength to ABS polymer.
- **Styrene:** It is manufactured by dehydrogenation of ethyl benzene. It provides rigidity & processability to ABS plastic.

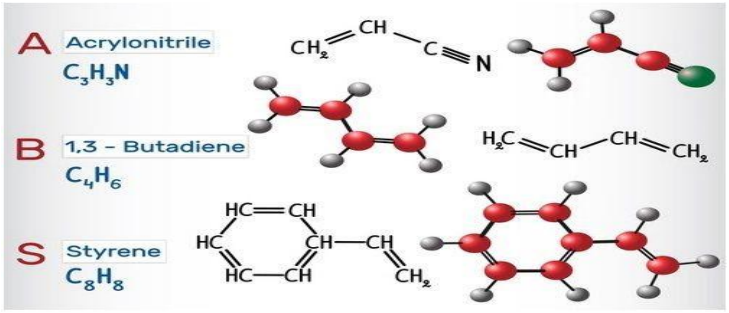

Fig.1: Monomers of Acrylonitrile Butadiene Styrene Polymers:

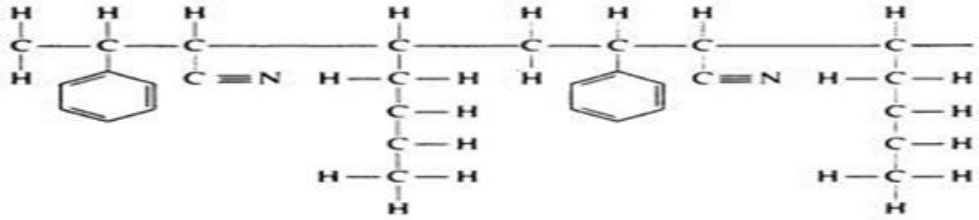

Fig.2: Molecular Structure of Acrylonitrile butadiene styrene:

Glass transition temperature of ABS is approximately 105 °C (221 °F). ABS is amorphous and therefore has no true melting point. ABS is a terpolymer made by polymerizing styrene and acrylonitrile in the presence of polybutadiene. The proportions can vary from 15 to 35% acrylonitrile, 5 to 30% butadiene and 40 to 60% styrene. The result is a long chain of polybutadiene crisscrossed with shorter chains of poly (styrene-co-acrylonitrile). The nitrile groups from neighbouring chains, being polar, attract each other and bind the chains together, making ABS stronger than pure polystyrene. The styrene gives the plastic a shiny, impervious surface. The polybutadiene, a rubbery substance, provides toughness even at low temperatures. For the majority of applications, ABS can be used between −20 and 80 °C (−4 and 176 °F) as its mechanical properties vary with temperature.[3] The properties are created by rubber toughening, where fine particles of elastomer are distributed throughout the rigid matrix. ABS polymers are resistant to aqueous acids, alkalis, concentrated hydrochloricc and phosphoric acids, alcohol s and animal, vegetable and mineral oils, but they are swollen by glacial acetic acid, carbon tetrachloride and aromatics hydrocarbons and are attacked by concentrated sulfuric and nitricc acids. They are soluble in esters, ketones, and ethylenee dichloride.

Tests Performed

1. Standard Proctor Test
2. California Bearing Ratio (CBR) test
3. Wet Sieve Analysis [IS 2720 (Part 4) - 1985]
4. Liquid Limit Test [IS 2720 (Part 5) - 1985]
5. Using Cone Penetration Method
6. Unconfined Compression Test [IS 2720 (Part 10):1991]

RESULT OF EXPERIMENT WORK

In this project have conducted various experiment to find the stabilization of the sub base using the industrial waste and plastic waste the various test conducted to find the stabilization of the sub base based on the ASTM procedure are listed below:

1. Liquid Limit
2. Plastic Limit
3. Sieve Analysis
4. Specific Gravity
5. Standard Proctor Compaction Test

1. **Liquid limit:** Liquid limit is defined as the moisture content at which soil begins to behave as a liquid material and begins to flow. The importance of the liquid limit test is to classify soils. Different soils have varying liquid limits. Also, once must use the plastic
limit to determine its plasticity index.

2. **Plastic limit**: Plastic limit is defined as the projects moisture content and expressed as a percentages of the project of the oven dried soil at which the soil can be rolled into the threads one-eight inch in a diameter without the soil breaking into pieces. This is also the moisture content of a solid at which a soil changes from a plastic state to a semisolid state.

3. **Sieve analysis:** A sieve analysis is a practice or procedure used assesses the practice size distribution of a granular material.

4. **Specific gravity:** Specific gravity is defined as the ration of the unit of soil solids unit of water. The specific gravity is needed for various calculation purposes in soil mechanics, e.g. void ratio, density.

5. **Standard proctor compaction test:** Compaction is the process of densification of soil mass by reducing air voids under dynamic loading. This test is conducted in order and maximum dry density of the soil. The plastic which was collected from used plastic TV sets are collected and are made into different strips. Plastic strips with a density about 0.44gm/cc are added to the soil in percentages of 2, 4, 6 and 8 and the modified proctor test has been conducted on the sample and graphs obtained are shown below in figures.

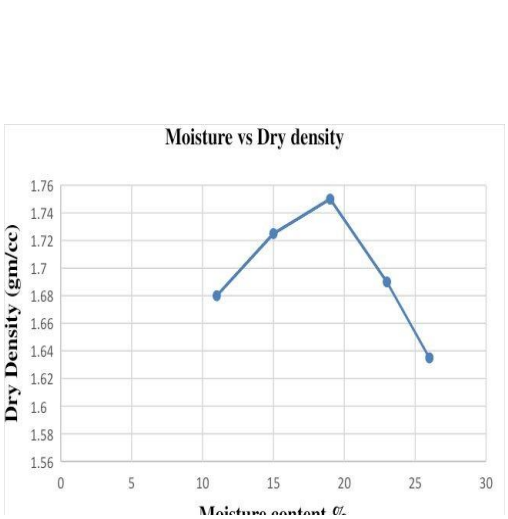

Fig.3: Soil with 2% plastic

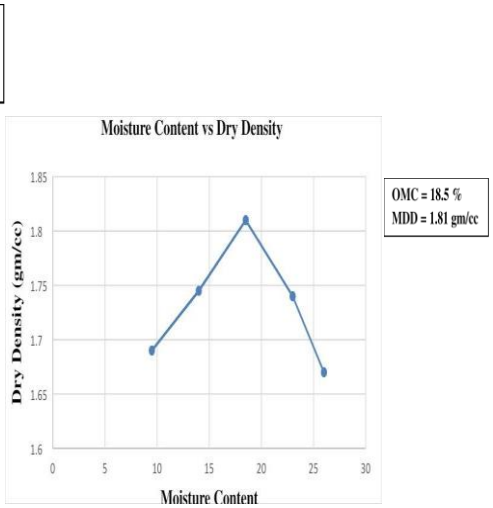

Fig.4: Soil with 4% Plastic

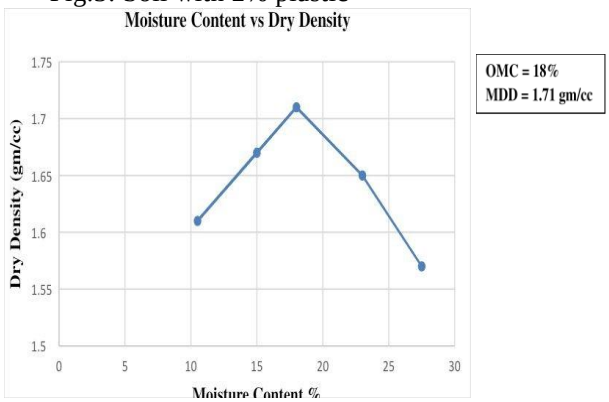

Fig.5. Soil with 6% Plastic

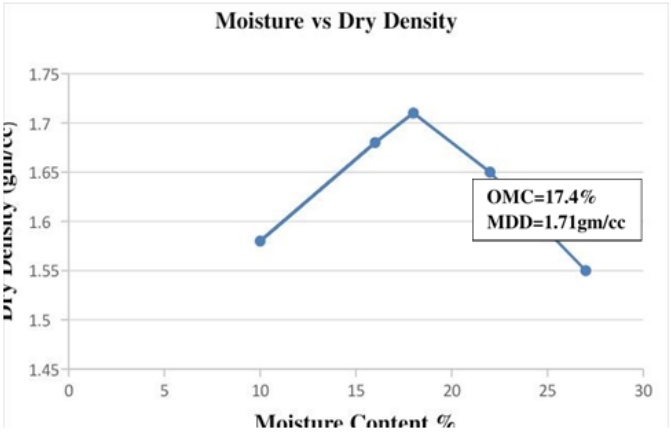

Fig.6: Soil with 8% plastic

Similarly, California bearing ratio test was conducted to obtain the CBR Value on the samples with plastics strips in various percentages of 2, 4, 6 and 8 and the results obtained are presented as load VS penetration graphs below in figures.

CBR Test:

CBR is the ratio expressed in percentage of force per unit area required to penetrate a soil mass with a standard circular plunger of 50 mm diameter at the rate of 1.25 mm/min to that required for corresponding penetration in a standard material. The ratio is usually determined for penetration of 2.5 and 5 mm. When the ratio at 5 mm is consistently higher than that at 2.5 mm, the ratio at 5 mm is used.

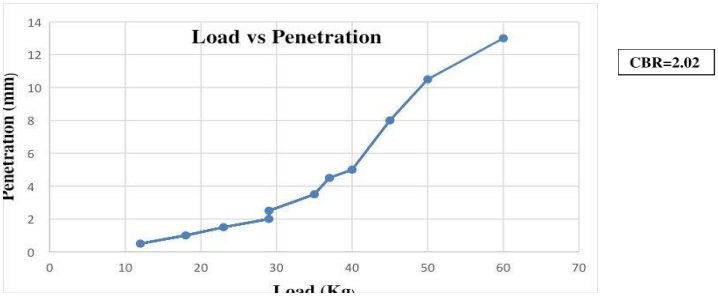

Fig.7: Soil with 2% plastic

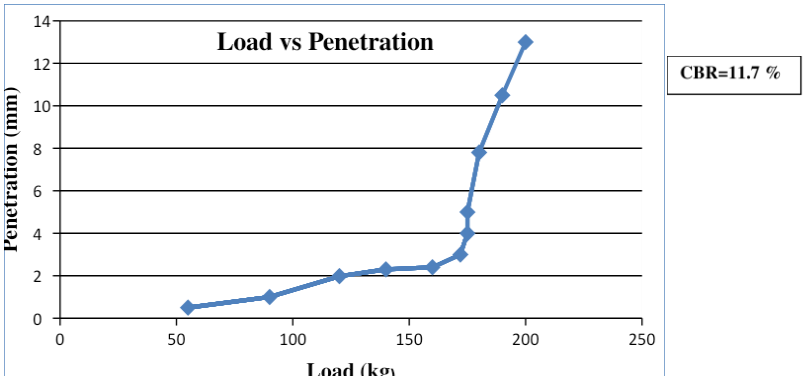

Fig.8: Soil with 4% plastic

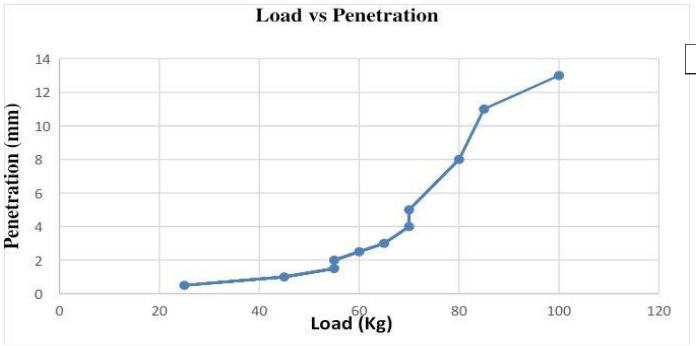

Fig.9: Soil with 6% plastic

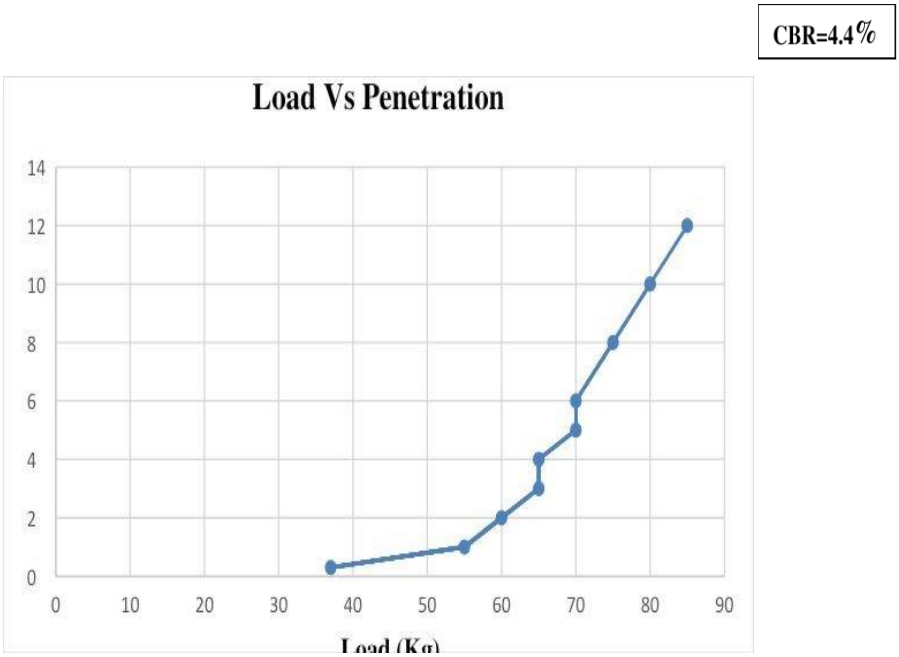

Fig.9:soil with 8% plastic

CBR test can be said as the indirect measure of the strength as soil deformed was shear in nature. From the results, it is evident that waste plastic increases the CBR value. There is a major increase in CBR value when the soil is incorporated with plastic strips and compared to that of soil with no plastic. The results are tabulated and presented below in table .CBR test is performed on the samples with varying percentages of plastic strips i.e., 2%, 4%, 6% and 8%. In this regard, the CBR value has been increasing up to 4% plastic content and thereon it started to decrease. From this, it can be inferred that, 4% plastic content is the Optimum Content of utilization of waste plastic in the soil.

The result of CBR are shown in the table below:

Table 5. The sample description with OMC and CBR %:

Sample Description	**MDD(gm/cc)**	**OMC (%)**	**CBR (%)**
Soil	1.62	20.5	1.0
Soil with 2% plastic	1.75	19.0	2.02
Soil with 4% plastic	1.81	18.5	11.70
Soil with 6% plastic	1.71	18.0	4.80
Soil with 8% plastic	1.65	17.4	4.40

Where:
MDD is Maximum Dry Density.
OMC is Optimum Moisture content.
CBR is California Bearing Ratio.

III. CONCLUSIONS

In the gift study, the improved cosmic radiation price of the soil is because of the addition of plastic strips. Plastic will be used mutually of the fabric that may be used as a soil stabilizing agent however the right proportion of plastic should be there, that helps in increasing the cosmic radiation of the soil. It will be ended that cosmic radiation proportion goes on increasing up to 4% plastic content within the soil and on that it decreases with increase in plastic content. Hence, we are able to say that 4% plastic content is that the optimum content of plastic waste within the soil. Utilization of plastic merchandise in numerous forms is enormously increasing day by day. This has Associate in Nursing adverse result in nature and it's unimaginable to limit its uses. during this regard, the disposal of the plastic wastes while not inflicting any ecological hazards has become a true challenge to the current society. Thus, victimization plastic as a soil stabilizer is a cheap and profitable usage as a result of there is lack of fine quality soil for numerous constructions

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