International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 09 | Sep 2019 www.irjet.net p-ISSN: 2395-0072

"Soil Stabilization by using Waste Material - Brick Dust"

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Abstract - *As we know that India is a farmer's country. It indirectly says that the quality of soil present in most of regions is very good for farming. But with the rapid growth of population fast urbanization and big construction of building and other important structure has taken as to use good quality available land .Due to fast urbanization and other all things, there is no choice for people to use soft and weak soils around for construction activities such soil offers poor shear strength and high swelling and shrinkage. To make this type of soil workable it has to be improved by employing stabilization techniques. The construction on black cotton soil is the major issue in India. There are many material can be used to stabilize the black cotton soil, like cement, lime, rise husk ash, fly ash etc. But in this report we are using the brick dust as a stabilizing material. The results of various test were observed weather it improves the black cotton soil or not. By using various laboratory test.*

KEYWORDS: Black cotton soil, Brick dust powder, stabilizationr.

1. INTRODUCTION

1.1 General

Black cotton soils are very fertile soils, they are not good as road or construction foundation. Black cotton soils are expansive clays with high potential for shrinking or swelling as a result of changing moisture content. Due to intensive shrinks well processes, surface crack resulting in openings during dry seasons.

These openings are usually more than 50mm wide and several millimeters deep. Cracks disappear during wet season but an uneven soil surface stays as a result of irregular swelling and heaving. The black cotton soils have low strength and are susceptible to excessive volume changes, making their use for construction purposes very difficult. Instability of these soils cause more damage to structures, than any other natural hazard, including earthquakes and floods, unless proper black cotton soil stabilization performed.

Expansive nature of this soil negatively affects its bearing capacity. When dry, black cotton soil is so hard that the clods cannot be easily pulverized for treatment for its use in road construction. This leads to serious problems related to consequent performance of the road. If black cotton soil stabilization is not applied, the damage will be apparent usually several years after construction. replacement of expansive soil with a no expansive material is a common method of reducing shrinks well risk. In the case when expansive soil or stratum is thin, then the entire layer can be removed. However, often the soil or stratum extends too deep and in that case this method is not economically efficient.

This problem can be by overcome by using Brick Dust in infrastructure projects such as highways, railways, water reservoirs. SinceBrick Dust is freely available for the project in the vicinity of brick manufacturing plants, it can be used for stabilization of soft fine grained soil.

1.2 Soil Stabilization

"Soil stabilization is a technique aimed at increasing or maintaining the stability of soil mass and chemical alteration of soil to enhance their engineering properties."

Stabilization allows for the establishment of design criteria as well as the determination of the proper chemical additive and admixture rate to be used in order to achieve the desired engineering properties. Benefits of the stabilization process can include higher resistance values, reduction in plasticity, lower permeability, reduction of pavement thickness, elimination of excavation material hauling or handling. Stabilization of expansive soils with admixtures controls the potential of soils for a change in volume, and improves the strength of soils.

Soil stabilization is done by various methods by adding fly ash, rise husk ash, chemicals, fibers, adding lime, by different geo materials like geo synthetic, geo grid and geo form. Soil stabilization allows engineers to distribute a larger load with less material over a longer life cycle.

1.2.1 Need for Soil Stabilization:-

- Effective utilization of locally available soils and other suitable stabilizing agents.
- Encouraging the use of Industrial Wastages in building low cost construction.
- This method is suitable for low volume roads i.e. Village roads in low rainfall areas.
- This method involves the correctly proportioning of aggregates and soil, adequately compacted to get mechanically stable layer.
- The Basic Principles of Mechanical Stabilization are Correct Proportioning and Effective Compaction.

1.2.2 Advantages of Soil Stabilization

- Stabilized soil functions as a working platform for the project.
- Stabilization waterproofs the soil.
- Stabilization improves soil strength.
- Stabilization helps reduce soil volume change due to temperature or moisture.
- Stabilization improves soil workability.
- Stabilization reduces dust in work environment.
- Stabilization upgrades marginal materials
- Stabilization improves durability.
- Stabilization dries wet soils.

1.2.3 There are two different methods of soil stabilization

A. Mechanical
B. Additive

A. Mechanical method of Stabilization

This is the process of altering soil properties by changing the gradation through mixing with other soils, densifying the soils using compaction efforts, or undercutting the existing soils and replacing them with granular material.

A common remedial procedure for wet and soft sub-grade is to cover it with granular material or to partially remove and replace the wet sub-grade with a granular material to a pre-determined depth below the grade lines. The compacted granular layer distributes the wheel loads over a wider area and serves as a working platform. To provide a firm-working platform with granular material, the following conditions shall be met.

1. The thickness of the granular material must be sufficient to develop acceptable pressure distribution over the wet soils.
2. The backfill material must be able to withstand the wheel load without rutting.
3. The compaction of the backfill material should be in accordance with the Standard Specifications.

Based on the experience, usually 12 to 24 in. (300 to 600mm) of granular material should be adequate for sub-grade modification or stabilization. However, deeper undercut and replacement may be required in certain areas.

The undercut and backfill option is widely used for construction traffic mobility and a working platform. This option could be used either on the entire project or as a spot treatment. The equipment needed for construction is normally available on highway construction projects.

B. Additive method or chemical method of stabilization

The transformation of soil index properties by adding chemicals such as cement, fly ash, lime, or a combination of these, often alters the physical and chemical properties of the soil including the cementation of the soil particles. There are the two primary mechanisms by which chemicals alter the soil into a stable sub-grade.

1. Increase in particle size by cementation, internal friction among the agglomerates, greater shear strength, reduction in the plasticity index, and reduced shrink/swell potential.
2. Absorption and chemical binding of moisture that will facilitate compaction.

1.2.4. Objectives

- To utilize the easily available material (Brick Dust) rather than other conventional materials such as cement, Murom etc.
- To reduce the cost of construction as using waste material.
- To provide a working platform on site by making soil waterproof.
- To improve physical properties of soil like stability as well as durability.
- To reduce drastic change in volume of Black Cotton Soil by using Brick Dust.

3.3.1 Materials Used

3.3.1.1 Black Cotton Soil:-

For the experimental investigation the soil was collected from Farm of Mr. Avinash Hiwarkar At.Mauza Menghapur, Tq.Ralegoan, Dist. Yavatmal. The laboratory tests were conducted to determine various engineering and physical properties of the soil. According to IS:1498-1970 classification system of the soil was clayey soil.

Table -1. Engg. Properties of Black Cotton Soil

Sr. No.	Properties	Values
1	Moisture Content	9.91 %
2	Liquid Limit (L.L.)	68.15%
3	Plastic Limit (P.L.)	29.92%
4	Plasticity Index	38.23%
5	Standard Proctor Test Maximum Dry Density	m./mm3
	Optimum Moisture Content	18%
6	Unconfined Compressive Strength	0.919 KN / cm2

Fig.No.1. Black Cotton Soil.

3.3.1.2. Brick Dust:-

Brick dust with its component burnt brick powder is a waste powder generated from the burning of bricks with the soil covered by surroundings. Due to burning of soil bricks it hardened and at the time of removal the set-up we get the powder form of brick. It has red color and fine in nature. It has great ability to reduce the swelling potential of black cotton soil. Brick due to burning of soil bricks it hardened and at the time of removal the set-up we get the powder form of brick. It has red color and fine in nature. It has great ability to reduce the swelling potential of black cotton soil.

Table -2 Chemical Composition of Brick Dust

Sr. No.	Chemical Constituent	Values
1	Alumina	20 % to 30 %
S2	Silica	50 % to 60 %
3	Lime	5 %
4	Oxide of Iron	5 % to 6 %
5	Magnesia	2 % to 3%

Fig.No .2. Brick Dusts

3. RESULT & DISCUSION

Sr. No.	Sample Name	Sample Contents
1	Sample - A	Black Cotton Soil + 0 % Brick Dust
2	Sample – B	Black Cotton Soil + 10 % Brick Dust
3	Sample – C	Black Cotton Soil + 20 % Brick Dust
4	Sample - D	Black Cotton Soil + 30 % Brick Dust

3.1. Moisture Content Test

Table -3 Moisture Content Test Result

Sr. No.	**Sample Name**	**Moisture Content**
1	Sample - A	9.91
2	Sample – B	8.24
3	Sample – C	7.66
4	Sample - D	6.21

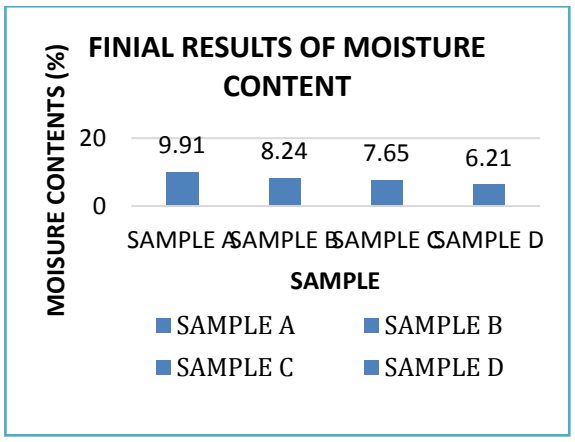

Chart 1:- Results of Moisture Content Test

Result :- When we added the brick dust in black cotton soil the initial moisture content present in the sample is decreases.

5.2Liquid Limit Test:-

Table -4 Liquid Limit TestResult

Sr. No.	Sample Name	Liquid Limit
1	Sample - A	68.16
2	Sample – B	66.63
3	Sample – C	67.94
4	Sample - D	61.04

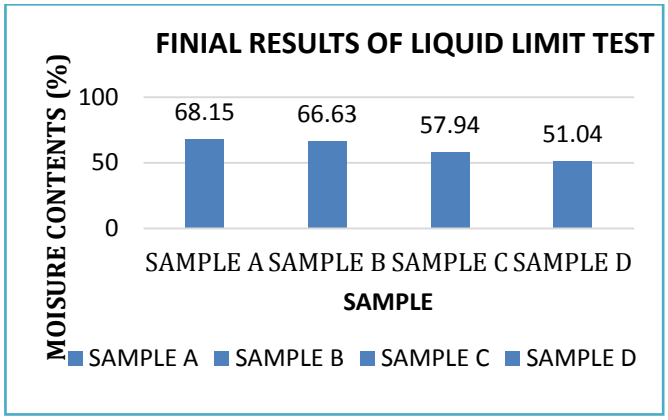

Chart 2:- Results of Liquid Limit Test

Result

1. On the basis of experimental test results, it is observed that the value of theLiquid Limit *of* plane black cotton soil i.e. Sample-A is greater value as that of the Sample B,C&D
2. From the above graph it is clear that the, If we increasing the % of brick dust in black cotton soil it reduces the plasticity of that soil.

Plastic Limit Test:-

Table -5 Plastic Limit Test Result

Sr. No.	Sample Name	Plastic Limit
1	Sample - A	29.92
2	Sample – B	27.47
3	Sample – C	23.40
4	Sample - D	20.39

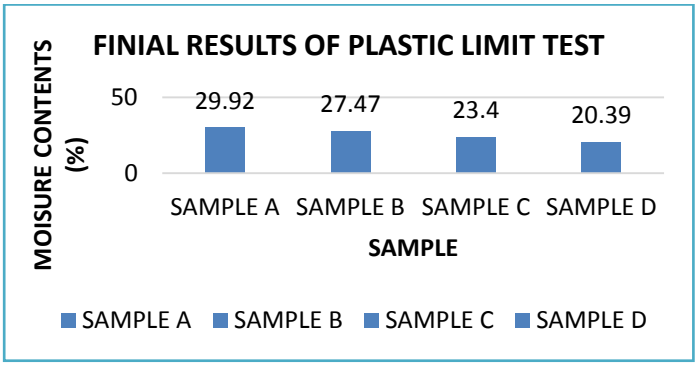

Chart 3:- Results of Plastic Limit Test

Result

1. On the basis of experimental test results, it is observed that the value of the plane black cotton soil i.e. Sample-A is greater value as that of the Sample B,C&D.
2. From the above graph it is clear that the, If we increasing the % of brick dust in black cotton soil it reduces the Plasticity of that soil.

5.4 Plasticity Index

It is the boundary between liquid limit and plastic limit.

Table -6 Plasticity Index of Given Soil Sample Result

Sr. No.	Sample Name	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI) PI=LL - PL
1	A	68.16	29.92	38.23
2	B	66.63	27.47	39.16
3	C	67.94	23.40	34.64
4	D	61.04	20.39	30.66

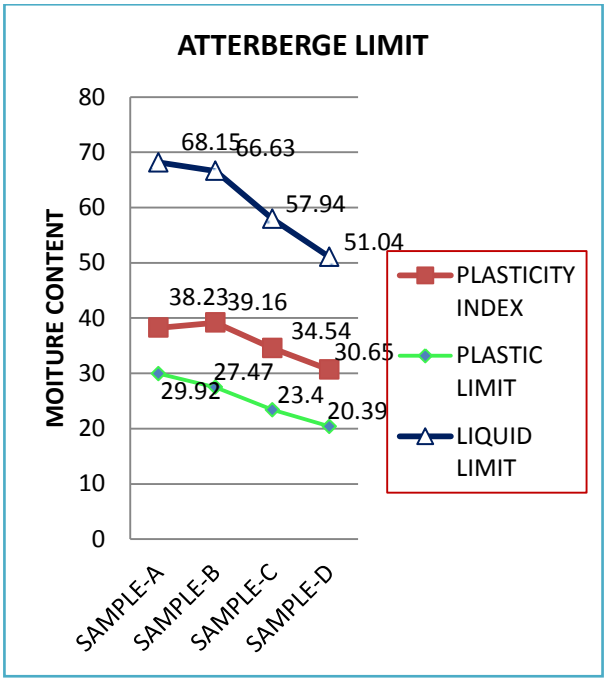

Chart 4:- Results of All Limit Test

Result: - The orange line shows the boundary of the soil between the solid states to liquid state.

Free Swelling Index

Table -7 Free Swelling Index Result

Sr. No.	Sample Name	Free Swelling Index (%)
1	Sample - A	47.91
2	Sample – B	37.49
3	Sample – C	26
4	Sample - D	14.68

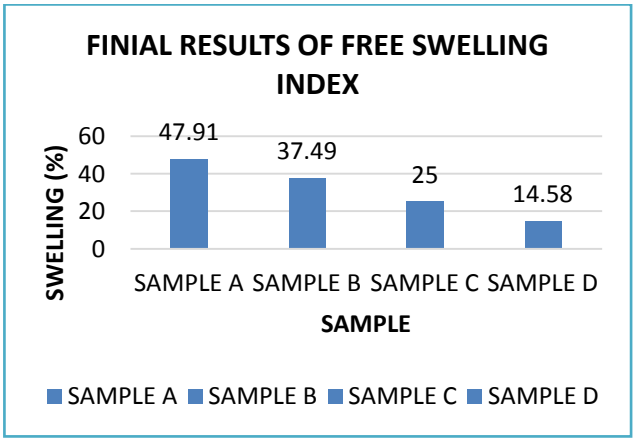

Chart 5:- Results of Free Swelling Index

Result

1. On the basis of experimental test results, it is observed that the swelling of the plane black cotton soil i.e. Sample-A is greater value as swelling of the Sample B, C&D.
2. From the above graph it is clear that the, If we increasing the % of brick dust it minimize the main swelling problem of that black cotton soil.

5.6 Standard Proctor Test

Table -8 Max. Dry Density of Standard Proctor Test Result

Sr. No.	Sample No.	Max. Dry Density(Gm./Mm^3)
1	Sample A	1.72
2	Sample B	1.74
3	Sample C	1.789
4	Sample D	1.818

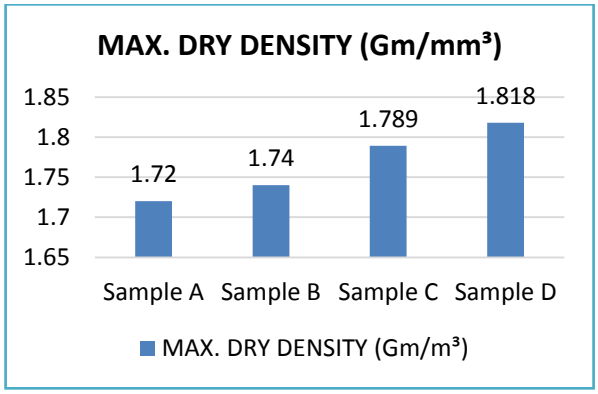

Chart 6:- Results of Dry Density of Standard Proctor Test

Result

1. On the basis of experimental test results, it is observed that the value dry density of the plane black cotton soil i.e. Sample-A is less value as that of the Sample B, C&D.
2. From the above graph it is clear that the, If we increasing the % of brick dust in black cotton soil its increasing density of that soil and gives the denser medium of hard surface

Table -9 Optimum Moisture Contentof Standard Proctor Test Result

Sr. No.	Sample No.	Optimum Moisture Contents (%)
1	Sample A	18
2	Sample B	16.94
3	Sample C	16.67
4	Sample D	14.36

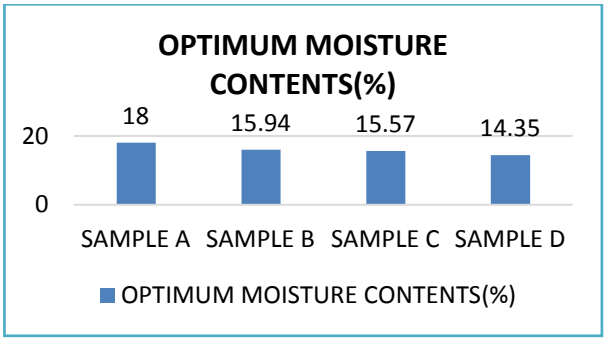

Chart 7:- Results of Moisture Contents of Standard Proctor

Result

1. On the basis of experimental test results, it is observed that the value optimum moisture content of the plane black cotton soil i.e. Sample-A is greater value as that of the Sample B, C & D.
2. From the above graph it is clear that the, If we increasing the % of brick dust in black cotton soil it reduces the moisture content of that soil. Its means the its absorb less water and gives the hard surface.

5.7 Unconfined Compression Test

Table -10 Unconfined Compressive Strength Result

Sr. No.	Sample Name	Unconfined Compressive Strength (KN/m^2)
1	Sample - A	0.919
2	Sample – B	1.051
3	Sample – C	1.181
4	Sample - D	1.331

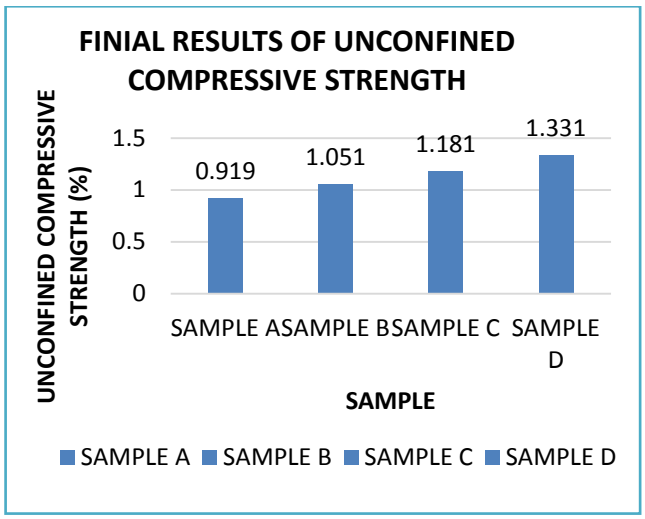

Chart 8:- Results of unconfined compressive strength

Result

1. On the basis of experimental test results, it is observed that the value unconfined compressive strength of the plane black cotton soil i.e. Sample-A is less value as that of the Sample B, C&D.
2. From the above graph it is clear that the, If we increasing the % of brick dust in black cotton soil its increase in unconfined compressive strength of that soil and gives the denser medium of hard surface .

CONCLUSIONS

From this experimental study we calculated that the,

- Moisture content decreases by 16.85%, 22.80% & 37.33% for the sample of 10%, 20% & 30% BD respectively in Black Cotton Soil.
- Liquid limit of the soil will be decrease if we increase brick dust in Black Cotton Soil if we add 10% BD, 20% BD and 30% BD. It reduced limit 2.30%, 14.98% and 25.10% respectively, from original soil liquid limits.
- Plastic limit of the soil sample will be decreases when we add 10%, 20% & 30% of Brick Dust separately in soil and the result we get are 8.18%, 21.79% & 31.85% respectively.
- From Standard Proctor Test we concluded that,
- The maximum dry density increased by 1.16%, 4.01% & 5.69% for the sample of 10%, 20% & 30% BD respectively in Black Cotton Soil.
- Optimum moisture content decreases by 11.44%, 13.50% & 20.28% for the sample of 10%, 20% & 30% BD respectively in Black Cotton Soil.

- The unconfined compressive strength increased by 14.36%, 28.50%& 44.83% for the sample of 10%, 20% & 30% BD respectively in Black Cotton Soil.

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