SOIL STABILISATION USING INDUSTRIAL WASTES LIKE BRICK KILN DUST AND FLYASH

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ABSTRACT

Presently, disposal of industrial waste products have been a global problem. Their disposal is costly as well as they are harmful to environment. In this project work, Soil stabilization is done with the addition of Fly Ash which is added from 0% to 20% by dry weight of soil. First of all, native soil properties like compaction characteristics, Atterberg's limits, compressive strength has been checked and then compared after addition of Fly Ash from 0% to 20%. So, as to utilize these soils in an effective way, proper treatment to the soil is required. Stabilization of soil is an effecient method of improving the soil characteristics. With the same goal, an attempt is done to alter the engineering properties with brick kiln dust and flyash in appropriate proportions for clayey soil collected. The different types of tests were conducted to know the stabilization percentage of admixtures for soil. The Results achieved from addition of brick kiln dust in proportions of 10% to 50% shows that the maximum dry density (MDD) increases and optimum moisture content (OMC) decreases when the quantity of admixture is increased. And the bearing capacity of soil increases when BKD – Brick Kiln Dust was added.

Keyword : - *Clay soil, OMC, MDD, UCS, Brick Kiln dust, fly ash.*

1. INTRODUCTION

The basic construction material of the geotechnical engineer's design foundation is the soil. In many cases of road works, foundation design and construction material cannot utilize the soil directly. The rising cost of the land, and huge demand for high rise buildings makes the improvement of soil at a site unavoidable. Therefore, it is required to revamp the quality of the soil.In India, Industrialization is growing heavily, and also a large part of land is present, the urge for dispose of industrial wastes which originates from industries is growing daily. From geotechnical engineering view, fly ash, cement kiln dust are the materials of wastes which have effective features required by an excellent soil stabilization admixture. Stabilization using waste is the different method to improve the properties of soil and to make it stable for construction works.

The main objective of soil stabilization process is to improve the soil strength in such a way to bear the load carrying capacity of constructed works and to make sub surface soil strong. Soil stabilization is mainly used in the construction of roads and buildings where the soil strength and bearing capacity of soil is elevated so the construction cost is reduced and stability of soil is increased.

2. METHODOLOGY

The soil collected from sarakkii lake of Bangalore is used as representative soil for soil stabilization. Further the soil is subjected to different experiments of the geotechnical lab.

The engineering properties of soil are determined using laboratory tests

which are as follows

[1] Sieve analysis

[2] Specific Gravity

[3] Atterberg's Limits

A. Liquid limit

B. Plastic limit

C. Shrinkage limit

[4] Compaction test

A. Optimum Moisture Content

B. Maximum Dry Density

[5] Unconfined compression test

3. MATERIALS

3.1 Soil

The soil sample used is clayey soil in this investigation. The soil sample was collected from sarakki lake by excavating the ground surface & from physical observation. According to IS classification (IS 1498:1970) the soil collected is classified as clay of Poorly graded Soil.

Fig -1: Clayey Soil

Fig 1. Clayey soil

3.2 Brick Kiln Dust

Brick kiln dust is the mixture of wood ash, brick bats and coal ash, outcome produced by fuel combustion in the BKD. Because of burning of soil bricks, it has hardened and at the time of removal the setup it produces the powder form of brick. It has red color and fine in nature. It has great ability to reduce the swelling potential for highly expansive clay soil.

Fig -2: Brick Kiln Dust

Fig 2. Brick Kiln dust

3.3 Fly Ash

Fly ash is a chemical substance that contains alumininum and silicon that creates cement when water is added. It is also a by-product of Coal which is generated in power plants. When compared with lime and cement , it has less properties than cement. Anyway, when a small quantity of activator is present it improves the strength of soil by reacting chemically to form cementitious compounds. It is cheaper, readily available and eco-friendly.

Fig -3: Fly Ash

4. RESULT AND ANALYSIS

The following table shows the values obtained during the geotechnical lab tests which were performed on the soil collected before addition of admixtures.

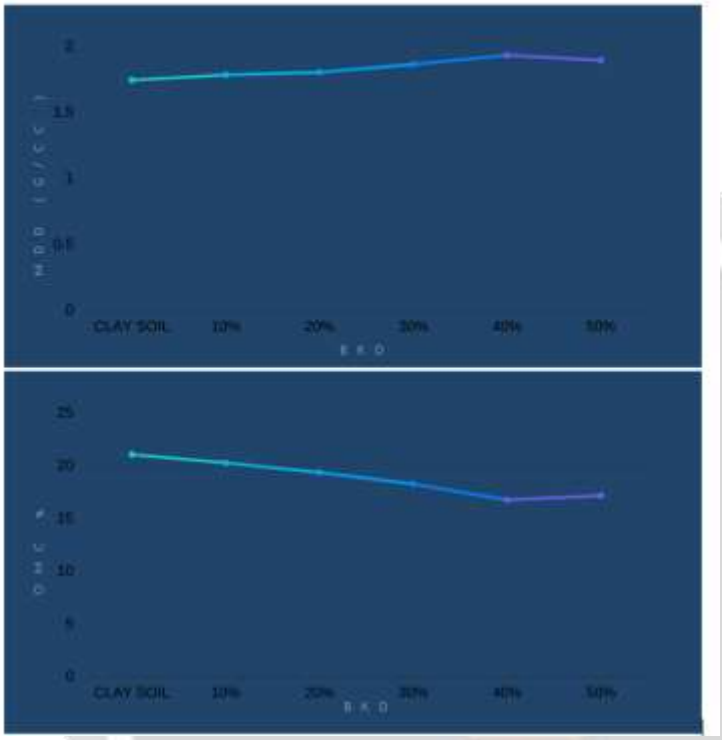
Table: Geotechnical properties of soil

SOIL PROPERTIES	**VALUES**
Liquid Limit (%)	32.84
Plastic Limit (%)	20.89
Plasticity Index	8.91
Classification of Soil	Poorly graded Soil
OMC (%)	21
MDD (g/cc)	1.740

3.1 Brick kiln dust

1. COMPACTION TEST

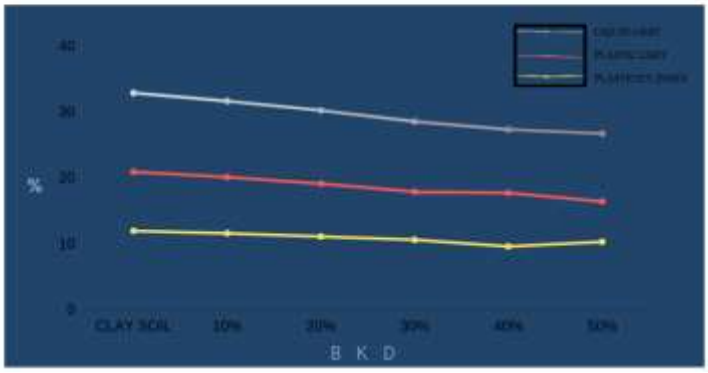
CONTENT	CLAY SOIL	10% BKD	20% BKD	30% BKD	40% BKD	50% BKD
MDD g/cc	1.74	1.78	1.8	1.86	1.93	1.89
OMC %	21	20.2	19.3	18.2	16.7	17.1



The values of MDD goes on increasing for addition of brick kiln dust in 10% successively and also the moisture content decreases respectively for successive addition of BKD with soil. The dry density reached peak at 40 % BKD addition to soil that is 1.93 g/cc, whereas moisture content at 40 % BKD was 16.7 % .

2. ATTERBERG'S TESTS

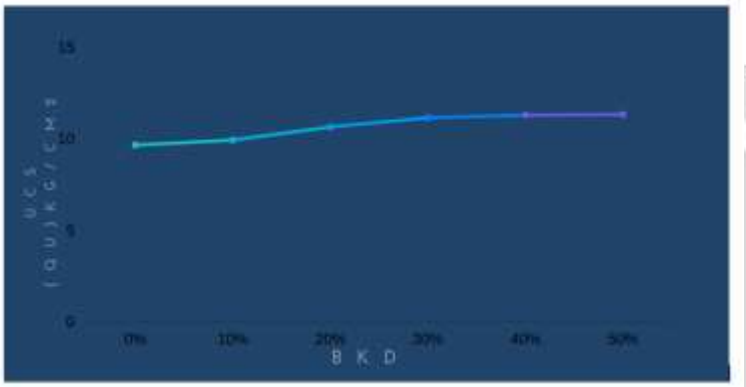
TEST	CLAY SOIL	10% BKD	20% BKD	30% BKD	40% BKD	50% BKD
LL	32.84	31.6	30.2	28.5	27.3	26.7
PL	20.89	20.1	19.1	17.9	17.7	16.4
PI	11.95	11.6	11.1	10.6	9.6	10.3



The Atterberg limit test was conducted and the results showed that the liquid limit without BKD was 32.84 %, but got decreased as on increasing the quantity of BKD added to soil for stabilization. The value of liquid limit at 40 % addition was 27.3 %. The plastic limit and plasticity index at 40% BKD was found to be 17.7 % and 9.6 respectively.

3. UNCONFINED COMPRESSION TEST

BKD %	UCS (qu) kg/cm2
0	9.653
10	9.92
20	10.634
30	11.14
40	11.28
50	11.32

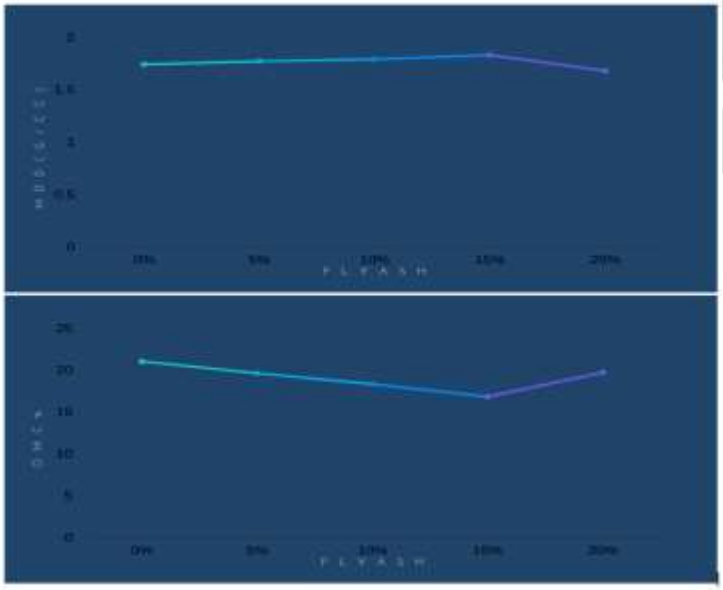


The quantity of unconfined compression strength increased rapidly after addition of BKD and the value at 50% BKD addition was found to be 11.32 kg/cm2.

3.2 Fly Ash

1. COMPACTION TEST

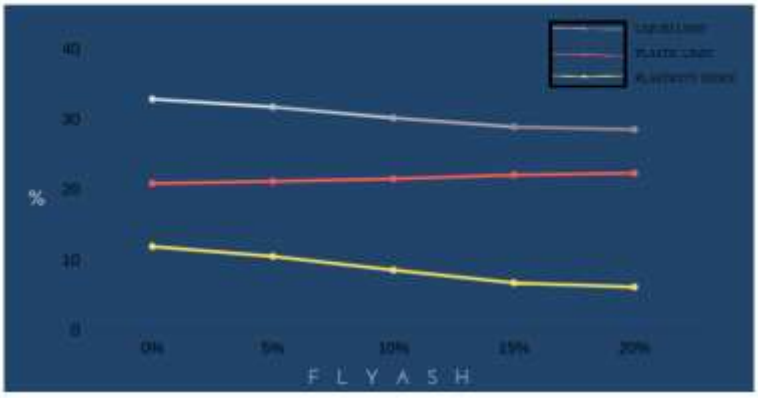
CONTENT	0% FLYASH	5% FLYASH	10% FLYASH	15% FLYASH	20% FLYASH
MDD g/cc	1.74	1.77	1.79	1.83	1.68
OMC %	21	19.6	18.3	16.8	19.7



As observed in the above graph we can see that the values of dry density increased in exponential form and reached maximum at 15% of addition of flyash as additive i.e 1.83g/cc and the moisture content at this point was found to be 16.8%.

2. ATTERBERG'S TESTS

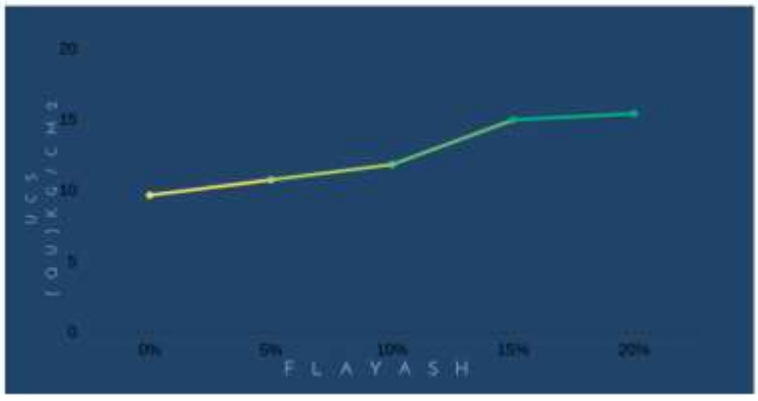
TEST	0% BKD	5% BKD	10% BKD	15% BKD	20% BKD
LL	32.84	31.72	30.16	28.89	28.54
PL	20.89	21.17	21.54	22.09	22.34
PI	11.95	10.55	8.62	6.8	6.2



From above graph it is seen that the values of liquid limit decreased on addition of flyash and was found 28.54%. The value of plastic limit increased on addition of admixture flyash and decreased in case of plasticity index.

3. UNCONFINED COMPRESSION TEST

FLYASH	UCS (qu) kg/cm2
0%	9.653
5%	10.73
10%	11.81
15%	14.95
20%	15.40



The quantity of unconfined compression strength increased rapidly after addition of BKD and the value at 20% BKD addition was found to be 15.40 kg/cm2.

4. CONCLUSIONS

The effect of the Brick kiln dust and Fly ash used in this study on the physical and engineering properties of the selected expansive soil can be summarised as follows:

I. It was observed that significant improvement is found when stabilized with brick dust content. However maximum improvement is found when stabilized with 40% brick dust.
II. The maximum dry density increases and OMC decreases when stabilized with brick dust. The maximum dry density was found of 1.93 g/cc at 16.7% OMC when stabilized with 40% brick dust.
III. The unconfined compressive strength value increases with increase of brick dust. However, the optimum UCS values was not found. The maximum UCS value is found of 11.32 kg/cm2.
IV. Therefore, marble dust and burnt brick dust may be utilized as a waste material to improve the properties of subgrade soil and decrease the above adjacent layer thickness.
V. The Flyash has a positive effect on the physical properties of the soft soil. The results showed that PI was decreased with the use of 15 FA, which would improve soil resistance against swelling and shrinkage effects.
VI. MDD decreased and OMC increased with the increase of the Flyash, which would increase the workability of soil mixing in the field and decrease the required effort to achieve the desired degree of compaction for the soil.
VII. The Flyash has significantly improved the unconfined compressive strength of the soft soil.
VIII. The waste material FA used in this study has the potential to be used as soft soil stabiliser and it has the ability to improve the physical and engineering properties.

5. REFERENCES

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