

A Experimental Study on Soil Stabilization Using Brick Kiln dust and Waste Coir Fibre

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Abstract- The aim of this research paper is to stabilize the clay soil as it is proved to be the poorest soil among all soils and also it is an expansive soil. So, as to utilize these soils in an effective way, proper treatment to the soil is required. Stabilization of soils is an effective method of improvement in soil properties. With the same intention, an attempt is made to modify engineering properties of clayey soil collected from Bareilly with brick kiln dust and waste coir fibre in appropriate proportions. A series of compaction tests, California bearing ratio tests and unconfined compression tests were carried out. The results so obtained from the tests shows that with increased in percentages (8%, 16% and 24%) of Brick kiln dust and waste coir fibre (0.25%, 0.5% & 1.0%) content, maximum dry density (MDD) increased while optimum moisture content (OMC) decreased. There was also an improvement in bearing strength of clay soil by the addition of Brick kiln dust and waste coir fibre.

Key Words: Clayey soil; brick Kiln dust; Coir Fibre MDD; CBR; UCS.

1. INTRODUCTION

Introduction Soil significantly changes its volume with changes in water content is commonly termed as clay soil. During rain, they imbibe water and swell and in summer they shrink on evaporation of water from the soil, because of this alternative swelling and shrinkage of soil characteristics cause failure of various structures constructed on clay soil. It is therefore, necessary to mitigate the problems posed by clay soils and prevents cracking of structures. These soils are poor because they contain high percentages of plastic clay. So, the improvement in poor soil could either be by modification or stabilization or both. Soil stabilization is done by using various method by adding different admixtures such as cement ,lime fly ash etc. and by reinforcing the soil by geopolymers geogrids, geomembranes etc. Stabilization of clay soils with various additives has also attained a lot of success. In this study, brick kiln dust is added to the highly compressive clay soil which resulted in

considerable improvement in strength characteristics of the soil. Many researchers had investigated soil stabilization by using different admixtures like lime, fly ash, rice husk, cement etc.

Ajay Kumar et al. (2016) The results are based on the tests carried out on various clay brick dust and lime mixes selected for the same. It has been seen that differential free swelling index and liquid limit decreases by adding lime and brick dust up to 6%lime&25% brick dust , whereas further addition of admixtures increases it. The optimum value of maximum dry density and unconfined compressive strength was found at 6% lime &25 % brick dust. Optimum moisture content was found gradually decreasing by adding admixtures and maximum reduction in OMC was found at 6% lime & 25 % brick dust. Increase in plastic limit was very less up to addition of 3% lime& 5% brick dust further addition of admixtures plastic limit was gradually decreased up to 6% lime &brick dust and after addition soil was found non plastic. Maximum CBR value was found at addition of 9% lime & 20% brick dust.

Nikhil Tiwari et al.(2018) The black cotton soil also known as expansive soil due to its property of swelling and shrinking with change in moisture content, this property makes the black cotton soil counterproductive for the construction of roads, designing of flexible pavements and embankments. Many researchers found that change in properties is due to reaction with water that leads to reduction in strength. To improve the behaviour and engineering properties of black cotton soil, it needs to be stabilized using suitable stabilizers. So in this present investigation lime and brick dust are used at different proportions to stabilize the black cotton soil. The proportion used in this experiment is 2% lime with 10, 20, 30, and 40% brick dust in black cotton soil& another proportion used is 4% lime with 10, 20, 30 and 40% brick dust in black cotton test result we observed exceptionally great decrement in swelling and increment in maximum dry density of the soil. **Kumar et al.(2016)**used brick dust(5%, 10%, 15%, 20%, 25%) blended with lime(3%,6%,9%) as a stabilizing agent to stabilize the soil . it is found that Optimum moisture content was found gradually decreasing by adding admixtures and maximum reduction in OMC was found at 6% lime & 25 % brick dust The optimum value of maximum dry density and unconfined compressive strength was found at 6% lime &25 % brick dust. there is a maximum improvement in strength

properties for the combination of lime and brick dust as compared to lime/brick dust individually.

Ishfaq Ahmad Mir et al. (2018) In this paper the author has worked on using various proportions of coconut fiber to the clayey soil. The tests conducted on the clayey soil are Liquid Limit, Plastic Limit, Standard Proctor Test and California Bearing Ratio (CBR). The percentages of the coconut fiber used in the soil are 0%, 0.3, 0.5%, 0.8% and 1.1%. The various parameters which were investigated in this research are dry density, optimum moisture content etc. It is concluded that the best results of OMC and MDD are obtained at 1.1% of coconut coir fiber. For CBR tests the highest values are also obtained at 1.1% of coconut fiber respectively. Hence the above proportion can be adopted in the road pavement designs, reinforcement of foundation soils etc.

Pokale et al. (2015) used brick dust as an admixture to improve the shear characteristics of soil in addition 30% of brick dust. Moisture content and swelling index of black cotton soil decreases on addition of brick dust up to certain limit. It is also observed that there is an improvement in UCS with partial replacement of 30% brick dust with the soil sample.

2. MATERIALS

2.1 Soil

The soil sample used in this investigation is a local clayey soil. The soil sample was collected from Bareilly region by excavating the ground surface and from physical observation, it was found that, According to IS classification (IS 1498:1970) the soil is classified as clay of medium plastic in nature (CI). After testing, Geotechnical properties of soil are shown in table-1.

Table -1 Geotechnical properties of soil

Sol Properties	Values
LL (%)	41
PL (%)	17.53
Plasticity Index (%)	2347
Classification of Soil	CI
OMC(%)	10.80
MDD(g/cc)	1.91

2.2 Brick Kiln Dust

The 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 colour and fine in nature. It has great ability to reduce the swelling potential for highly expansive clay soil.

2.3 Waste Coir Fibre

Coir, or coconut fibre, is a natural fibre extracted from the outer husk of coconut and used in products such as floor mats, doormats, brushes and mattresses. Coir is the fibrous material found between the hard, internal shell and the outer coat of a coconut. Other uses of brown coir (made from ripe coconut) are in upholstery padding, sacking and horticulture. White coir, harvested from unripe coconuts, is used for making finer brushes, string, rope and fishing net.

3. METHODOLOGY

Laboratory Studies

Following laboratory tests are carried out as per IS: 2720.

The tests were carried out both on natural soil and stabilized soil with brick dust collected.

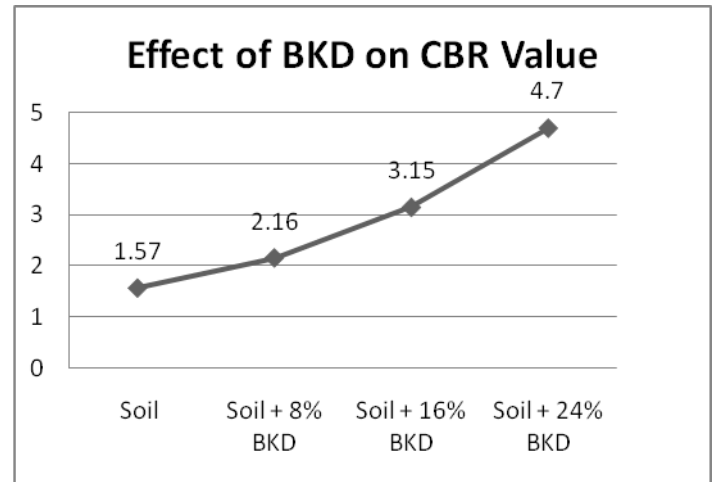
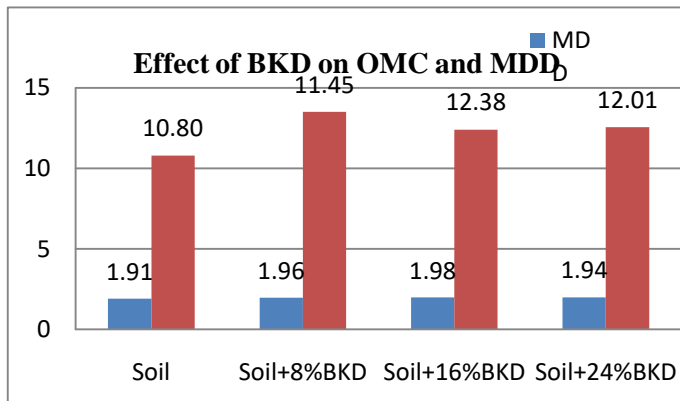
1. Liquid Limit Test
2. Plastic Limit Test
3. Compaction Test
4. CBR Test.

Test Results and Discussions

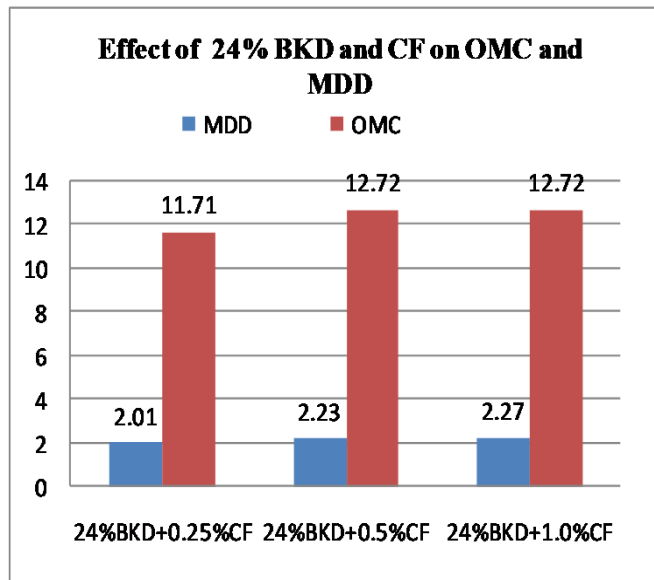
The results obtained from various experiments are discussed below.

3.1 Compaction Characteristics

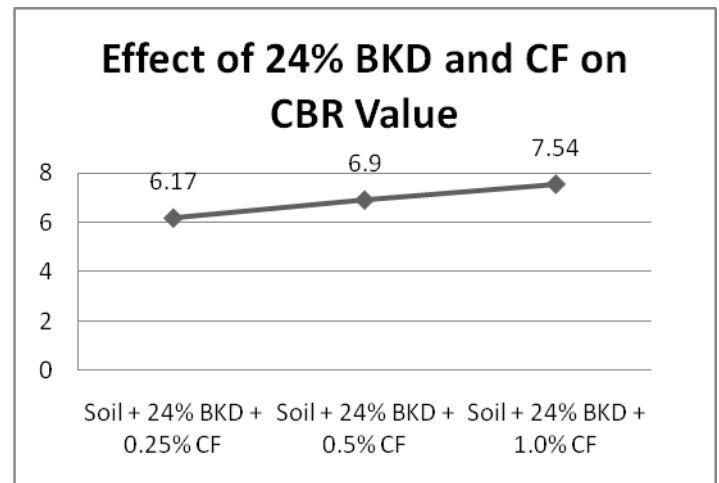
The brick dust was thoroughly mixed with clay soil with distilled water to obtain the optimum moisture content (OMC) and maximum dry density (MDD). A series of modified standard proctor test were conducted to obtain optimum moisture content (OMC) and maximum dry density (MDD) of the soil treated with brick kiln dust and waste coir fibre. Soil samples prepared by mixing with different percentage of brick kiln dust i.e. 8%, 16%, 24% were compacted in the modified proctor mould to determine the respective OMC and MDD. With the addition of brick kiln dust content to clayey soil OMC decreased as shown in fig.1



Effects of optimized BKD with blending of waste coir fibre in varying percentages and length on the OMC and MDD as shown in fig. 2



Soaked CBR Test Effect of brick kiln dust on California Bearing Ratio When the value of CBR effect is compared between the plain soil- which is basically a clayey Soil, and the soil combined with 24% brick kiln dust addition, the latter method gave a much better increase in value. The method of including the brick kiln dust in soil at a percentile of 8%, 16% and 24%, the CBR value is seen to increase continuously with increasing the percentage of brick kiln dust Table .3 Soaked CBR Value for mix proportions of soil, brick kiln dust (BKD)



3.2 California Bearing Ratio Test

From the obtained results of MDD and OMC of different percentage if MD, BBD and composite of these two materials, separate CBR tests were performed. The various test results of soak CBR are shown in the below figures.3

In accordance with IS: CBR soaked Test was performed on virgin soil, soil blended with brick kiln dust and lastly on brick kiln dust optimized soil mixed with varying percentages of waste coir fibre.

4. CONCLUSIONS

In the present study variations of the shear strength and permeability of the soil mass with the addition of varying percentages of brick kiln dust and waste coir fibre was observed and finally from these observations following conclusions have been made.

- i. It is found that on addition of brick kiln dust and waste coir fibre, MDD increases while OMC decreases, which helps in stabilizing the subgrade of the road and embankment.
- ii. On addition of brick kiln dust and waste coir fibre to the soil mass leads to increased the CBR value of the soil.
- iii. On addition of optimized 24% of brick kiln dust to the soil, with coir fiber the CBR values increased upto 333%.

From the study it can be concluded that the use of clayey soil mixed with brick kiln dust and waste coir fibre is suitable for stabilizing the subgrade of the road and embankment construction. Hence brick kiln dust and waste coir fibre can be used as an appropriate stabilizing admixture.

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