

Impact Of Soil Stabilization By Using Lime And Brick Powder

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Abstract: Soil stabilization is the process of improving the engineering properties of the soil and thus making it more stable. It is required when soil available for construction is not suitable for the intended purpose. Unstable clay soils can create significant problems for pavement or structures, therefore soil stabilization techniques are necessary to ensure the good stability of clay soil so that it can successfully sustain the load. Black cotton soil which is one of the major soil deposits in India becomes highly problematic because of its property of higher degree of swelling and shrinkage. This study focuses on the impacts of conventional ground improvement techniques and alternative of these such as by adding brick powder which contains higher proportions of silica and is found near brick kilns in rural areas the objective of the study is to investigate the use of lime-stabilized black cotton soil and brick powder mixture as subbase material in flexible pavements. Lots of parameters have been selected for comparison including index properties and consolidation characteristics. After the results were obtained they were found to be promising and ecofriendly as subbase material in flexible pavements.

1. INTRODUCTION

Black cotton soil are inorganic clays of medium to high plasticity and from a major soil group in India. The clay mineral is predominantly montmorillonite or a combination of montmorillonite and illite. They are susceptible to high seasonal volume changes on wetting and drying . We can see the cracks in many lands having black soil, this is because during the dry season they form the crack for the circulation of the air. Though it is very good soil for cultivation but is problematic soil for civil engineering work due to its swelling and shrinkage property.

Over the past few decades, stabilization is found to be the best technique for reducing the swelling and shrinkage nature of black cotton soil. Various researchers had tried stabilizing black cotton soil using lime, cement, fly ash, rich ,husk ash, vegetable waste etc. When lime is

added to a lime reactive soil there is a reduction in plasticity and gradual increase in strength with time after compaction.

2. MATERIALS

2.1 Black Cotton Soil

Black cotton soil used in the study is procured from Kinhi, area of Yavatmal, Maharashtra, India. Extensive laboratory work is carried out to characterize the black cotton soil. The plasticity index is calculated by determining Atterberg's limits. Compaction characteristics are determined by conducting IS light compaction test and strength characteristics by conducting California bearing ratio (CBR) test. The results obtained are presented in Table 1

2.2 Brick Powder

The brick powder used for increasing the engineering properties is procured from brick kiln in Yavatmal. The engineering properties of the brick powder is determined by various laboratory test the results are obtained and tabulated in table

2.3 Lime

Black cotton soil is mixed with lime in varying proportions of 2%, 4%, and 6%.lime-mixed soil. The mixture is then oven-dried for 24 hours. Results of various tests carried out on black cotton soil mixed with various percentages of lime are tabulated in Table 3

TABLE 1: Engineering properties of black cotton soil

ENGINEERING PROPERTY	VALUE
Specific gravity	2.67
Gravel size (%)	0
Sand size (%)	4
Fines (%)	96
Liquid limit (%)	86
Plastic limit (%)	40.6
Plasticity index (%)	45.4
Free Swell index (%)	100
Maximum dry density (g/cc)	1.36
Optimum moisture content	33
Soaked CBR (%)	1.17

Table 2 Engineering Properties Of Brick Powder

ENGINEERING PROPERTY	VALUE
Gravel size (%)	0
Sand size (%)	86
Fines (%)	14
Liquid Limit (%)	NP
Plastic Limit (%)	NP
Plasticity index (%)	NP
Maximum dry density(g/cc)	1.30
Optimum dry density (%)	33
Soaked CBR	21.17

TABLE 3 Properties of black cotton soil stabilized with varying contents of lime

Engineering property	2%lime	4%lime	6%lime
Liquid limit(%)	64.4	NP	NP
Plastic limit(%)	34.4	NP	NP
Plasticity index(%)	30.4	NP	NP
Free swell index (%)	90	60	40
Maximum dry density(%)	1.37	1.51	1.34
Optimum dry density(%0	28	25	32
CBR (%)	7.59	8.52	0.62

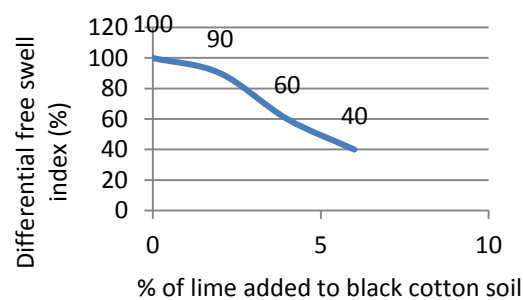


FIGURE 1 Variation of differential free swell index with varying percentages of li

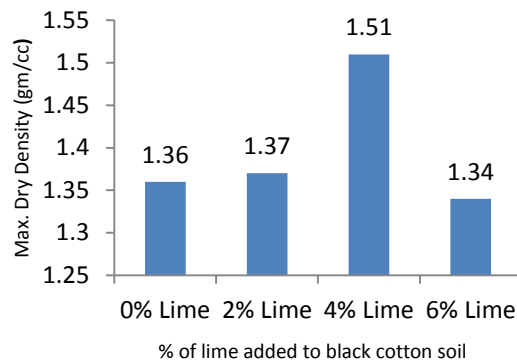


FIGURE 2 Variation of maximum dry density with varying percentage of lime.

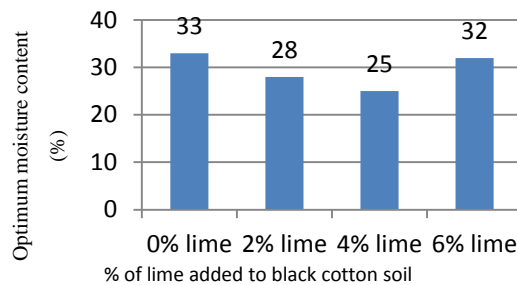


FIGURE 3 Variation of optimum moisture content with varying percentages of lime

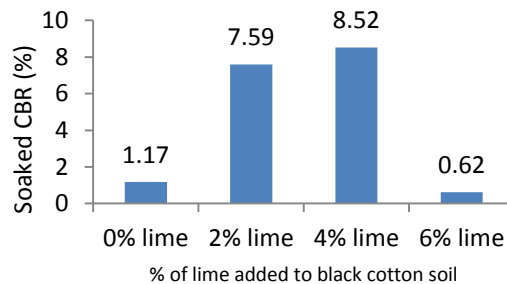


FIGURE 4 Variation of soaked CBR with varying contents of lime.

3. METHODOLOGY

Black cotton soil was collected from Kinhi, area of Yavatmal, Maharashtra, India. The sample was oven dried and then mixed with lime and brick powder at different concentration. The test of index properties as well as test lie standard proctor test and California bearing test is done on black cotton soil for stabilization. The waste product removed from brick kiln which can be used as soil stabilizer. The appropriate use of waste product gives stability and also gives strength to the soil. Brick powder showed rich composition of silica 55%, along with minor composition of iron oxide (8%),aluminium oxide(15%), calcium oxide(7%), magnesium oxide (2%) and sulphur trioxide(1%).

Addition of 4% lime to black cotton soil for stabilization did not yield the required value of CBR of 20% for subbase (Clause 401, Morth). Hence the lime-stabilized black cotton soil is mixed with brick powder, as it is rich in silica, in various proportions to obtain the optimum mixture suitable for use as subbase material. Also use of brick powder reduces the cost, as it is freely available at brick kilns. Lime-stabilized black cotton soil (LS) and brick powder (BP) are mixed in various proportions viz. 80% LS + 20% BP, 60% LS + 40% BP, 40% LS+60% BP, and 20% LS + 80% BP. Maximum dry density and optimum moisture content of each proportion are determined by carrying out the IS light compaction test. CBR of the mixture is determined by carrying out the soaked CBR test. The results so obtained are presented in Table 4.

ENGINEERING PROPERTY	80%LS+ 20%BP	60%+ 40%BP	40%LS +60%BP	20%LS +80%BP
MDD(%)	2.02	1.83	1.80	1.73
OMC (%)	17	21	25	29
CBR(%)	20.07	7.81	4.67	11.82

TABLE.4 Engineering properties of brick powder and lime-stabilized black cotton soil

Table 4 shows the variation of maximum dry density for various mix proportions of brick powder and lime-stabilized black cotton soil. Maximum dry density decreased from 2.02 g/cc for 80% LS+ 20% BP to 1.73 g/cc for 20% LS + 80% BP. The variation of optimum moisture content for various mix proportions of brick powder and lime-stabilized black cotton soil is also presented in Table 4. Optimum moisture content increased from 17% for 80% LS + 20% BP to 29% for 20% LS+80% BP. The decrease in maximum dry density and increase in the optimum moisture content, with increase of brick powder content, is attributed to the low maximum dry density and high optimum moisture content of brick powder shown in Table 2.

Variation of soaked CBR for different mix proportions of brick powder and lime-stabilized black cotton soil is presented in Figure 5. The soaked CBR value decreased from 20.07% for 80% LS+20% BP to 4.67% for 40% LS + 60% BP and then increased to 11.82% for 20% LS + 80% BP.

4. CONCLUSION

- Lime stabilization has definitely improved the strength characteristics of soil but by additional mixing it with brick powder it is more suitable for subbase.
- By replacing 20% of brick powder and 80 % of lime of its dry weight gives maximum improvement in engineering properties.
- So using brick powder with lime is suitable as stabilizer as brick powder is easily and freely available waste material .

5. REFERENCES :-

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