

Clay's Properties Improvement with RBI Grade 81 and Brick Kiln Dust

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Abstract: Clay is plastic in nature but swells when comes in contact with water. Such types of soils is classified as expansive soils. To remid this problem, different techniques are to be used which improves strength and durability of clay and reduces its compressibility due to contact with water. The best technique which can be used to improve the consistency limits as well as shear strength of the soil is the soil stabilization. In this study, observation will be done to improve the various engineering properties of soil after the addition of Brick kiln dust and RBI grade 81 into the clay.

Keywords: Clay, Brick Kiln Dust, RBI grade 81, Stabilization, CBR value, UCS value, Compaction, Atterberg's limit.

Introduction: In India about 20 % of land cover mostly with clayey soil which can't be neglected. Hence, it is very difficult to get the desirable land for construction purpose, there is need to improve the strength and properties of the soil. In this paper the work is on clayey soil, clayey soil swell with moisture and shrink when water squeeze out from it. Due to this behavior of soil, plenty of damages occur to different structures built upon them. To overcome this problem there are various techniques to be used, so that property of soil can be improved. And *stabilization* is the best technique which improves the quality as well as property of soil.

The main objectives are:

1. To optimize mix of BKD, RBI grade 81 and clay.
2. Determination of compaction test parameters i.e. MDD and OMC
3. Determine stress and strain behavior of optimum mix on the basis of UCS test at different curing periods of 3, 7 and 28 days.
4. To determine Load v/s penetration graph by using CBR test.

Literature Review:

Anitha K.R. (Nov. 2009) observed the effect of RBI Grade 81 on different types of subgrade soil. RBI Grade 81 will be added to the soil in dry state in percentage (by weight) varying from 1% to 2% and the tests has been carried out for lateritic (red soil) and black cotton soil.. Black cotton soil and lateritic soil are such that they represent a wide range of variation in their properties. Liquid limit and

plasticity index decreases with the addition of RBI Grade 81 with varying percentage (1%, 2%) for both soils which shows good effectiveness of RBI-81. The unconfined compressive strength (UCS) of BC soil and lateritic soil shows strength increases as variation in percentage of RBI-81 increases. CBR value for specimens increase more with curing as addition of optimum percentage of RBI-81 increases. **Dr. B. Satyanarayana et al (2013)** worked on stabilization of expansive soils using brick kiln waste. The results obtained, indicates a general decrease in the maximum dry density (MDD) and increase in optimum moisture content (OMC) with increase in Brick Kiln Waste content. There was also an improvement in UCS with the addition of Brick Kiln Waste. The results shows increase in the strength of expansive soil by the addition of Brick Kiln Waste. The treatment with Brick Kiln Waste showed a general decrease in the MDD and increase in OMC with increase in the Brick Kiln Waste content. UCS value increases as the curing period increases.

Tanveer Asif Zerdi et al (2016) investigated soil stabilization using lime and brick dust. This paper deals with the complete analysis of the improvement of soil properties and its stabilization using lime and brick dust. From the results it is concluded that the impact of brick dust and lime on black cotton soil is positive. By replacing soil by 35% of brick dust and 5% of lime of its dry weight it gives maximum improvement in the engineering properties of black cotton soil. So use of brick dust and lime is preferable for stabilization because it gives positive results as stabilizer and also it is a waste utilization.

Material Required and Experimental Methodology:

Clay: Clay is an expansive soil. Expansive soil tends the property to swell when comes in contact with water and it shrinks when water get evaporated from it due to increase in temperature. But as we know that clay particle is very finer when there is excess amount of water the clay particles going to swell. That's why the clay has very high compressibility as well as low bearing strength. The soil collected from Himachal Pradesh, India.

BRICK KILN DUST: Brick kiln dust is obtained from brick kiln industries and it is waste material. Now a days large scale of construction work is happening due to which demand of bricks also increases, so this brick kiln industries all over the world also increases. A large amount of brick kiln dust comes out from such brick kiln industries.

RBI GRADE 81: RBI means Road Building International, RBI 81 is natural stabilizer which is cost effective and environment friendly which is made up of natural occurring compounds. The application of RBI Grade 81 chemical stabilizer causes the liquid limit to decrease and the plastic limit to increase, thereby decreasing the plasticity index of clayey soil under investigation. RBI grade 81 contains fibre in it. It works by hydration reaction. The basic tests performed includes test for

1. Specific Gravity (IS: 2720, Part-III),
 2. Atterberg’s limits (IS: 2720, Part-V),
 3. Compaction characteristics (IS: 2720, Part-VII),
 4. Unconfined Compressive Strength (IS: 2720, Part-X),
 5. California Bearing Ratio (IS: 2720 Part-VI).
- For conducting different geotechnical tests, the soil sample was mixed with BKD from 0% to 60% at an increment of 20%. RBI grade 81 powders has mixed with expansive soil from 0% to 6% at an increment of 2%.

Table. 1 Various mixes of Clay, BKD and RBI grade 81

Clay: BKD: RBI 81 (%)	Test’s value obtained
100 : 0 : 0	-
78 : 20 : 2	-
58 : 40 : 2	-
38 : 60 : 2	-
76 : 20 : 4	-
56 : 40 : 4	-
36 : 60 : 4	-
74 : 20 : 6	-
54 : 40 : 6	-
34 : 60 : 6	-

Results

Moisture–density relationship: The OMC increases from 11% to 18% and the MDD decreases from 1.87 to 1.56 g/cc from virgin soil to stabilized clay soil. The increase in OMC (from 11% to 18%) is observed at 56: 40: 04 (Clay: BKD: RBI 81).

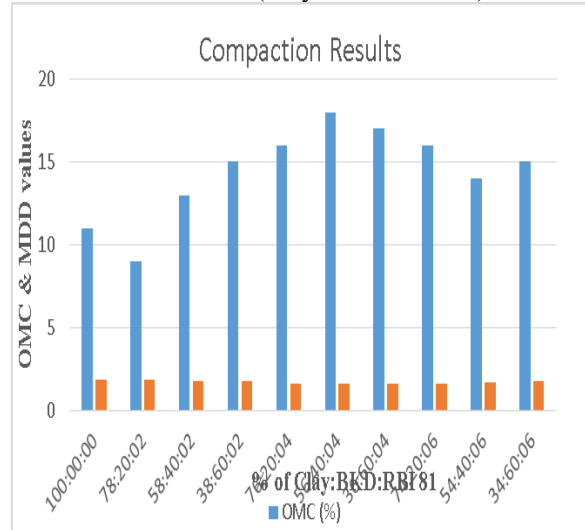


Fig. 1 Compaction results of various mix Atterberg’s limits: There is decrease in the value of liquid limit from 52.3 % to 43 % and from 27.9 to 15.3 in case of plasticity index and there is increase in the case of plastic limit from 24.4 % to 27.7 %.

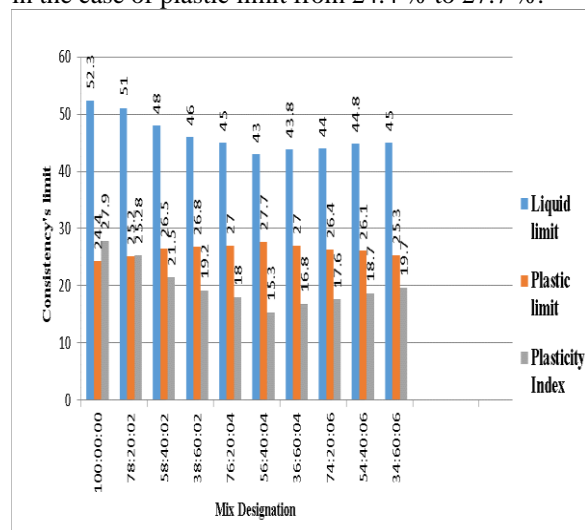


Fig. 2 Consistency’s limits of various mix Unconfined Compressive Strength

The unconfined compressive strength is the parameter which shows the ability to bear the compressive load by the soil. In this test various samples has been done and kept for 3 days, 7 days and 28 days for curing for testing. The aim of keeping it under curing to make the pozzolanic action to take place. The results shows that with an increase in curing days there is vast increase in the strength of the samples. The increase in the strength after curing period is vary from 80 kN/m² to 690 kN/mm².

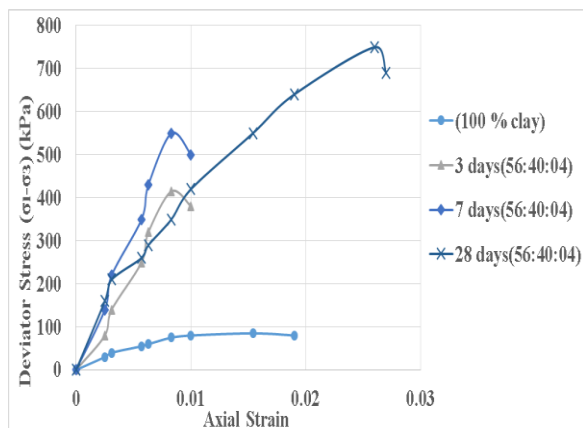


Fig. 3 Stress strain value of pure clay and optimum mix on the basis of UCS California Bearing Ratio

The California bearing ratio represents the bearing capacity of the soil at how much load how much penetration happens in the soil surface. The increment in the CBR value in the optimum mix (56: 40: 04) sample under dry condition is from 52.04 to 162.43.

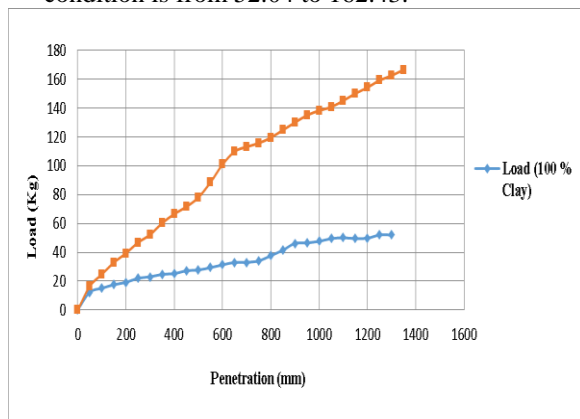


Fig. 4 Load vs penetration graph by CBR test

Conclusions:

1. The optimum mix is found to be 56: 40: 04 (% of Clay: BKD: RBI 81) on the basis of Atterberg's limit test and compaction test. The optimum mix is the proportion at which the soil gives satisfactory results.
2. The maximum dry density is decreasing and optimum moisture content is increasing, with increase in percentage of addition RBI grade 81 and BKD into the soil. This happens due to water absorb by mix.
3. The stress strain graph shows that with an increase in curing days there is vast increase in the strength of the samples. With an increase in the curing period the strain value also goes on increasing but at greater strength, which shows that sample at 28 days resist much amount of load and prevent our structure from sudden collapse.
4. From load vs penetration graph the modulus of elasticity is calculated which shows the ductility of the soil which indicates earlier to the soil, it is going to be fail under the load with the help of which we can prevent our structure to get fail.

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