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# Effect of Fly ash and RBI grade 81 Index properties and compaction characteristics of Expansive soil

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***Abstract:*** ***Geotechnical properties of fine grained especially of expansive soils are not suitable to that extent to construct various civil engineering structures. To utilize these soils in an effective way, various ground improvement techniques are adopted. One of the most widely used techniques is to stabilize the expansive soil by using different admixtures like lime, cement, and fly ash. In the present study, an attempt is made to modify engineering properties of a black cotton soil from Jabalpur region, Madhya Pradesh India by stabilizing it with a natural inorganic stabilizer RBI Grade 81 to make it suitable as a sub grade material. Test such as Atterberg limits and Modified Proctor test were carried out on the untreated and stabilizer treated soil with varying Fly ash% as 0%,10%,15%and 20% and RBI81 as 0%,2%,4%and6%. The results indicate that RBI-81 is effective in improving engineering properties of expansive soil. However, an additional additive flyash along with RBI-81 seems to be a better option in minimizing cost of stabilization.***

***Keywords: Geotechnical properties, expansive soil, RBI grade 81, Fly ash, C.B.R.***

## I. INTRODUCTION

Expansive soils are mostly found in the arid and semi arid regions and it cover very large area of the world. It covers nearly 20% of the land in India and includes approximately the entire Deccan Plateau. Maharashtra, Andhra Pradesh, Karnataka and parts of Gujarat and western Madhya Pradesh. Expansive soils are the soils which swell when come in contact with moisture and shrink when it becomes dry. The construction works can be improvised using RBI grade 81 with Fly ash in this type of soil. RBI grade 81 decreases liquid limit, plasticity index and a considerable Increase can be seen in CBR values. If we use only RBI81 the cost of construction increases while when mixed with fly ash it show effective results, cost efficiency and can solve disposal problem of industrial waste product like fly ash.

## II. LITERATURE REVIEW

Madurwar et al. (2013) made an attempt to modify engineering properties of black cotton soil by using RBI-81 and sodium silicate. After then Atterberg limit , CBR and UCS test were conducted out on the sample of soil with RBI-81 in proportion of 2% & 6% with curing period of 7,14 &28 days. Which finally made them to come to the conclusion that the normal soil which was having 2.33% CBR & 2.69% UCS has been increased to 10.03% & 3.62% at 14 days curing by adding 2% RBI-81 & 8.03% & 2.97% with 7 days curing. After then authors increased the percentage of RBI-81 from 2% to 4% which gave them result of 18.87% & 4.44% with 14 days curing and 16.24 % & 3.96% with 7 days curing. Overall the final conclusion which has been made by them was that the UCS & CBR value increases with increase in RBI 81.

Patil et al. (2013) have studied “Effect of Fly ash and RBI grade 81 on Swelling Characteristics of Clayey Soil”. They concluded that with stabilization of clayey soil by using fly ash and RBI Grade 81 is effective in improving the geotechnical properties of soil. The results show that, the LL, MDD, OMC and DFS index of clayey soil improved considerably. The LL of untreated soil is 67% and it reduces to 46% for mix of soil: fly ash: RBI Grade 81 for 76:20:04 proportion. The DFS of untreated soil is 65% and it reduces to 40% for addition of fly ash and RBI Grade 81.

Sushant et. al (2010) carried out an investigation to study the influence of RBI Grade 81 and lime on the stabilization of blast furnace slag and fly ash. Standard proctor test and unconfined compressive strength test for different combinations of the stabilizing agents were conducted. It was concluded that UCS of stabilized sample increases with increase in the period of curing. But the percentage of increase in strength was more upon lime addition compared to addition of RBI-81.

Anitha et. al (2009) studied the effect of RBI Grade 81 in stabilizing kaolinite, red soil and lateritic soil. The different percentages of RBI Grade 81 varying from 2% to 8% was added and test results indicated 42% reduction in plasticity index for kaolinite, 4% for red soil and 116% for laterite. Soaked CBR value increased for all three soils treated with RBI-81. The OMC increased and MDD decreased with addition of RBI Grade 81 for red soil and kaolinite.

## III. MATERIALS

### A. *Soil*

In the present study the soil sample is collected from bypass road near Tilheri in Jabalpur district of Madhya Pradesh state of India. The soil in this region is fine grained. The various properties of soil are tested in the laboratory and results are as given in table 1.

Table-1 : Basic Properties of Soil

| Properties of Untreated Soil | Values |
|---|---|
| Specific Gravity | 2.4 |
| Liquid Limit (%) | 60 |
| Plastic Limit (%) | 25.8 |
| Plasticity Index | 34.19 |
| Maximum Dry Density | 1.551 |
| Optimum Moisture Content | 25 |
| California Bearing Ratio (%) | 2 |
| Silt and Clay Content % (below 0.075 mm) | 98.53 |
| Sand Content % (0.075 to 4.75 mm) | 1.47 |
| Gravel Content %(4.75 to 80 mm) | 0 |

### B. *Fly ash*

Fly ash is obtained after burning of coal, about 80% of total ash is collected by electrostatic precipitator, this ash is known as Fly ash. The main content of Fly ash is silica and alumina and some amount of organic material in the form of unburnt carbon. The Fly ash sample is collected from the Thermal power plant located at Birsingpur District Shahdol M.P. The basic properties of fly ash are given in table 2.

Table-2 : Basic Properties of Fly Ash

| Properties | Values |
|---|---|
| Colour | Light grey |
| Specific Gravity | 2.32 |
| Plasticity Index | Non-Plastic |
| fine% (Below 0.075) | 83 |
| courser content % (0.075 to 4.75 mm) | 17 |

### C. *RBI Grade 81*

Road building international grade 81 is a natural inorganic stabilizer. Odorless, hydration activated, grey color powder contains fibers of propylene, non UV degradable, inert and chemically stable compound RBI 81 improves the structural properties of wide range of soil . Its basic properties are given in table 3.

Table-3: Basic Properties of RBI Grade81

| Properties | Values |
|---|---|
| Color | Grey Powder |
| Odor | Odorless |
| Specific Gravity | 2.5 |
| Self Life | 12 Months |
| Propylene Fiber %( By Mass) | 1 |

## IV. EXPERIMENTAL WORK

The properties of the soil sample are obtained from laboratory work as given in table 1. Atterberg limits, Modified proctor test for compaction, CBR were carried out as per Indian standards. All tests were carried out for different mixes of soil, fly ash and RBI grade 81 and L.L, O.M.C., M.D.D. values are found. The California bearing ratio found for soil mixes for different proportions.

## V. RESULT AND DISCUSSION

Table 4: Effect of RBI 81 and fly ash on soil sample

| Clayey soil + Fly Ash + RBI-81 | Samples | Liquid Limit (%) | Plastic Limit (%) | Plasticity Index (%) | Maximum Dry Density (gm/cc) | Optimum Moisture Content (%) |
|---|---|---|---|---|---|---|
| Clayey soil + 0% + 0% | CF0R0 | 60 | 25.8 | 34.19 | 1.551 | 25 |
| Clayey soil + 0% + 2% | CF0R2 | 57 | 26.5 | 28.5 | 1.585 | 25.2 |
| Clayey soil + 0% + 4% | CF0R4 | 55 | 27.6 | 24.4 | 1.592 | 24 |
| Clayey soil + 0% + 6% | CF0R6 | 49 | 28 | 21 | 1.6 | 23.5 |
| Clayey soil + 10% + 0% | CF10R0 | 57 | 27.3 | 29.7 | 1.56 | 25 |
| Clayey soil + 10% + 2% | CF10R2 | 55.6 | 28.5 | 27.1 | 1.61 | 24 |
| Clayey soil + 10% + 4% | CF10R4 | 53 | 29.7 | 23.3 | 1.615 | 23.6 |
| Clayey soil + 10% + 6% | CF10R6 | 45 | 30.5 | 14.5 | 1.618 | 23 |
| Clayey soil + 15% + 0% | CF15R0 | 56 | 28.7 | 27.3 | 1.58 | 24.8 |
| Clayey soil + 15% + 2% | CF15R2 | 55 | 29 | 25 | 1.62 | 23 |
| Clayey soil + 15% + 4% | CF15R4 | 50 | 29.8 | 20.2 | 1.625 | 22.7 |
| Clayey soil + 15% + 6% | CF15R6 | 44.3 | 30.7 | 13.6 | 1.629 | 23 |
| Clayey soil + 20% + 0% | CF20R0 | 54 | 29 | 25 | 1.59 | 25 |
| Clayey soil + 20% + 2% | CF20R2 | 54.5 | 29.2 | 25.3 | 1.63 | 24 |
| Clayey soil + 20% + 4% | CF20R4 | 48 | 30.01 | 17.99 | 1.631 | 23.7 |
| Clayey soil + 20% + 6% | CF20R6 | 42.7 | 30.8 | 11.9 | 1.632 | 22.4 |

### *A. Atterberg Limits*

The liquid limit of untreated soil was found to be 60 and Plasticity index was found to be 34.19. The liquid limit value for mix of soil: fly ash: RBI 81 for proportion of 78:2:20, 76:4:20 and 74:6:20 found to be 54.5%,48% and 42.7% respectively. All the other values at different proportions are tabulated in Table 4 and graphs were plotted between proportions and liquid limit values. Plasticity Index values for mix of soil: fly ash: RBI 81 for proportion of 78:2:20,76:4:20 and 74:6:20 found to be 25.3%,17.99% and 11.9% respectively . Hence as the values show due to the addition of RBI 81 and fly ash the plasticity of soil decreases as the proportion of RBI 81 increases and give satisfactory result for 4% of RBI 81.

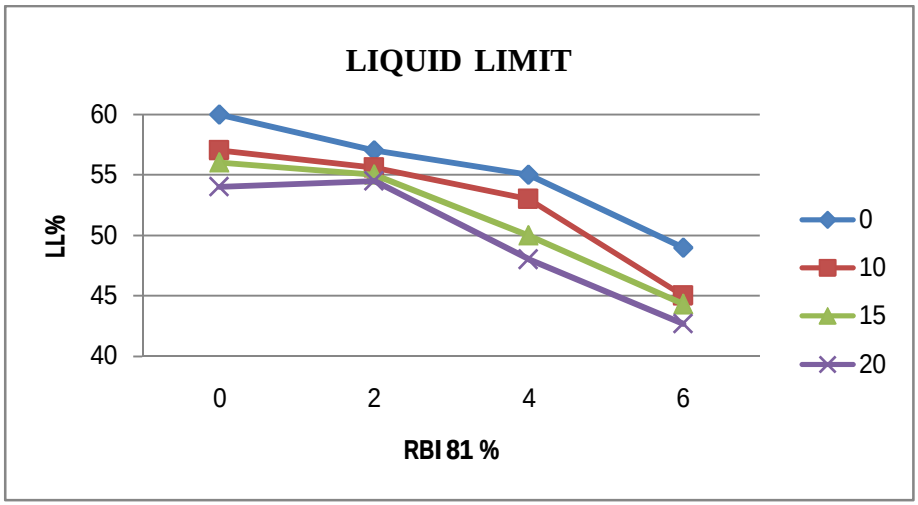


Figure1: Effect of RBI81 and fly ash on L.L. soil

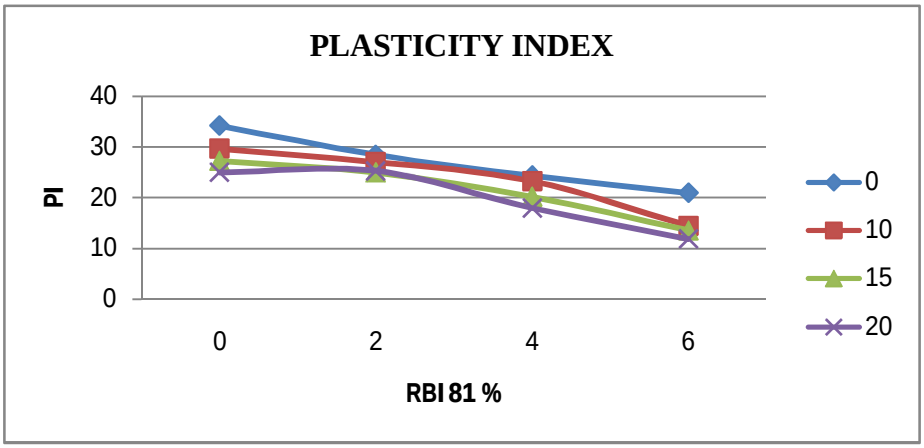


Figure2: Effect of RBI81 and fly ash on P.I. in soil.

*B. Optimum moisture content*

The Optimum moisture content of the untreated soil sample was 26%. O.M.C. values for mix of soil: fly ash: RBI 81 for proportion of 78:2:20,76:4:20 and 74:6:20 found to be 24%,23.7%, and 22.4 % respectively. All the other values at different proportions are tabulated in Table 4 and graphs were plotted between proportions and O.M.C values.

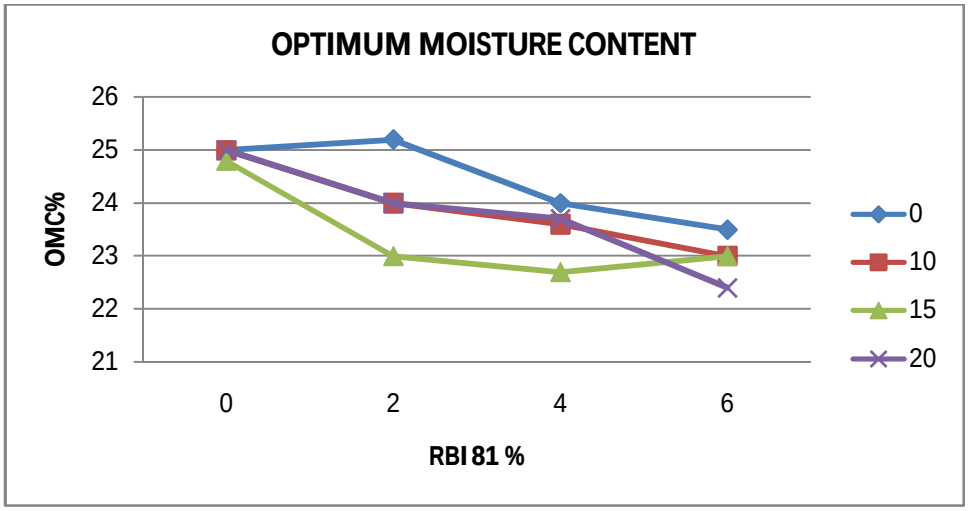


Figure3: Effect of RBI81 and fly ash on OMC

*C. Maximum Dry Density*

The Maximum dry density of the untreated soil sample was 1.551gm/cc M.D.D. values for mix of soil: fly ash: RBI 81 for proportion of 78:2:20,76:4:20 and 74:6:20 found to be 1.630gm/cc, 1.631gm/cc and 1.632 gm/cc respectively. All the other values at different proportions are tabulated in Table 4 and graphs were plotted between proportions and M.D.D. values.

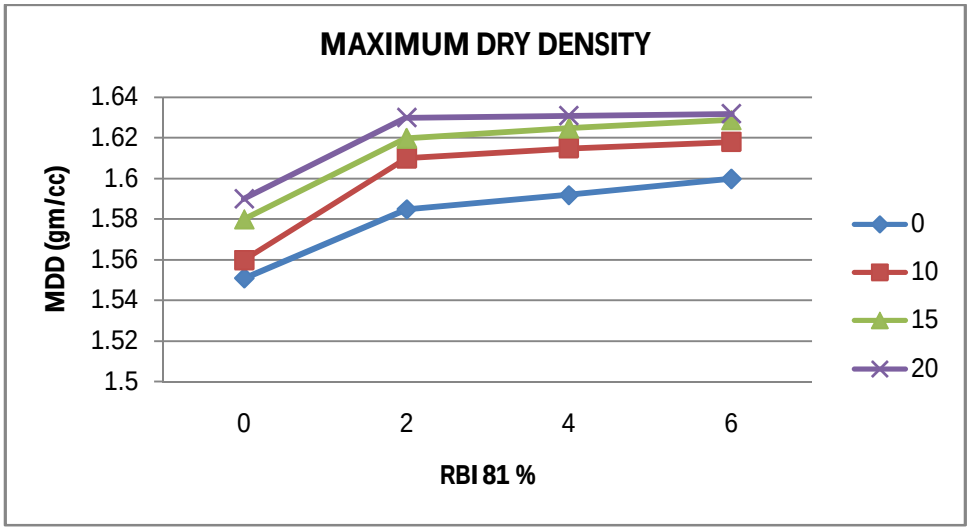


Figure4: Effect of RBI81 and fly ash on M.D.D. of soil

## VI. CONCLUSION

Based on a series of experimental investigations conducted to study the effects of fly ash and RBI grade 81 stabilizer on liquid limit, plastic limit, plasticity index, maximum dry density, Optimum moisture content of locally available clayey soil. The following conclusion can be drawn:

*A.* The L.L,P.I. goes on decreasing irrespective of the percentage of addition of fly ash.
*B.* The L.L.decreases from 60% to 42.7% on addition of 20% flyash and 6% RBI grade 81 into the soil.
*C.* The addition of 20% fly ash and 6% RBI grade 81 change the soil form CH to MI group as per Indian standard classification system.
*D.* The plasticity index decreases from 34.2% to 11.9% if we add 20% flyash and 6% RBI grade 81.
*E.* The OMC goes on Decreasing and M.D.D goes on increasing with increase in percentage of addition of RBI Grade 81 and fly ash at different proportions.
*F.* From the above points it can be concluded that the RBI grade 81 material mixed in the flyash is effective to stabilize expansive soil and made it suitable as subgrade material for roads.

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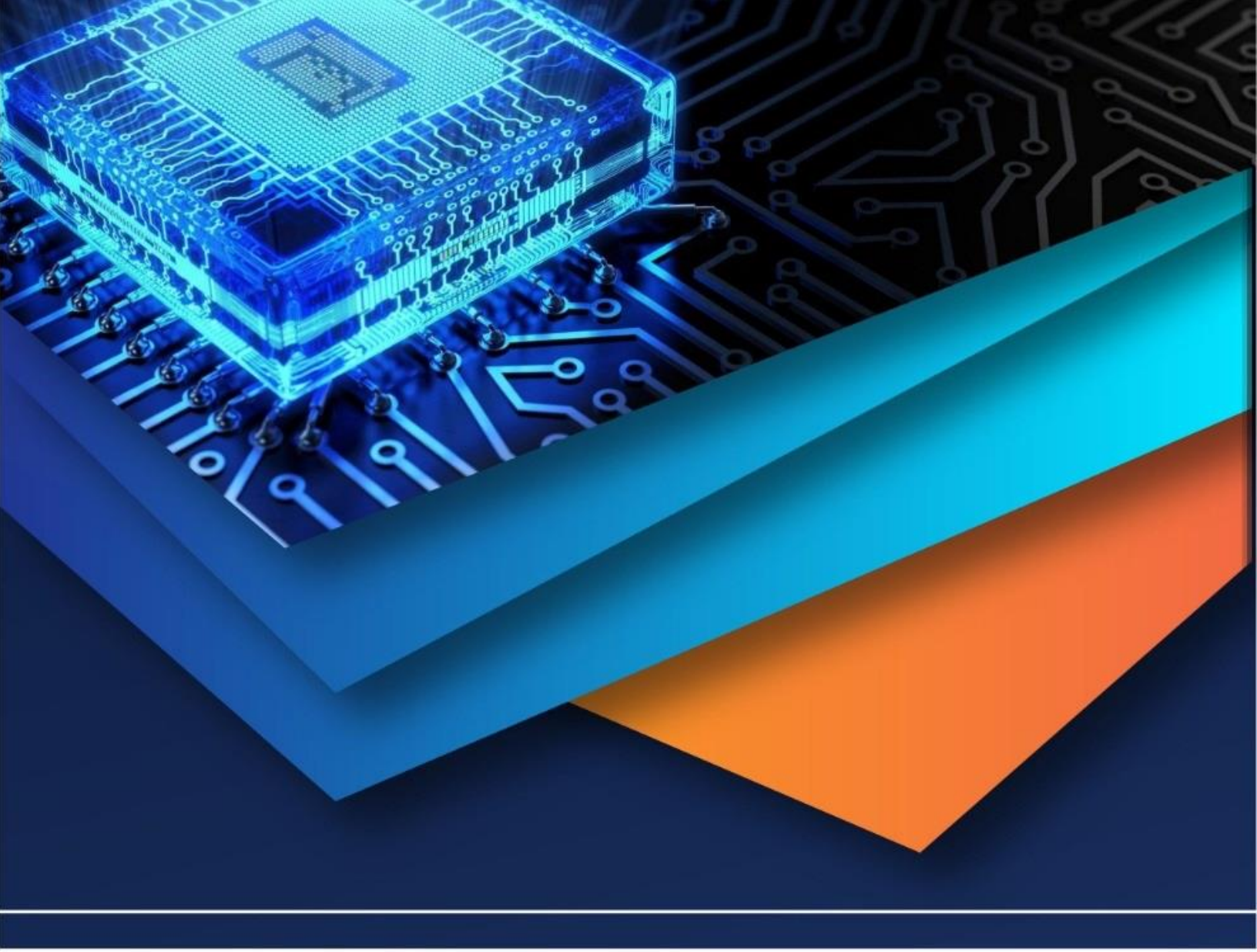

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