

Study a Behaviour of Expansive Soil with 6% Lime and Crusher Dust

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Abstract: *Expansive soil which has a property to expands when it contacts with moisture. This is one of the major reason offailure of engineering structures. This property of expansive soil may be improved by adding or mixing the different types of admixture or fibre or stabilizing agents. In this research paper, the engineering properties of expansive soil is tried to improve by using crusher dust with 6% Quick lime. In this experimental work, the 6% Quick Lime is mixed with different percentage of crusher dust in expansive soil. The following tests were conducted for determine the performance of 6% Quick lime with Expansive soil mix specimen Standard Proctor Test, Unconfined Compression Test(3days soaked), California Bearing Ratio.*

Keywords: MDD, OMC, UCS, CBR, Quick Lime, Crusher dust

1. Introduction

Expansive soil is one among the problematic soils that has a high tendency of shrinkage or swelling due to change of moisture content. This expansive soil occurs mostly in the central and western parts and covers approximately 20% of the total area of India. Because of its high swelling and shrinkage characteristics, the expansive soils (E.S) has been a challenge to the highway engineers. The expansive soil is very hard when dry, but loses its strength completely when in wet condition. The racks disappear during wet season but an uneven soil surface stays as a result of irregular swelling and heaving. The black cotton soils have low strength and are susceptible to excessive volume changes, making their use for construction purposes very difficult. In this research paper, for the improvement of expansive soil the following tests were performed:- Standard proctor, UCS(3days soaked), CBR test(3days Soaked) on 6% of Quick lime and different percentage of crusher dust. The main objective of this work was to investigate the potential of improving engineering properties of expansive soil by using Lime and Crusher Dust.

2. Literature Review

(i) **RafaellaLeite, et. al**-The all test were performed on a disturbed soil samples. The soil was taken from Nossa Senhora do Socorro – Sergipe, Brazil, and the following laboratory tests were performed: sieve and hydrometer tests, Atterberg's Limit, standard proctor, free swell and swelling pressure. All test were performed for the natural soil has a tendency of high to very high degree of expansion, which reached approximately 20% of free swell and nearly 200 kPa of swell pressure. In order to carried out the effect of lime on expansive soil with various percentage of lime 3%, 6% and 9%.

(ii) **Das Champakali, et. al**- Concluded that the improvement in strength of the stabilized mix the soil sample has been stabilized with 1.0%, 2.0%, 4.0%, 8.0%,

16.0%, 32.0% of crusher dust. The tests were performed like grain size distribution of soil and crusher dust, Standard Proctor test, CBR test and UCS test (curing days are 7, 14, 21, 28). Results shows that optimum moisture content (OMC) decreases and maximum dry density (MDD) increases with increasing percentage of crusher dust.

(iii) **Amruta A. Badgeet. al** – This investigation have been evaluated the results of different mixing proportion of lime as reinforcement with black cotton soil sample. A list of experiments such as Liquid limit test, Plastic Limit Test, Unconfined compressive Strength, California bearing ratio test (CBR) test is performed on black cotton soil sample with different mixing proportion of lime. From this lime-soil, bearing strength of soil sample was found to be increase, in all the proportions the strength increases gradually. Lime stabilization can be used successfully for projects to improve very poor subgrade soils strength, increase the soil support value and eliminate wasting bad soils.

3. Experimental Investigations

Various such as OMC and MDD, UCS, CBR etc. tests have been performed to find out the engineering properties of expansive soil with 6% Quick lime and varied percentage of Crusher dust. The percentage of Quick lime is 6% and Crusher dust may have varied from 5% to 20% at 5% interval.

3.1 Engineering Properties of Soil and Crusher Dust

The following data were obtained by experimental work.

Table 1: Engineering Properties of Expansive Soil

S.No.	Property	Value
1	Liquid Limit (L.L.)	41.64
2	Plastic Limit (P.L.)	20.45
3	Plasticity Index (P.I.)	21.19
4	Specific gravity (G)	2.68
5	Max. Dry Density (Y _d)	1.68 kg/cm ³
6	O.M.C	18.35%
7	Unconfined Compression Strength	2.12kg/cm ²
8	CBR %	2.13
9	Free Swell Index	47.06%
10	Swelling Pressure	1.14kg/cm ²

Table 2: Engineering Properties of Crusher dust

S.No.	Property	Value
1	Liquid Limit (L.L.)	19.90
2	Plastic Limit (P.L.)	Non - plastic
3	Plasticity Index (P.I.)	Nil
4	Specific gravity (G)	2.96
5	Max. Dry Density (Y _d)	1.97
6	O.M.C (%)	13.88
7	CBR %	29.35

3.2 Standard Proctor Test

The object of testing is to find out the maximum dry density and optimum moisture content of mix specimen. The mix specimen is prepared by different percentage of crusher dust with 6% Quick lime in expansive soil. The test results of mix specimen are showing in Table 3.

Table 3: Standard Proctor Tests Result Obtained For Expansive Soil With 6% Lime and Various Percentage of Crusher Dust

Particulars	MDD(kg/cm ³)	OMC(%)
EXPANSIVE SOIL	1.698	18.35
E.S + 6%	1.599	21.30
E.S + 6% + 5% C.D.	1.63	19.80
E.S + 6% + 10% C.D.	1.67	19.16
E.S + 6% + 15% C.D.	1.69	18.24
E.S + 6% + 20% C.D.	1.72	17.47

From fig. 1, it shows that the MDD and OMC, 1.698 kg/cm³ and 18.35% respectively for expansive soil on the 6% of lime mixed with expansive soil the value of MDD and OMC respectively 1.59kg/cm³ and 21.90 but on the increment percentage of crusher dust the value of MDD is increases and OMC is decreases up to 1.72kg/cm³ and 17.47% respectively.

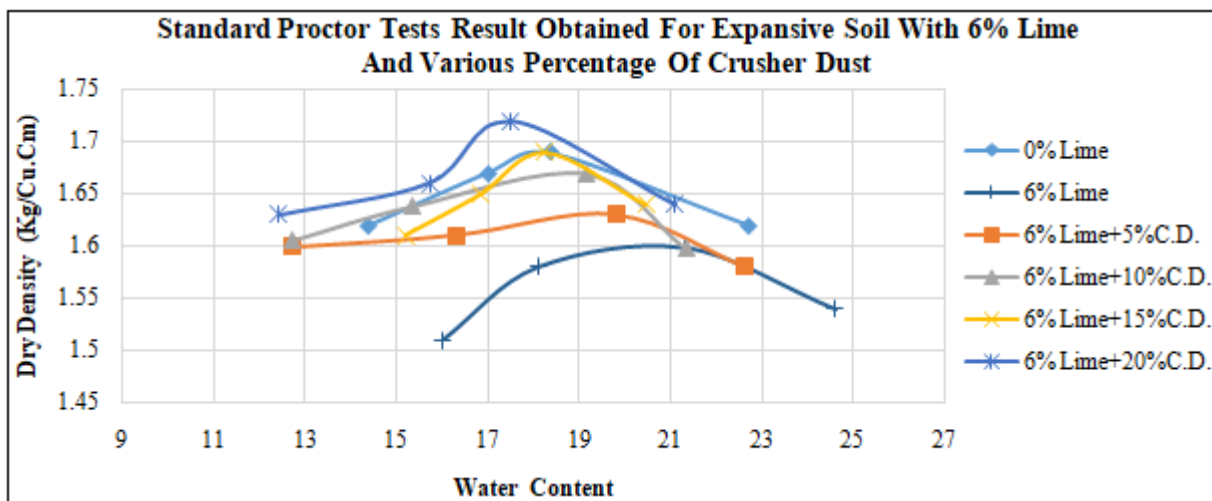


Figure 1: Standard Proctor Tests Result Obtained For Expansive Soil With 6% Lime and Various Percentage of Crusher Dust

3.3 Unconfined Compressive Strength

The object of testing is to determine the shear strength parameter of soil with 6% Quick lime and varied percentage

of Crusher dust by loading axially cylindrical specimen in a 3 days soaked condition. The observation and calculation of UCS test is shown in Table 4.

Table 4: UCS for Expansive Soil With 6% Lime and Diff. Per. of Crusher Dust

Test specimen (Quick Lime + C. D.) %	Unconfined Compressive Strength, q _u (kg/cm ²)	% Variation for Compressive Strength	Shear Strength Cu (kg/cm ²)	% Variation for Shear Strength, Cu
Expansive Soil	2.12	-	1.06	-
E.S. + 6% Lime	4.15	95.75	2.075	95.75
E.S. + 6% Lime + 5% C.D.	4.36	105.66	2.18	105.66
E.S. + 6% Lime + 10% C.D.	4.52	113.20	2.26	114.62
E.S. + 6% Lime + 15% C.D.	4.98	134.90	2.49	129.24
E.S. + 6% Lime + 20% C.D.	5.45	157.07	2.725	157.07

From Table 4, it is shown that the value of UCS for expansive soil is 2.12Kg/cm², when 6% Quick lime is added in expansive soil, the value of shear strength is 4.15kg/cm²

and the increment percentage of crusher dust the value of shearing strength is increases upto 5.45kg/cm².

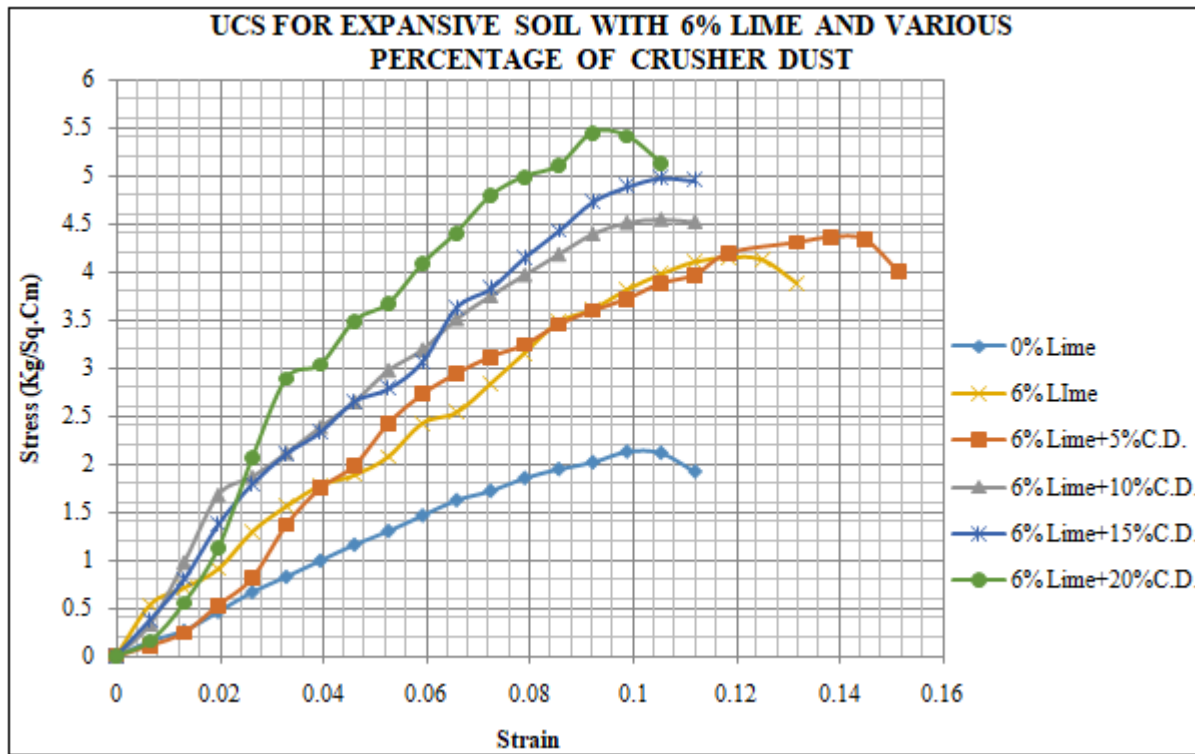


Figure 2: UCS for Expansive Soil With 6% Lime and Various Percentage of Crusher Dust

3.4 California Bearing Ratio

By varying the proportions of crusher dust with 6% Quick lime in expansive soil, the CBR observed when 20% crusher dust with 6% Quick lime is added in expansive soil is 9.34% and there is increment of 338.49% for expansive soil.

Table 5: CBR Test Results (3Days Soaked) Obtained for Expansive soil with 6% Quick Lime and Diff. Per. of Crusher Dust

Test Specimen	CBR Value %	Increment%
Expansive soil	2.13	-
Crusher dust	29.06	-
E.S. + 6% Lime	6.07	184.97
E.S. + 6% Lime + 5%Crusher Dust	6.38	199.53
E.S. + 6% Lime + 10%Crusher Dust	7.14	235.21
E.S. + 6% Lime + 15%Crusher Dust	8.54	300.93
E.S. + 6% Lime + 20%Crusher Dust	9.34	338.49

4. Conclusion

- 1) The result shows that the maximum dry density was decreased and optimum moisture content increases on 6% of quick lime but on increment of crusher dust percentage the MDD was increases while OMC decreases.
- 2) The UCS value of soil is 2.12kg/cm² and after mixing 6% lime it increases up to 4.15kg/cm², the increment is 95.75%.
- 3) By the increment % of crusher dust with 6% lime the value unconfined compressive strength is increases up to 157.07% of mix specimen.
- 4) The value of CBR test observed when 20% crusher dust with 6% Quick lime is added in expansive soil is 9.34% and there is increment of 338.49% for expansive soil.

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