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A Study on Strength Properties of Expansive Soil Treated with Quarry Dust

K. V. Visalakshi[1], K.Sridevi[2,] Ch. Shivanarayana[3], Dr. D S V Prasad[4]
[1](M.Tech Student, Department of Civil Engineering, BVC Engineering College, Odalarevu, India)
[2, 3](Assistant Professor, Dept. of Civil Engineering, BVC Engineering College, Odalarevu, AP, India.)
[4](Principal & Professor of Civil Engineering, BVC Engineering College, Odalarevu, AP, India.)
Corresponding author: Dr. D S V Prasad

Abstract : *Expansive soils have problems to civil engineers in general and to geotechnical engineers in particular because of alternate swell and shrinkage, distress is caused to the foundations of structures laid on such soils.* Stabilization of the expansive soil is studied by using quarry dust. This paper includes the evaluation of soil properties like compaction, unconfined compressive strength test and California Bearing Ratio (CBR) test. Detailed experimental study has been undertaken to investigate the characteristics and behavior of expansive soil mixed with quarry dust with different percentage. From the experimental results, it has been observed that various properties of soil added with these stabilizers at certain percentage show remarkable positive changes as compared to the expansive soil. The value of compaction parameters has increased enabling increase California Bearing Ratio in both soaked and unsoaked conditions which indicates that improved in strength. From these results, it was found that optimum quarry dust (10%) gives the maximum increment in the CBR value compared with all the other combinations.

Keywords *- Black Cotton Soil, Quarry Dust, Compaction, CBR, UCS*

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I. Introduction

Stabilisation is a broad sense for the various methods employed and modifying the properties of a soil to improve its engineering performance and used for a variety of engineering works. Soil stabilization is broadly used in connection with road, pavement and foundation construction. It improves the engineering properties of the soil in terms of volume stability, strength, and durability. Black cotton soils are found in many parts of the India. It covers an extensive area 3,00,000 km^2. Black cotton soil contained montmorillonite as the predominant mineral, due to which it has the greatest swelling property. Stabilization of black cotton soil with industrial wastes generated from industries has been found successful for improving the engineering properties of black cotton soil. The quarry dust is a waste product generated during the processing of stones at quarries. The quarry dust generally produced by blasting of quarry. The large number of quarries has been produced quarry dust to construction purpose. Since quarry dust is a waste material from quarries and shows pozzolanic characteristics, it is always encouraged to use quarry dust for stabilization where easily and economically available. Quarry dust is extracted from the quarries is a non-plastic fine silt. Its composition varies according to blasting done in quarries. Many efforts are being directed toward beneficial utilization of this waste product in several ways. Quarry dust has been used as a pozzolana to enhance the improvements noticed in some of geotechnical properties of clayey soils, only with quarry dust are not adequate for its use in road work and foundation design. [1] conducted experiments with 10 %, 15% and 20 % of Granite waste and Quarry dust content in soil on tests for soil Liquid limit, O.M.C., M.D.D, Bulk density, Dry density and Grain size analysis and from the results Specific gravity of Black cotton soil increased with the addition of quarry dust and granite waste, this increment of specific gravity value may be due to the addition of plasticity character of Black cotton soil, liquid limit decreased from 21%to 17% with the addition of quarry dust and granite waste from 0% to 20%, Unconfined compressive strength improved in Black cotton soil after adding 20% quarry dust and granite waste and addition of different ratio of quarry dust and granite waste to the black cotton soil gets stabilized, thus the Maximum dry density increases and Optimum moisture content goes on decreases. [2] Studied the variation in properties of expansive soil mixed with quarry dust and flyash. They concluded that, as the percentage of flyash alone/quarry dust alone/combination of both (flyash + quarry dust) increases, optimum moisture content decreases. [3] study the effect of stone dust on geotechnical properties of poor soil and from test results the CBR and MDD of soils can be improved by mixing stone dust and also liquid limit, plastic limit, plasticity index and optimum moisture content decrease by adding stone dust which in turn increases usefulness of soil as highway subgrade material. [4] Conducted plasticity, compaction and strength tests on gravel soil with various percentage of stone dust and

found that by addition of stone dust plasticity characteristics were reduced and CBR of the mixes improved. Addition of 25-35% of stone dust makes the gravel soil meet the specification of MORTH as subbase material. [5] has study the effect of lime on Atterberg's limits, MDD, OMC, shear strength and durability of quarry dust stabilized expansive soil mixes and from the test results with increase in percentage of lime in expansive soil-quarry dust mixes the liquid limit, plasticity index goes on decreasing and plastic limit and shrinkage limit goes on increasing, OMC goes on increasing and MDD goes on decreasing the cohesion and angle of internal friction value increases up to 5% addition of lime. Addition of lime makes the soil-quarry dust mixes durable. [6] studies the effect of shear strength on soil-quarry dust mixtures. The results showed that the quarry dust proved to be a promising substitute for sand and can be used to improve the engineering properties of soils. The dry density increased with the addition of quarry dust and decrease in the optimum moisture content. Quarry dust is a waste material produced from aggregate crushing industries. The quantities of these waste materials imposing hazardous effect on environment and public health. Limited research is available done on the effect of Quarry Dust on different geotechnical properties of expansive soil. The present paper discusses the properties of selected expansive soil and quarry dust mixed into it in different proportions. Index properties, Compaction properties Unconfined Compressive Strength (UCS) and California Bearing Ratio (CBR) Test are considered in this investigation.

II. Materials Used

2.1 Expansive Soil: The Expansive soil used in this investigation was collected from Tummalapalli village near Amalapuram, East Godavari District Andhra Pradesh in India. The properties of the Expansive soil are presented in Table:I

Table1: Properties of Expansive Soil

S.NO	PROPERTY	VALUE
1	**Grain Size Distribution** Sand (%) Silt (%) Clay (%)	 11 38 51
2	**Atterberg limits** Liquid limit (%) Plastic limit (%) Plasticity index (%)	 70 36.6 33.4
3	**Compaction Properties** Optimum Moisture Content (O.M.C) (%) Maximum Dry Density(MDD) (g/cc)	 22.56 1.455
4	**Specific Gravity (G)**	2.65
5	**IS Classification**	CH
6	**Soaked C.B.R (%)**	1.77
7	**Differential Free Swell (%)**	130

2.2 Quarry Dust**:** Quarry Dust for this study was collected from Rajahmundry, East Godavari District of Andhra Pradesh, India. Quarry dust can be used in very large quantity, reducing the total cost of construction in addition to providing a solution to an environmental problem. The index and Engineering properties of the soil were determined as per IS codes and are presented in Table-II.

Table II: Properties of Quarry Dust

S.No	Property	Value
1	Specific Gravity	2.46
2	**Grain Size Distribution**	
	Coefficient of Uniformity (Cu)	17.65
	Coefficient of Curvature (Cc)	2.92
3	**Compaction Properties**	
	Optimum Moisture Content (OMC) %	12.5
	Max. Dry Density (MDD) g/cc	1.63
4	California Bearing Ratio Test (CBR)	6.20

III. Laboratory Experimentation

Laboratory tests were conducted for finding the index and other important properties of the soils used during the study. Compaction, CBR and Unconfined compressive strength tests were conducted by using different percentages of quarry dust mixed with black cotton soil materials for finding optimum percentages and strength parameters.

3.1 Index Properties: Liquid Limit, Plastic Limit of the untreated and treated expansive soil were determined by following Standard procedures as per IS: 2720 (Part-5)-1985; IS: 2720 (Part-6)-1972. Specific Gravity test were determined by using Pycnometer bottle method as per IS 2720 Part III.

3.2 Compaction Properties: Optimum Moisture Content and Maximum Dry Density for black cotton soil blending with different percentages of quarry dust were mixed with a view to determine optimum percentages by conducting I.S heavy compaction test as per IS: 2720 (Part VIII).

3.3 California Bearing Ratio (CBR) Tests: Samples were prepared for CBR test using expansive soil material mixing with different percentages of admixes quarry dust with a view to determine optimum percentages. The unsoaked and soaked CBR tests were conducted in the laboratory for all the samples as per IS Code (IS: 2720 (Part-16)-1979) as shown in the Fig.4

3.4 Unconfined Compression Strength Test: The Unconfined Compression Strength Tests were conducted in the laboratory as per IS Code (IS: 2720, Part X (1991). Unconfined compressive strength is one of the most widely referenced properties of stabilized soils. For strength testing, specimens are generally tested at their maximum dry density and optimum moisture content. The strain rate was kept 1.2 mm/min in all the experiments. The proving ring of capacity 2 kN was used for testing specimens as shown in the Fig.5.

Fig.1 California Bearing Ratio Test Apparatus

Fig.2 Unconfined Compressive Testing Machine

IV. Results And Discussions

4.1 Index Properties

Liquid limit values were reduced from 70, 68, 66, 64 and 60, plastic limit values are also decreased from 36.6, 35.78, 34.8, 31.5 and 2945 by adding 0 %, 5%, 10%, 15% and 20 % of quarry dust respectively when blended with the expansive soil as shown in the Fig. 3.

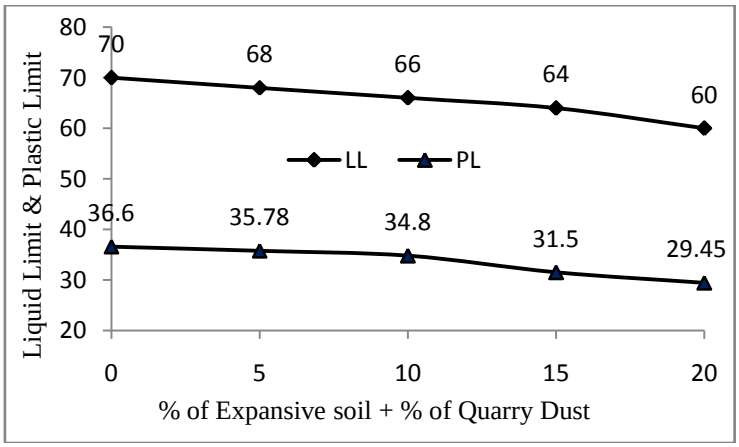

Fig.3 Variation Liquid Limit and Plastic Limit Values of Expansive Soil Treated with Different Percentage of Quarry Dust

4.2 Compaction Test

All the Samples are tested as per I.S.Heavy compaction IS: 2720 (Part VIII). Graphs drawn between water content and dry density for each percentage, from these results Optimum Moisture Content and Maximum Dry Density values are arrived. The results and graphs from these tests are presented in the Fig. 4. From the compaction test results the maximum dry density values are increased from 14.5 kN/m^3,16.2 kN/m^3,17.3 kN/m^3,16.9 kN/m^3 and 16.85 kN/m^3 the optimum moisture content values are decreasing from 22.9%, 22.7%, 21.5%, 20.9 % and 20.5 % respectively when the soil is mixed with 0 %, 5 %, 10 %,15% and 20 % of quarry dust .

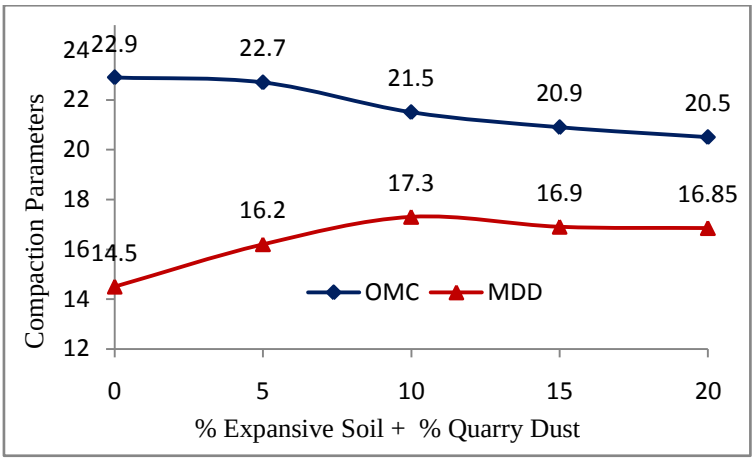

Fig.4 Variation of Compaction Parameters of Expansive Soil Treated with Different Percentage of Quarry Dust

4.3 California Bearing Ratio (CBR) Test

CBR tests were conducted for expansive soil material mixed with different percentages of quarry dust and the results were presented in the Fig. 5. It is observed from that expansive soil mixed with different percentages of quarry dust unsoaked and soaked CBR values are 2.56,1.77;4.5,2.62,7.6,4.32,6.9,3.75 and 5.6,3.58 for 0 %, 5 %, 10 %, 15 % and 20 % of quarry dust respectively.

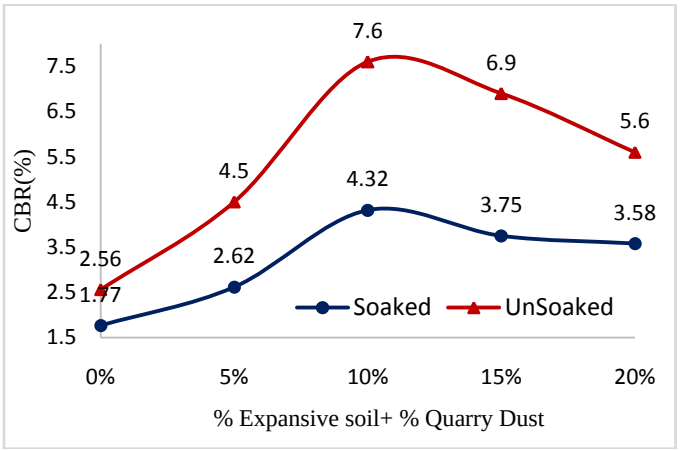

Fig.5 Variations of CBR Values for Expansive Soil with Different % Quarry Dust

4.4 Unconfined Compressive Strength

The unconfined compressive strength of expansive soil treated with Quarry dust has increased for the optimum percentages at 28 days. The value obtained when expansive soil treated with quarry dust for optimum percentage at curing periods of 1day,14 days,21days,28 days are 138 kPa,142 kPa,144 kPa,146 kPa as shown in the Fig.6.

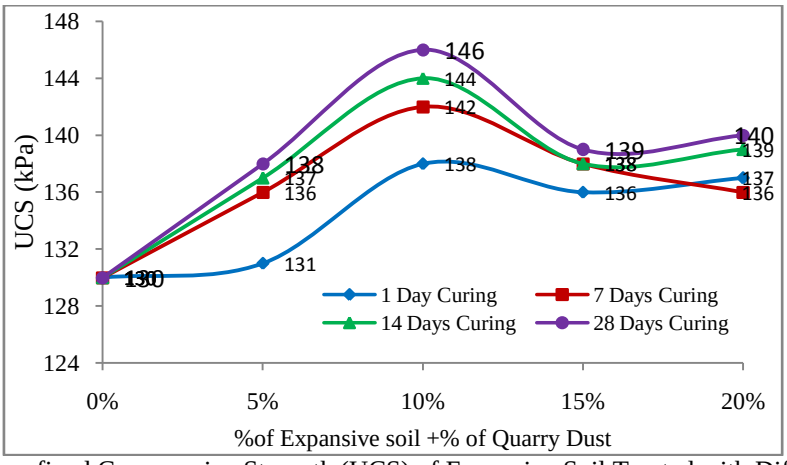

Fig.6 Variation Unconfined Compressive Strength (UCS) of Expansive Soil Treated with Different % of Quarry dust

V. Conclusion

The following conclusions were drawn based on the laboratory studies carried out on this study. Liquid limit of the expansive soil decreases from 70 % to 60 % and the plastic limit decreased from 36.6% to 29.5% by adding with the addition 5%, 10%, 15%, 20% quarry dust. Optimum moisture content has been decreased from 22.5% to 21.5% with the optimum percentage of quarry dust and to expansive soil. It is observed from the laboratory investigations that the unsoaked and soaked CBR value of the expansive soil as 2.56% and 1.77% are increased up to 7.6% and 4.32% uo to 10% adding qurry dust and beyond decreased. The UCS value for untreated expansive soil is 130 kPa and increased by 138 kPa for 1 day, 142 kPa for 7 days, 144 kPa for 14 days and 146 kPa for 28 days curing respectively at 10% quarry dust. Hence, from the laboratory results, the optimum percentages of quarry dust as 10%. The utilization of industrial wastes like quarry dust is an alternative to reduce the construction cost of roads particularly in the rural areas of developing countries.

References

[1]. Thirumalai,.R, Dr.S.Suresh Babu,V. Naveennayak ,B.Ragavendra and G.Praveenkumar (2017),"Stabilization of Black Cotton Soil Using Granite Waste and Quarry Dust" International Research Journal of Engineering and Technology (IRJET) , Volume: 04 , Issue: 08,PP. 226-229.

[2]. Indramma P. and Sudharani Ch.(2014), "Variation of Properties of an Expansive Soil Mixed with Quarry Dust and Fly Ash" International Journal of Emerging Technology and Advanced Engineering,Vol.4,Issue 4,pp.51-54.

[3]. Bshara, A.S.; Bind, Y.K. and Sinha, P.K. (2014). "Effect of Stone Dust on Geotechnical properties of Poor Soil", International Journal of Civil Engineering and Technology (IJCIET), vol. 5, issue 4, pp.37-47.

[4]. Satyanarayana, P.V.V.; Raghu, P.; kumar, R.A. and Pradeep, N. (2013)." Performance of Crusher Dust in High Plastic Gravel Soils as Road Construction Material", IOSR Journal of mechanical and civil engineering, vol.10, issue 3, pp.01-05.

[5]. Akshaya Kumar Sabat(2012),". A Study on Some Geotechnical Properties of Lime Stabilized Expansive Soil-Quarry Dust Mixes",. International Journal of Emerging Trends in Engineering and Development Volume- 1, Issue-2. ISSN 2249-6149.

[6]. Sridharan A, Soosan T.G, Babu T. Jose, Abraham B.M, (2006), "Shear Strength Studies on Soil- Quarry Dust Mixtures", SPRINGER, Geotechnical and Geological Engineering , pp.1163–1179.

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