ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 4, Issue 10, April 2015

Study on Behavior of Expansive Soil Treated With Quarry Dust

H.Venkateswarlu, A.C.S.V Prasad, Dr. DSV Prasad & Dr.GVR Prasada Raju

Abstract: Quarry dust is a type of solid waste material that is obtained from aggregate crushing industries. Disposal of such waste materials creates lots of problems to the environment and public. Considering this aspect an experimental study was conducted on locally available expansive soil by mixing it with Quarry dust. This paper presents the variation of index and engineering properties of expansive soil such as liquid limit, plastic limit, plasticity index, compaction characteristics, California Bearing Ratio and shear strength when it is mixed with different percentages (0%, 5%, 10% and 15%) of Quarry dust and the results were found that up to the addition of 10% of stone dust there is an increase in strength parameters beyond it is not effective.

***Index Terms*—Expansive soil, California Bearing Ratio, Compaction Characteristics, Quarry Dust.**

I. INTRODUCTION

With the rise in development of countries the rate of production of wastes has increased tremendously in almost all parts of the world in the past few decades. Quarry dust is a waste material producing from aggregate crushing industries. The quantities of these waste materials imposing hazardous effect on environment and public health. In order to eliminate the negative effect of these waste materials it can dispose proper and safe manner. Also it cant be disposed of properly and its disposal is not economically viable but it is blended with other construction materials like clayey soil then it can be used best for various construction purposes like sub grade, foundation base and embankments. Due to rapid industrialization there is scarcity of land having desirable soil bearing capacities. soil stabilization is the technique which improves the properties of expansive soil to meet the engineering requirements. For a successful stabilization, a laboratory tests required to determine engineering properties.

various researchers have been done on Quarry dust for stabilization of Expansive soils, like Jagmohan Mishra et al., (2014) studied the effect of granite dust on significance decrease in the expansive behavior of the Black Cotton Soil as the liquid limit and plasticity index decreases from 37% to 28% and 17.45% to 4.80%, respectively if Black Cotton Soil is blended with 5% lime and granite dust from 0% to 30% by weight of Black Cotton Soil. With the increase in the granite dust percentage the liquid limit values decrease from 57% to 28%, plasticity index values decrease from 37.2% to 3.7%, differential free swell decreased drastically from 56.6% to 4.1%, shrinkage limit values increases from 8.15% to 18% with the increase in granite dust. Bshara et al., (2014) reported the effect of stone dust on geotechnical properties of poor soil and concluded that the CBR and MDD of poor soils can be improved by mixing stone dust. They also indicated that the liquid limit, plastic limit, plasticity index and optimum moisture content decrease by adding stone dust which in turn increases usefulness of soil as highway sub-grade material. Sabat and Bose (2013) had studied the effect of fly ash –quarry dust mixes with fly ash: quarry dust as 1:2, on engineering properties of an expansive soil. The optimum proportion of fly ash –quarry dust mix was found to be 45%. Satyanarayana et al., (2013) 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 sub-base material. Roobhakhshan and Kalantari (2013) conducted consistency limit, standard compaction test, unconfined compressive test and CBR test and concluded that there is remarkable influence on strength and CBR value at 1% lime + 6% waste stone powder for CBR and 7% lime + 6% waste stone powder for U.C.S which are optimum percentage. **Sabat (2012)** had investigated the effect of lime on Atterberg's limit, compaction(modified proctor), shear strength parameters and durability of an expansive soil stabilized with optimum percentage of quarry dust (40%).The lime added were 2 to 7 % at an increment of 1%. The effect of 7 and 28 days of curing were also studied on shear strength parameters. From the study it was concluded that with increase in percentage of addition of lime the w_P, w_S, C, Ø, OMC increased, the w_L, IP, MDD of the soil-quarry dust mixes decreased. Though MDD decreased but it was greater than the MDD of the virgin soil at 5% addition of lime. Addition of lime had made the soil-quarry dust mixes durable. Curing had positive effects on shear parameters and had maximum values at 5% addition of lime and 28 days of curing.

The main objective of this investigation is to utilize industrial waste such as Quarry dust in the field of geotechnical engineering. In this investigation an attempt is made to stabilize black cotton soil using quarry dust. Atterberg's limits, Compaction Characteristics, California Bearing Ratio and Direct shear tests were conducted on Expansive soil with different percentage of Quarry dust.

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 4, Issue 10, April 2015

II MATERIALS USED

The different materials used for the experimental investigation are Expansive soil and Quarry dust.

Expansive Soil

The Expansive Soil used in this investigation was brought from Tummalapalli village, Allavaram Mandal East Godavari District of Andhra Pradesh State, India. Index and Engineering properties of Expansive soil were determined as per IS codes and are presented in Table-1. The soil is classified as **CH.**

TABLE-I: INDEX AND ENGINEERING PROPERTIES OF EXANSIVE SOIL

Property of expansive Soil	Value
Index properties	
Liquid Limit(%)	**89**
Plastic Limit(%)	**41.26**
Plasticity Index	**47.73**
Specific Gravity	**2.70**
Grain(Particle) size Distribution	
Coefficient of Uniformity(Cu)	**11.33**
Coefficient of Curvature(Cc)	**3.176**
Differential free swell(%)	**100**
Engineering Properties	
Optimum Moisture Content(%)	**28.5**
Maximum Dry Density(KN/m^3)	**15.80**
California Bearing Ratio(Un soaked)	**3.2**
Unconfined Compressive Strength(Kg/cm^2)	**0.545**
Coefficient of permeability(mm/sec)	**0.035**

Quarry Dust

Quarry Dust for this study was collected from Rajahmundry, East Godavari District of Andhra Pradesh, India. The index and Engineering properties of the soil were determined as per IS codes and are presented in Table-II.

TABLE-II: INDEX AND ENGINEERING PROPERTIES OF QUARRY DUST

Property of expansive Soil	Value
Index properties	
Liquid Limit(%)	**Nil**
Plastic Limit(%)	**NP**
Plasticity Index	**NP**
Specific Gravity	**2.52**
Grain(Particle) size Distribution	
Coefficient of Uniformity(Cu)	**18.57**
Coefficient of Curvature(Cc)	**3.956**
Engineering Properties	
Optimum Moisture Content(%)	**12.16**
Maximum Dry Density(KN/m^3)	**15.58**
California Bearing Ratio	**7.0**
Coefficient of permeability(mm/sec)	**0.0725**

III. EXPERIMENTAL INVESTIGATION

In Order to determine the strength variations on different properties of expansive soil, it was mixed with the Quarry dust from 0% to 15% at an increment of 5%. In total 4 mixes were prepared. Liquid Limit tests, plastic limit tests, Modified proctor compaction tests, Un soaked CBR tests were conducted on these mixes as per Indian Standard Codes for finding optimum percentage of Quarry dust material.

Index Properties

Liquid Limit, Plastic Limit of the un treated 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.

Compaction Characteristics

The Compaction Characteristics of untreated and treated Expansive soil with various percentages of Quarry dust such as Optimum Moisture Content and Maximum Dry Density were determined in the laboratory by following standard test procedure of IS heavy compaction test as per IS 2720 part VIII.

California Bearing Ratio (CBR) Test

In present investigation CBR test was carried out on prepared soil samples of Untreated Expansive soil and treated Expansive soil with various percentages of Quarry dust under un soaked condition as per recommendations in IS 2720 part XVI-1987 as shown in the fig.1.

Fig: 1 California Bearing Ratio Test Apparatus

IV. RESULTS AND DISCUSSIONS

Effect of Quarry Dust on Index properties

The Liquid limit of Expansive soil was found to decrease from 89% to 75.5% with the increase in percentage of Quarry Dust(Fig.2).On the other hand Plastic Limit of expansive soil decreases to 41.26% to 36%(Fig.3).

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 4, Issue 10, April 2015

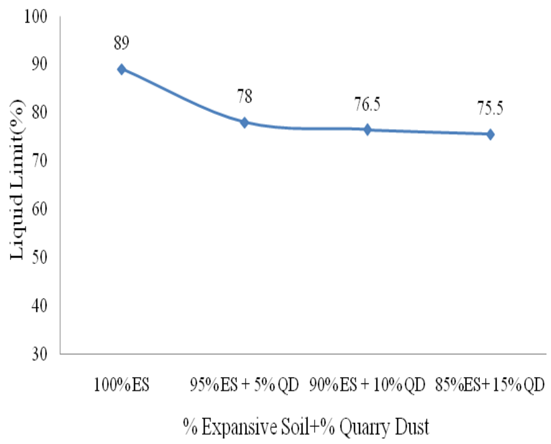

Fig.2 Variation Of Liquid Limit With Increase in % of Quarry Dust.

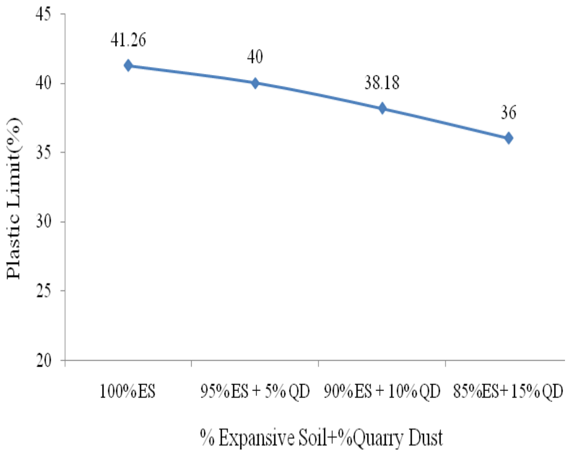

Fig.3 Variation Of Platic Limit with Increase in %of Quarry Dust.

Effect of Quarry Dust on Compaction Characteristics

The Maximum Dry Density of Expansive soil was found to increase from 15.80kN/m^3 to 17.75 kN/m^3 and subsequently Optimum moisture content decreases from 28.5% to 25.2% up to the addition of 10% of stone dust ,beyond it decreases as shown in the figs.4and 5.

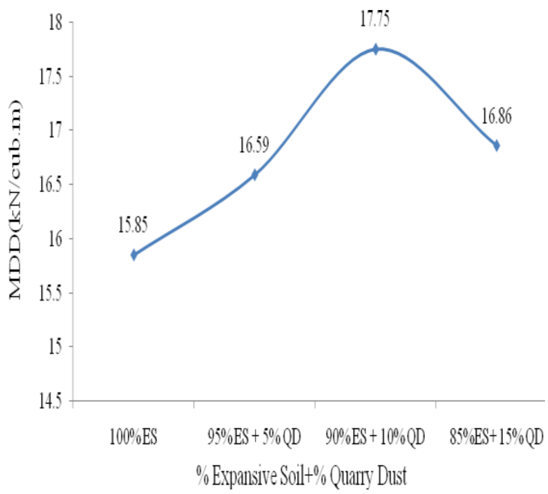

FIg.4 Variation Of Maximum Dry Density with Increase in % of Quarry Dust.

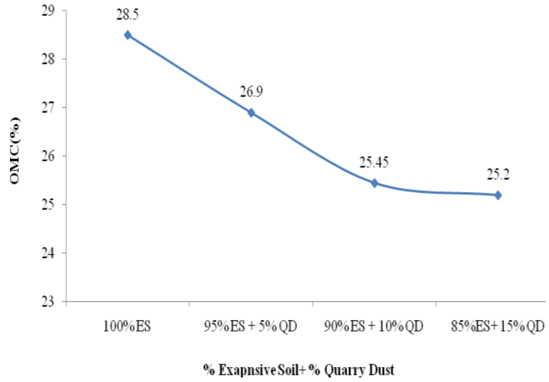

Fig.5 Variation Of Optimum Moisture Content with Increase in % of Quarry Dust.

Effect of Quarry Dust on CBR Results

The California Bearing Ratio value of expansive soil was found to increase from 3.2 to 8.24 under un soaked condition with the increase in percentage of Quarry Dust up to 10 %. (Fig.6).

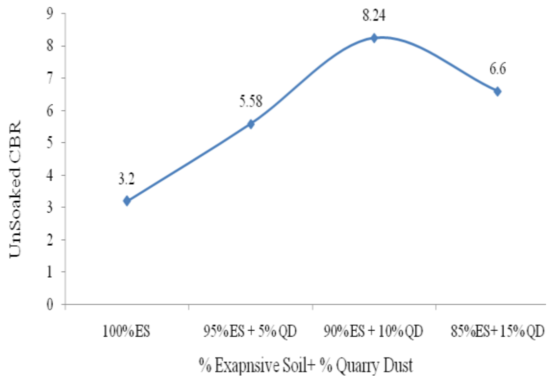

FIg.6 Variation Of Un Soaked CBR with Increase in % of Quarry Dust.

Effect of Quarry Dust on Cohesion

The cohesion of expansive soil was found to be decreased from 0.16 kg/cm^2 to 0.01 kg/cm^2 with the addition of quarry dust.

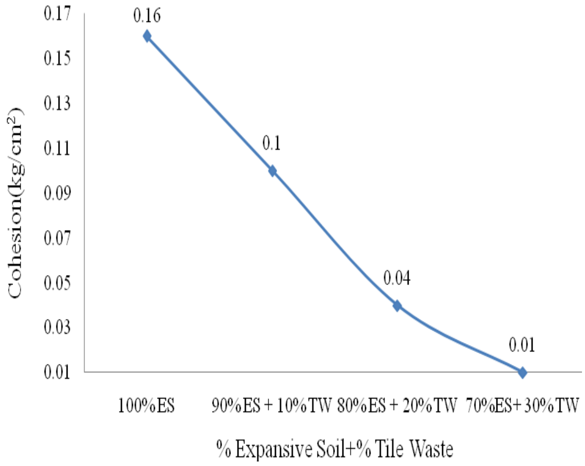

FIg.7 Variation Of Cohesion with Increase in % of Quarry Dust.

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 4, Issue 10, April 2015

V.CONCLUSIONS

The following conclusions are obtained based on the laboratory studies carried out in this investigation.

(1) It was observed that the liquid limit and plastic limit decreasing irrespective of the percentage of addition of Quarry Dust.

(2) It was found that the Maximum Dry Density attained at 10% Quarry Dust and OMC goes on decreasing with increase in percentage of Quarry Dust.

(3) It was noticed that the Un-soaked CBR goes on increasing with increase in percentage of addition of Quarry Dust.

(4) It was found that cohesion goes on decreasing with increase in percentage of quarry dust.

From the above experimental analysis it is found that Quarry Dust up to 10% can be utilized for strengthening the expansive soil with a substantial save in cost of construction.

REFERENCES

[1] Soosan, T.G.; Jose, B.T. and Abraham, B.M. (2001). "Use of Crusher Dust in Embankment and Highway Construction", Proc. Indian Geotechnical Conference, December, Indore, pp.274-277.

[2] Roobhakhshan, A. and Kalantari, B. (2013), "Stabilization of Clayey Soil with Lime and Waste Stone Powder", Int. Journal of Scientific Research in Knowledge, vol. 1, issue 12, pp.547-556.

[3] Sabat, A.K. (2012). "A Study on Some Geotechnical Properties of Lime Stabilized Expansive soil-Quarry Dust Mixes", Int. Journal of Emerging Trends in Engineering and Development, vol.1, issue 2, pp.42-49.

[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] Ali, M.S. and Koranne, S.S. (2011),"Performance Analysis of Expansive soil Treated with Stone Dust and Fly Ash",. EJGE, vol.16, pp.973-982.

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

AUTHOR BIOGRAPHY

H.VENKATESWARLU
M.Tech Student
Soil Mechanics and Foundation Engineering
Department Of Civil Engineering,
BVC Engineering College,
Odalarevu, A.P., India.

A.C.S.V PRASAD
Associate Professor
Department of Civil Engineering
SRKR Engineering College
Bhimavaram, A.P., India.

Dr. D. S. V. Prasad working as Principal BVC Engineering College, Odalarevu, AP, has more than 20 years of experience in teaching. Published more than 67 technical papers in National & International Journals & Conferences in the research area of soil mechanics and foundation engineering. He got a prestigious Crop's of Engineers Award constituted by IEI Journal.

Dr. GV R. Prasada Raju working as Registrar, JNT University, Kakinada has more than 24 years of experience in teaching and research, has more than 107 technical papers in National &International Journals & Conferences, Crop's of Engineers Award received by IEI Journal