ISSN: 2278-4632
Vol-10 Issue-6 No. 7 June 2020

STUDY OF BEARING CAPACITY OF SOIL BY USING FLY ASH ANDCOPPER SLAG

D.Janaki Ramudu [1],P. Paul Raj [2], J. Vamsi[3], R.Teja[4],M.V.Dinesh[5],Y.Venkateswarlu[6]

[1] Assistant Professor, Department of Civil Engineering, Narayana Engineering College, Gudur, SPSR Nellore, A.P, India.

[2, 3,4,5,6]UG Students, Department of Civil Engineering, Narayana Engineering College, Gudur, SPSR Nellore, A.P, India.

ABSTRACT

The Research aims to investigate the effect of adding fly ash and copper slag on the engineering properties of expansive soils .The various amount of percentages of fly ash and copper slag is (2%,4%,6%,8%,and 10%)were added to the study the effect on the compaction characteristics ,Atterberg limits ,and the stabilization characteristics using CBR .The results showed that the increase in the percentage of fly ash and copper slag increased the maximum dry density and decrease optimum moisture content. The results shows the stabilization characteristics of soil increased by using the appropriate percentage dosage to the soil .It gives the uniform stabilization for the pavements, embankments and etc.To investigate the bearing capacity of soil using CBR test at soaked and un-soaked conditions .It results shows the optimum dosage of fly ash and copper slag.

The objective of the present work is to study the impact of the engineering properties of expansive soil through laboratory experimentation.

Keywords: Copper slag, Fly ash, Optimum moisture content and Maximum Dry Density, CBR

1.INTRODUCTION

Site feasibility study for geotechnical projects is of far most beneficial before a project can take off. Site survey usually takes place before the design process begins in order to understand the characteristics of subsoil upon which the decision on location of the project can be made. The following geotechnical design criteria have to be considered during site selection.

- Design load and function of the structure.

ISSN: 2278-4632
Vol-10 Issue-6 No. 7 June 2020

- Type of foundation to be used.
- Bearing capacity of subsoil.

In the past, the third bullet played a major in decision making on site selection. Once the bearing capacity of the soil was poor, the following were options:

- Change the design to suit site condition.
- Remove and replace the in-situ soil.
- Abandon the site

The current practice is to modify the engineering properties of the native problematic soils to meet the design specifications. Nowadays, soils such as, soft clays and organic soils can be improved to the civil engineering requirements. This state of the art review focuses on soil stabilization method which is one of the several methods of soil improvement.

Soil stabilization is to improving soil strength and increasing resistance to softening by water through bonding the soil particles together, water proofing the particles or combination of the two (Sherwood, 1993). Usually, the technology provides an alternative provision structural solution to a practical problem. The simplest stabilization processes are compaction and drainage (if water drains out of wet soil it becomes stronger). The other process is by improving gradation of particle size and further improvement can be achieved by adding binders to the weak soils (Rogers et al, 1996). Soil stabilization can be accomplished by several methods. Copper slag and fly ash

A) PROPERTIES OF EXPANSIVE SOIL

S.NO	PROPERTY	GUDUR SOIL
1.	**Grain size distribution**	
	Sand (%)	2
	Silt (%)	20
	Clay (%)	78
2.	**Atterberg limits**	
	Liquid Limit (%)	52
	Plastic Limit (%)	20
	Plasticity Index (%)	32

ISSN: 2278-4632
Vol-10 Issue-6 No. 7 June 2020

3.	**Compaction properties** Optimum moisture content (%) Maximum dry density (MDD)(g/cc)	 16 1.66
4.	**Specific gravity**	2.70
5.	**Is Classification**	CH
6.	**Soaked CBR**	2
7.	**Un soaked CBR**	3.5

B) PROPERTIES OF FLY ASH

S.NO	CONSITUENTS	VALUE (%) BY WEIGHT
1.	Silica	64.22
2.	Aluminium	20.37
3.	Iron Oxide	4.44
4.	Manganese	0.12
5.	Titanium Oxide	0.49
6.	Potassium Oxide	2.35
7.	Calcium Oxide	4.32
8.	Magnesium Oxide	0.40
9.	Phosphorus	0.37
10.	Sulphur Tri Oxide	1.25
11.	Sodium Oxide	0.80
12.	Loss on Ignition	0.89

C) PROPERTIES OF COPPER SLAG

Physical properties	Copper slag
Particle shape	irregular
Appearance	Black &glassy
Type	Air cooled
Specific Gravity	3.91

ISSN: 2278-4632
Vol-10 Issue-6 No. 7 June 2020

Percentage of voids	43.20%
Bulk density	2.08g/cc
Fine modulus	3.4%
Angle of internal friction	$51^0 20$
Hardness	6-ohms
Water absorption	0.3-0.4%
Moisture content	0.1%
Fineness	$125m^2/kg$

2. METHODS AND METHODOLOGY

All the tests are conducted as per the relevant Is codes of practice. Brief descriptions of the test procedures are given below. The following are the tests conducted on the soil:

I. Liquid Limit

II. Plastic Limit

III. Plasticity Index

IV. OMC and MDD

V. CBR (Soaked and Un-Soaked)

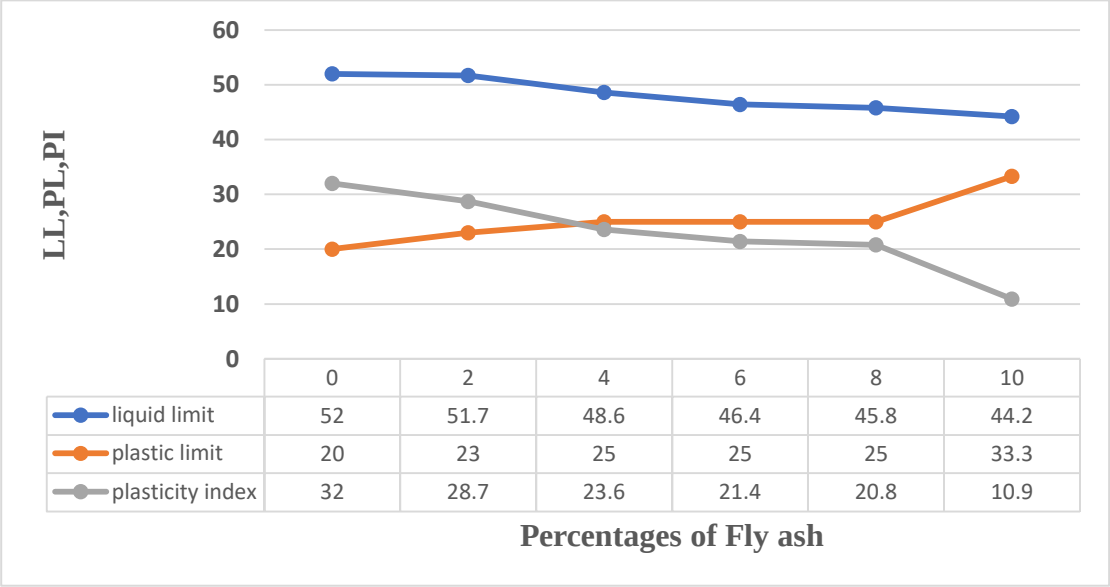
3.RESULTS AND DISCUSSIONS

S.NO	PROPERTY	SOIL+0% FLYASH	SOIL+2% FLYASH	SOIL+4% FLYASH	SOIL+6% FLYASH	SOIL+8% FLYASH	SOIL+10% FLYASH
1.	Liquid limit (%)	52	51.7	48.6	46.4	45.8	44.2
2.	Plastic Limit (%)	20	23	25	25	25	33.3
3.	Plasticity Index (%)	32	28.7	23.6	21.4	20.8	10.9

ISSN: 2278-4632
Vol-10 Issue-6 No. 7 June 2020

4.	Optimum moisture conte (%)	16	18	18	18	18	14
5.	Maximum dry density (KN/m3)	16.6	15.8	16.2	16	16	15.9
6.	CBR (soaked)	3.5	2.85	2.69	2.66	2.36	2.08
7.	CBR (un-soaked)	3.7	2.93	3.09	3.14	2.98	2.35

3.1 FLY ASH -SOIL MIXTURES

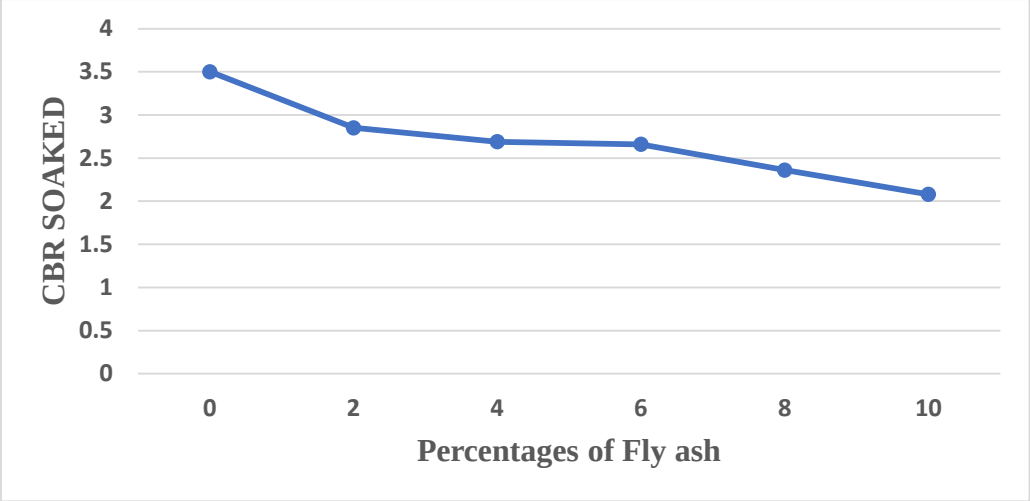


Graph 3.1variation of Liquid limit, Plastic limit, Plasticity index with different percentages of fly ash

3.1.1 CBR Soaked

Graph 3.1.1, shows the variation of CBR value with different percentages of fly ash for the soil mixtures. From graph it can be observed the CBR 3.5. It decreases to 2.65 at 2% and addition of fly ash it gradually decreases to 2.08 at 10% of fly ash.

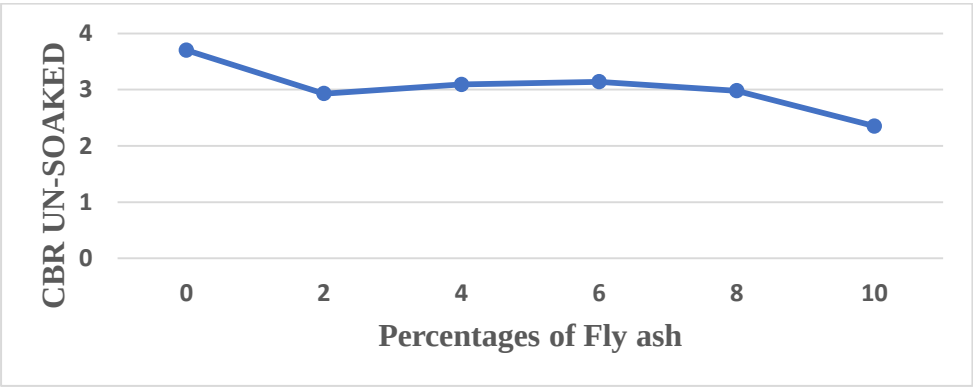
ISSN: 2278-4632
Vol-10 Issue-6 No. 7 June 2020



Graph 3.1.1: Variation of CBR (soaked) with different variations of Fly ash

3.1.2CBR Un Soaked

Graph 3.1.2, shows the variation of CBR value with different percentages of fly ash for the soil mixtures. From graph it can be observed the CBR 3.7. It decreases to 2.93 at 2% and addition of fly ash it gradually decreases to 2.35 at 10% of fly ash.



Graph3.1.2 Variation of CBR (un soaked) with different variations of Fly ash

CBR Value	**Sub grade& Strength**	**Comments**
3% and less	poor	Capping is required

ISSN: 2278-4632
Vol-10 Issue-6 No. 7 June 2020

3%-5%	Normal	Widely encountered CBR range capping considered according to road category
5% - 15%	Good	Capping" normally unnecessary except on very heavily trafficked roads.

Table: CBR For Commonly Found Sub-Grade Conditions

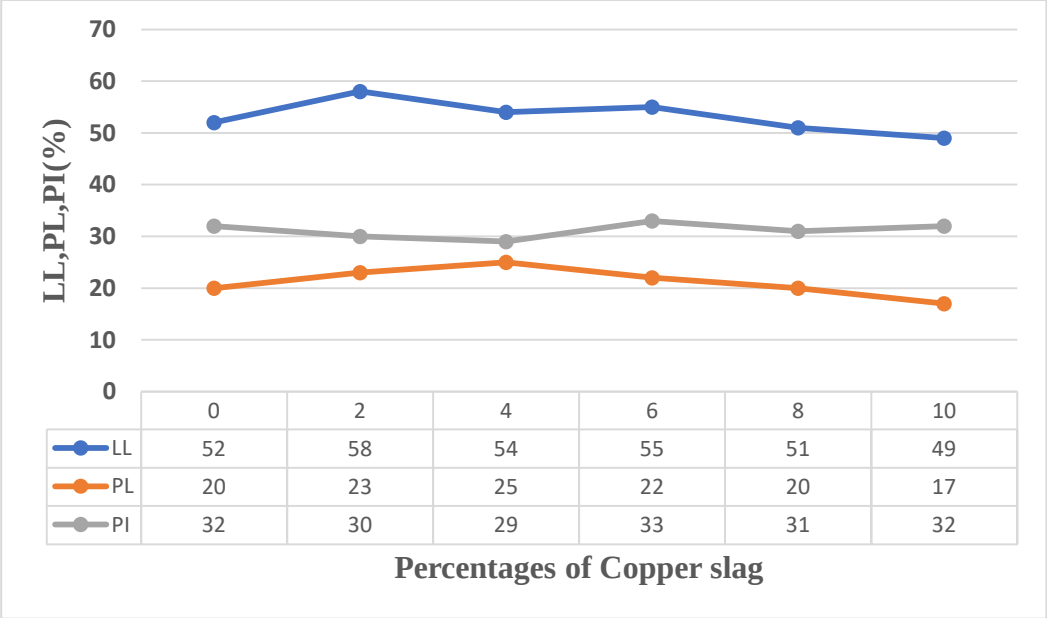
Compare the CBR value with Sub-Grade Conditions 10%, of copper slag got more than 5% of CBR value.

3.2 COPPER SLAG -SOIL MIXTURES

S.NO	PROPERTY	SOIL+0% COPPER SLAG	SOIL+2% COPPER SLAG	SOIL+4% COPPER SLAG	SOIL+6% COPPER SLAG	SOIL+8% COPPER SLAG	SOIL+10% COPPER SLAG
1.	Liquid limit (%)	52	58	54	55	51	49
2.	Plastic Limit (%)	20	23	25	22	20	17
3.	Plasticity Index (%)	32	30	29	33	31	32
4.	Optimum moisture conte (%)	16	16	14	15	14	16
5.	Maximum dry density (KN/m3)	16.6	19.2	20.0	20.3	20.0	19.8

ISSN: 2278-4632
Vol-10 Issue-6 No. 7 June 2020

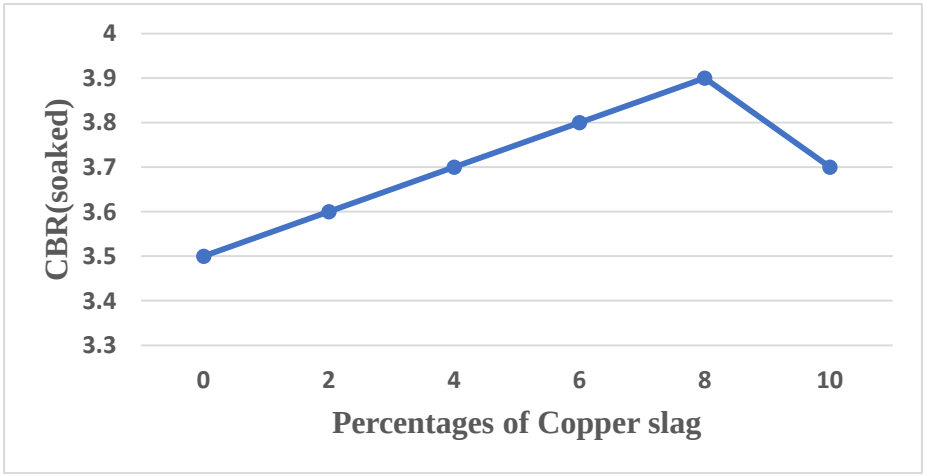
6.	CBR (soaked)	3.5	3.6	3.7	3.8	3.9	3.7
7.	CBR (un-soaked)	3.7	3.87	3.9	3.93	3.96	3.8



Graph 3.2.1: Variation of Liquid limit, plastic limit, plasticity index with different percentages of copper slag.

3.2.2 CBR Soaked

Graph 3.2.2, shows the variation of CBR value with different percentages of copper slag for the soil mixtures. From graph it can be observed the CBR 3.5. It increases to 3.6 at 2% and addition of copper slag it remains 3.9 to 3.7at 10% of copper slag.

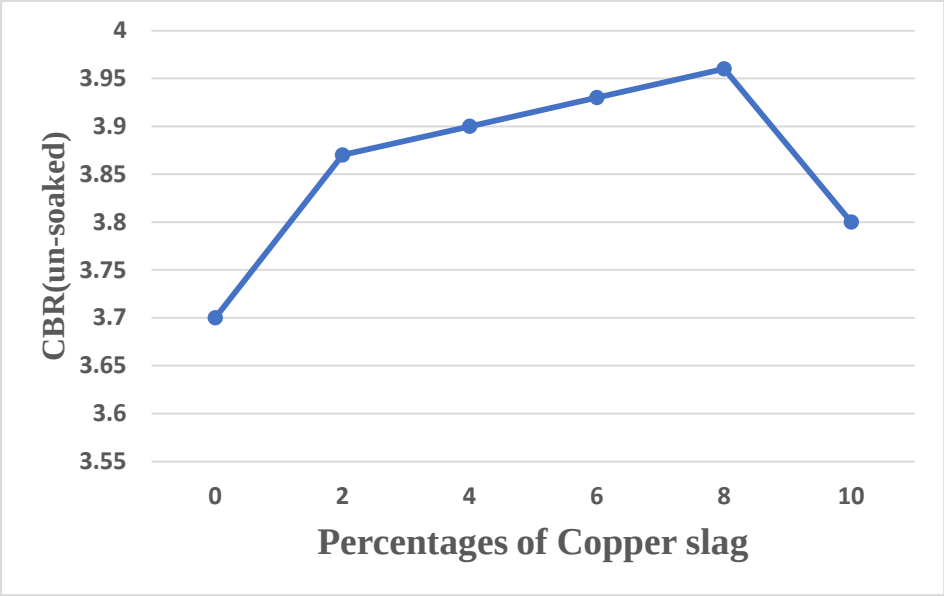


ISSN: 2278-4632
Vol-10 Issue-6 No. 7 June 2020

Graph 3.2.2: Variation of CBR (soaked) with different percentages of copper slag

3.2.3. CBR Un-Soaked

Graph 3.2.3, shows the variation of CBR value with different percentages of copper slag for the soil mixtures. From graph it can be observed the CBR 3.7. It increases to 3.87 at 2% and addition of copper salg it gradually decreases to 3.8 at 10% of copper slag.



Graph 3.2.3: Variation of CBR (un-soaked) with different percentages of copper slag.

4. CONCLUSIONS

The scope of the present investigations en-compass studying the strength and deformation characteristics of mechanically stabilized expansive soils using Fly ash.

Chapter1 gives a brief introduction followed by detailed listing of scope and objectives. Chapter2 is devoted for review of literature concerning identification and classification of expansive soils followed by works related to stabilization of expansive soils by different techniques. Chapter 3 deals with the materials used, details for series of tests conducted and testing procedure adopted in this investigation. The results pertaining to effect of as well as fly ash and copper slag on strength and deformation characteristics are presented and discussed in chapter 4.optimum fly ash and copper slag is obtained from these results were also presented in chapter 4.chapter 5 present the results pertaining to determination of optimum fly ash and optimum percentage of copper slag .All the test results are analysed to

ISSN: 2278-4632
Vol-10 Issue-6 No. 7 June 2020

study the effect liquid limit and coarse fraction on strength and deformation characteristics .Based on the results presented in this investigations , the following conclusions are drawn.

i) The maximum optimum moisture content of 18% is obtained for 4% replacement of fly ash.

ii) The minimum optimum moisture content of 14% is obtained for 10% replacement of fly ash.

iii) The minimum dry density of 15.9 KN/m3 is obtained by 4% replacement of fly ash. considering the maximum dry density.

iv) The maximum dry density of 16.2 KN/m3 is obtained by 10% replacement of fly ash.

v) The maximum CBR value at soaked condition is obtained 2.85 at 2 % replacement of fly ash and minimum CBR value at soaked condition is obtained 2.08 at 10% replacement of fly ash.

vi) The maximum CBR value at un-soaked condition is obtained 3.14 at 4% replacement of fly ash and minimum CBR value at un-soaked condition is obtained 2.35 at 10 % replacement of fly ash.

vii) The maximum optimum moisture content of 16% is obtained for 10% replacement of copper slag.

viii) The minimum optimum moisture content of 14% is obtained for 8% replacement of copper salg.

ix) The minimum dry density of 19.2 KN/m3 is obtained by 2% replacement of copper slag. considering the maximum dry density.

x) The maximum dry density of 20.3 KN/m3 is obtained by 6% replacement of copper slag.

xi) The maximum CBR value at soaked condition is obtained 3.9 at 8% replacement of copper slag and minimum CBR value at soaked condition is obtained 3.6 at 2% replacement of copper slag.

xii) The maximum CBR value at un-soaked condition is obtained 3.96 at 8% replacement of copper slag and minimum CBR value at un-soaked condition is obtained 3.8 at 10 % replacement of copper slag.

xiii) Further tests has to be studied to obtain good knowledge on this subject.

5. REFERENCES

1. Mandeepsingh, anupammittal. March 2014 ‘a review on the soil stabilization with waste materials’

ISSN: 2278-4632
Vol-10 Issue-6 No. 7 June 2020

2. M. K. Rahman, s. Rehman& o. S. B. Al-amoudiApril 2011, 'literature review on cement kiln dust usage in soil and waste stabilization and experimental investigation'
3. Dr d dhiggins September 2005 'soil stabilisation with ground granulated blastfurnace slag'
4. Thomas l. Brandon, jonathan j. Brown, w. Lee daniels, thomas l. Defazio, George m. Filz, james k. Mitchell (23 February 2004),
5. Jared musselman and clintonforsha (15 5.January 2009). 'Rapid stabilization polymerization of wet clay soils'
6. Dr. Robert M. Brooks December 2009 'soil stabilization with fly ash and rice husk ash'
7. Christopher M. Geiman, May, 2005. 'Stabilization of soft clay sub grades in Virginia Phase I laboratory study'
8. Susan rafalko, November 27, 2006. 'Rapid soil stabilization of soft clay soils for contingency airfields'.
9. Baykal, G. and Doven, A. G, (2000), Resources, Conservation & Recycling 30 59-77.
10. E. Cokca, Z. Yilmaz**Use of rubber and bentonite added fly ash as a liner material** Waste Manag., 24 (2) (2004), pp. 153-164

