



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 4, April 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com



Soil Stabilization by Using Alum Sludge

Sagar Vetal ¹, Prasad Chavan ², Vishvjeet Patil ³, Rutvik Basagare ⁴, Umesh Dhotre ⁵.

U.G. Student, Department of Civil Engineering, Adarsh Institute of Technology and Research Center, Vita, India^{1,2,3,4}

Professor, Department of Civil Engineering, Adarsh Institute of Technology and Research Center, Vita, India⁵

ABSTRACT: The soil stabilization is essential requirement before road infrastructure development is carried out. No. of binding materials are used world wide as a soil stabilizer. In this project waste material [i.e Alum Sludge] was used as soil stabilizer. Alum sludge can solve the problem of waste management at large scale as well as work as low cost soil stabilizer. Use of alum sludge can be a sustainable solution and environmental friendly. The alum sludge was applied as a binding material similar as a cement and lime. To stabilize the soil with the addition of 5%,10%,15%, 20%, and 25% etc. To investigate the resulting improvement in soil strength by using California Bearing Ratio [CBR] particle size analysis atterberg's limit test and modified proctor test with addition of 5%, 10%, 15%,20%, 25%. of alum sludge to soil sample after inspection of result. From the experimental result i.e. CBR , at 15% alum sludge replacement shows greater strength.

KEYWORDS: Alum, sludge, soil, stabilization, Testing

I. INTRODUCTION

The process of stabilization of soil is used to maintaining and increasing the soil stability and chemical modification of soil to increase their engineering properties by mixing waste material with soil to develop certain strength. The main aim of stabilization of soil is improve soil mass strength and also increasing resistance to reducing by water to bonding the soil particle.

Transportation is essential for the working of various economical action for any country. The development and total life of highway is usually depend upon the highway design and construction method. When road construction site comes under black cotton soil it possess high shrinkage and swelling while road construction on this type of soil for safe road construction it is essential to improve property of soil by using some techniques or soil stabilization. The improvement of soil can be used to help large heap of sub-grade materials from black cotton soil to coarse material.

By using alum sludge the stabilization of soil carried out in this project this waste products are decreate product and there are lots of disposal problems in whole world hence, increasing the rate of utilizing the alum sludge effectively for the construction purpose and decrease disposal problem and reduce environmental hazardous by using alum sludge in 5%,10%,15%,20% and 25% etc.

II. AIM & OBJECTIVES

- To study the engineering properties or index properties, compaction properties and CBR of expensive soil mixing with various percentage of alum sludge to find out the optimum percentage dosage comparing with natural expensive soil.
- To develop the rational approaches for use of alum sludge for geotechnical purposes. Hence, increasing the rate of utilizing the alum sludge effectively for the construction purpose and to reduce disposal problem and minimize the environmental hazards.

III. METHODOLOGY

The methodology includes the basic test like sieve analysis test for grain size distribution specific gravity engineering properties test like Atterberg limit compaction and CBR for untreated soil sample with addition alum sludge waste which are conducted as per procedure given in IS code the study is to investigate variation in the soil properties by adding the alum sludge in soil sample at 5%, 10%, 15%, 20%, 25% etc weight of soil sample and conducting various



test to find out optimum percentage of dosage of alum sludge which give maximum strength.

1) **The Stepwise Plan Comprise:**

- Step1: Soil Sample Collection
- Step2: Soil Stabilizer (Alum Sludge) Addition
- Step3: Atterberg Limit Tests
- Step4: Compaction Test
- Step5: California Bearing Ratio (CBR) Test

Sample Collection

Soil taken for inspection is black cotton soil. The soil sample taken from Wagholi (Pune, Maharashtra) and its properties verified by using AASHTO and USCS standard.

Soil Stabilization (alum sludge) Addition

Alum sludge was added in the soil sample to achieve the better strength of soil. Alum sludge is waste material produced by water treatment plant. Alum sludge are grey- colour, which is exit in slurry from, and use in crushed and dry from. The sample are prepared with different percentage, i.e, 5%, 10%, 15%, 20% and 25%.

Atterberg limit test

Atterberg limit tests establish the moisture content at which fine-grade clay and silt soil transition between solid, semi-solid, plastic and liquid states. Basic test of atterberg limit test include plastic limit, liquid limit and shrinkage limit

Compaction test

A compaction test is used to determine the optimum water content at which a soil can be compacted so as to yield the maximum density (dry unit weight). There are two different methods to obtaining the maximum density that are standard proctor and modified proctor test. Modified proctor is most commonly used for small dams, the standard proctor may still be the reference. Compaction test will be increased the dry density of soil, along with these it increases bearing ability.

California Bearing Ratio

The california bearing ratio test is penetration test meant for the evaluation of subgrade strength of roads and pavements. The results obtained by these tests are used with the empirical curves to determine the thickness of pavement and its component layers. This is the most widelyused method for the design of flexible pavement.

Properties of the soil	Black Cotton soil
Colour	Black
Specific Gravity	2.17
Grains Sizes Distribution	Well graded
Atterberg's Limit	
Liquid Limit in(%)	27.28
Plastic limit in(%)	36.11
Plasticity Index in (%)	38.54
Compaction Characteristics.	
Maximum Dry Density (g/cc)	1.56
Optimum Moisture Content (%)	18
CBR value in (%)	4.76

Table 1. Physical properties of used Black cotton soil



|| Volume 12, Issue 4, April 2023 ||

| DOI:10.15680/IJIRSET.2023.1204288 |

Properties of the soil	Alum sludge
Color	Black
Specific Gravity	2.57
Grain Size Distribution: Coefficient of Uniformity (Cu) Coefficient of Curvature (Cc)	3.053 1.88
Compaction Properties: OMC (%) MDD (g/cc)	22 1.45

Table 2. Physical Properties Of Used Alum Sludge

IV. EXPERIMENTAL RESULTS

OMC (Optimum moisture content)	MDD (maximum dry density)
15	1.22
18	1.56
20	1.01

Table 3. Compaction Test On Black Cotton Soil



Fig1. Compaction Test On Black Cotton Soil

OMC	MDD
17	1.29
18	1.17
19	1.32
20	1.42
22	1.45
24	1.4
26	1.33
28	1.29

Table 4. Compaction Test On Black Cotton Soil With % Of Alum Sludge

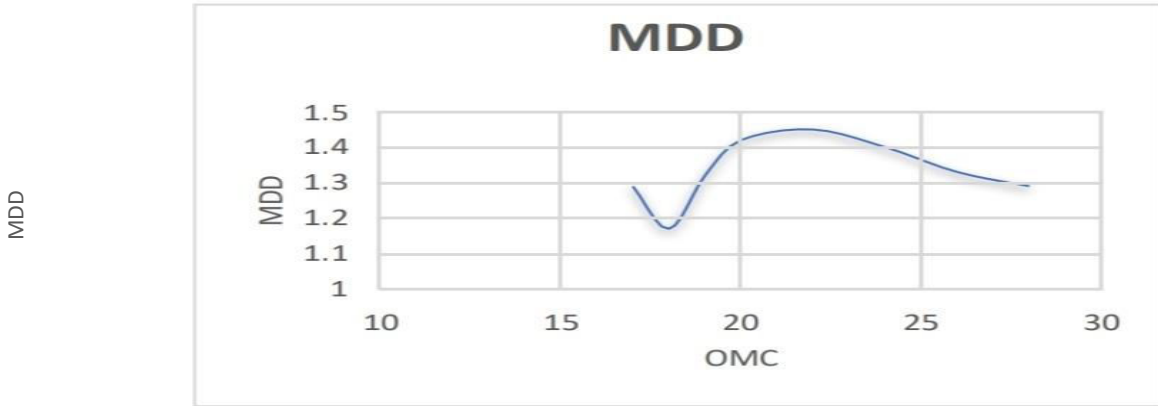


Fig 2. Compaction Test On Black Cotton Soil With Different % Of Alum Sludge.

% Of Alum Sludge	OMC
5%	20%
10%	20%
15%	22%
20%	22%
25%	22%

Table 5. Compaction Test On Black Cotton Soil With Different % Of Alum Sludge

SOIL WITH ADDITIVES	CBR VALUE
SOIL+5% AS	3.279
SOIL +10% AS	3.923
SOIL + 15% AS	4.772
SOIL +20% AS	4.178
SOIL +25% AS	3.347

Table 6. CBR Test On Black Cotton Soil With % Alum Sludge

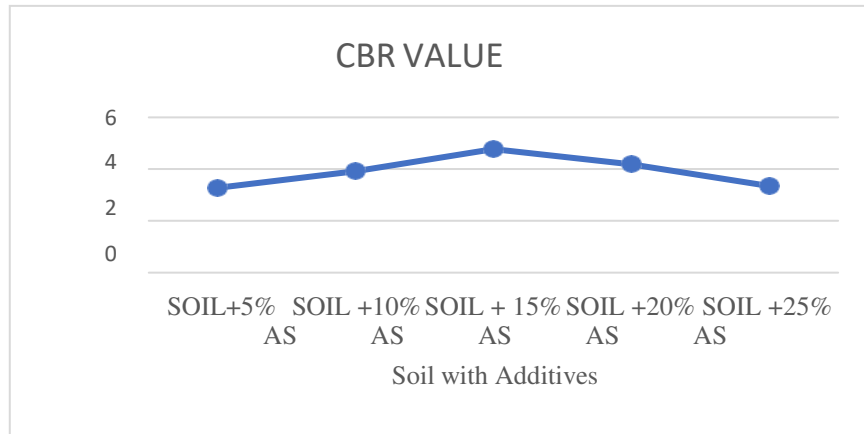


Fig 3. CBR Test On Black Cotton Soil With% Of AlumSludge.

V. CONCLUSION

- There is increase in MDD at 22% addition of water by weight of soil for the 15% replacement of alum sludge.
- CBR of the soil obtained as greater value 4.772 % for the 15% of replacement of alum sludge compare to other variation i.e 5%,10%,15%,20%,25%.
- From the above Experimental investigation, can be concluded that the addition of Alum Sludge (optimum replacement of alum sludge 15%) in Black cotton soil decreases the swelling behavior, shrinkage limits, increases the MDD of soil, decreases plasticity index, increases the Plastic-limit,and improves soil CBR value.

REFERENCES

1. Brooks R. M. "Soil Stabilization with Fly Ash and Rice Husk Ash" International Journal of Research and Reviews in Applied Sciences, vol.1, no. 3, pp.209-217, 2009.
2. Rifa'i, A.; Yasufuku, N.; Tsuji, K. Characterization and effective utilization of coal ash as soil stabilization on road application. In Proceedings of the International Symposium on Ground Improvement Technologies and Case Histories, ISGI'09, Singapore, 9–12 December 2009.
3. Ayyappan S., Hemalatha, M.K. and Sundaram M., "Investigation of Engineering Behaviour of Soil, Polypropylene Fibres and Fly Ash- Mixtures for Road Construction", International Journal of Environmental Science and Development, vol.1, no.2, pp.171, 2010.
4. Anas Ashraf et.al, "Soil stabilization by using raw plastic bottles" Proceedings of Indian Geotechnical Conference", December 15- 17,2011, Kochi (Paper No.H3.)
5. Saravanan R., Thomas, R.S. and Joseph, M., "A Study on Soil Stabilization of Clay Soil using Fly Ash. "International Journal Research. Civil Engineering Architecture Design, vol. 1, pp.33-37,2013.
6. Kawade U. R., V. R. Rathi, and Vaishali D. Girge. "Effect of Use of Bagasse Ash on Strength of Concrete." International Journal of Innovative Research in Science, Engineering and Technology vol.2, no. 7, pp. 2997-3000, 2013.
7. Owaid, H.M.; Hamid, R.; Taha, M. Influence of thermally activated alum sludge ash on the engineering properties of multiple-blended binders concretes. Constr. Mater. 2014, 61, 216– 229.
8. Brajesh Mishra (2015) "A study on Engineering behaviour of black cotton soil and its stabilization by use of lime", International journal of science and research. Volume no : 4,issue no : 11, page no : 290-294
9. Jasmin Varghese Kalliyath, et.al. "Soil stabilization using plastic fibers" Int.J. of Science Technology and Engineering, Vol.2, Issue: 12, 2016
10. Mosa, A.M.; Taher, A.H.; Al-Jaberi, L.A. Improvement of poor subgrade soils using cement kiln dust. Case Stud. Constr. Mater. 2017, 7, 138–143.
11. Rajeswari, K.; Naidu, C.D.; Rao, K.B.; Kumari, G.H. Study of soil stabilization on subgrade using bagasse ash and phosphogypsum. Int. J. Technol. Res. Eng. 2018, 5, 3133–3142.
12. Subhash, K. et.al. "Stabilization of black cotton soil using glass and plastic granules" Int. J. of Engineering Research and Technology, Vol.5, Issue: 4, pp, 480 483.,2016.



INNO SPACE
SJIF Scientific Journal Impact Factor
Impact Factor: 8.423



ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

9940 572 462 **6381 907 438** **ijirset@gmail.com**



www.ijirset.com

Scan to save the contact details