iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** V **Month of publication:** May 2022

DOI: https://doi.org/10.22214/ijraset.2022.42240

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue V May 2022- Available at www.ijraset.com

Experimental Investigation of Soil Stabilization by Using Alum Sludge

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Abstract: ***The soil stabilization is essential requirement before road infrastructure development is carried out. No. of binding materials are used worldwide 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 develope 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 descrate 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

1) 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.
2) 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.

The Stepwise Plan Comprise:

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

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A. 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.

B. 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%.

C. 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

D. 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.

E. 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 widely used method for the design of flexible pavement.

Table 1. Physical properties of used Black cotton soil

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

Table 2. Physical Properties Of Used Alum Sludge

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

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IV. TEST AND RESULT ANALYSIS

Table 3. Compaction Test On Black Cotton Soil

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

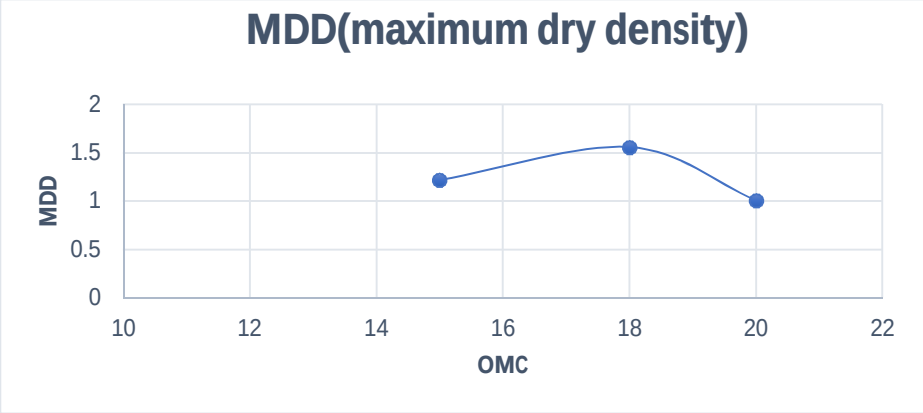


Fig1. Compaction Test On Black Cotton Soil

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

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

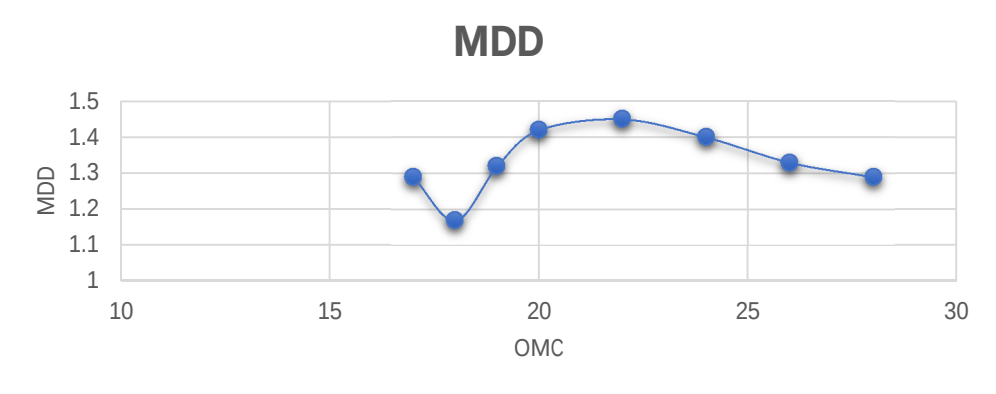


Fig 2. Compaction Test On Black Cotton Soil With Different % Of Alum Sludge.

Table 5. 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 6. CBR Test On Black Cotton Soil With % 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

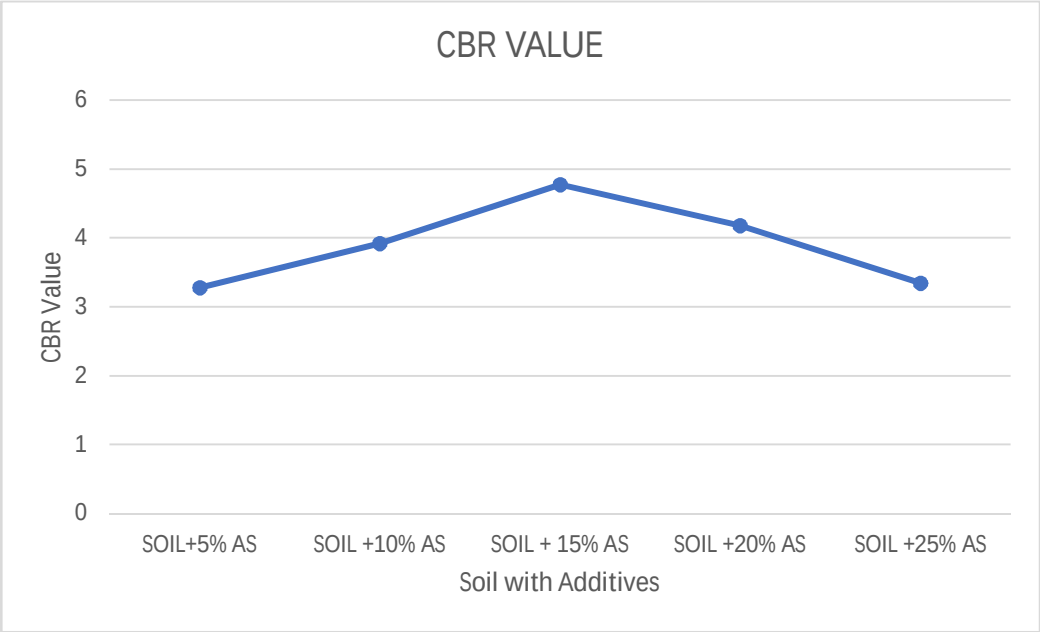


Fig 3. CBR Test On Black Cotton Soil With% Of Alum Sludge.

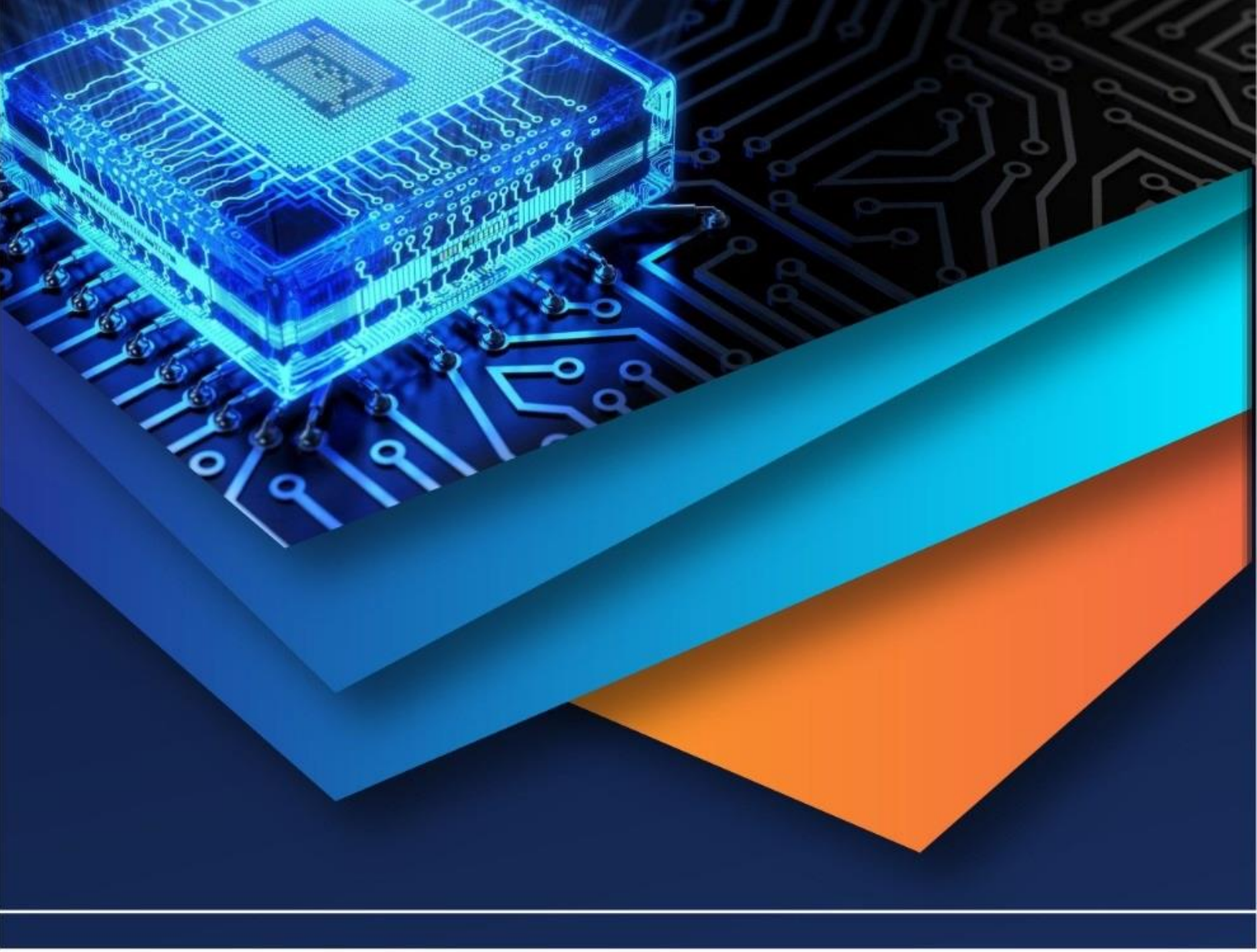
V. RESULT & CONLUSION

1) There is increase in MDD at 22% addition of water by weight of soil for the 15% replacement of alum sludge.
2) 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%.
3) 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.

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