Stabilization of Sediment Soil by Alccofine and Geogrid

Mrs. Shimna Manoharan[1], Shashinaga C[2], Pradeepa U[3] and Pavana Kumara P R[4]
[1]Assistant Professor, Department of Civil Engineering, BMS Institute of Technology and Management, Avalahalli, Yelahanka, Bengaluru, Karnataka – 560064
[2,3,4] Undergraduate Students, Department of Civil Engineering, BMS Institute of Technology and Management, Avalahalli, Yelahanka, Bengaluru, Karnataka – 560064

Abstract. The main objective of this work is to study the engineering characteristics of sediment soil. The sediment soil having poor CBR value and is porous and loamy in nature. This property of sediment soil poses problems worldwide that serves as challenge to overcome, for the Geotechnical engineers. The aim of this project is to stabilize the sediment soil using different percentages of the stabilizer i.e. Alccofine 1108SR and to check for which percentage of the stabilizer added will be the maximum strength gained with the aid of Geo-grid (Biaxial type geogrid) as reinforcement and also to improve the overall engineering properties of the sediment soil. The results will be then compared with the standard ratio of soil without any stabilizing agent and reinforcement.

Keywords: Alccofine · Biaxial Geogrid ,Sediment soil ,Unconfined compression strength

1 Introduction

Soil is a mixture of organic matter, minerals, gases, liquids and organisms that support life. Soil is the relatively loose mass of mineral and organic materials and sediments found above the bedrock, which can be relatively easily broken down into its constituent mineral or organic particles. Soil consists of a solid phase of minerals and organic matter as well as porous phase that holds gases and the water. Accordingly, soils are often treated as a three-state system of solids, liquid and gases. For any type of construction, the priority is given to stabilize the soil as the initial step of construction, so that the soil has to bear the effective load coming over that structure. There are many types of stabilization process such as mechanical stabilization, Chemical stabilization, Cement stabilization, Resin stabilization etc.

2 Materials and Methodology

Alccofine 1108SR - Alccofine is a new generation, micro fine material of particle size much finer than other hydraulic materials like cement, fly ash, silica etc. being manufactured in India. It is produced in special equipment to achieve particle distribution in a well-designed range. Alccofine 1108SR has an average particle size of 4-5 microns. The computed Blaine value is around 8000 cm^2/gm. Its specific gravity is about 3.

Biaxial Geogrid - A geogrid is geosynthetic material used to reinforce soils and similar materials. Geogrids are commonly used to reinforce retaining walls, as well as subbases or subsoils below roads or structures. Soils pull apart under tension. Compared to soil, geogrids are strong in tension. This fact allows them to transfer forces to a larger area of soil than would otherwise be the case. In this experimental study, Geogrid made of plastic material is used whose aperture size is 15mm and thickness of about 1.5mm. The geogrid type used is Biaxial. The reason for choosing this type of Biaxialgeogrid is that, it is stretched along two directions (longitudinal and transverse), thus the stress is equally distributed along both directions whereas uniaxial is stretched along longitudinal direction. In biaxial geogrids, the longitudinal direction is called as machine direction and transverse direction is called as cross machine direction.

2.1 Materials

Table 1. Properties of Geo grid

Sl No	Properties	Results
1	Material of geogrid	Plastic
2	Type of geogrid	Biaxial type
3	Aperture size	15mm
4	Thickness of geogrid	1.5mm

Properties of Alccofine 1108SR.

The Alccofine 1108SR are been tested for knowing some of the standard value of some of the basic properties. This helps us to know the standard of material used in the stabilization process of the soil, in this experimental study.

Table 2. Properties of Alccofine 1108SR

Sl No	Properties	Results
1	Specific Gravity	2.94
2	Blaine's permeability value	8068.65cm^2/g
3	Normal consistency value	36%
4	Compression strength	33.6N/mm^2

Properties of Soil.

The sediment soil for this experimental study is collected from Gantiganahalli lake, near Yelahanka, Bangalore. This soil is been tested to determine the various basic properties of the soil such as natural water content, specific gravity plasticity index, swell index etc. All the tests have been conducted as per Indian Standard codes. The results of the basic tests have been tabulated below.

Table 3. Properties of Soil

Sl No	Particulars	Results
1	Natural water content	10.79%
2	Specific gravity of soil	2.56
3	Liquid limit: Casagrande method	30.89%
4	Plastic limit	22.22%
5	Plasticity Index	10.06%
6	Free Swell Index	20%

Table 4. Soil classification based on Free Swell Ratio (FSR)

Free Swell ratio	**Clay type**	**Degree of expansion**	**Dominant clay mineral type**
≤1.0	Non swelling	Negligible	Kaolinitic
1.0-1.5	Mixture of non-swelling and swelling	Low	Mixture of Kaolinitic and Montmo-rillonitic
1.5-2.0	Swelling	Moderate	Montmorillonitic
2.0-4.0	Swelling	High	Montmorillonitic
>4.0	Swelling	Very high	Montmorillonitic

2.2 Standard Proctor Test

The soil is compacted under Standard proctor test according to the reference code IS 2720: Part 7: 1980. The standard proctor test is done for the soil without adding any stabilizer i.e. Alccofine 1108SR and also by adding various percentages of Alccofine as stabilizing agent to determine the OMC and Maximum dry density of the sample. Samples have been tested for Standard proctor test with and without addition of Alc-cofine. The results are computed as follows:

Table 5. Standard Proctor Test

Sl No	**Particulars**	**OMC (%)**	**MDD (g/cc)**
1	Soil	13	1.89
2	Soil + 1%Alccofine	16	1.83
3	Soil + 2.5%Alccofine	15	1.89
4	Soil + 5%Alccofine	15	1.92
5	Soil + 7.5%Alccofine	13	1.86
6	Soil + 10%Alccofine	14	1.96

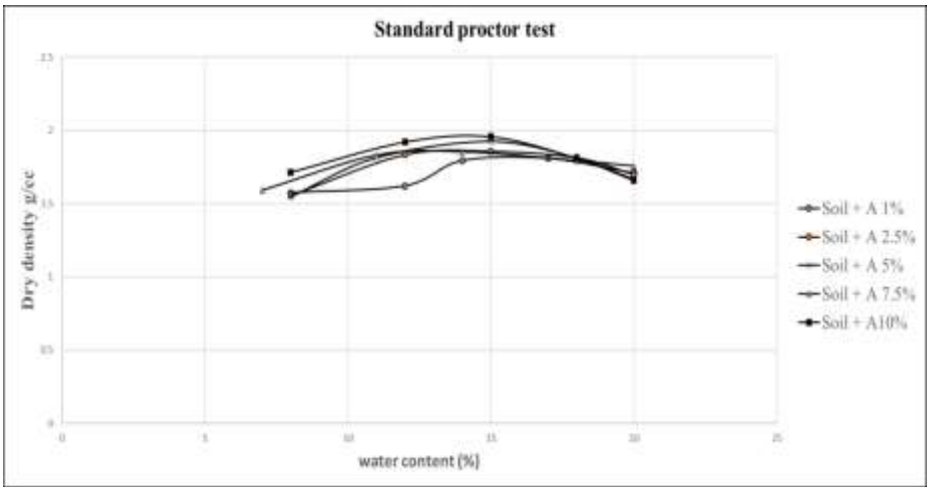

Fig. 1. Compaction curves obtained for various percentages of Alccofine addition

2.3 Unconfined compression test (UCCT)

Unconfined compression test (UCCT) is conducted on samples consisting of soil with various percentages of Alccofine as stabilizer and Geogrid used as reinforcement placed at $1/4^{th}$,1/2th and $1/4^{th}$ height from the bottom of the specimen, with curing and also without curing. The curing method adopted in this experimental study is Air dry method of curing. It is found that the unconfined compressive strength of the soil is will be increased with the addition of Alccofine. The geogrid is placed at various heights and tested for UCCT.Then the sample having combination of Alccofine and geogrid is tested for unconfined compression strength.

It is found that the maximum compression strength is found in the sample which is having 7.5% Alccofine, and for the sample which has geogrid at its central position i.e. geogrid is placed at 1/2th height from the bottom of the sample, under uncured condition.

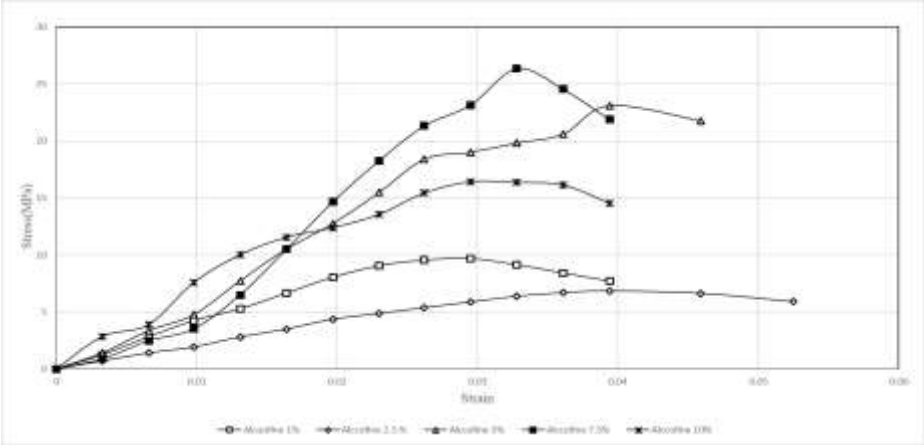

Fig. 2. Unconfined compressiontest (UCCT) of soil having various percentages of Alccofine, without curing

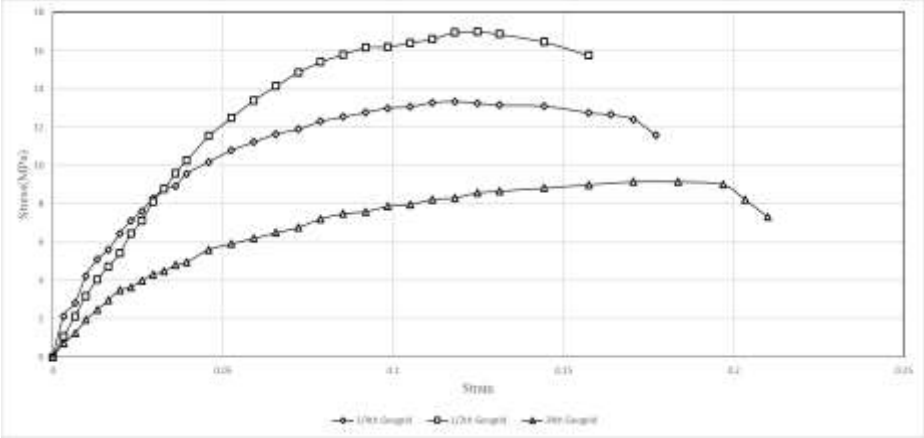

Fig. 3. UCCT test of soil reinforced with Geogrid placed at various heights (uncured)\

But, after the curing of sample by air dry method for 7 days, when the UCCT is done for the samples, the maximum compression strength is found in the samples which has 10% Alccofine and for the geogrid reinforced sample, the maximum UCS is maximum in the sample where geogrid is placed at 1/2th height from the bottom of the sample.

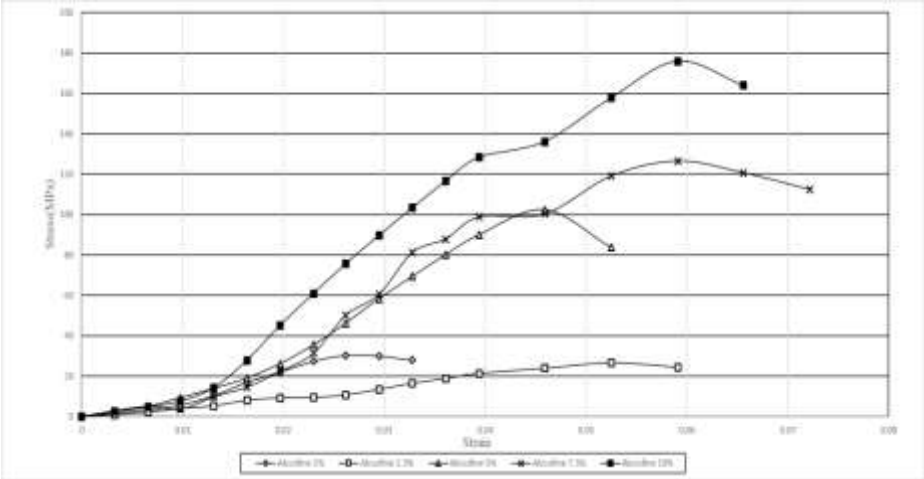

Fig. 4. UCCT test of soilhaving various percentages of Alccofine, with curing

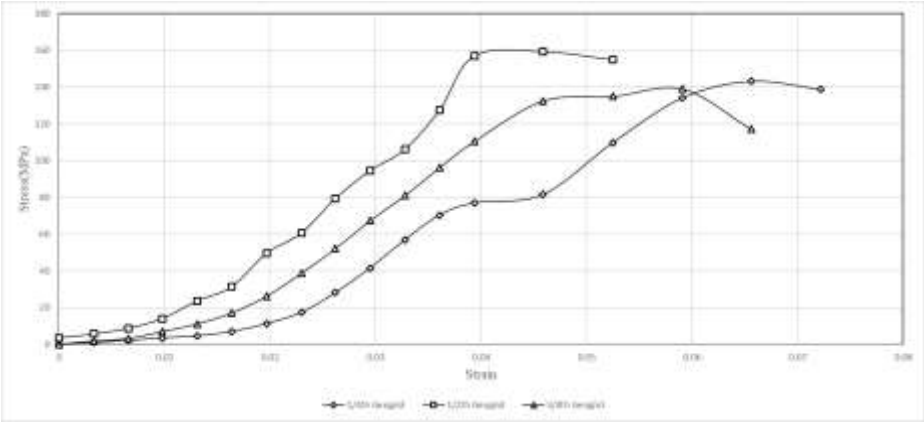

Fig. 5. UCCT test of soil reinforced with Geogrid placed at various heights (air-dried)

Samples with combination of 7.5% Alccofine and geogrid placed at $1/4^{th}$,$1/2^{th}$ and $3/4^{th}$ height from the bottom of the specimen and samples with 10% Alccofine and geogrid placed at $1/4^{th}$,$1/2^{th}$ and $3/4^{th}$ height from the bottom of the specimen. This combination is selected because of the reason that the maximum UCS is found for the sample with 7.5% Alccofine under uncured sample and for the sample with 10% Alccofine under cured condition for 7days. Even though the maximum UCS is found in the sample which is reinforced with geogrid placed at $1/2^{th}$ height form the bottom of the specimen, it is tested for all the heights again because of the reason that Alccofine being cementitious material, its not possible to predict how it reacts when it is used in combination with geogrid. We conclude this as the specimen became brittle after

7days of air dry, it is difficult to predict that how the reinforcement will be reacting on such sample.

Under these combinations, the maximum UCS is found in the samples having 7.5% Alccofine and geogrid placed at 1/2th height from the bottom of the specimen, for uncured samples and in the samples having 10% Alccofine and geogrid placed at 1/2th height from the bottom of the specimen, after air dried for 7days.

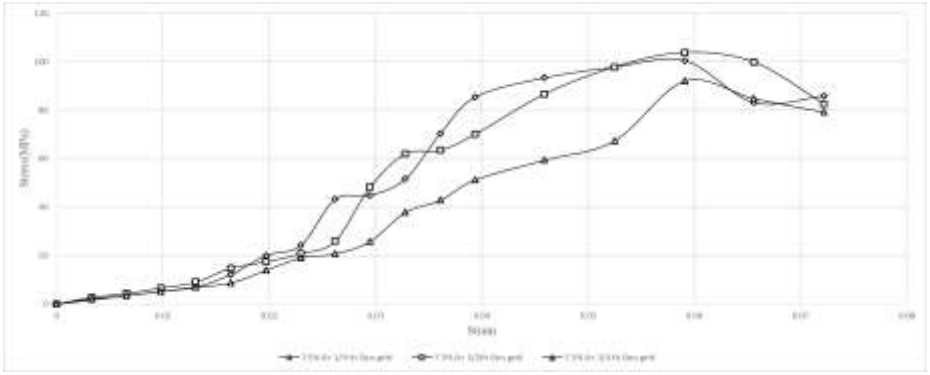

Fig. 6. UCCT test of soil having 7.5% Alccofine and geogrid placed at various heights from the the bottom of the specimen, without curing

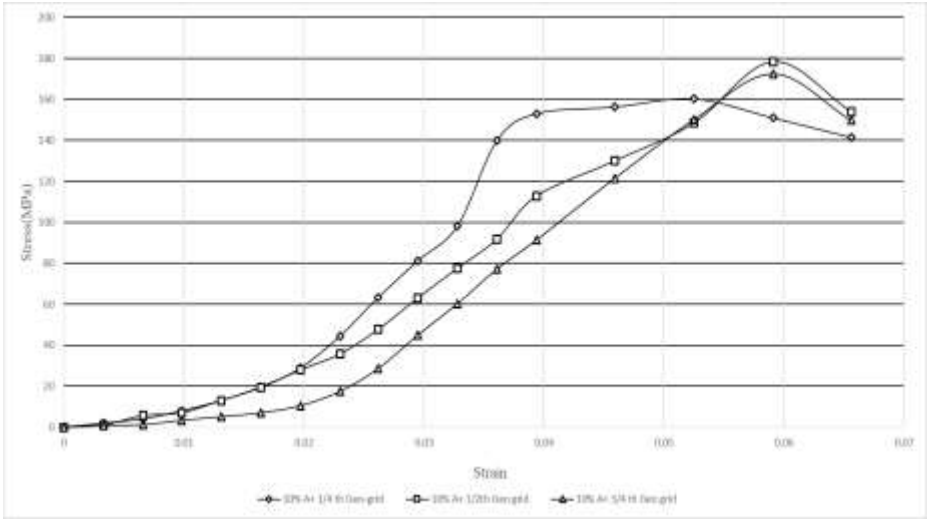

Fig. 7. UCCT test of soil having 10% Alccofine and geogrid placed at various heights from the bottom of the specimen, with curing (air-dried)

3 CONCLUSIONS

- The Plasticity index of the soil is determined as 10.06%. Hence, the soil comes under slightly plastic category.
- The Free swell index of the soil is about 20% and Free swell ratio (FSR) is 1.2. As per the soil classification based on FSR, it can be concluded that the dominant clay mineral type present in the soil is a mixture of Kaolinite and Montmorillonite. Hence, the soil has a mixture of swelling and non-swelling clay type.
- The OMC of the soil samples even after adding various percentages of Alccofine, has been within the range of 13-15%, which is nearer to the OMC of raw soil determined.
- The Unconfined compression strength is found maximum for the sample having 7.5% Alccofine and for the sample which is reinforced with geogrid which is placed at the centre of the specimen, under uncured condition.
- The Unconfined compression strength is found maximum for the sample having 10% Alccofine and for the sample which is reinforced with geogrid which is placed at the centre of the specimen, under cured condition i.e. sample cured for 7 days by air dry method.
- When the Alccofine and Geogrid used in combination, the maximum UCS is found for the sample which has 7.5% Alccofine and geogrid placed at centre of the specimen, for uncured sample, whereas for cured sample, the maximum UCS is found for the sample which has 10% Alccofine and geogrid placed at centre of the specimen.

4 REFERENCES

1. Lovedeep Singh Sambyal, Neeraj Sharma "Utilizing Fly Ash and Alccofine for Efficient Soil Stabilization" International Journal of Scientific & Engineering Research Volume 9, Issue 3, March-2018.
2. Sachin Dev, Er., Neeraj Sharma "Stabilization of Expansive soil with Marble dust and Alccofine" International journal of Advance Research in Science and Engineering, 2017.
3. Amit Talgotra, Er., Neeraj Sharma, "Stabilization of clayey soil with Cement kiln dust and Alccofine 1101" International Journal of Advance Research in Science and Engineering, 2017
4. Sujit Kawade, Mahendra Mapari, Mr Shreedhar Sharanappa "Stabilization of Black cotton soil with Lime and Geo-grid" International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163 Volume 1 Issue 5, June 2014.
5. Mohammed Abbas Al-Jumaili, Hamid A. Al-Jameel, "Reinforcement of poor sandy subgrade soil with Geogrid" Al-Qadisiyah journal for Engineering Sciences, Volume 9, Number 3, April 2016

6. Olaniyan, O.S, Akolade, A.S "Reinforcement of Subgrade Soils with the Use of Geogrids" International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Impact Factor (2012): 3.358.