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Performance Evaluation of BC Soil by using Alccofine as an Additive

Kiran Kumar M S¹, Harish K S², Ragavendra Naik M D³, Ramesha M⁴

^{1, 2, 3, 4} Assistant Professor, Civil Engineering Department, Jain Institute of Technology, Davangere, Karnataka State, India

Abstract: Soil stabilization is the alteration of one or more soil properties to create an improved soil material possessing the desired engineering properties. In day to day soil stabilization is the major problem for civil engineers, either for construction of road and also for increasing the strength or stability of soil and reduces the construction cost. From our experimental study it can be concluded that usage of alccofine will gradually improves the various soil properties and promising one of the good stabilising agent.

Keywords: Soil stabilisation, alccofine, CBR, BC soil.

I. INTRODUCTION

Soil stabilization is the alteration of one or more soil properties to create an improved soil material possessing the desired engineering properties. Stabilization is a broad sense for the various methods employed and modifying the properties of a soil to improve its engineering performance and used for a variety of engineering works. In day to day soil stabilization is the major problem for civil engineers, either for construction of road and also for increasing the strength or stability of soil and reduces the construction cost. Soils stabilized with industrial waste materials have been extensively tested and do not have any adverse environmental impact and consequences. The necessity of improving the engineering properties of soil has been recognized for as long as construction has existed.

A. Black Cotton Soil

In Civil Engineering aspect this soils are giving hazardous problems to Engineering. With the rapid development in soil improvement procedure, various structures construction is taking place. Though various techniques are utilized, the cracking (Minor cracking) is seen in buildings. BCS is igneous rock (basalt) formed by rapid cooling of basaltic lava. Black color of BCS is due to titanium oxide present in small concentration. It is inorganic clay of medium to high compressibility with high shrinkage and swelling properties, very hard when dry but lose its strength completely in wet condition. Black cotton soils are one of the most prevalent causes of damages to buildings and construction. This in turn can be immense loss to a nation's economy.

1) Engineering Problems with BC soil

- In rainy season, these soils become very soft by filling up of water in crack.
- In saturated conditions, this soil has consolidation settlements.
- These soils have high swelling nature. Due to this structure causes damage.
- When lands are applied on these soils in wet conditions. These soils get shrinkage.

B. Alccofine

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. Alccofine has unique characteristics to enhance 'performance of concrete' in fresh and hardened stages due to its optimized particle size distribution. It can be used as practical substitute for Silica Fume as it has optimum particle size distribution not too coarse, not too finer either per the results obtained by Counto Micro\ fine products Pvt. Ltd (A joint venture with ambuja cement ltd and alcon developers).

It is manufactured in the controlled conditions with special equipment's to produce optimized particle size distribution which is its unique property. Alccofine 1203 and Alccofine 1101 are two types of Alccofine with low calcium silicate and high calcium silicate respectively. Alccofine 1200 series is of 1201, 1202, 1203 which represents fine, micro fine, ultrafine particle size respectively. Alccofine 1203 is slag based SCM having ultra-fineness with optimized particle size distribution whereas Alccofine 1101 is a micro finer. Cementations grouting material for soil stabilization and rock anchoring. The performance of alccofine is superior to all the other admixtures used in India due to high Calcium oxide (Cao) content

- 1) *Types of Alccofine*
 - a) Scm Alccofine-1203 (Used for cement)
 - b) Grouting Alccofine-1101 (Used for soil)
- 2) *Applications - Alccofine 1101 Micro fine Cement-Grout*
 - a) It is used in Tunnels, caverns, mines, etc. as Rock injection
 - b) It can be used for pre and post excavation injection.
 - c) It can also be used for soil stabilization and sealing of ground water
 - d) Soil injection
 - e) Pre packed injection
 - f) Contact injection

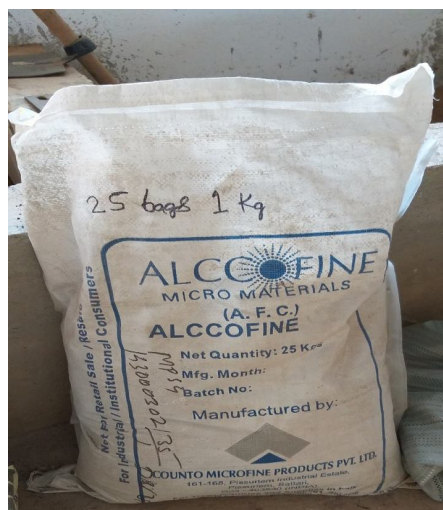


Fig1. Alccofine

II. OBJECTIVES

Based on the literature review the following objectives are derived:

- A. To study the properties of black cotton soil and soil stabilized with Alccofine with different varying percentage (5%, 10%, and 15%)
- B. Effect of Alccofine on strength parameter of Black cotton soil.
- C. To determine optimum percentage of Alccofine incorporated with black cotton soil of varying percentage.

III. METHODOLOGY

A. Addition of Alccofine in Percentage

Alccofine of Varying Percentages Such As 5%, 10%, and 15%, Were Added to Black Cotton Soil in dry condition and various tests are conducted in laboratory. The combinations & coding are given below in table 1

Table 1: Showing Soil Samples

Sl.No	Soil particulars	Percentage of Alccofine added
1	Natural B C Soil	Natural BC Soil+0% Alccofine
2	Soil sample-1	Natural BC Soil+5% Alccofine
3	Soil sample-2	Natural BC Soil+10% Alccofine
4	Soil sample-3	Natural BC Soil+15% Alccofine

IV. EXPERIMENTAL RESULTS

A. Basic Tests on BC Soil

The following test results shown in table 2 are obtained testing BC soil in laboratory.

Table 2: Tests on BC soil

SL.No	TESTS CONDUCTED	RESULTS
1	Specific Gravity	2.43
2	Grain Size Analysis	$C_u = 6.66$
		$C_c = 0.70$
3	Liquid Limit (W_L)	27.66
4	Plastic Limit	30
5	Heavy Compaction Test(g/cc)	1.83
6	Water Content (%)	14.47
7	Unconfined Compression Test q_u (kg/cm^2)	36.74
8	CBR Test (%)	3.61

B. Liquid Limit test results

Table 3 gives the liquid limit results. It can be observed from the results, liquid limit is gradually decreasing with addition of Alccofine.

Table 3: Liquid limit test results

Alccofine Added (%)	0	5	10	15
Average Liquid Limit (%)	27.66	24.93	19.05	17.65

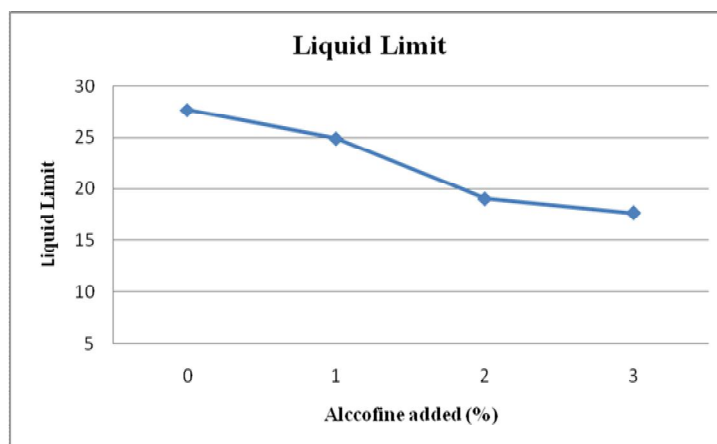


Fig2. Liquid limit results

C. Plastic Limit test results

Table 4 gives the plastic limit results. It can be observed from the results, liquid limit is gradually increasing with addition of Alccofine.

Table 4: Plastic limit test results

Alccofine Added (%)	0	5	10	15
Average Plastic Limit (%)	30	36.2	35.07	33.85

D. Heavy Compaction Test

Table 5 gives the maximum dry density and optimum moisture content results. It can be observed from the results, MDD is gradually increasing with addition of Alccofine, mean while optimum moisture content (OMC) is decreasing.

Table.5. MDD & OMC results

Soil mix	Optimum moisture content %	Maximum dry density(g/cc)
Natural Soil	15.10	1.83
Soil Sample 1	14.8	1.85
Soil Sample 2	14.42	1.9
Soil Sample 3	13.9	1.92

E. Unconfined Compression Test

Table 6 and figure 3 give the unconfined compression test results. It can be observed from the results, compression stress is gradually increasing with addition of Alccofine and getting maximum 54.52 kg/cm².

Table.6. Unconfined compression test for different % of Alccofine mix

Soil Mix	Compression Stress (Kg/Cm ²)
Natural Soil	36.74
Soil Sample 1	38.87
Soil Sample 2	42.35
Soil Sample 3	54.52

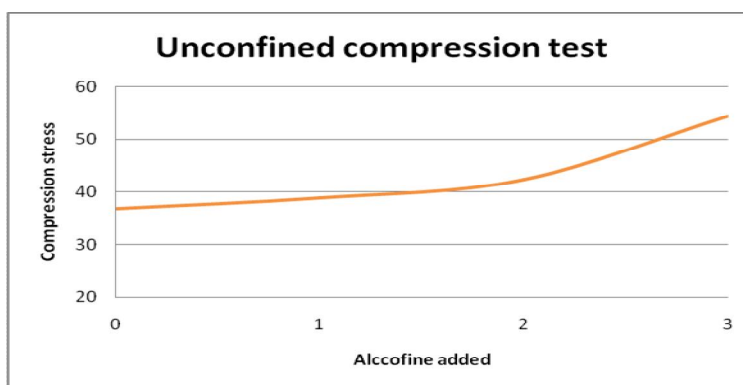


Fig3. Unconfined test results

F. California Bearing Ratio Test

Table 7 and figure 4 give the CBR test results. It can be observed from the results, Penetration is gradually increasing with addition of Alccofine and getting maximum 9.55%.

Table 7: CBR test for different % of Alccofine mix

Soil Mix	Average penetration in %
Natural Soil	3.61
Soil Sample 1	8.56
Soil Sample 2	9.21
Soil Sample 3	9.55

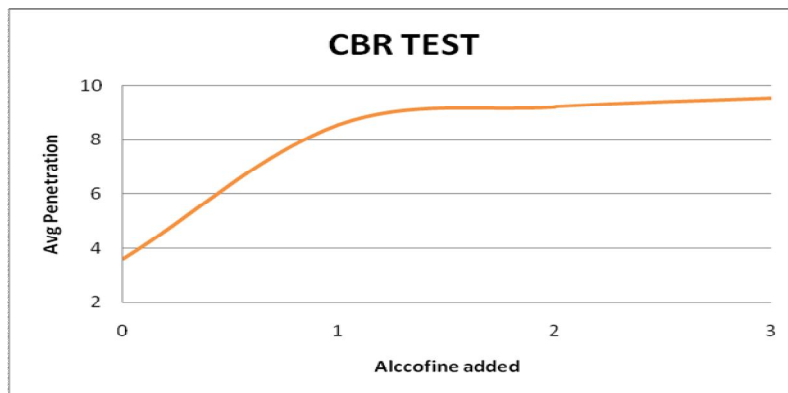


Fig4. CBR test results

V. CONCLUSIONS

- A. It can be concluded that adding of Alccofine with 5%, 10% and 15% will increase the value of BC soil.
- B. The addition of Alccofine to Black cotton soil increases the CBR value 9.55% at 15% of Alccofine mix.
- C. The addition of Alccofine to the Black Cotton soil, the maximum dry density is increases with 1.83 to 1.923 gm/cc at the 15% of Alccofine added.
- D. The addition of Alccofine increases the unconfined compression strength of soil from 36.74 kg/cm² to 54.52 kg/cm² at 15% of Alccofine added.
- E. In regions where black cotton soil is encountered, the construction of buildings and roads is highly risky on geotechnical grounds as the soil is highly compressible, possessing low shear strength and is susceptible for volumetric instability.

Finally from our experimental work, it can be concluded that strength parameters of BC soil improved with increasing of Alccofine.

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