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Research Paper

EFFECT OF GRANITE DUST ON INDEX PROPERTIES OF LIME STABILIZED BLACK COTTON SOIL

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In this study the effect of granite dust on the index properties of Black Cotton Soil stabilized with 5% lime have been presented. Soil samples containing 5% lime and 0%, 10%, 20% and 30% of granite dust was prepared and the liquid limit, plastic limit and differential free swell were conducted as per relevant IS code of practise. The test results showed significance decrease in the expansive behavior of the Black Cotton Soil. The liquid limit and plasticity index decreases from 37% to 28% and 17.45% to 4.80%, respectively if Black Cotton Soil is blended with 5% lime and granite dust from 0% to 30% by weight of Black Cotton Soil. The test results reveal that the expansive behavior of the Black Cotton Soil is checked to a great extent.

Keywords: Black cotton soil, Stabilization, Granite dust, Consistency limits

INTRODUCTION

Soil improvement is of major concern in the construction activities due to rapid growth of urbanization and industrialization. The term soil improvement is used for the techniques which improve the index properties and other engineering characteristic of weak soils. In India expansive soil cover about $0.8x10^6$ km^2 area which is approximately one-fifth of its surface area. These soils contain montmorillonite mineral; due to this they swell and shrink excessively with change of water content. Such tendency of soil is due to the presence of fine clay particles which swell, when they come in contact with water, resulting in alternate swelling and shrinking of soil due to which differential settlement of structure takes place. Expansive soils can be stabilised by the addition of a small percentage of lime and other admixtures. These techniques have been used for many construction purposes, notably in highway, railroad and airport construction to improve subgrades and sub-bases. The Granite dust is a by-product produced in granite factories while cutting huge granite rocks to the desired shapes. About 3000 metric ton of granite dust/ slurry is produced per day as a by-product during manufacturing of granite tiles and slabs from the raw blocks. The marble and granite cutting

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industries are dumping these wastes in nearby pits or open lands. This leads to serious environmental pollution and occupation of vast area of land especially after the slurry dries up. This study envisages the effect of granite dust on the consistency limits and differential free swell (DFS) of Black Cotton Soil mixed with 5% lime and 0 to 30% granite dust by weight of soil.

LITERATURE REVIEW

There are number of studies on the use of industrial waste materials to improve the performance of weak soils.

Ali and Koranne (2011) presented the effect of stone dust and fly ash on characteristics of fly ash. They concluded thatthere is a marked improvement in the properties of expansive soil if stone dust and fly ash is mixed in equal proportions. There is a significant control in the swelling behaviour of the expansive clay.

Cokca (2001) studied the effect of Fly ash on the expansive soil. He found that the plasticity index, activity and swelling potential of the samples decreased with increasing percent stabilizer and curing time and the optimum content of fly ash in decreasing the swell potential was found to be 20%. Also concluded that both high calcium and low calcium class C fly ashes can be recommended as effective stabilizing agents for improvement expansive soils.

Kumar and Prasanna (2012) studied the effect of silica and calcium extracted from rice husk ash on geo technical properties of expansive soils. They concluded that the characteristicsof such soils are improved remarkably.

Similarly many researchers Kumar Sabat (2012), Phanikumar *et al*. (2004), Qian Guoping *et al*. (2011), Osman Sivrikaya (2013), Rezende, *et al*. (2003), Kamon *et al*. (1994), Yorimichi *et al*. (1999) haveinvestigated the use of industrial wastes like fly ash, granite mill tailings, marble dusts, other stone wastes to improve the properties of weak/ expansive soils. They concluded that these industrial wastes can increase the strength and decrease the swelling behaviour of expansive soils if used individually or as an admixture to such soils.

EXPERIMENTAL PROGRAM

The black cotton soil used in the present investigation was collected from Bilheri area of Jabalpur town of Madhya Pradesh state. The properties of Black Cotton Soil are as under:

Fines (-75μ)	= 90%
Specific Gravity	= 2.58
Liquid limit	= 57%
Plasticity Index	= 37.2%
Shrinkage Limit	= 8.1%
Differential Free Swell	= 56.60%

The granite dust was collected from the plant located near the granite quarry near Chhatarpur district of Madhya Pradesh. The grain size distribution of the dust is presented in Table 1. The specific gravity of granite dust was found to be 2.69.

The black cotton soil was blended with 5% lime and soaked for a period of 4 days. After oven drying the lime clay mixture was again mixed with different percentage of granite dust. The mix specification are as under

CL0G0	Clay with 0% lime and 0% granite dust.
CL5G0	Clay with 5% lime and 0% granite dust.
CL5G10	Clay with 5% lime and 10% granite dust.

CL5G20 Clay with 5% lime and 20% granite dust.

CL5G30 Clay with 5% lime and 30% granite dust.

The consistency limits (liquid limit and plastic limit) tests were conducted as per IS: 2720 the differential free swell tests were also conducted as per IS 2720 (Part XL) 1977.

Table 1: Particle Size Distribution of Granite Dust

Sieve Size	Percentage Passing
4.75mm	99.98
2.00mm	99.48
1.00mm	96.55
600 micron	88.78
425 micron	64.85
300 micron	53.63
212 micron	36.15
150 micron	23.17
75 micron	4.71

Table 2: Index Properties and DFS

Mix Proportions	LL (%)	PL (%)	PI (%)	SL (%)	DFS (%)
CL0G0	57	19.85	37.2	8.10	56.60
CL5G0	38.5	22.96	15.5	10.40	20.0
CL5G10	34.5	25.50	9.0	14.64	11.10
CL5G20	33	26.20	6.80	16.50	5.26
CL5G30	28	24.34	3.7	18	4.1

Note: L L – liquid Limit; P L- plastic limits; P I – plasticity Index; DFS – Differential Free Swell.

RESULTS AND DISCUSSION

The test results are summarized in Table 2. The variations in the liquid limit, plasticity index and Differential Free Swell are shown in the Figures 1 to 5.

Figure 1: Liquid Limit

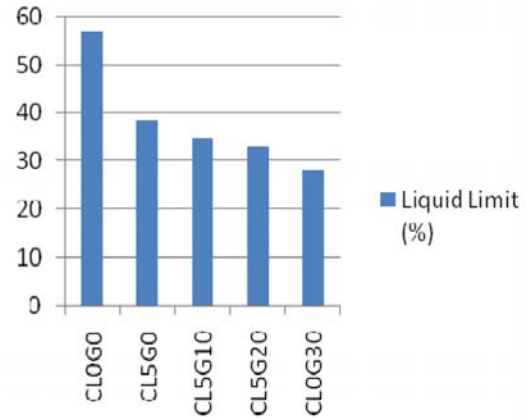


Figure 2: Plastic Limit

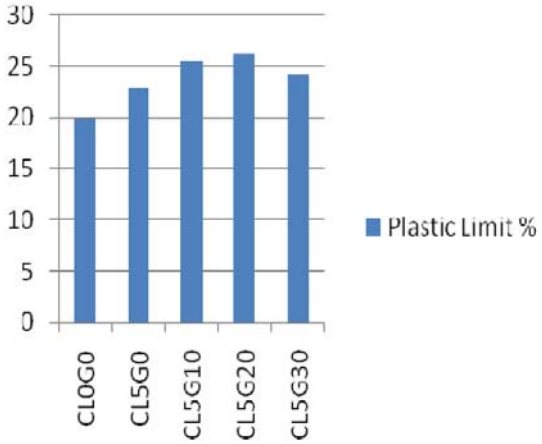


Figure 3: Plasticity Index

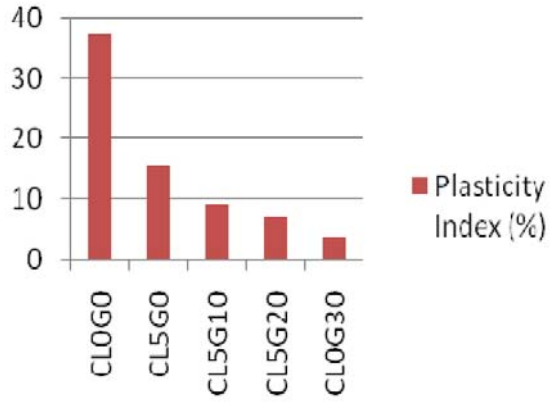


Figure 4: Shrinkage Limit

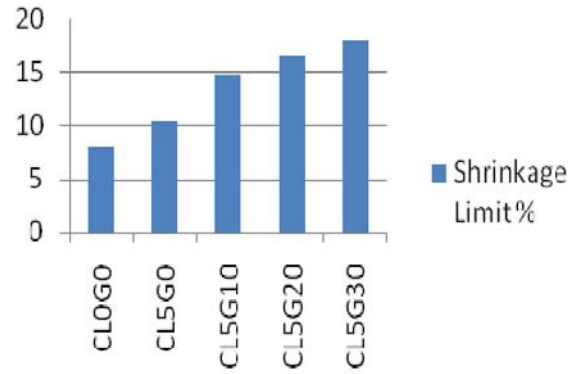
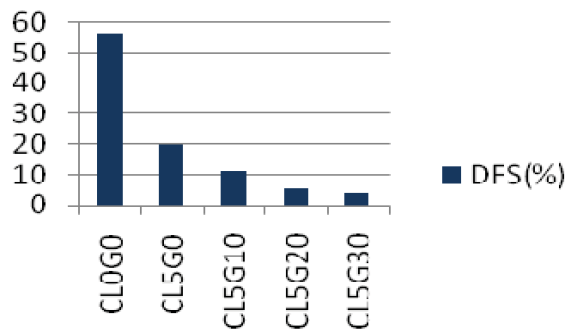


Figure 5: DFS



CONCLUSION

From the series of tests conducted on Black Cotton soil mixed with lime and granite dust, the following conclusions are drawn:

1. With the increase in the granite dust percentage the liquid limit values decrease from 57% to 28%.
2. The plasticity index values decrease from 37.2% to 3.7%.The differential free swell results are also decreased drastically from 56.6% to 4.1%.
3. The shrinkage limit values increases from 8.15% to 18% with the increase in granite dust.

From the test results it can be concluded that the addition of granite dust to lime stabilized BC soil decreases its swelling behaviour to a great extent.

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