EFFECT OF SAW DUST ASH AND FLY ASH ON STABILITY OF EXPANSIVE SOIL

Naranagowda M J[1], Nithin N S[2], Maruthi K S[3], Mosin Khan D S[4]

[1]*Assistant Professor, Civil Engineering Department, Jain Institute of Technology Davanagere, Karnataka, India*
[2]*Under Graduate Student, Civil Engineering Department, Jain Institute of Technology Davanagere, Karnataka, India*
[3]*Under Graduate Student, Civil Engineering Department, Jain Institute of Technology Davanagere, Karnataka, India*
[4]*Under Graduate Student, Civil Engineering Department, Jain Institute of Technology Davanagere, Karnataka, India*

Abstract

This study is focused on evaluating the effects of saw dust ash and fly ash on properties of laterite soil. These soils tend to have low shear strength and further it may lose shear strength in presence of moisture. This undesirable engineering property of the soil may cause potential natural hazard. These soils are plastic, compressible and expansive in nature which has the tendency to swell in presence of moisture and shrink in dried condition. Fly ash and saw dust ash which are disposed materials from industries are used in the stabilization process to improve the properties of soil. Fly ash is a cementatious material which reduces the swell of the soil when added in proper proportion. Saw dust ash by itself has a little cementatious property in addition with the presence of moisture it influences to the strength and compressibility characteristics of soil. The tests that are carried out on the natural soil sample are specific gravity, consistency limits, CBR, compaction, UCC and differential swell index. Further these tests were carried out on stabilized state of soil by adding 5, 10, and 15 of fly ash and saw dust ash. The results gives the effect of fly ash and saw dust ash on geotechnical properties of laterite soil.

Keywords: *FA-Fly Ash, SDA-Sawdust Ash, Stabilization, CBR-California Bearing Ratio, UCC-Unconfined Compression Test*

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1. INTRODUCTION

Soil used as foundation material and subgrade material should be strong enough to bear the load. The soil which are expansion in nature tends to swell in presence of moisture and shrink in dried condition this undesirable properties of expansive soil cause damage to structures.

The laterite soil used in this study is expansive in nature. Laterite soil in India is found in Eastern Ghats of Orissa, southern parts of Western Ghats, Malabar coastal plains and Ratnagiri of Maharashtra and some parts of west Bengal. Laterite soil is rich in aluminium and iron formed in wet and hot tropical region. Almost all laterite soil are red in colour due to presence of iron oxide. Laterite soil in Karnataka are mainly found in Udupi, Kodagu, Shivamogha, Kolar, Belgaum, Chikkamangalur, Bangalore, Bidar, Dharwad. For any construction activities in these regions, the soil needs to be stabilized.

The application of industrial waste such as fly ash and saw dust ash or the combination of them often results in transformation of stability of soil. Some studies have been carried out on geotechnical properties of laterite soil using stabilizers (okunade 2010, olorutola et al. 2008, amu et al 2011, okafor and okankno 2009). Soil stabilization results in improved engineering properties of soil. The purpose of this study is to determine the effect of fly ash and saw dust ash on properties of soil and to study the changes in CBR of soil with or without admixtures.

2. MATERIALS AND METHODOLOGY

The materials used in this study are laterite soil samples, saw dust ash, fly ash.

Laterite soil which is expansive in nature was collected from Soraba Taluk, Shivamogga District, Karnataka. Fly ash is one of the residues created during the combustion of coal in coal-fired power plants. Fly Ash is the waste by-product material that must be disposed of or recycled. Fly ash mainly comprises of SiO_2, Al_2O_3 Fe_2O_3, CaO, MgO, SO_3 . Specific gravity of fly ash is 1.97 Saw dust is a by-product of Timber milling industry, Saw dust ash is obtained from burning of Saw dust and the Specific gravity of saw dust ash is 2.10.

Four soil samples were prepared as shown in Table 1. And for each soil samples Differential free swell index test (DFS), Atterberg limits, Proctor compaction, California bearing ratio (CBR) and Unconfined compression test (UCC) were conducted.

Table -1: Showing Soil Sampling

Soil Sample 1	100% Soil
Soil Sample 2	90% Soil + 5% FA + 5% SDA
Soil Sample 3	80% Soil + 10% FA + 10% SDA
Soil Sample 4	70% Soil + 15% FA + 15% SDA

2.1 Differential Free Swell Index Test

Differential Free Swell (DFS) is a parameter used for the identification of the expansive soil. The procedure is followed as per IS 2720 Part-XL, 1977.

2.2 Atterberg Limits

Liquid limit test was conducted on Laterite Soil samples using Casagrande's apparatus as per the procedure given in IS 2720 Part-5, 1985.

Plastic limit test was conducted on Laterite Soil samples as per the procedure laid down in IS 2720 Part-5, 1985.

2.3 Proctor's Compaction Test

Preparation of the soil samples for proctor compaction test and the test on the soil samples was done as per IS 2720 Part-8, 1983.

2.4 California Bearing Ratio Test

Preparation of the soil samples for California bearing ratio (CBR) and the test procedure was followed as per IS 2720 Part-16, 1987.

2.5 Unconfined Compression Test

Preparation of the soil samples for Unconfined compression test (UCC) and the test was conducted on the Laterite soil samples as per procedure laid down in IS 2720 Part-10, 1991.

3. RESULTS AND DISCUSSIONS

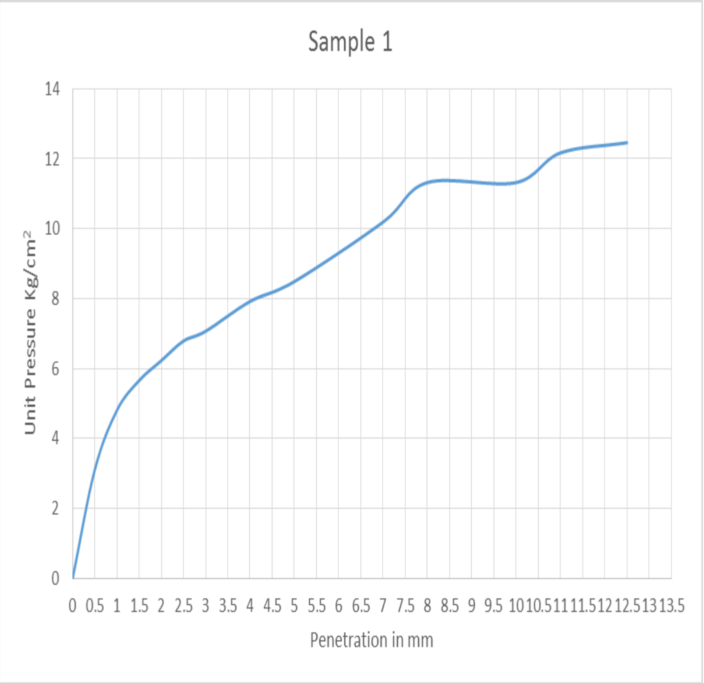

Chart -1: Showing CBR curve for Soil Sample 1

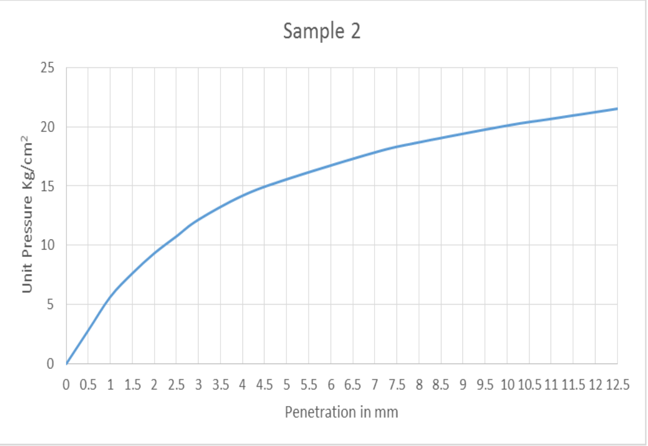

Chart -2: Showing CBR curve for Soil Sample 2

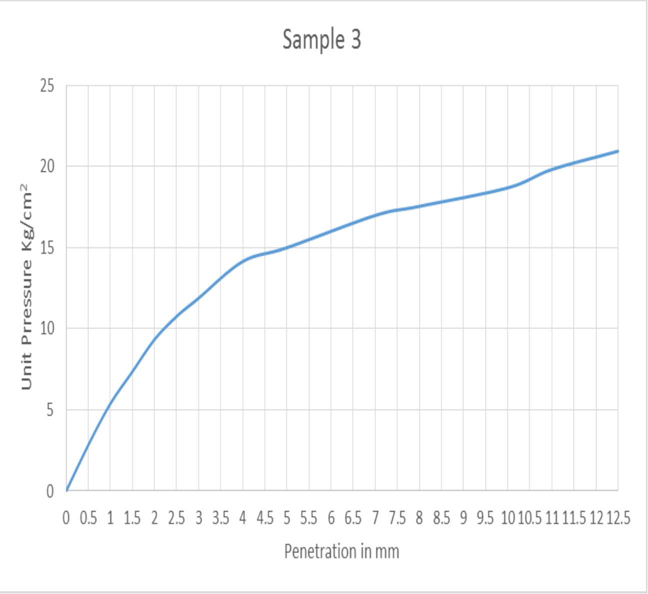

Chart -3: Showing CBR curve for Soil Sample 3

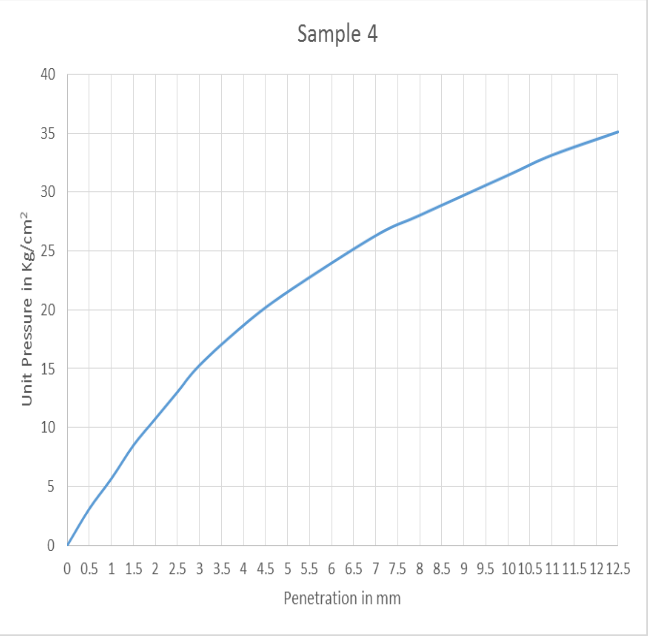

Chart -4: Showing CBR curve for Soil Sample 4

Table -2: Showing experimental results of Soil Samples

Description	Soil Sample 1	Soil Sample 2	Soil Sample 3	Soil Sample 3
Swell index (%)	50	20	0	9
Liquid Limit (%)	43.5	40	40.9	42
Plastic Limit (%)	20.3	22	28.26	27.67
Plasticity index (%)	23.2	18	12.64	14.33
Max dry density MDD(g/cc)	1.93	1.94	1.86	1.79
Optimum moisture content OMC (%)	16.66	17.44	19.13	16.88
CBR (%)	9.71	15.42	15.42	20
UCC (kg/cm^2)	12.99	9.87	14.15	5.93

The Swell index of the Laterite soil has decreased from 50% to 0 % with an increase in the saw dust ash and fly ash for soil sample 1 to sample 3 and further swell index has increased to 9 % for soil sample 4

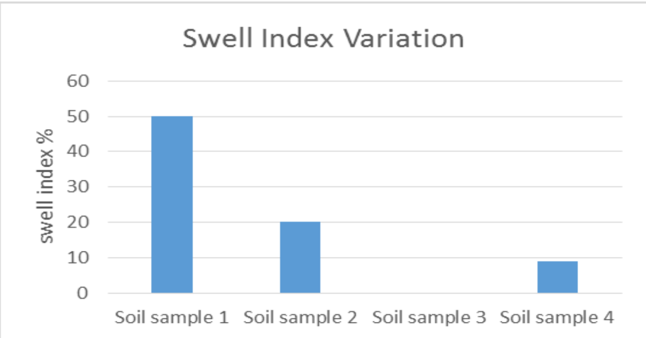

Chart -5: Showing variation of Swell index

The Plasticity index decreased from 23.2 % to 12.64 % when saw dust ash and fly ash was raised from 0 to 20 % and the liquid limit further increased to 14.33 % for the addition of 30 % of the fly ash and saw dust ash.

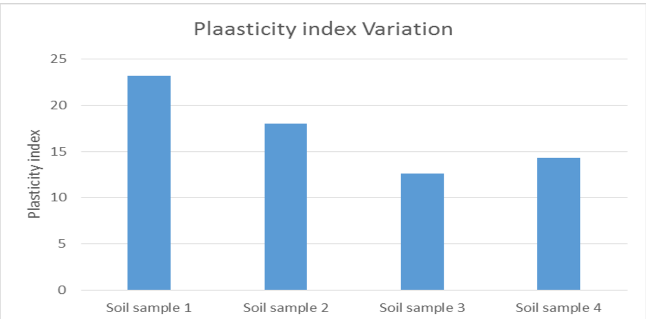

Chart -6: Showing variation of Plasticity index

The Maximum dry density increased from 1.93 g/cc to 1.94 g/cc when saw dust ash and fly ash was raised from 0 to 10 % and further decreased from 1.86 to 1.79 for the addition of 20% to 30 % of the fly ash and saw dust ash.

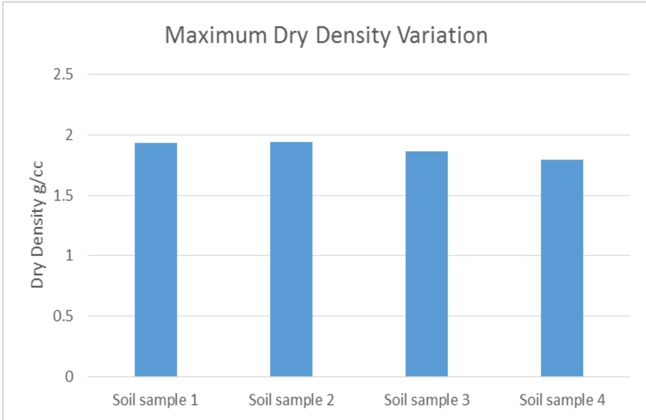

Chart -7: Showing variation of Maximum dry density

The Optimum moisture content increased from 16.66% to 19.13 % when saw dust ash and fly ash was raised from 0 to 20 % and further decreased to 16.88 % for the addition of 30 % of the fly ash and saw dust

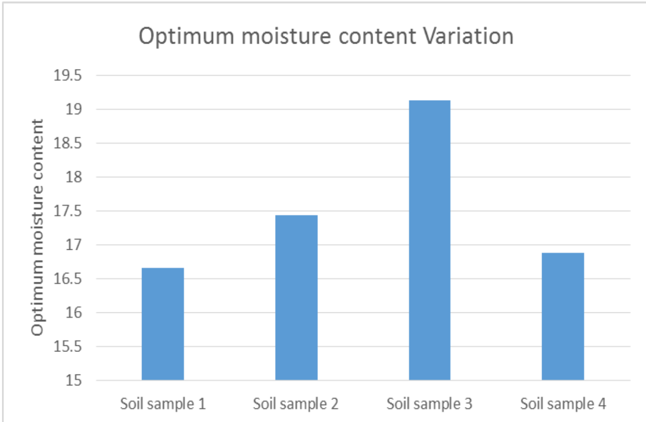

Chart -8: Showing variation of Optimum moisture content

The CBR value increased from 9.71% to 20 % when saw dust ash and fly ash was raised from 0 to 30 %.

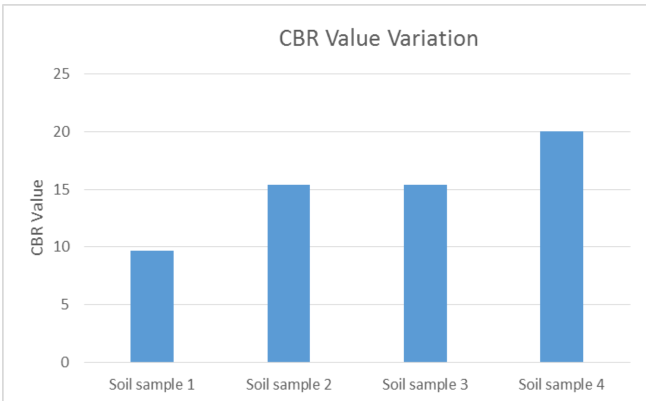

Chart -9: Showing variation of CBR value

The Unconfined Compressive decreased from 12.99 Kg/cm^2 to 9.87 Kg/cm^2 when saw dust ash and fly ash was raised from 0 to 10 % and further increased to 14.15 Kg/cm^2 for the addition of 20 % of the fly ash and saw dust ash and further decreased 5.93 Kg/cm^2.

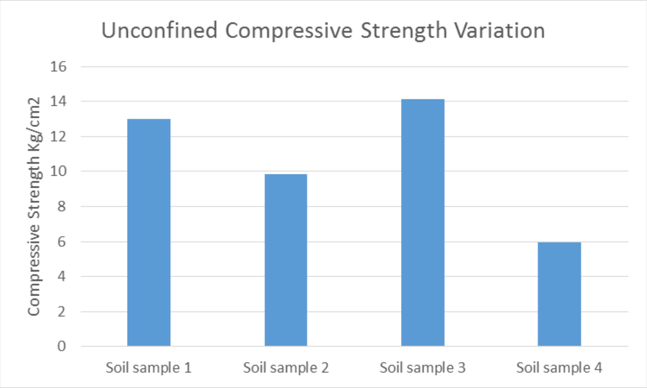

Chart -10: Showing variation of UCC value

4. CONCLUSION

1. Optimum moisture content of soil has improved on addition of 10% fly ash and 10% saw dust ash.
2. Maximum dry density of the soil has improved on addition of fly ash and saw dust ash.
3. By adding admixtures like fly ash and saw dust ash controls the swelling index of soil. From our test soil with a 10% fly ash and 10% sawdust ash reduce the swelling index from 50% to 0%,
4. Plasticity index of soil has improved on the addition of 10% of fly ash and 10% of saw dust ash.
5. CBR value of the soil has improved on addition of 15% fly ash and 15% saw dust ash.
6. Unconfined compressive strength has varied with addition of fly ash and saw dust ash and was found maximum with addition of 10% fly ash and 10% saw dust ash.

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BIOGRAPHIES

Naranagowda M J, Assistant Professor, Civil Engineering Department, Jain Institute of Technology, Davanagere, Karnataka, India.

Nithin N S, Undergraduate Student, Civil Engineering Department, Jain Institute of Technology, Davanagere, Karnataka, India.

Maruthi K S, Undergraduate Student, Civil Engineering Department, Jain Institute of Technology, Davanagere, Karnataka, India.

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