International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 1 Issue 5, July - 2012

Expansive Soil Stabilization Using Bagasse Ash.

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Abstract

Expansive clay soils, those that change significantly in volume with change in water content are the cause of distortions to structures that cost taxpayers several billion dollars annually in the India. This paper is based on some of the key advances developed over the past 60 years in improving our understanding of the nature and methods of modifying and stabilizing expansive clay soils. Hence to improve the strength of expansive soil of Surat region, bagasse ash used as the additive which increase the stability of soil and decrease the swelling of soil. As bagasse ash is high in silica, calcium, and other minerals is provides the necessary homogenous mass for performing the required test. Different tests are carried out with varying percentage of bagasse ash to check the effect on swelling pressure and on basic properties. If any research organization needs to examine, they can use this result for a quick solution for this region, unless there is extensive change in geological formation of the strata.

1. Introduction.

Expansive soils are those whose volume change take place while it comes in contact with water. It expand during the rainy season due to intake of water and shrink during summer season. Expansive soils owe their characteristics to the presence of swelling clay minerals. Expansive soils cover nearly 20% of the landmass in India and include almost the entire Deccan plateau, Western Madhya Pradesh, parts of Gujarat, Andhra Pradesh, Uttar Pradesh, Karnataka, and Maharashtra. The swelling soils are commonly known by the name of black cotton soils. Surat city which is also called diamond city situated in state of Gujarat, India also contain black cotton soil. Generally main properties of expansive soil are swelling properties like free swell index, swell potential and swelling pressure which directly affect the bearing capacity and strength of foundation lying on such a soil. Typical behavior of swell and shrink of expansive soil generate many problem like cracking in foundation. Hence it is necessary to improve the properties of such a soil to avoid damages of structure.

2. Effect of Expansive Soils.

In

the field, expansive clay soils can be easily recognized in the dry season by the deep cracks, in roughly polygonal patterns, in the ground surface as shown in figure 1.

Figure 1. Crack pattern of expansive soil.

Description	Abbreviation	Percentage (%)
Silica	Sio_2	60.26
Iron	Fe_2o_3	5.03
Calcium	Cao	8.35
Magnesium	Mgo	0.40
Sodium	Na_20	1.33
Potassium	K_2o	5.57
Chloride	Cl	0.20
Sulphate	So_4	1.30
Phosphorus	P_2o_5	2.69
Loss of Ignition	-	3.39
Alumina	Al_2o_3	10.73
Titanium	Tio_2	0.13
Manganese	Mn	0.078
Wax Content	-	Nil

Figure 2. Damage to foundations due to expansive soil.

The most obvious way in which expansive soils damage foundations is by uplift as they swell with moisture increases. Swelling soils lift up and crack lightly-loaded, continuous strip footings, and frequently cause distress in floor slabs. Such differential movement of the foundation can also cause distress to the framing of a structure.

3. Stabilization Material.

Bagasse is the matted cellulose fiber residue from sugar cane that has been processed in a Sugar mill. Utilization of industrial and agricultural waste products in the industry has been the focus of research for economical, environmental, and technical reasons. Sugar-cane bagasse is a fibrous
waste product of the sugar refining industry, along with ethanol vapor. This waste-product is already causing serious environmental pollution which calls for urgent ways of handling the waste. In this paper, Bagasse ash has been chemically and physically characterized, in order to evaluate the possibility of their use in the industry.

To stabilize expansive soil, the waste product bagasse ash is collected from boiler / furnace bed of sugarcane located at Sayan located near Surat, Gujarat. Following are the chemical properties of furnace ash.

Table 1. Properties of bagasse ash.

4. Index Properties of Stabilized Soil.

The soil sample is taken from VESU area of Surat region, 14 feet below the ground level. Various tests like Liquid Limit, Plastic Limit, Plasticity Index, Shrinkage Limit, Free Swell Index and Swelling Pressure perfomed.

The percentage of furnace ash is kept 0 % , 3% , 5%, 7% and 10% respectively and all the tests are conducted. The results show that when the percentage of furnace ash is increased in the soil sample, all the properties decrease. The table below shows the laboratory test results of soil properties for region “VESU”.

Table 2. Test result

Ash %	L.L %	P.L %	P.I %	S.L %	F.S.I	Sp Kg/Cm^2	S.I %
0	72	30	42	21	143	0.120	21
3	67	29	38	19	127	0.099	19
5	63	28	35	17	103	0.084	18
7	58	26	32	15	85	0.074	17
10	52	25	27	12	80	0.046	15

Where,
Ash (%) = Percentage of bagasse ash
F.S.I=Free Swell Index
L.L=Liquid Limit
P.L=Plastic Limit
P.I=Plastic Index
S.L=Shrinkage Limit
S.I=Shrinkage Index
Sp=Swelling Pressure

5. Graphical Representation of Test Result.

From the graph below, Free Swell Index decreases as Percentage of bagasse Ash increases; and shows some linearity between them.

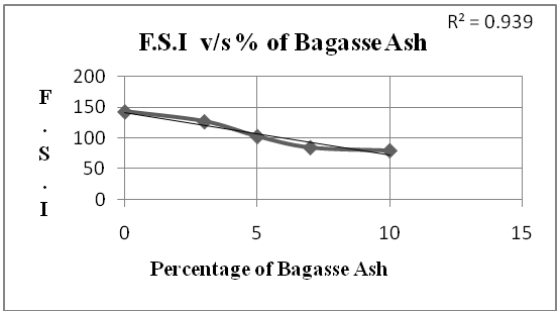

Figure 3. Relation between free swell index & percentage of bagasse ash.

From the graph, Swelling Pressure decreases as Percentage of bagasse ash increases; and shows some linearity between them.

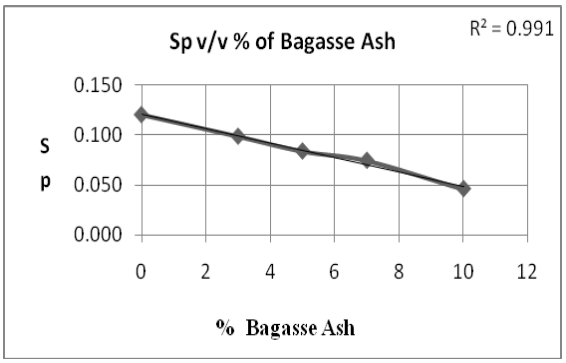

Figure 4. Relation between swelling pressure & percentage of bagasse ash.

6. Conclusion.

Soil stabilization method by applying waste product bagasse ash is successfully improve the existing poor and expansive sub grade soil. Bagasse ash is free of cost and available locally, hence it proved economical also. Bagasse ash effectively dries wet soils and provides an initial rapid strength gain, which is useful during construction in wet, unstable ground conditions. Bagasse ash also decreases swell potential of expansive soils by replacing some of the volume previously held by expansive clay minerals and by cementing the soil particles together. This method will be applicable to this region in future, unless there is extensive change in geological formation of the strata.

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