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Paper Authors

**Bhjana Venkata Ratnam, Dr. Ch.Bhavannarayana**



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## A STUDY ON STRENGTH PROPERTIES OF EXPANSIVE SOIL TREATED WITH BAGASSE ASH AND PHOSPHORUS PENTOXIDE

Bhjana Venkata Ratnam\*, Dr. Ch. Bhavannarayana \*\*

\*PG Scholar, Kakinada Institute of Engineering and Technology - II, Korangi, Kakinada

\*\* Professor PhD, Kakinada Institute of Engineering and Technology - II, Korangi, Kakinada

**Abstract:** Expansive soils have problems to civil engineers in general and to geotechnical engineers in particular. In India, expansive soils popularly known as black cotton soils are highly problematic, as they swell on absorption of water and shrink on evaporation. It is observed from the laboratory studies that maximum improvement in the properties of Expansive soils for Bagasse ash treatment with phosphorus pentoxide in this investigation. A methodical process, involving experimentation on Atterberg limits (liquid limit, plastic limit), Differential free swell, Sieve analysis, specific gravity, Proctor compaction test, California Bearing Ratio (CBR), Unconfined Compressive Strength (UCS) tests were conducted by adding 0.5%, 1%, 1.5% & 2% of Phosphorous pentoxide to the expansive soil by dry weight under controlled conditions in the laboratory. The effect of randomly distributed Bagasse ash on MDD, OMC, UCS and CBR has been discussed in this paper. Phosphorous pentoxide is an orange to brown-black solid. The percentages of Bagasse ash by dry weight of soil was taken as 5%, 10%, 15% and 20%. The first series of compaction, CBR and UCS tests were conducted on the Expansive soil and the same tests were conducted in the second series on soil samples mixed with stone dust and similarly tests were conducted in the third series on soil samples mixed with Bagasse ash and Phosphorous pentoxide. Laboratory experiments favorably suggest that mixing Bagasse ash and Phosphorous pentoxide with soil would be effective in improving soil properties.

### 1. INTRODUCTION

Expansive soil is one among the risky soils that has a high potential for contracting or swelling because of progress of dampness content. Far reaching soils can be found on practically every one of the landmasses on the Earth. Dangerous outcomes brought about by this kind of soils have been accounted for in numerous nations. In India, huge tracts are secured by extensive soils known as dark cotton soils. The significant zone of their event is the south Vindhya range covering nearly the whole Deccan Level. These darts spread a region of around 200,000 square miles and consequently structure about 20% of the complete territory of India. The essential issue that emerges concerning sweeping soils is that distortions are altogether more prominent than the flexible misshapeness and they can't be anticipated by the old style versatile or plastic hypothesis. Development is more often than not in an uneven example and of such an extent to make broad harm the structures laying on them. Appropriate healing measures are to be embraced to change the dirt or to decrease its unfavourable impacts if sweeping soils are distinguished in an undertaking. The therapeutic measures can be diverse for arranging and structuring stages and post development stages. Numerous adjustment systems

are by and by for improving the extensive soils in which the qualities of the dirt are modified or the risky soils are evacuated and supplanted which can be utilized alone or related to explicit structure choices. Added substances, for example, lime, concrete, calcium chloride, rice husk, fly fiery debris and so forth are likewise used to change the attributes of the broad soils. The qualities that are of worry to the plan designers are piousness, compressibility and solidness. The impact of the added substances and the ideal measure of added substances to be utilized are reliant chiefly on the mineralogical arrangement of the dirt's. The paper centres about the different adjustment strategies that are practically speaking for improving the broad soil for diminishing its swelling potential and the constraints of the technique for adjustment there on. In India, the region secured by far reaching soil is almost 20% of the absolute zone. The far reaching soils regularly spread over a profundity of 2 to 20m. In stormy season, they experience hurl and shed pounds. In summer, they psychologist and increase thickness and become hard. This substitute swelling and shrinkage harm the structures harshly. This is increasingly extreme for the light structures. During summer, polygonal breaks are show up at the surface, which may stretch out to a profundity of about 2m demonstrating the dynamic zone wherein

volume change happens. The profundity of dynamic zone characterized as the thickness of the dirt beneath the ground surface inside which dampness content varieties and subsequently volume changes dotake place. Sustained endeavours are being made everywhere throughout the world on thruway research field to develop additionally encouraging treatment strategies for appropriate structure and development of asphalts running over broad soil sub grade.

## 2. REVIEW OF LITERATURES

**R.Thirumalai(2017)** It represents the recent trends in stabilization of expansive soil using industrial waste (granite and Bagasse ash , cement kiln dust, silica fume , rice husk ash) as stabilizers for decreasing the environmental hazards.

**A.Dinesh(2017)** has concluded that the soil stabilization by using various minerals like Bagasse ash ,sawdust, copper dust, and flyash were most commonly used.

**Aditya Chansoria (2016)** has presents the effect of Bagasse ash on engineering characteristics of blackcotton soil. Black cotton soil samples blended with 10%,20%,30% and 40% of Bagasse ash were prepared and series of laboratory experiments have been performed. The test results showthat the CBR value increases from 1.75% to 7.05% and OMC has been reduced from 21.12 % to 12% and MDD increased from 1.6 to 1.72 g/cc. In this experimental study it can be concluded that the expansive soil behavior of black cotton soil is reduced to a considerable extent with utilization of Bagasse ash.

**P.Indiramma (2016)** A study is carried out to check the improvement in the properties of expansive soil with addition of Bagasse ash in different percentages .The test results for as atterbergs limits , compaction characteristic ,DFS,UCS obtained from the tests on expansive soil mixed with different proportions of Bagasse ash as an admixture.

## 3. Materials

**EXPANSIVE SOIL:** The Expansive soil was collected from "TUMMALAPALLI" village near Amalapuram, East Godavari District in India.



Figure: 1 Black cotton soil

**BAGASSE ASH:** Bagasse is a residue obtained from the burning of bagasse in sugar producing factories. Bagasse is the cellular fibrous waste product after the extraction of the sugar juice from cane mills. It is currently used as a bio fuel and in the manufacture of pulp and paper products and building materials. For each 10 tons of sugarcane crushed, a sugar factory produces nearly 3 tons of wet bagasse which is a by-product of the sugar cane industry. When this bagasse is burnt the resultant ash is bagasse ash. Western Maharashtra is having maximum number of sugar factories, these factories faces a disposal problem of large quantity bagasse. The effective utilization of these waste products is a challenging task for a researcher through economical and environmental impact. This material contains amorphous silica which is indication of cementing properties, which can develop good bonding between soil grains in case of weak soil

Figure: 2 Bagasse



**PHOSPHOROUS PENTOXIDE:** Phosphorus Pentoxide is white colored sticky powder form, which is highly reactive with water and clay particles of soil. Phosphorus Pentoxide is white colored sticky powder form, which is highly reactive with water and clay particles of soil. It improves the index properties, dry density, and optimum moisture content of soil. It improves the index properties, dry density, and optimum moisture content of soil. The amount of Phosphorous pentoxide used was between 0 to 2% by dry weight of soil. The Quantity of Phosphorous pentoxide is varied from 0-2% by dry weight of the Expansive Soils.

Figure: 3 Phosphorus Pentoxide



### 3. Results

3.1 Plastic limit and Liquid limit values of untreated expansive soil and expansive soil treated with Bagasse ash

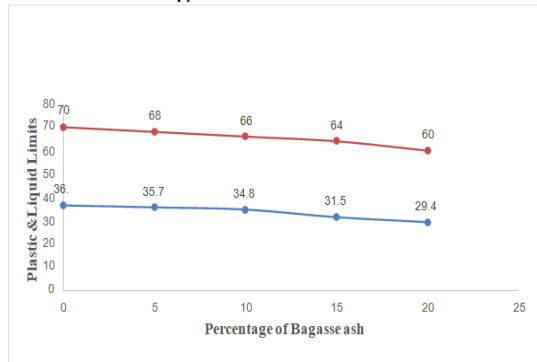


Figure: 4 Represents the Plastic limit and Liquid limit values of untreated expansive soil and expansive soil treated with Bagasse ash

3.2 OMC and MDD Values of Untreated Expansive soil and Treated Expansive soil with Percentage variations of Bagasse ash

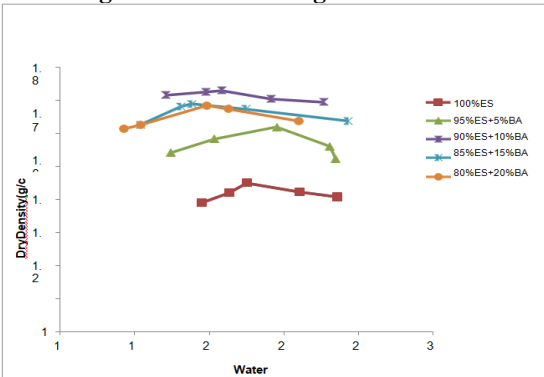


Figure: 5 Represents the OMC & MDD values of Expansive Soil Treated with % Variations of Bagasse ash

3.3 CBR values of Untreated and Treated Expansive soil with percentage variations of Bagasse ash

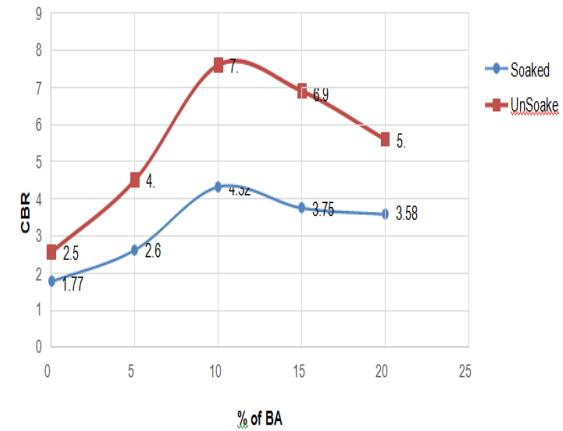


Figure:6 Represents the CBR values of Untreated and Treated Expansive soil with percentage variations of Bagasse ash

3.4 Optimum moisture Content and Maximum Dry Density of 10% Bagasse ash Treated Expansive Soil with percentage Variation of Phosphorous pentoxide

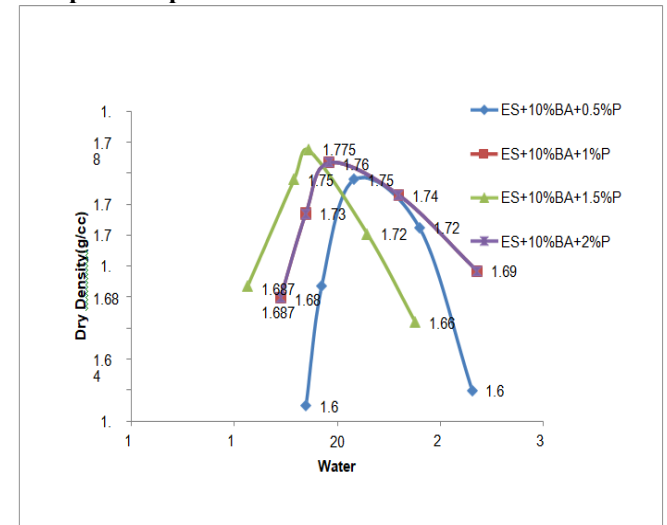


Figure : 7 Optimum moisture Content and Maximum Dry Density of 10% Bagasse ash Treated Expansive Soil with percentage Variation of Phosphorous pentoxide

### 3.5 CBR values of treated expansive soil with 10 % Bagasse ash with various percentages of Phosphorous pentoxide

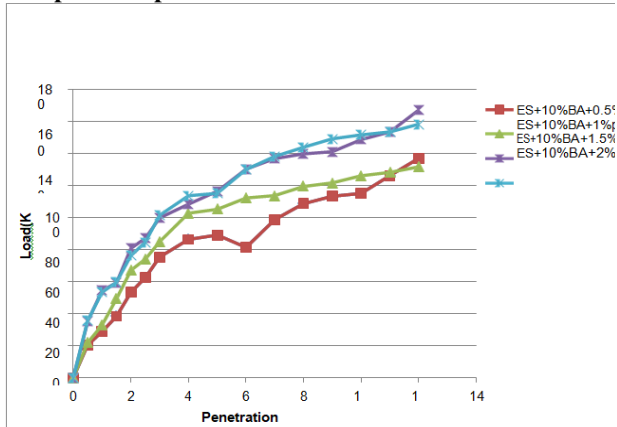


Figure: 8 Represents the CBR values of treated expansive soil with 10 % Bagasse ash with various percentages of Phosphorous pentoxide

### 3.6 UCS values of treated expansive soil with 10 % BA with various percentages of P<sub>2</sub>O<sub>5</sub>

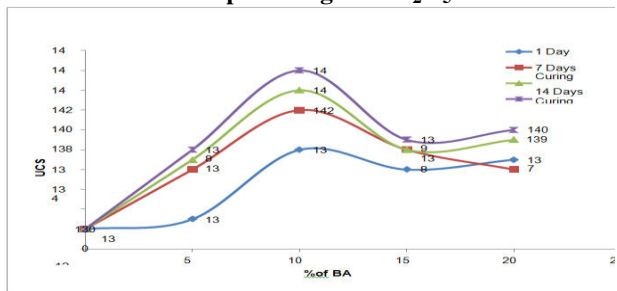


Figure: 9 UCS values of treated expansive soil with 10 % BA with various percentages of P<sub>2</sub>O<sub>5</sub>

## 4. Conclusions

1. It is noticed from the laboratory investigations that the liquid limit of the expansive soil has been decreased by 6.06% on addition of 10% Bagasse ash and further the liquid limit of Phosphorous pentoxide treated expansive soil has been decreased by 12.9% with the addition of 1.5 % Phosphorous pentoxide as an optimum when compared with untreated expansive soil
2. It is observed from the laboratory investigations that the plastic limit of the expansive soil has been improved by 2.75% on addition of 10% Bagasse ash and further the plastic limit of Phosphorous pentoxide treated with expansive soil has been improved by 13.29% with the addition of 1.5% Phosphorous pentoxide as an optimum when compared with untreated expansive soil.
3. It is observed from the laboratory investigations that the plasticity index of the

expansive soil has been improved by 9.75 % on addition of 10% Bagasse ash and further the plasticity index of Phosphorous pentoxide treated expansive soil has been improved by 12.49% with the addition of 1.5% Phosphorous pentoxide as an optimum when compared with untreated expansive soil

It is found from the laboratory investigations that the optimum moisture content of the expansive soil has been decreased by 4.65% on addition of 10% Bagasse ash and further the optimum moisture content of Phosphorous pentoxide treated expansive soil has been decreased by 20.96% with the addition of 1.5% Phosphorous pentoxide as an optimum when compared with untreated expansive soil

4. It is found from the laboratory investigations that the maximum dry density of the expansive soil has been improved by 18.9% on addition of 10% Bagasse ash and further the maximum dry density of Phosphorous pentoxide treated expansive soil has been improved by 21.99% with the addition of 1.5% Phosphorous pentoxide as an optimum when compared with untreated expansive soil.

5. It is observed from the laboratory investigations that the C.B.R. value of the expansive soil has been improved by 111.86% on addition of 10% Bagasse ash as an optimum and further the C.B.R value of Phosphorous pentoxide treated with expansive soil has been improved by 258.75% with the addition of 1.5% Phosphorous pentoxide as an optimum when compared with untreated expansive soil.

7. The soaked CBR values of expansive soil on stabilizing treated with Phosphorous pentoxide is found to be 4.58% and it is satisfying standard specifications. So finally it is concluded from the above results that the Phosphorous pentoxide can potentially stabilize the expansive soil.

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