# Effect of Bagasse Ash on Geotechnical Properties of Expansive Soil

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***Abstract-*** *Expansive soils swell under the influence of water and shrink when they become dry, and hence cause various problems and may also lead to failure of the structures built upon them. So, it is the duty of an engineer to evaluate and possibly modify the properties of the expansive soil before constructing any structure over the same. This paper presents the study of similar researches performed worldwide.*

## I. INTRODUCTION

Expansive soils may be defined as the soils that expand in volume with the ingress of water and shrink when the soils get devoid of water. The variation of volume depends upon the moisture content, also many researchers have shown swelling and shrinkage follow two different mechanisms and generally shrinkage limit does not relate to the swelling characteristics of the soil. As a result of this volume change in soil, significant distress in the soil occurs, causing severe damage to the overlying structure. On the onset of the rainy season, these soils swell and lose their capacity to bear water and generally become softer. In the seasons which are relatively dry, these soils shrink due to evaporation of water and become harder. The resulting volume change can be the reason of cracking of the structures built upon it. The code of IS-1498 has given a basic idea about the classification of various expansive soil and their expansion characteristics based on their liquid limit and plasticity index values.

Various attempts at stabilization of expansive soil have been performed by researchers using admixtures like lime, bitumen or cement. Although the stabilization with these admixtures is effective; it is not very much compatible from an economic view point. Attempts have been made to stabilize expansive soil with various locally available materials which are cheap and abundantly available in that very region where the problematic soil is present. Various wastes, whose disposal becomes a problem, are tried as admixtures to modify the property of soils. Swelling in clays can be sub-categorized into two distinctive types, namely:

- Elastic rebound in the compressed soil mass due to reduction in compressive force.
- Imbibing of water resulting in expansion of water-sensitive clays.

Swelling clays are the clays that exhibit latter type of swelling, where the clay minerals with largely inflating lattice are present. One of the fundamental characteristics of clayey soil is that they display little cohesion and strength when wet, but they become hard when devoid of water. However, all of them do not swell due to wetting action. Decrease in ultimate bearing capacity at saturation, and large differential settlement due to this occurs. Thus, clayey soils exhibit foundation problems.

## II. LITERATURE REVIEW

Expansive soils are mostly found in the arid and semi-arid regions and it covers very large area of the world. It covers nearly 20% of the landmass in India and includes almost the entire Deccan plateau, Western Madhya Pradesh, parts of Gujarat, Andhra Pradesh, Uttar Pradesh, Karanataka, and Maharastra. The swelling soils are commonly known by the name of Black Cotton Soils. For swelling to occur, these soils must be initially unsaturated at some water content. If the unsaturated soil gains water content, it swells. On the other hand, if a decrease in water content occurs the soil shrinks. The presence of montmorillonite clay in these soils imparts them high swell–shrink potentials.

Proper remedial measures are to be adopted to modify the soil or to reduce its detrimental effects if expansive soils are indentified in a project. Many stabilization techniques are in practice for improving the expansive soils in which the characteristics of the soils are altered or the problematic soils are removed and replaced which can be used alone or in conjunction with specific design alternatives. Additives such as lime, cement, calcium chloride, rice husk, fly ahs etc. are also used to alter the characteristics of the expansive soils. The characteristics that are of concern to the design engineers are permeability, compressibility and durability. The effect of the additives and the optimum amount of additives to be used are dependent mainly on the mineralogical composition of the soils.

Table 1 - Review on Expansive Soil Stabilization

| S.NO. | RESEARCHER | WORK |
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| 1 | **Boominathan and Ratnea (1996)** | **"**The effect of (Rice husk ash + Sugarcoating bagasse ash) on soil was investigated. There were various tests conducted for this research work such as Atterberg's Limit, Compaction and UCS". These studies have been carried out to proposed use of Rice husk ash for equilibrium of soil with and without Sugarcoating bagasse ash incorporate. |
| 2 | **Pandian (2002)** | The impact of two kinds of Rice husk fiery remains Raichur Rice husk slag (Class F) and Neyveli Rice husk powder (Class C) on the CBR attributes of the dark cotton soil was examined by The Rice husk cinder content was expanded from 0 to 100%. For the most part the CBR/quality is contributed by its union and erosion. |
| 3 | **Venkataswamy.(2003)** | Studied the improvement of expansive clay by deep in-situ technique. They concluded that the pozzolonic reaction due to presence of lime has shown marked increase in unconfined compressive strength and reduction in swelling pressure as well as plasticity index. |
| 4 | **Phanikumar and Sharma (2004)** | studied the effect of mixing fly ash (content 5, 10, 15 and 20% by dry weight of soil) on engineering properties of expansive soil through an experimental investigation. Free swell index was found to reduce by 50% on addition of 20% fly ash. The hydraulic conductivity of expansive soil decreases with increase in fly ash content. The undrained shear strength increases with increase in the ash content. |
| 5 | **White (2005)** | Soil compaction characteristics, compressive strength, wet/dry durability, freeze/thaw durability, hydration characteristics, rate of strength gain, and plasticity characteristics are all affected by the addition of fly ash |
| 6 | **Jha (2006)** | Effect of (RHA +Sugarcoating bagasse ash) on soil was studied by The tests like Compaction, CBR and UCS test were directed and assess the viability of utilizing rice husk powder as a puzzuolanae to improve the Sugarcoating bagasse fiery debris treatment of soil. The Studies did to ponder the impact of various blended extents of Sugarcoating bagasse fiery debris and RHA on different properties of the dirt. The outcome demonstrates that expansion of RHA improves quality advancements as well as it builds toughness of Sugarcoating bagasse fiery debris balanced out soils. |
| 7 | **Brooks (2009)** | investigated the soil stabilization with flayash and rice husk ash. This study reports; stress strain behavior of unconfined compressive strength showed that failure stress and strains increased by 106% and 50% respectively when the flyash content was increased from 0 to 25%. When the rice husk ash (RHA) content was increased from 0 to 12%, Unconfined Compressive Stress increased by 97% while California Bearing Ratio (CBR) improved by 47%. Therefore, an RHA content of 12% and a flyash content of 25% are recommended for strengthening the expansive subgrade soil. A flyash content of 15% is recommended for blending into RHA for forming a swell reduction layer because of its satisfactory performance in the laboratory tests. |

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| **8** | **Narasimha and Chittaranjan (2011)** | Discussed the effects of certain agricultural and domestic wastes in geotechnical applications, The agricultural wastes considered for discussion are rice husk ash, sugarcane bagasse ash, ground nut shell ash, burnt olive waste, domestic waste including paper waste, plastic scrap tires, glass, ceramics and carpet waste. |
| **9** | **Osinubi et al(2011)** | Ordinary Portland cement (OPC) / locust bean waste ash (LBWA) blend in stepped concentration of 0, 2, 4, 6 and 8% each by dry weight of soil, was used to treat the soil. Compaction was carried out using British Standard light (BSL) energy and the three criteria for the evaluation of strength (i.e., UCS, CBR and Durability) were considered. The UCS values of specimens treated with 6% OPC / 6% LBWA increased from 178, 381 and 760kN/m2 for the natural soil to 986, 1326 and 1348kN/m2 when cured for 7, 14 and 28 days, respectively. The CBR value of 5% of the natural soil increased and peaked at 42% for 6% OPC / 6% LBWA treatment, while the durability in terms of resistance to loss in strength increased from 13% for the natural soil to 58%. The strength and durability values also increased with curing ages, thus indicating that the blend has potential for time-dependent increase in strength that will reduce the quantity of cement needed for the construction of low volume roads over the expansive soil. |
| **10** | **Kharade (2014)** | The use of agricultural waste slightly improves the properties of expansive soils, bagasse can be used as replacement in black cotton soil up to certain limits. The blend suggested from this research is Black cotton soil + 6% replacement by bagasse ash, without any addition of cementing or chemical material, this would be an economic approach |
| **11** | **Kumar et al. (2016)** | Study was aimed to use rice husk ash and sugar cane straw ash with lateritic soil to improve the properties the soil. They planned to add admixtures at a dosage of 2%,4%,6%&8% of total weight of soil and the index properties and engineering properties were determined and compared with unstabilized soil. |

## III. DISCUSSION AND CONCLUSIONS

Several methods of soil improvement using pozzolanic materials have been developed and used successfully in practice. It has been applied in a variety of civil engineering works, like in the construction of base courses where good materials are not economically available; for reducing the permeability and compressibility of soils in hydraulic and foundation works; for stabilisation of slopes, embankments and excavations. A considerable amount of research concerning stabilisation of soil with additives such as cement, lime, lime – fly ash and salt, bitumen and polymers is available in the literature. But soil stabilisation with lime and bagasse ash is a relatively new method. In recent years the use of various waste products in civil engineering construction has gained considerable attention in view of the shortage and high costs of suitable conventional aggregates, the increasing costs of waste disposal and environmental constraints. Bagasse is major agricultural by–product obtained after the juice is extracted from the sugar cane. Generally, it was considered a worthless by–product of the sugar mills.

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