Impact of Corn Husk on the Swelling Behaviour of an Expansive Soil

Shubhendu Mishra[1], Dr. Bipin Prajapati[2], Raj Kumar Gupta[3]

[1]*PG Student, Department of Civil Engineering, KNIT, Sultanpur, Uttar Pradesh, India*
[*2]*Assistant Professor, Department of Civil Engineering, KNIT, Sultanpur, Uttar Pradesh, India*
[3]*Head of Civil Department, BBDEG, Lucknow, Uttar Pradesh, India*

Abstract - *Soil is the basis for every Civil engineering construction. All the construction whether light or heavy in supported on the soil. We can say that the soil bear the load of all type of structure. Now a days major problem that civil engineers facing is the problem of its moisture content. Expansive soils are characterized by volumetric changes due to dampness varieties and being a wellspring of danger to the population as it eventually causes heavy monetary misfortunes, extraordinary damage to structures and structure. They may cause some damage to common developments, particularly to light weight structures, including breaks and gaps. This audit paper manages the adjustment of soil utilizing Corn Husk. Corn husk buildup gathered from the removal of the little road market. Each example of corn husk is being sun dried cleaned physically again, choped into little pieces, ground in a mallet plant. Corn husk has lignin content and comparative measures of hemicellulose and α-cellulose. What's more, the corn husk fiber demonstrated preferable elastic property over piassava and coir and comparative most extreme security temperature to that of caroa and olive husks.*

***Key Words*: Corn Husk, Lignin Content, Hemicellulose, Tensile strength, Swelling potential**

1. INTRODUCTION

Nowadays, problem of expensive soil is major concern, it is necessary that it have sufficient strength. This importance motivates researchers to develop new solutions, which can be mentioned in the various technical papers that uses the waste material such as Lime, bagasse ash, Rice Husk ash, Ground graduated blast furnace slag, waste glass material, sisal, polypropylene, hybrid fiber, compacted cement dust etc to reduces the swelling potential of soil and increases the strength of soil.

Due to the physical and chemical properties of some clays, large swelling occurs when water is absorbed. Conversely when the water dries up these clays contract (shrink). The presence of these clay minerals is what allows soils to have the capacity to shrink and swell. It is a type of damage in which formation permeability is reduced because of the alteration of clay equilibrium. Clay swelling occurs when water-base filtrates from drilling, completion, work over or stimulation fluids enter the formation. Clay swelling can be caused by ion exchange or changes in salinity.

Present paper study the effect of swelling potential on addition of different percentage of Corn Husk to the soil and examine the change in swelling behaviour.

1.1 LITERATURE REVIEW

Extensive studies have been carried out on the stabilization of expansive soils using various additives such as lime, cement, fly ash, industrial waste products, potassium nitrate, calcium chloride and phosphoric acid. However, the literature indicates minimal studies on the stabilization of expansive soils in Oman. Therefore, this study was carried out to add new information to the literature in this area.

1.2 Lime Stabilization

Lime is widely used in civil engineering applications such as road construction, embankments, foundation slabs and piles. When lime is added to clay soils in the presence of water, a number of reactions occur leading to the improvement of soil properties. These reactions include cation exchange, flocculation, carbonation and pozzolanic reaction. The cation exchange takes place between the cations associated with the surfaces of the clay particles and calcium cation of the lime. The effect of cation exchange and attraction causes clay particles to become close to each other, forming flocs; this process is called flocculation. Flocculation is primarily responsible for the modification of the engineering properties of clay soils when treated with lime [4].

1.3 Cemet Stabilization

Cement stabilization is similar to that of lime and produces similar results. Cement stabilization develops from the cementitious links between the calcium silicate and aluminate hydration products and the soil particles [2].

2. EXPERIMENTAL PROGRAM

2.1 Site selection and Material

In the present investigation, expansive soil was procured from a site having as **Khala Bazar, haiderganj, Lucknow, U.P.** The soil was collected by method of disturbed sampling after removing the top soil at 500 mm depth and transported in sacks to the laboratory. Little amount of the sample was sealed in polythene bag for determining its natural moisture content. The soil was air dried, pulverized and sieved with 4.75 mm Indian as required for laboratory test.

2.1.1Material

The main material used in this study was waste corn husk that had an average length and width of 240–245 mm and 110–135 mm, respectively. The selection process was aimed at maintaining the uniformity of the selected CHFs. Corn Husk have high Lignin Content, Hemicellulose and have high flexibility, which give strength to the soil. Firstly consistency of untreated soil is determined ,then again consistency is checked on different percentage of corn husk.

The physical, mineralogical and chemical characteristics

of the untreated soil are shown in Table 1. All geotechnical tests were performed in accordance with British Standard 1377. Based on Casagrande plasticity chart, the soil was classified as inorganic Clay of high plasticity (CH). The soil showed a high plasticity index (51%) and an activity of 1.03. Generally, the higher the plasticity index and activity of a soil, the higher the swelling potential.

Table 1 : Geotecnical properties of soil

S.NO	PROPERTIES	VALUE
1	Coefficient of uniformity (Cu)	2.82
2	Coefficient of curvature (Cc)	1.18
3	Specific gravity (G)	2.64
4	Maximum dry density (MDD)	1.55 gm/cc
5	Optimum moisture content (OMC)	23.31%
6	Natural moisture content	7.11%
7	Liquid limit	72%
8	Plastic limit	21%
9	Classification	CH

2.1.2 Initial testing conditions

The swelling potential of expansive soils depends primarily on the initial testing conditions of the samples [9]. Therefore, in order to compare the effectiveness of Corn husk, it was essential to test the samples at identical placement conditions. In this study,the natural water content and dry unit weight were used to prepare the test samples (Table 1).

2.1.3 Sample preparation for swelling potential tests

To prepare remolded samples, the soil was first cut into small pieces and air dried for 24 h, and then it was pulverized repeatedly using a plastic hammer. Because of its cohesive nature, the soil was then fully soaked for another 24 h. After soaking, the soil disintegrated into its individual components and additional lumps were broken by hand. The soil was then placed in an oven at 105 1C for 24 h to ensure complete dryness. The dry soil was further pulverized to minus 10 sieve size. At this stage, the soil was ready for remolding.

For performing swelling potential tests, an amount of dry soil required for the desired dry unit weight was weighed and mixed with different percentage of corn husk. The water needed for a specific water content was also weighed. The soil-additive mixture was thoroughly mixed with water until a wet homogeneous mixture was achieved. The wet soil-additive was then placed into the mold and compacted to exactly fit the cutting ring. All remolded specimens were left in a desiccator for 24 h before testing. This process allowed the water to be distributed uniformly within the sample without any loss of moisture.

2.1.4 Measurement of swelling potential

Many researchers have used the term swelling potential. However, a clear definition of the term has not been established. Generally, swelling potential has been used to describe the ability of a soil to swell, in terms of volume change or the pressure required to prevent swelling. Therefore, it has two components: the swell percent which is defined as the percentage increase in height in relation to the original height, and the swell pressure which is designated as the pressure required to prevent swelling.

Swell percent: The swell percent of each test specimen

was measured using the loaded-swell method [15]. The apparatus used was the standard one-dimensional oedometer. The specimen in its ring was placed between two porous stones with load plate resting on the upper porous stone. The consolidation cell was assembled in the consolidation frame. The specimen was then loaded to a seating pressure of 25 kPa. The pressure was maintained until full settlement was achieved. The specimen was then flooded with water and allowed to swell under the seating load. Deformation readings were taken at 0, 0.5, 1.0, 2.0, 4.0, 8.0, 15.0, 30.0, 60.0, 120 and 1440 min, and then every four hours on subsequent days until no further changes in readings were observed and full swell was attained. The increase in vertical height of a sample, expressed as a percentage, due to the increase in moisture content was designated as the ‘‘swell percent’’.

Swell pressure: The swell pressure of each test specimen was measured using the constant volume method [15]. The specimen placement in the consolidation cell and the seating pressure (25 kPa) were the same as in the swell percent test. The specimen was then given free access to water, while the volume was kept constant by continuous addition of loads at each vertical expansion of the tested specimen. Loads were applied using sand added to a plastic bag hanging from the loading arm. The addition of loads was continued until deformation ceased.

3. RESULT AND DISCUSSION

3.1 Effect of Corn Husk on the Swelling Potential

Swell percent was carried out on untreated samples to measure these two parameters in order to examine the effect of the different proportion of corn husk additives on the reduction of the swelling potential of the soil. The swell percent value obtained was 1.02% at 35% of CH added. A summary of the swelling potential results is given in Table 2 and Chart 1.

Table 2: Swelling Potential result

Sample	Swell percentage
100 %Untreated soil(S)	11.39
97% S + 3% CH	9.02
95% S + 5%CH	8.63
91% S + 9% CH	6.03
90% S +10%CH	5.43
88% S +12% CH	5.32
85% S + 15%CH	4.44
82% S + 18%CH	3.23
80 % S + 20%CH	2.34
75 % S + 25%CH	2.12
70 % S + 30 %CH	2.01
68% S + 32%CH	1.34
65% S+ 35%CH	1.02

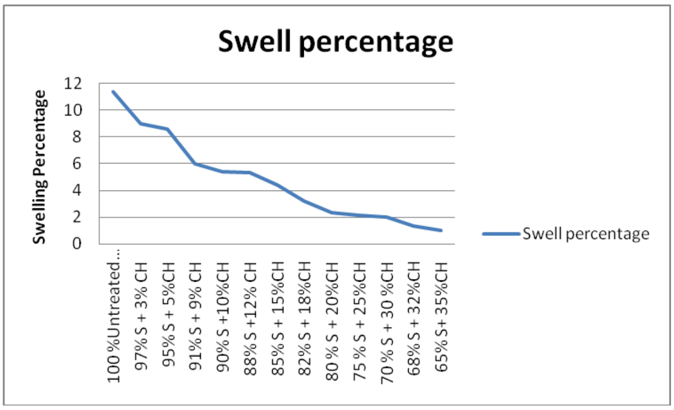

Chart 1: Effect of corn husk on Swell percentage

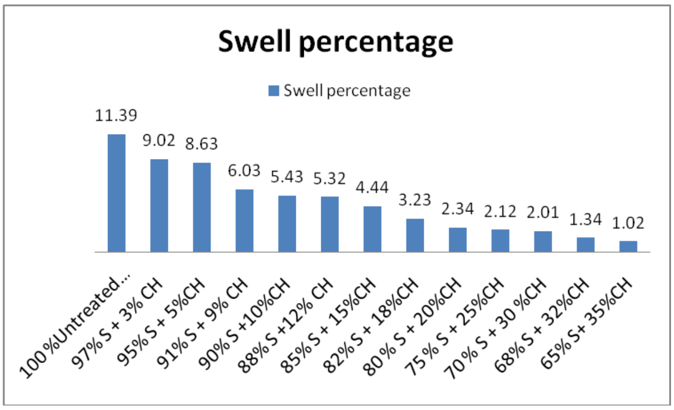

Chart 2: Effect of corn husk on Swell percentage

CH = Corn Husk

4. CONCLUSION

This paper evaluated the effect of Corn Husk on the swelling potential of expansive soil. Corn Husk caused a reduction in swell percent. With the addition of 35 % Corn Husk swell percent were reduced to 1.02.

REFERENCES

[1] Al-Rawas AA, Woodrow LKR. The distribution of expansive soils in Oman. Proceedings of the seventh international conference on expansive soils, Dallas, vol. 1, 1992. p. 432–7.

[2] Croft JB, The influence of soil mineralogical composition on cement stabilization Geotechnique, vol. 17, London, England, 1967. p. 119–135.

[3] Basma AA, Tuncer ER. Effect of lime on volume change and compressibility of expansive clays. Transportation Research Board, Washington DC, TRR No. 1296, 1991. p. 54–61.

[4] Sherwood PT. Soil stabilization with cement and lime: state-ofthe- art review. Transport Research Laboratory, London: Her Majesty's Stationery Office; 1993.

[5] Bell FG. Lime stabilization of clay minerals and soils. Engineering Geology 1996;42:223–37.

[6] Mir B.A.; A few investigations on the impact of fly debris and lime on physical and mechanical properties of far reaching mud; Global Diary of Structural Designing; Vol. 13, Nos. 3&4B, Exchange B: Geotechnical Designing, September and December 2015.

[7] Sharma, A.K.; Sivapullaiah, P.V.: Ground granulated impact heater slag revised fly debris as a broad soil stabilizer. Soils Found. 56(2), 205–212 (2016).

[8] Mendes carlos augusto de carvalho, Fernando antônio de oliveira adnet, Márcia christina amorim moreira leite,

Cristina russi guimarães furtado , Ana maria furtado de sousa; Compound, Physical, Mechanical, Warm and Morphological portrayal of corn husk buildup; 2014.

[9] JAN R. PRUSINSKI AND SANKAR BHATTACHARJA; Viability of Portland Concrete and Lime in Balancing out Mud Soils; TRANSPORTATION Exploration RECORD 1652.

[10] Benazzoug R. Bahar a, Kenai M. a; Execution of compacted concrete balanced out soil; Concrete and Solid Composites 26 (2004) 811–820

[11] Guneya Yucel,_, Sarib Dursun, Cetinc Murat, Tuncana Mustafa; Effect of cyclic wetting–drying on growing conduct of lime-balanced out soil; Building and Climate 42 (2007) 681–688.