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Experimental Study on Performance of Expansive Soil Stabilized with Treated Wheat Husk

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ABSTRACT

The improvement of unstable soil is thus called soil stabilization.The effect of use of waste material available in Amravati region such as wheat husk, Marble waste, coir fibers, iron oxide, etc. Wheat husk is one of the waste materials which can be used for expansive soil stabilization. It is a lignocelluloses waste product which is about 15–20 % of wheat and some extents of wheat husk uses as a scattle food. For better results it is necessary to treat wheat husk. It is treated with Sodium Hydroxide (NaOH) and Potassium Permanent ($KMnO_4$) chemicals at different percentages. In order to improve the charateristics of expansive soil the treated wheat husk is used. In this experimental study,by experimenting wheat husk with various treatment such as NaOH and $KMnO_4$ that improve the CBR values, reduce environmental hazards as well be very cost effective. Also the results obtained from the compaction properties and C.B.R. values between original soil sample and sample using treated waste material. Based on it**,** the conclusions will be made for effective, economical and ecofriendly method of soil stabilization.
Keywords : Wheat husk (WH), Sodium Hydroxide (NaOH), Potassium Permanent ($KMnO_4$)

I. INTRODUCTION

Construction is a very vital stage in execution of civil engineering structures. The expansive soil known as black cotton soil seem to be the most challenging type of soil encountered by engineer due to presence of montmorrillonite which is a mineral that is highly unstable thus leading to shrinking incineration are put back into the soil to improve engineering properties such and swelling of this type of soil on slight change in moisture content of black cotton soil. Since it not only uneconomical to excavate soil with poor engineering characteristics and replace from borrow sites with soil having better engineering properties but as well constitute environmental hazards, the use of material wastes but would have constituted such environmental hazards to the society through indiscriminate disposal or wrong method of the as California Bearing Ratio (CBR), Unconfined Compressive Strength (UCS), plasticity, liquid limit, Maximum Dry Density (MDD), Optimum Moisture Content (OMC)etc.

Soil stabilisation should performed to eliminate the risk of environmental concern, therefore there has to be a way to control the damage to the environment.

Scarcity of land with good bearing capacity is one of the major problems the word faces now. This leads to the construction of building on the available land which may not be good with respect to bearing capacity. For safety of the structure, it is necessary to improve the quality of soil by adopting of some ground improvement technique. The method of ground improvement technique adopted depends on the soil to be treated and availability of materials required for improving the soil and also on the cost effectiveness.

By using a particular waste material individually, a number of investigations have been performed by different researchers to improve the engineering properties of expansive soil such as index properties, compaction properties and C.B.R. value etc.

The soil which exhibit high volume change in moisture content are called expansive soil .Engineering classification of such soil is be done by various

mechanical parameters. In India expansive soil are heavy clay with montmorrillonite as the predominant clay mineral, exhibiting excessive swelling and shrinkage resulting in high volume changes.

Soil can be improved by using various wastes materials such as wheat straw, coir fiber, wheat husk etc.

II. METHODS AND MATERIAL

A. Methodology

Following test were carried out to determine the properties of virgin soil and wheat husk.

Determination of all index properties and engineering properties of soil.

1. Water Content (oven drying method) This method covers the determination of water content of soil expressed as a percentage of the oven dry method. IS 2720 (part-2) 1973.
2. Differential Free Swell index – IS 2720 Part-XI, 1972.
3. Grain size analysis – IS 2720 Part 4, 1985
4. Specific gravity - IS 2720 Part-3, 1980
5. Liquid limit and plastic limit - IS 2720 Part-5, 1985
6. Proctor Compaction – IS 2720 Part-8, 1983
7. CBR test – IS 2720 Part-16, 1987

B. Materials

Soil:

In this project, the soil was collected from Rahatgaon Village, Taluka Amravati, District Amravati, Maharashtra, India.

Figure 1. Photo-view of Virgin soil

Wheat Husk:

Wheat is planted to a limited extent as a forage crop for livestock and straw can be used as fodder for livestock or as a construction material for roofing thatch.

Wheat husk is a lignocelluloses waste product which is about15–20 % of wheat and some extents of wheat husk uses a scattle food and fuel .Also it contain some amount of light yellow colour fibers.

Figure 2.: Wheat Husk

Sodium Hydroxide (NaOH):

Sodium hydroxide is highly caustic base alkali, that decomposes protinns at ordinary ambient tempreture and may cause severe chemical burns. It is highly soluble in water and readily absorbs moisture and carbon dioxide from the air.

The influence of NaOH concentration in the range of 4M to 18M was systematically studies using Fourier Transform Infrared Spectroscopy (FTIR) for structural elucidation Scanning Electron Microscope (SEM) to observe the morphology and determination of mechanical properties (flexural strength) was carried out by Universal Testing Machine (UTM).

Figure 3. : Sodium Hydroxide (NaOH)

Potassium Permanganate ($KMnO_4$):

Potassium permanganate is a strong oxidizing agent. It dissolves in water to give intensely pink or purple solutions.

Figure 4.: Potassium Permanganate ($KMnO_4$)

Experimental Programme

Preparation of soil sample for test

Soil sample as received from the field is dried in the air. In wet weather a dying apparatus may be used in which case the temperature of the sample should not exceed 60 deg C. The organic matter like tree roots and pieces of bark is removed from the sample. Similarly matter like oil, shells is separated from the main soil sample, such sample taken for the testing.

Figure 5 . : Preparation of soil sample

Expansive soil having various engineering properties such as liquid limit, plastic limit, specific gravity, optimum moisture Content (OMC), calofornia bearing ratio (CBR) etc. According to various test performed on expansive soil, it is observed that expansive soil have 40% to 100% liquid limit and plastic limit is found to be in the range of 20% to60%.

The soil which is collected from Rahatagaon village at Amravati various test performed on it and following engineering properties were obtained

Table 1: Engineering Properties of Virgin Soil

Sr.No.	Engineering Properties	Values
1	Liquid Limit	49.01
2	Plastic Limit	37.50
3	Plasticity Index	11.51
4	Specific Gravity	2.61
5	Optimum Moisture Content(OMC)%	14.04
6	Maximum Dry Density(MDD)(gm/cm^3)	1.94
7	IS soil classification	CH
8	California Bearing Ratio (%) (Unsoaked)	4.83

Preparation of $KMnO_4$ and NaOH solution for test

The standard molar (M) concentration of $KMnO_4$ and NaOH for 24 hour are taken in a beaker from the chemistry lab so as to treat them with wheat husk, the solution so obtained is called treated wheat husk.

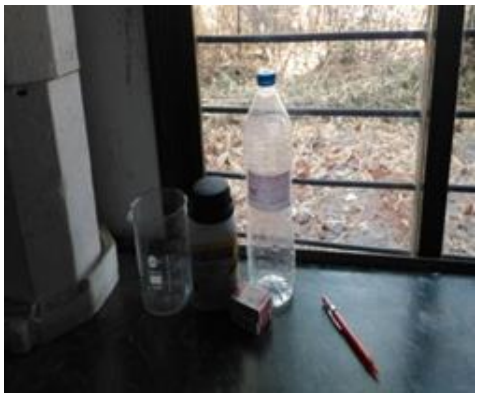

Figure 6. Preparation of $KMnO_4$ and NaOH

Studying the engineering properties of virgin soil, it needs stabilization. Hence, CBR test is performed on such soil at different percentages of wheat husk that is 0.5%, 0.75%, 1%, 2%, 3%. After that effective percentage of wheat husk is taken so that effective percentage of wheat husk is treated with standard molar (M) concentration of $KMnO_4$ and NaOH for 24 hour, such treatment of wheat husk is called treated wheat husk. Then CBR test is performed on virgin soil and treated wheat husk.

III. RESULTS AND DISCUSSION

According to engineering properties of virgin soil, it is found that the virgin soil is expansive in nature and IS classification is CH. By stabilizing such soil with different percentages of wheat husk and treated wheat husk CBR values are obtained.
Following compaction test results and CBR values are obtained by treating original soil with effective percentage of wheat husk and standard concentration of NaOH and $KMnO_4$.

Table 2: Compaction and CBR results

Sr No.	Materials	Proctor Test		CBR Values
		OMC (%)	MDD(gm/cm^3)	Unsoaked
1	**Original Soil**	**14.04**	**1.94**	**4.83**
2	Soil+0.5%WH	15.82	1.68	7.98-
3	Soil+0.75%WH	16.77	1.74	8.29
4	**Soil+1.0%WH**	**12.59**	**1.85**	**8.35**
5	Soil+2.0%WH	13.51	1.78	8.30
6	Soil+3.0%WH	10.49	1.79	8.10
7	Soil+1.0%WH+ NaOH	-	-	16.39
8	**Soil+1.0%WH +$KMnO_4$**	-	-	**10.98**

From the above table, as the quantity of wheat husk is added to the virgin soil sample the dry density increases up to 1.85 gm/ml further addition of wheat husk shows that dry density decreases. Hence 1% wheat husk is effective.

When wheat Husk is added in the virgin soil, CBR value is increases. Also Wheat Husk is treated with NaOH and $KMnO_4$ CBR value shows the better results. It is found that, CBR value is maximum when Wheat Husk is treated with NaOH solution.

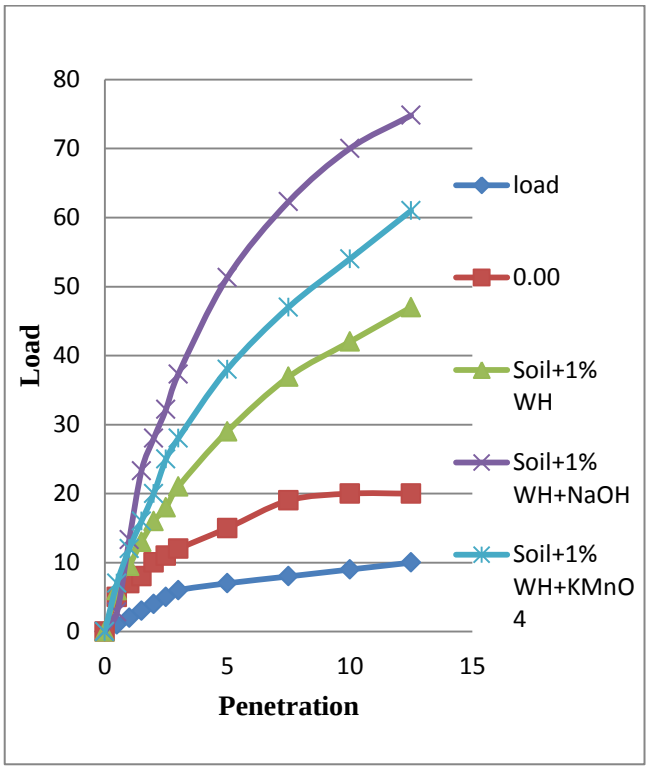

Figure 7. Unsoaked CBR values of untreated and treated wheat husk

The unsoaked CBR value of original soil sample is found to be 4.83%.When soil is treated with 1% wheat Husk CBR value increase by 8.35%, further it is treated with NaOH and KMnO4concentration CBR value increase by 16.39% and 10.98% ; which is represented by following graph.

According to observe results were performing the various test on expansive soil. It is found that 1% wheat husk is sufficient to increase the CBR value of original soil, also standard concentration of NaOH shows more remarkable effect on original soil sample than that of $KMnO_4$concentration.

IV. CONCLUCION

- Wheat husk is biodegradable, low cost and easily available waste product.
- The effect of 1% Wheat Husk on California Bearing Ratio is remarkable.
- After treating wheat husk with NaOH and $KMnO_4$ gives better results than that of untreated wheat husk.
- The treatment of NaOH shows better results than that of KMnO4.
- The standard concentration of NaOH and KMnO4are helpful to increase the CBR values.

V. REFERENCES

[1] A.O.Ogundalu1, G.L. Oyekan1, "E.A.Meshid (Vol.3, No.12, 2013), Effects of Steel Mill Scale on the strength characteristics of Expansive Clay Soil," Civil and Environmental Research, ISSN 2224-5790 (Paper) ISSN 2225-0514 ,

[2] A. K. Raji, R. Karthika, G. R. Amrutha lekshmi, Anju K. Peter, M. Mohamed Sajeer, (December,15-17, 2011), "Study Of Rut Behaviour Of Coir Reinforced Black Cotton Soil Using Wheel TrackinApparatus", Proceedings of Indian Geotechnical Conference, Kochi (Paper No.J-258)

[3] Andrzej K. Bledzki, Abdullah A. Mamuna, Jürgen Volk, composites: part a 41 (2010) "Physical, Chemical and Surface Properties of Wheat Husk, Rye Husk and Soft Wood and Their Polypropylene composites", 480–488

[4] Arash Barazesh, Hamidreza Saba, Mehdi Gharib, 2349-2354, Science Explorer Publications,(2012) "The Effect Of Adding Iron Powder On Atterberg Limits Of Clay Soils", International Research Journal of Applied and Basic Sciences,,ISSN 2251-838X / Vol, 3 (11):

[5] Chayan Gupta1, Dr. Ravi Kumar Sharma, (2014) "Influence of Marble Dust, Fly Ash and Beas Sand on Sub Grade Characteristics of Expansive Soil", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN,

[6] E.A. Meshida, G.L.Oyekan, A.O.Ogundalu, (May-2013) "Effects of Steel Mill Dust on the Strength Characteristics of Black Cotton Clay Soils", International Journal of Scientific & Engineering Research, Volume 4, Issue 5