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EFFECT OF WHEAT STRAW ON THE SPECIFIC GRAVITY, OPTIMUM MOISTURE CONTENT AND MAXIMUM DRY DENSITY OF CLAYEY SOIL

Gul Muhammad[1*], Amanullah Marri[2], Ali Asghar[3], Jahanzaib Sherani[4]

[1,4] Ziauddin University, Faculty of Engineering Science Technology & Management, Department of Civil Engineering, Karachi, Sindh Pakistan 75050.

[2] NED University of Engineering & Technology, Department of Civil Engineering, Karachi, Sindh Pakistan 75270.

[3] Tongji University, Department of Civil Engineering, Shanghai, China, 200070.

Corresponding Author: Gul Muhammad *

ABSTRACT

Worldwide, clayey soils are common and abundant. Large lakes, marine basins, and river deltas are examples of depositional systems with relatively little energy that are typically associated with clayey soil deposits. It is believed that clayey soils are more susceptible to variations in moisture. In addition, these soils provide a variety of difficulties, including excessive compressibility, water softening, limited bearing capacity, and expansive qualities. The aim of this study is to determine the specific gravity,optimum moisture content and maximum dry density on the clayey soil with the impact of wheat straw.The previous studies mainly focused on the the chemical properties shearstrength characteristics and biological properties of clayey soil with the adding of natural fibers content.it is little focused on the influence of wheat starw on the average specific gravity and compaction characteristics of clayey soil.In present investigation the wheat straw fiber is incorporated in a clayey soil sample at the dosages of 0% (standard sample), 2%, 4%, 6% , 8% and 10% by weight and apply the modified proctor test on the samples and the average specific gravity was determined by applying the equation. The test findings show that increasing the percentages of wheat straw components causes a drop in maximum dry density and specific gravity and an increase in optimal moisture content.

Keywords: Wheat Straw, Optimum Moisture Content, Specific Gravity, Maximum Dry Density

1. INTRODUCTION

The procedure of altering the soil properties to meet design requirements is known as "ground improvement." The idea of modifying soil through the use of soil stabilizing chemicals dates back countless years. (Mitchell 1981). To improve outcomes, soil stabilization involves modifying the physical features of the soil. The mechanical qualities of soil stabilization can be increased, enhancing the supporting foundations' capacity to support loads. [1-4]. Even now, many regions of the world are beginning to embrace soil stabilization using bituminous materials, Portland cement, lime, lime-fly ash, fibers, and geogrids. [5]. It is possible to alter the soil's different mechanical and physical properties by using a soil stabilizing agent. Therefore, Soil reinforcement is one way to modify the qualities of the soil. These days, fiber material is added to soil to improve its mechanical performance and strength. [6-9]. Fine grain soil are thought to be extra sensitive to water content; for example, they can be as hard as rocks when completely dry or as mushy as a flowing fluid when extremely damp. Thus, Clayey soils behave in a way that varies with moisture content, going from a solid to a liquid state. Both natural and synthetic fibers are utilized to strengthen the ground, with numerous researchers using natural fibers to reinforce the soil. [9-18]. The maximum dry density (MDD) of clayey soil is contingent upon various aspects, such as the particular kind of clay, its mineral makeup, and the properties of its compaction. Usually, laboratory tests—the Proctor compaction test or the Modified Proctor compaction test—are used to determine the MDD Generally speaking, clayey soils have lower maximum dry densities than sandy soils. The soil composition, compaction effort, and moisture content are some of the variables that affect the MDD. It is noteworthy that the ideal moisture contents and maximum dry densities of various clayey soils may vary. To find the maximal dry density for a particular clayey soil, you must compaction test representative samples in a lab. In these tests, the soil is compacted at different moisture contents, and the dry densities that result are measured. The point at which the highest dry density is attained is called the optimum moisture content.

2. MATERIALS AND METHODS

The soil which was used in this study as shown in Figure 1.The specific gravity of the clayey soil (Gs) is 2.68.The Figure 12 shows the threshed wheat straw stock at the agricultural farm

land. Figure 3 shows the grading curve of used clayey soil. The basic physical properties of Wheat straw (WS) are given in

Table 1.The MDD and OMC of the clayey soil and soil with wheat straw content was obtained as per ASTM D1557 – 07 method.

Figure 1.Clayey soil

Figure 2. Threshed Wheat straw

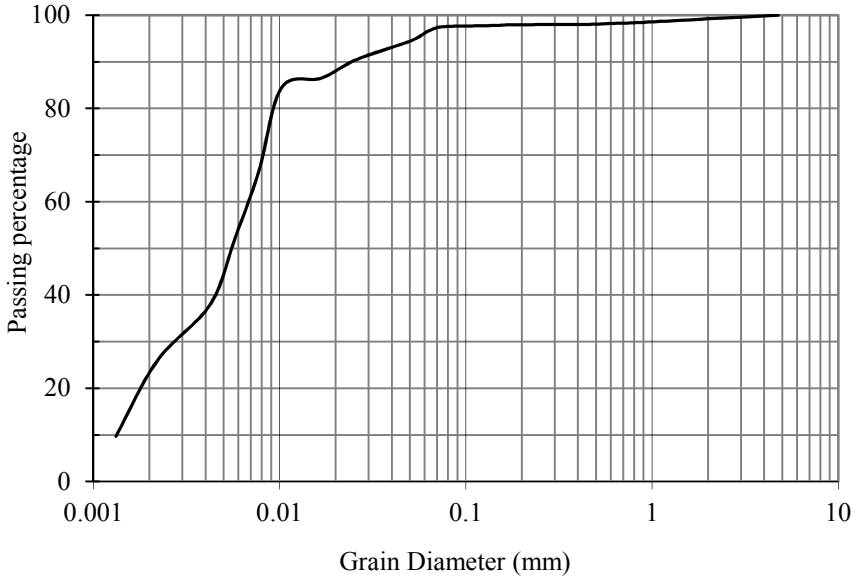

Figure 3.Grading curve of clayey soil

Table 1.Wheat Straw Properties [19]

Average length, L (mm)	Average diameter, D (mm)	Water Absorption (%)	Specific gravity (Gs)	Tensile strength (MPa)
18.4	3.1	300% (After 24 h)	0.34-0.38	10.133 (1470 psi)

3. EXPERIMENTAL SETUP

The compaction properties of clayey soil mixed with varying amounts of wheat straw were ascertained using a modified Proctor compaction test. The motorized modified Proctor test setup are displayed in Figure 4. The specific gravity of the composite materials can be ascertained using the weightage average of the specific gravity. The following equation (1) was utilized to get the average specific gravity.

$$G_{av} = \frac{100-F}{100} \times G_{soil} + \frac{F}{100} \times G_{Fibre} \quad \text{Equation (1)}$$

Where; F is the wheat straw fiber content percentage-wise, G_{av} is the average specific gravity of combined content.

(a) Modified Proctor test apparatus (b) Modified proctor during Testing

Figure 4. Modified Proctor Test

4. SAMPLE PREPARATION

The clayey soil sample is taken from the District East of Karachi Division – Pakistan the soil sample for modified proctor test was prepared to add after adding many amounts of wheat straw by the dry weight of the soil, the soil was sufficiently "dry mixed" before being combined with water and completely mixed once more, a process known as "wet mixing." as depicted in the Figure 5. The determination of OMC and MDD at each fiber content was then done using modified Proctor compaction tests.

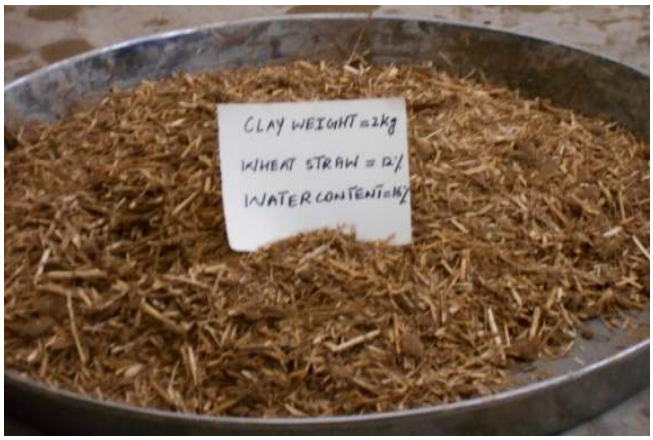

Figure 5.Wet mixing of soil with wheat straw

5. RESULTS AND DISCUSSION

5.1 AVERAGE SPECIFIC GRAVITY AND THE IMPACT OF WHEAT STRAW

Each component of a composite material may have a different specific gravity. Therefore, the specific gravity of the contents that combine might be ascertained using the weighted average of the specific gravity. It was discovered that the average specific gravity of clayey soil was 2.60 and that of wheat straw was 0.34. Based on the percentage of wheat straw, the average specific gravity is given in Table 2. Average specific gravity of composite soil soil samples The impact of adding wheat straw as a percentage is displayed in Figure 6. The figure shows that as the amount of wheat straw

increases, the average specific gravity of the combine contents gradually decreases. This might be as a result of wheat straw's comparatively low specific gravity of 0.34 compared to soil's 2.60 specific gravity. A decrease in specific gravity was also noted in earlier research when comparatively light materials were added. For example, adding polypropylene fiber to black cotton soil resulted in a decrease in specific gravity reported by Naranagowda, Kumar [20].

Table 2. Average specific gravity of composite soil soil samples

Reinforcement %	**specific gravity of used soil G_{soil}**	**Wheat straw specific gravity G_{ws}**	**G_{av} with wheat straw content**
0	2.60	0.34	2.60
2	2.60	0.34	2.56
4	2.60	0.34	2.51
6	2.60	0.34	2.47
8	2.60	0.34	2.42
10	2.60	0.34	2.38

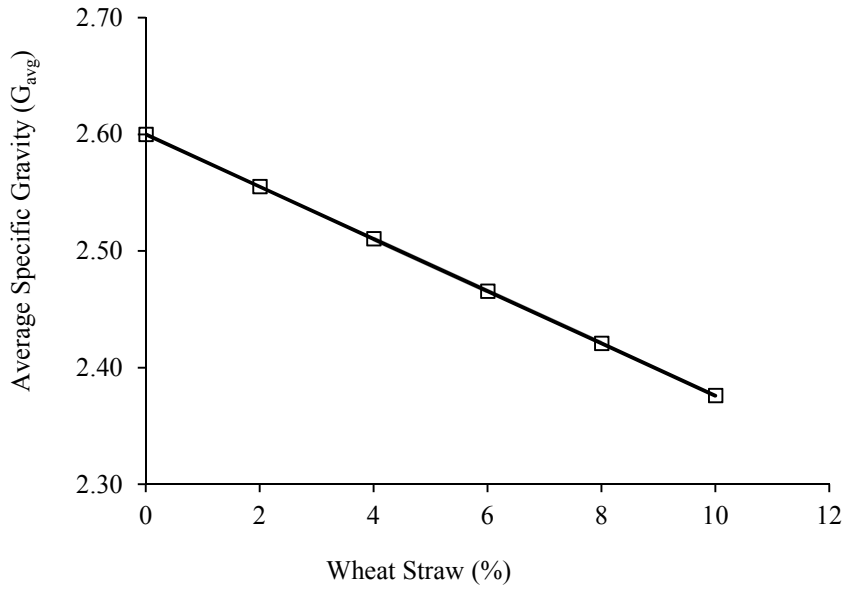

Figure 6. Result of the G_{avg} of soil

5.2 WHEAT STRAW IMPACT ON OPTIMUM MOISTURE CONTENT (OMC)

The impact of different percentages of wheat straw content on the OMC are shown in Figure 7. The graph indicates that when the proportion of wheat straw content is increasing, which causes the OMC to gradually rise. The observed 300% absorption of wheat straw may be the cause of the

rise in the ideal moisture content. Parallel outcomes about wheat straw were also stated in the literature by [21-24] .

Table 3. OMC values at different content of WS

Wheat straw content (%)	Optimum Moisture Content (OMC)
0	16
2	17
4	18
6	20
8	22
10	24

Figure 7. Impact of WS on the OMC

5.3 IMPACT OF WHEAT STRAW ON MAXIMUM DRY DENSITY

In terms of maximum dry density (MDD), the impacts of varying proportions of wheat straw added by dry weight to the soil were measured. The wheat straw contents and the corresponding MDD or dry unit weight values are shown in Table 4. Compaction curves developed by Proctor are shown in Figure 8. The figure revealed that the addition of wheat straw into the clayey soil

resulting in a decrease in the MDD. The weight difference between the primary material (specific gravity Gs = 2.6 approx.) and wheat straw (G_F = 0.36 approx.) may be the cause of the MDD decrease. Parallel results about wheat straw were also reported in the literature by [25-27].

Table 4. Dry unit weight values at different amount of WS

Wheat straw content (%)	Unit weight (kN/m^3)	Dry unit weight (kN/m^3)
0	20.91	18.02
2	19.76	16.88
4	18.66	15.82
6	17.74	14.78
8	17.05	13.97
10	15.85	12.78

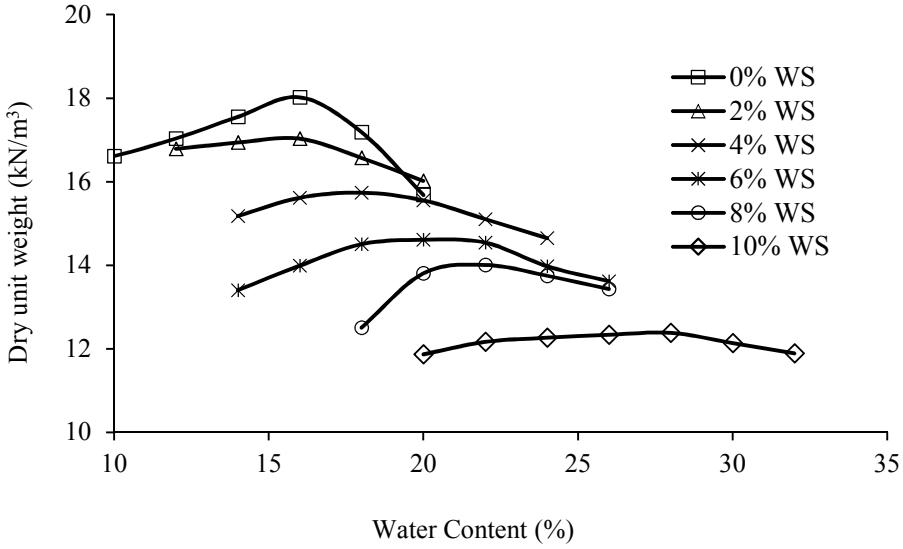

Figure 8. Dry unit weight values with wheat straw contents

6. CONCLUSION

It is possible to conclude from the compaction characteristic data that wheat straw was applied to the clayey soil at a concentration of 0% to 10% and that its effects on the OMC and MDD were investigated. The test results show that when the amount of wheat straw increases, the OMC

increases and the MDD decreases. The maximum dry unit weight of clayey soil is decreased by 18.02 to 12.78 kN/m^3 upon addition of wheat straw content at 10%. While the Optimum moisture content is increased by 16 to 24%. Matching outcomes were also stated by other researchers for addition of natural fibers in the soil.

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