Experimental Study on The Effect of Tea Waste And Silica Fume In The Engineering Properties of Weak Soil

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Abstract- *Weak soil poses significant challenges in construction projects, often requiring extensive stabilization techniques to enhance their engineering properties. In this experimental study, we investigate the potential of utilizing two unconventional materials, tea waste and silica fume, to improve the mechanical characteristics of weak soil. The research aims to contribute to sustainable and cost-effective solution for soil stabilization, particularly in regions where weak soils are prevalent. The study consists of series of laboratory tests conducted on weak soil samples collected from a site with low bearing capacity. Tea waste, a readily available organic waste material, and silica fume, an industrial byproduct, were incorporated into the soil in varying proportions. The key parameters examined include the soil compressive strength.*

Keywords- Tea waste, Silica Fume, weak Soil, Soil Compressive Strength.

I. INTRODUCTION

In this experimental study, the focus is on investigating the impact of two distinct additives, silica fume and tea waste, on the engineering properties of weak soil. Silica fume, a byproduct of silicon metal production, and tea waste, derived from used tea leaves, are chosen for their potential to enhance soil strength and stability. Weak soils pose significant challenges in construction and infrastructure development, often requiring innovative solutions to improve their mechanical properties. Silica fume, known for its pozzolanic properties, is expected to contribute to soil stabilization by enhancing the cementitious characteristics of the weak soil matrix.

The experimental setup involves a series of tests to assess key engineering properties of the treated soil samples.The study aims to provide valuable insights into the effectiveness of silica fume and tea waste as soil stabilizers, shedding light on their respective roles in enhancing the overall performance of weak soils. Understanding the influence of these additives on soil behavior is crucial for sustainable and cost-effective geotechnical solutions.By exploring the synergistic effects of silica fume and tea waste on weak soils, this research contributes to the ongoing efforts to develop efficient and ecofriendly soil stabilization techniques in civil engineering.

II. LITERATURE REVIEW

1. M.W. Tjaronge et al.., (2022) In this study, the feasibility of PWTA as a cement replacement in concrete was investigated, and its effects on the embodied carbon in concrete were discussed. The following conclusions can be drawn from the test results: The slump value of concrete decreased with an increase in the amount of PWTA in the mixture but was still above 20 mm for practical application. PWTA concrete exhibited a lower fresh density than normal concrete. This is because the specific gravity value of PWTA is lower than.

2.Savas Ozturk et al.., (2019) Transforming from a consumer society to sustainable is very crucial for our future in the modern world. In this respect, industrial by-products have been used as raw materials in other industries. Construction and building industry is an important sector with high capable of recycling many kinds of waste material to useful products. The purpose of this study was determination of household tea waste in production of clay based baked bricks.

3.SumitGaikwad et al..,(2019) The study found that a mixture of waste paper sludge and Activated Charcoal Powder can effectively substitute cement in concrete production. This combination notably improved compressive, flexural, and split tensile strengths in various proportions, offering increased durability, especially with 10% PS and 1% ACP. Additionally, it was observed to be more cost-effective for bulk construction when compared physical.

4.P. Singh, et al..,(2020) Investigating the effect of SF on different engineering properties of Expansive soil was ultimate goal of this research. This study shows the effective utilization of SF to dwindle the outcome of swelling in expansive soils. Different soil samples were prepared with varying percentage of silica fume in expansive soil and their compaction properties, DFS, UCS, C, ϕ were compared to obtain a suitable proportion with required strength.

III.MATERIALS AND METHODOLOGY

3.1 MATERIALS USED

3.1.1 Weak soil

Weak soil is a type of soil which contains saturated clays, fine silts and loose sand. This soil has less bearing capacity and strength. Weak soil is not used for any construction purposes, mostly seen in paddy field and damped areas.This soil is collected from paddy field nearKaduvapallyTrivandrum,Kerala.

Fig 3.1.1 Weak soil

Table 1: Property analysis of soil collected from site

Sl no	Properties	Result
1	Water content(%)	36
2	Gravel(%)	5.7
3	Coarse sand (%)	24.3
4	Medium sand (%)	48
5	Fine sand (%)	21.1
6	Silt (%)	0.9
7	UCS (kg/sq.cm)	0.475
8	Liquid limit (%)	38
9	Compaction (g/cc)	18
10	CBR (%)	0.1925-0.209 (Extremely weak)

3.1.2 Silica fume

Silicafume is by-product from the production of alloy containing silicon in electric arc furnace. It is used as an admixture in concrete because of its better engineering properties.

Fig 3.1.2 Silica fume

3.13 Tea waste

Tea waste is the residue that remain after tea.

This waste include discardedTea leaves, buds and tender stems of tea plants. Addition of tea waste with soil in a specific proportion improves microbial activity and bearing capacity.

Fig 3.1.3 Tea waste

3.2 METHODOLOGY

This project follows the step given below:

- The soil has been collected from the site nearKaduvapally and studied the properties of the soil.
- Then determine the strength of the soil by adding Silica fume and Tea waste.

3.2.1 Tests for the soil

Standard proctor Compaction test

Test used to find the optimum moisture content and Maximum dry density. OMC is the moisture content at which soil attains maximum dry density. Dry density is the ratio of the mass of solid to the total volume of soil.

Unconfined compressive strength test

It is the load per unit area at which the cylindrical specimen of a cohesive soil fails in compression

Qu=P/A
P- Axial load at failure
A- Corrected area

IV. RESULTS

Table 2:Change in properties of soil after adding Silica fume (SF)

Quantity of SF (%)	OMC (%)	MDD (g/cc)	UCS (Kg/sq.cm)
10	18	1.62	0.216
12	24	1.73	0.734
14	27	1.60	0.273
16	24	1.22	0.691

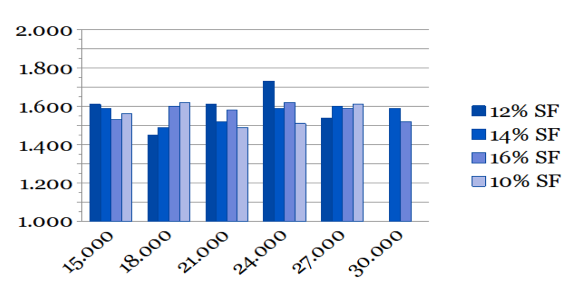

Fig 4.1: Graph showing variations in water content and Maximum dry density while adding SF

Table 3:Change in properties of soil after adding Tea waste (TW)

Quantity of TW (%)	OMC (%)	MDD (g/cc)	UCS (Kg/sq.cm)
10	30	1.57	0.374
12	27	1.32	0.575
14	27	1.22	0.446
16	30	1.17	0.216

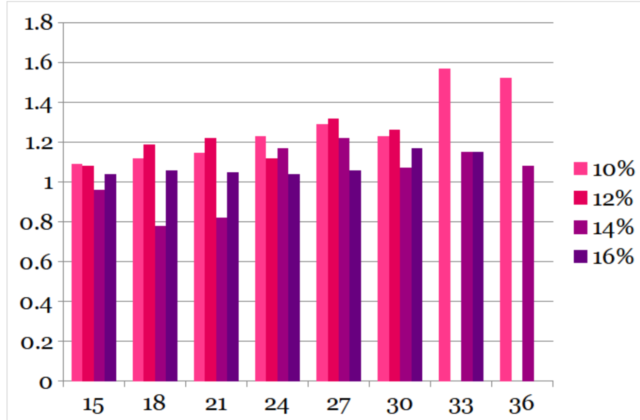

Fig 2: Graph showing variation in water content and maximum dry density while adding TW

Table 4: Changes in properties of soil by adding SF and TW

Quantity of SF and TW (%)	OMC (%)	MDD (g/cc)	UCS (Kg/sq.cm)
SF5%+TW 5%	30	1.69	0.559
SF6%+TW 6%	33	1.50	0.809
SF7%+TW7%	27	1.39	0.461
SF8%+TW8%	33	1.51	0.777

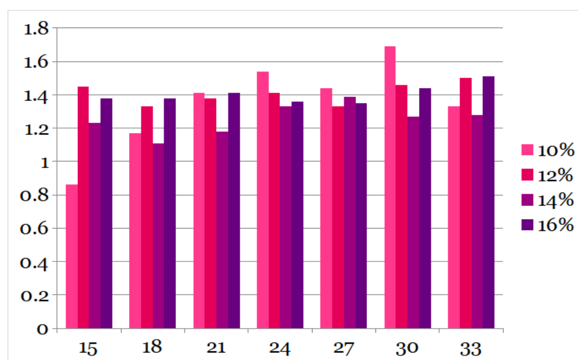

Fig 3: Graph showing variation in water content and maximum dry density while adding SF and TW

V. CONCLUSION

1. By the addition of 12% SF, soil attain its maximum strength (0.734 Kg/sq.cm).
2. By the addition of 12% TW, soil attains maximum strength (0.575 Kg/sq.cm).

3. By the addition of 12% (SF 6%+TW6%) TW and SF, soil attains maximum strength (0.809 Kg/sq.cm).
4. Individual addition of TW and SF in the soilshows less strength comparing with mixed addition of TW and SF into the soil.

REFERENCES

[1] J K (2019) Soil Stabilization using Used Tea Leaves with Lime International Journal for Research in Applied Science and Engineering Technology 7 162–6

[2] Kassa R B, Workie T, Abdela A, Fekade M, Saleh M and Dejene Y 2020 Soil Stabilization Using Waste Plastic Materials Open Journal of Civil Engineering 10 55

[3] Wubshet M (2013) Bagasse ash as a sub-grade soil stabilizing material Addis Ababa Institute of Technology

[4] Sunny T and Joy A(2016) Study on the effects of marine clay stabilized with banana fiber International Journal of Scientific Engineering and Research 4 96-8

[5] Kharade A S, Surya vanshi V V, Gujar B S and Deshmukh R R(2014) Waste product bagasse ash from sugar industry can be used as stabilizing material for expansive soils International Journal of Research in Engineering and Technology 3 506-12

[6] Mansour Ebailila, John Kinuthia, Jonathan Oti, Qusai Al-Waked(2022) “Sulfate soil stabilisation with binary blends of lime–silica fume and lime–ground granulated blast furnace slag”

[7] M.W. Tjaronge , IrwanRidwan Rahim, Rita Irmawaty , Franky E.P. Lapian(2022) “Feasibility study on the use of processed waste tea ash as cement replacement for sustainable concrete production”

[8] Savas Ozturk, MucahitSutcu, ErtugrulErdogmus , Osman Gencel(2019) “Influence of tea waste concentration in the physical, mechanical and thermal properties of brick clay mixtures”

[9] P. Singh, H. Kumar Dash and S. Samantaray(2020)“Effect of silica fume on engineering properties of expansive soil”