

An Experimental Study on Sustainable Soil Stabilization Using Copper Slag and Nylon Fiber

Pooja¹, Anoop Sharma²

¹PG student, Dept. of Civil Engineering, Sri Sai College of Engineering & Technology, Badhani, Punjab, India

²Assistant Professor, Dept. of Civil Engineering, Sri Sai College Of Engineering & Technology, Badhani, Punjab, India

anoopsharma777r@gmail.com

Abstract - The performance of civil engineering structures largely depends on the strength and stability of the supporting soil. Clayey soils often exhibit undesirable engineering characteristics, including low shear strength, high plasticity, excessive compressibility, and significant shrink-swell behavior, which may lead to structural distress. Improving these properties through sustainable stabilization techniques has become an important area of geotechnical research. The use of industrial by-products and synthetic reinforcing materials not only enhances soil performance but also supports environmentally responsible construction practices by reducing industrial waste. The present investigation focuses on evaluating the effectiveness of copper slag and nylon fiber as stabilizing materials for clayey soil. Copper slag, an industrial by-product obtained from the copper smelting process, is used at 10%, 20%, and 30% by the dry weight of soil, whereas nylon fiber is incorporated at 0.5%, 1.0%, and 1.5%. The untreated soil is considered as the reference sample to assess the improvement achieved after stabilization. The study is carried out through a systematic experimental program following relevant Indian Standard testing procedures. Laboratory investigations include the determination of index properties, compaction characteristics, and engineering properties of the stabilized soil. Tests such as Specific Gravity, Atterberg Limits, Standard Proctor Compaction, Unconfined Compressive Strength (UCS), and California Bearing Ratio (CBR) are performed to evaluate the influence of different combinations of copper slag and nylon fiber. The experimental results are analyzed to determine the optimum dosage that provides maximum improvement in the engineering behavior of the soil. The incorporation of copper slag is expected to improve the density, load-bearing capacity, and strength of the soil due to its granular nature, while nylon fiber is anticipated to enhance ductility, reduce crack formation, and improve resistance to deformation under loading.

The combined effect of these stabilizers is expected to produce a stronger and more durable stabilized soil suitable for subgrade, embankment, and foundation applications. In addition to improving engineering performance, this study encourages the productive utilization of industrial waste, thereby contributing to sustainable infrastructure development and environmental conservation. The findings are expected to provide a practical and economical stabilization technique for the effective treatment of problematic clayey soils.

Key Words: Compaction test, CBR, UCS, Copper Slag, Nylon Fiber

1. INTRODUCTION

Soil is a non-slip deposit or a combination of minerals, organic matter, and fragments that envelops the majority of the earth's crust. Therefore, soil structures are subject to variation on a global scale due to the existence of various soil varieties. Vast soils comprise approximately 20% of the landmass in India. We are aware that soil experiences a decrease in shear strength when it is saturated with water. Therefore, it is imperative that the soil used to construct an engineering structure be of an adequate strength. Hence, when it is imperative to enhance soil engineering structures and assess the appropriateness of soil stabilization techniques. Soil consolidation is the process of modifying one or more areas of soil to enhance soil performance by utilizing a soil stabilizer. Consequently, sustainability is implemented in a diverse array of engineering endeavors. The most prevalent application of soil consolidation is in the construction of roads and airfield pavements, where the primary objective is to enhance the soil's strength or suitability. We are all aware that landslides can be caused by a variety of factors, including intense rainfall, earthquakes, melting snow, and human activities. Consequently, the ground structures are disrupted. Soil erosion is a common

occurrence in numerous regions due to the use of soil compaction to prevent landslides.

Two significant methods are employed to stabilize the soil: chemical stabilization and mechanical stabilization. Chemical compounds are employed to enhance soil stability. To achieve this stability, a specific chemical compound is introduced into the expanded soil. At times, mechanical stabilization is neither economically viable nor practicable, and it is not advisable to replace undesirable soil with desirable soil.

This method results in changes to soil properties, including ground strength, compression, hydraulic conductivity, and soil volume. Rollers, plate compactors, and tampers are employed to apply mechanical power to enhance soil structures through bonding. This procedure is known as mechanical reinforcement. It is extensively employed in the construction of railroads, road barriers, and other structures. Mechanical stabilization is a straightforward method of stabilization. Mechanical stability is contingent upon the degree of compression, which is typically the compression that is generated by high humidity. It is employed to enhance the lower levels of low load capacity and the construction of foundations, lower foundations, and over roads.

1.1 Copper Slag

Copper slag is generated during the pyrometallurgical extraction of copper from its ores. Approximately 2.2 tons of slag is generated for every ton of steel produced. At now, the global production of slag amounts to 33 tons, with three Indian manufacturers—Sterlite Copper, Birla Copper, and Hindustan Copper—generate 6 to 6.5 tons of slag across several sites. The annual output of copper slag is from 120 to 130 tons per lakh. India's copper manufacturing facilities generate thousands of tons of copper slag as daily refuse. The management of slag heaps presents an inherent difficulty. The exceptional physicommechanical characteristics of copper slag render it advantageous for applications such as concrete additives, construction filters, ballast, abrasives, aggregates, roofing granules, glass, and tiles. (Granular material, pulverized from natural stones)It is broadly endorsed by ready-mixed concrete producers and governmental road authorities for concrete application in accordance with BIS ARE 383: 2016 (Bureau of Indian Standards) in numerous prior regions. Numerous corridor initiatives have recently employed these alternatives, thereby preventing the exhaustion of precious natural resources that aid in environmental preservation and sustainability. India is projected to

emerge as the sixth largest copper market by 2020, with the Electrical, Transport, and Telecommunications sectors being the predominant users. The application of copper slag as a substitute in many sectors has been extensively evaluated over the last ten years. Investigations on the application of copper slag as a substitute for coarse or fine aggregate demonstrate its appropriateness as a construction material.

➤ The Benefits of Using the Copper Slag

The benefits of copper slag are as follows,

- 1) The use of copper slag in road construction helps to reduce environmental impacts due to excavation.
- 2) Using copper slag in construction reduces waste volume, reduces environmental concerns such as metallurgy, groundwater pollution and solves the waste disposal problem for disposal.
- 3) Copper slag used as an alternative material can meet the growing demand for natural building blocks. Using such Industrial waste leads to sustainability and economy in construction.



Fig.1. Copper Slag sample

- 4) In areas such as Kerala, Maharashtra and Gujarat, sand mining in rivers has been banned due to environmental impact. Therefore, slag has great potential for development as another suitable material for these resources.
- 5) Its new use in stabilization is found to increase soil strength.
- 6) Copper slag is also suitable as filler for land reclamation.

1.2 Nylon Fiber

Nylon Fiber 6 is a synthetic polymer engineered to emulate the characteristics of nylon 6, 6. It is a partially crystalline polyamide. Nylon 6 fiber is robust,

exhibiting significant tensile strength, flexibility, and sheen, along with superior abrasion resistance. Nylon 6 is typically white, although it can be colored in a solution bath before manufacturing to achieve various hues. Nylon fiber is used in soil stabilization to increase the load carrying capacity of soil via the frictional interaction between the soil and the reinforcement and it should be randomly mixed with soil in correct amounts.

Nylon fiber has good elasticity characteristics and it is very resistant to abrasion and temperature therefore it can be utilized in high temperatures as well. The aspect ratio of nylon fiber i.e. L/D ratio of fiber is the decisive element for the size that is to be employed. The monomer of nylon 6 is caprolactam ($C_6H_{11}NO$). A 7-membered cyclic amide (lactam) comprising a 6-carbon chain.



Fig.1.2 Nylon Fiber (Nylon 6) sample

2. Literature Review

H.N Sridhar et al. (2026) Industrial byproducts are progressively utilized in geotechnical engineering as substitutes for cement, providing economical and eco-friendly options. This research examines the California Bearing Ratio (CBR) and unconfined compressive strength (UCS) of lateritic soil enhanced with red mud (RM), copper slag (CS), and iron ore tailings (IOT) in ratios ranging from 5% to 45%. A methodical laboratory initiative produced 155 experimental datasets, which were subsequently utilized to construct prediction models employing machine learning methods such as K-Nearest Neighbors (KNN), Decision Tree Regressor (DTR), Random Forest Regressor (RFR), and Multi-Layer Perceptron (MLP). Statistical metrics such as the coefficient of determination (R^2), root mean square error (RMSE), and mean absolute error (MAE), in conjunction with Taylor diagrams and Regression Error Characteristic (REC) curves, were utilized for the assessment of the model. RFR and MLP attained R^2 values exceeding 0.90, indicating exceptional performance. SHAP (SHapley Additive exPlanations)

study identified curing duration, maximum dry density (MDD), and CS dosage as the most significant factors. Findings validated that 30% CS markedly improves both UCS and CBR, indicating its efficacy as an additional stabilizer. The research presents a comprehensive experimental machine learning system that accurately forecasts UCS and CBR while offering mechanistic insights, hence endorsing circular economy initiatives and sustainable pavement design.

Vijayan et al. (2026)

Waste materials from industry are being more frequently employed in geotechnical engineering as alternative components to cement, presenting budget-friendly and sustainable solutions. This analysis explores the California Bearing Ratio (CBR) and unconfined compressive strength (UCS) of lateritic soil fortified with red mud (RM), copper slag (CS), and iron ore tailings (IOT) in varying fractions of 5% to 45%. An organized laboratory program yielded 155 experimental datasets, which were later applied to formulate predictive models using machine learning techniques like K-Nearest Neighbors (KNN), Decision Tree Regressor (DTR), Random Forest Regressor (RFR), and Multi-Layer Perceptron (MLP). The evaluation of the model employed statistical indicators including the coefficient of determination (R^2), root mean square error (RMSE), and mean absolute error (MAE), alongside Taylor diagrams and Regression Error Characteristic (REC) curves. RFR and MLP reached R^2 values greater than 0.90, demonstrating outstanding efficacy. Outcomes substantiated that 30% CS considerably boosts both UCS and CBR, highlighting its promise as a supplementary stabilizer. This investigation introduces a solid experimental machine learning framework that not only delivers precise predictions for UCS and CBR but also imparts mechanistic understanding, facilitating circular economy strategies and low-carbon pavement development.

Sridhar et al. (2026)

The rising need for eco-friendly construction materials has prompted initiatives to substitute conventional cement-based stabilizers due to their significant carbon emissions. This research examined the application of industrial byproducts, specifically copper slag (CS), iron ore tailings (IOT), and red mud (RM), as sustainable substitutes for cement in the stabilization of Lateritic Soil (LS) inside pavement subgrades. A thorough experimental protocol was employed to evaluate the

impact of these additions on the Atterberg limits, compaction properties, unconfined compressive strength (UCS), California bearing ratio (CBR), permeability, and fatigue lifespan. Among the stabilizers, 30% CS produced the most favorable results. Diminishing the plasticity index from 14% to 8%, elevating the maximum dry density to 2.15 g/cc (up from 1.93 g/cc), and lowering the optimal moisture content to 10.5%. Following a 28-day curing period, the UCS escalated from 365 kPa to 1121 kPa (a 207% enhancement), while the unsoaked and soaked CBRs advanced from 20% to 73% and from 6% to 18.8%, respectively. The endurance lifespan at 1/3 UCS increased from 5,324 to 87,351 cycles, surpassing the 6% cement-treated soil's lifespan of 73,221 cycles. The CS-stabilized soil exhibited moderate permeability (1.35×10^{-5} cm/s) and enhanced microstructural cohesion, as verified by SEM examination. These findings confirm that 30% CS serves as a high-efficiency, low-carbon substitute for cement in improving LS in pavement subgrades, providing both ecological and technical advantages.

Kashyap Warikoo et al. (2023)

The assessment commences with fundamental principles of soil stability and factors influencing additive selection. It subsequently analyzes copper slag and cement as agents for soil stabilization. The effects of copper slag and cement on the compaction, strength, permeability, and durability of stabilized soils are analyzed. The document additionally examines both laboratory and field studies concerning copper slag and cement soil stabilizers. Copper slag and cement enhance the geotechnical properties of soil, such as its load-bearing ability, compaction, and resistance to erosion. Effective implementation of copper slag and cement stabilization techniques necessitates attention to appropriate dosage, environmental factors, and durability over time. Various soil classifications, ecological factors, and the resilience of stabilized soil require additional investigation. The assessment determines that copper slag and cement possess the ability to stabilize soil. Scholars and practitioners in geotechnical engineering and construction get advantages from an in-depth examination of their attributes and soil dynamics.

K. Venkata Surya Sandeep et al. (2022)

The stability of any edifice is contingent upon the strength characteristics of the subterranean soil upon

which it is built. several forms of failure may arise, including structural settling, fissures, and similar issues. Addressing this problem requires soil enhancement, as it reduces building expenses and mitigates the potential for structural damage in the future. A variety of enhancement techniques can be employed to render typical soil sufficiently stable to bear construction loads. This study may involve doing several experiments with both conventional soil and stabilized soil. The stabilizing agents employed in this research include Copper Powder. The differing proportions of 5%, 10%, 15%, 20%, and 25% incorporated into the expanding soil.

Manish Kumar Jha et al. (2022)

The main aim of this research is to examine the relationship between black cotton soils and Copper Slag as well as GGBS. To enhance the geotechnical and engineering characteristics of black cotton soil. To investigate the behavior of strength enhancement in black cotton soil through the stabilization of Copper Slag and GGBS.

Chandrakaran et al. (2021)

The research employed soil that was only amended with fly ash and nylon fibers. Initially, the techniques utilized to identify the optimal fly ash suitable for application in untreated soil. Moreover, varying quantities of nylon fiber (0.25 and 0.5) were utilized at distinct fly ash proportions (10, 20, 30, and 40), leading to the identification of the optimal combination.

The ideal proportions of nylon fiber and fly ash (derived from dense soil) are 0.25 percent and 20 percent, respectively. The influence of positive percentage on the compressive strength and plastic characteristics of cultivated soil was evaluated across application durations of 1 day, 7 days, and 28 days. This research demonstrates that the fortitude of soil reinforced with nylon fibers and fly ash is enhanced, and the soil's tillage strength also improves when fly ash and nylon fibers are combined.

Suresh et al. (2020)

Expansive soil is classified as a difficult type of soil that exhibits significant shrinkage upon desiccation and swelling in response to variations in moisture levels. Expansive soils, commonly referred to as black cotton soils in India. This review article examines the characteristics of clayey soil enhanced with different proportions (0.5-10%) of coir fiber and Nano silica, through the assessment of its index and engineering

properties. Coir is a naturally occurring biodegradable substance that is plentiful in certain areas of southern and coastal India. Nano silica, as diminutive filler materials, enhances ductility without compromising strength.

P. Bharath Goud et al. (2020)

The current research was conducted to assess the efficacy of various proportions of rice husk ash and copper slag as soil stabilizers. The assessments conducted on the blended mixture of BC soils, Copper Slag, and Rice Husk Ash include Vane shear, California Bearing Ratio (CBR), Atterberg limits, free swell index (FSI), and compaction evaluations. Few investigations have been documented about the amalgamation of copper slag and rice husk ash for soil stabilization. The ideal combination was determined to be 64%BC, 30%CS, and 6%RHA. The FSI of soil treated with RHA and CS plummeted from 100% to 20.4%. A minor alteration occurred in the maximum dry density of the treated soil. The unsoaked CBR assessment indicates that the strength of the ideal mixture was 12.7%.

Sharana Kumar et al. (2018)

The aim of the research is to determine the reinforcing effect of randomly distributed short polypropylene fibers on the California bearing ratio test and unconfined compressive strength of black cotton soil. The proliferation of polypropylene supports resulted in an increase in optimal moisture content and a decrease in maximum dry density. Copper slag is a waste product that is extensively utilized in structural design enhancement. This study investigates the influence of polypropylene fibers and copper slag on the engineering characteristics of black cotton soil. The dry density, California Bearing Ratio (CBR) value, and unified compression test were conducted here. The ratios of copper slag utilized are (6%, 12%, 18%, and 24%) relative to the dry weight of the soil, while the ratios of polypropylene fiber employed are (0.5%, 1%, 1.5%, and 2%) concerning the dry weight of the earth. Subsequently, by blending polypropylene fiber and copper slag in proportions of 0.5%, 1%, 1.5%, 2%, and 3%, as well as 6%, 9%, and 12%, relative to the dry weight of the soil.

P. Bharath Goud et al. (2018)

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blended mixture of BC soils, Copper Slag, and Rice Husk Ash include Vane shear, California Bearing Ratio (CBR), Atterberg limits, free swell index (FSI), and compaction evaluations. Few investigations have been documented about the amalgamation of copper slag and rice husk ash for soil stabilization. The ideal combination was determined to be 64%BC, 30%CS, and 6%RHA. The FSI of soil treated with RHA and CS plummeted from 100% to 20.4%. A minor alteration occurred in the maximum dry density of the treated soil. The unsoaked CBR assessment indicates that the strength of the optimal mixture was 12.7%. The stabilized soil composites exhibit adequate strength properties and are suitable for economical construction of residential buildings and roadway infrastructure.

Rokade et al. (2017)

Incorporation of nylon fiber with fly ash to assess the variation in strength characteristics of black cotton soil. The California Bearing Ratio of the soil was ascertained by the execution of three sets of experiments. Experiments were conducted on BC soil blended with different proportions of fly ash, ranging from 10% to 40%, with 20% proving to be optimal. Subsequently, nylon fibers with aspect ratios of 20, 40, 60, and 80 were tested, with fiber contents ranging from 0.25% to 1.5% in 0.25% increments, identifying 0.75% fiber content as optimal based on maximum dry density (MDD) and peak California Bearing Ratio (CBR) values.

Parvathy S (2016)

In this research, copper slag is utilized as an additive. Copper slag is a waste product that is widely utilized in the civil engineering construction sector. The examination will be carried out according to the differing proportions of lime and copper slag mixed with the clayey soil. The drawbacks of clay can be mitigated by reinforcing it with appropriate substances. Principal laboratory assessments encompass the Unconfined Compressive Strength test (UCS) and the California Bearing Ratio test (CBR). This research aims to investigate the engineering properties of lime-stabilized clay soil incorporating copper slag.

G. R. Ashwin Kumar et al. (2015)

Marine clay constitutes a variety of clay located in coastal areas globally. The predominant issue in marine clay regions is the subsidence and uplift of building foundations that are three feet deep or shallower.

Following multiple cycles, the foundation's rebound may diminish progressively, leading to more substantial fissures. The primary objective of this document is to enhance the engineering properties of marine clay. Marine clay can be compacted by blending it with cement or comparable binding agents at defined ratios. This study demonstrates that copper slag can be utilized to stabilize marine clay. This technique is typically employed on highways when marine clay serves as the subgrade material.

3. Materials

3.1 SOIL

Source of soil

The soil is alluvial in nature and contains high amounts of clay. The total quantity of soil collected is about 120 Kg. All the soil that is used is sieved using 4.75mm sieve before start of the tests. The soil is oven dried for 24 hours before use to eliminate presence of any moisture in the soil. Firstly, Virgin soil without any admixture is tested for its properties and strength value and after that it is tested along with the addition of various proportions of Copper slag and Nylon Fiber.

Table no. 1 Properties of soil used in the study

S.No.	Properties	Result
1.	Liquid limit (%)	44
2.	Plastic limit (%)	26
3.	Plasticity Index (%)	18
4.	Specific Gravity	2.61
5.	Maximum Dry Density (kN/m ³)	16.90
6.	Optimum Moisture Content (%)	13.65
7.	Soil Classification	CI (Intermediate Compressive Clay)
8.	CBR (%) (soaked)	2.6
9.	CBR (%)	4.1

	(Unsoaked)	
9.	UCS (kN/m ²)	170.30

3.2 COPPER SLAG

Copper slag was collected from the Air blast equipment India Pvt. Ltd. Hyderabad the shade of the copper slag is dark, smooth, utilized as a part of the examination. Copper slag is a residue that is produced as a secondary product during high-temperature smelting processes. Its major constituents are iron and silica oxides, and it also contains small amounts of Al, Ti, Ca and Mg, and other elements. The production of one ton of refined copper is typically accompanied by the generation of 2.0–3.0 tons of copper slag. The global annual production of copper is approximately 17.0 million tons, and the production of copper slag amounts to 37.7 million tons.

Table 2: Chemical Composition of Copper Slag

S.No	Compound	Value (%)
1	SiO ₂	25-35
2	Al ₂ O ₃	2-9
3	Fe ₂ O ₃	45-55
4	CaO	1-3.5
5	MgO	1-5
6	So ₃	0.11
7	K ₂ O	0.61

3.3 NYLON FIBER

Nylon fiber is a synthetic, high-strength polymer fiber that can be mixed with soil to improve its mechanical behavior. When randomly distributed throughout the soil, the fibers act as small reinforcing elements and help resist deformation and cracking. Nylon fiber that is used in this project is known as Gujcon-CRF and is manufactured by Gujarat state fertilizers and chemicals limited (GSFC) which was collected from their warehouse in New Delhi. The physical properties of this Nylon Fiber are shown in table.

Table 3:- Properties of Nylon Fiber

S.No.	Property	Value
1.	Density	1.12gm/cc
2.	Melting point	215°C
3.	Length(L)	12mm
4.	Specific gravity	1.10
5.	Diameter(D)	0.20mm

SOIL:CS:NF	MDD (kN/m ³)	OMC (%)
100:00:00	16.90	13.65
79.5:20:0.5	16.30	14.10
79.25:20:0.75	16.70	13.80
79.0:20:1.0	17.20	13.50
6.	Aspect ratio(L/D)	40

3.4 RESEARCH OBJECTIVES

The objectives of the research work are:

- To study the plastic limit, liquid limit and specific gravity of untreated soil.
- To check the Optimum Moisture constant and Maximum Dry Density of Soil by adding Copper Slag and Nylon fiber at different percentages.
- To study the effect of Copper Slag and Nylon fiber on California Bearing Ratio value of soil.
- To find out the effect of Copper Slag and Nylon fiber on Unconfined Compression strength value of soil.

4. EXPERIMENTAL RESULTS

4.1 STANDARD PROCTOR TEST

Table no. 4: Results of OMC and MDD for mix proportions of Soil, Copper Slag and Nylon Fiber

Fig:-1 Variations b/w MDD and OMC of Copper Slag, Nylon Fiber & soil with different proportions

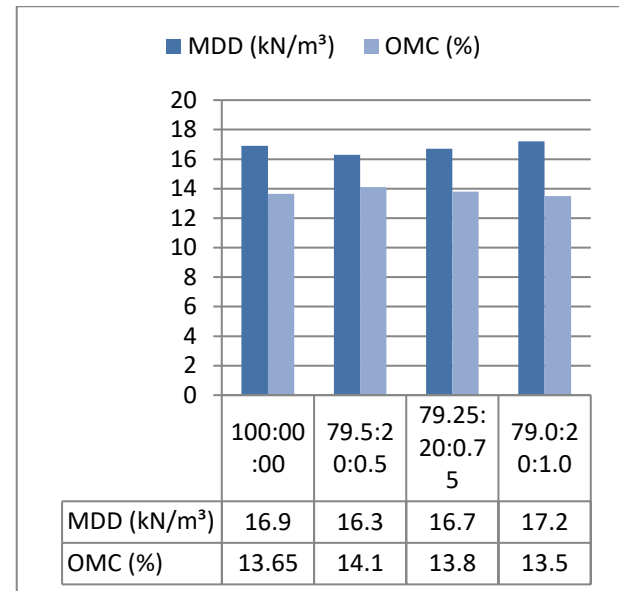


Table 5: Results of UCS of Copper Slag and Nylon Fiber Mix with Soil

SOIL:CS:NF	Curing Period (Days)	UCS (kN/m ²)
100:00:00	7	170.30
79.5:20:0.5	7	310
79.25:20:0.75	7	360
79.0:20:1.0	7	390

Fig:-2 Variations b/w UCS values of Copper Slag, Nylon Fiber & soil with different ratios

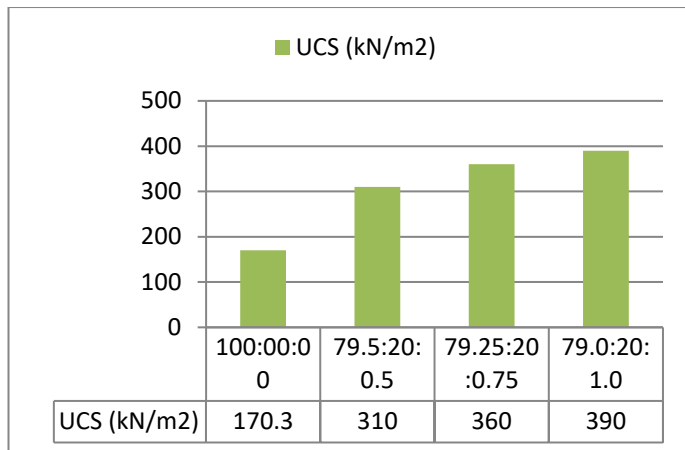
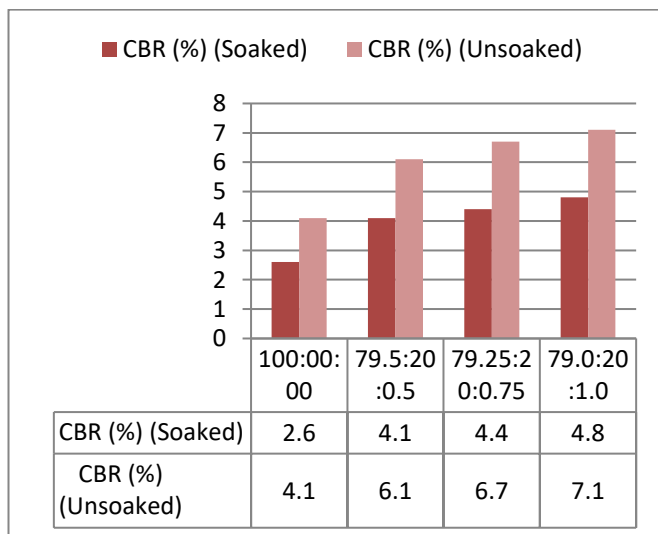


Table 6: Results of CBR of Copper Slag and Nylon Fiber Mix with Soil

SOIL:CS:NF	CBR (%) (Soaked)	CBR (%) (Unsoaked)
100:00:00	2.6	4.1
79.5:20:0.5	4.1	6.1
79.25:20:0.75	4.4	6.7
79.0:20:1.0	4.8	7.1

Fig:-3 Variations b/w CBR values of Copper Slag, Nylon Fiber & soil with different ratios



- The CBR value of soil is 2.6 and it increases to 1.73 times with addition of Copper Slag 20% and Nylon Fiber 1.0% when observed in soaked conditions.

5. DISCUSSIONS

5.1 STANDARD PROCTOR TEST:

- There is an also decrease of OMC from 14.10 to 13.50% and increase of MDD from 16.30 to 17.20% when the percentages of Copper slag is fixed at 20% and Nylon Fiber vary from 0.5, 0.75 and 1.0%.The increase in maximum dry density (MDD) with the incorporation of copper slag can be attributed to the relatively higher specific gravity and granular nature of copper slag, which improves particle packing and reduces the void ratio of the compacted soil.
- The reduction in optimum moisture content (OMC) may be attributed to the replacement of a portion of the water-demanding clay fraction by relatively non-absorbent copper slag particles. The addition of small quantities of nylon fiber (0.5–1.0%) further modifies the particle arrangement and soil matrix, while its low water absorption results in comparatively lower moisture requirements during compaction.

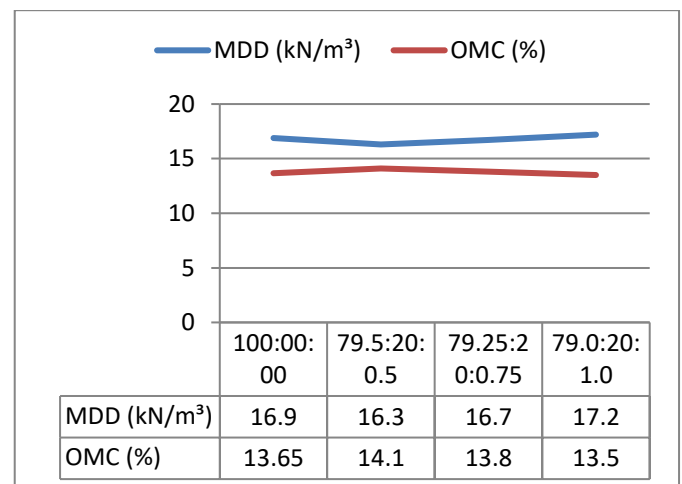


Fig:-4 Variations b/w MDD and OMC values of Copper Slag and Nylon Fiber Mix with Soil

5.2 CBR TEST:

- The CBR value increased with the addition of 20% copper slag and nylon fiber (0.5–1.0%) due to improved particle interlocking, frictional resistance, and tensile reinforcement provided by the fibers. Copper slag enhances the granular structure, while nylon fibers restrict particle movement and deformation under loading. The highest CBR indicates the optimum nylon fiber content within the selected range.

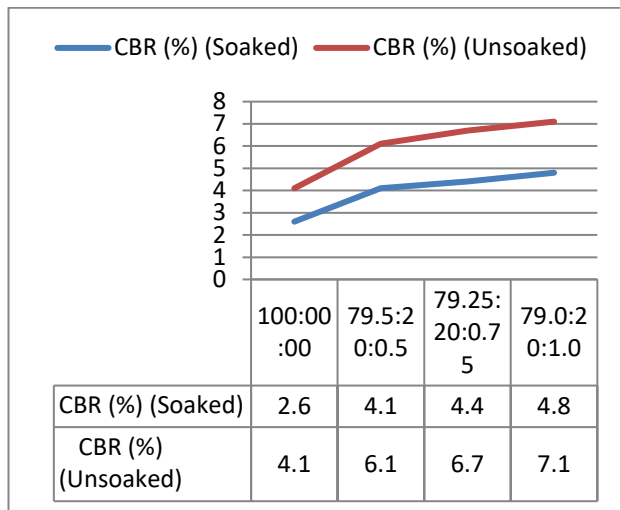


Fig:-5 Variations b/w CBR Values of Copper Slag and Nylon Fiber Mix with Soil

5.3 UCS TEST:

- The UCS value showed an increasing trend with the addition of 20% copper slag and nylon fiber (0.5–1.0%). The improvement is mainly attributed to better particle interlocking and frictional resistance provided by copper slag. The nylon fibers act as reinforcing elements and develop tensile resistance within the soil matrix, thereby restricting particle movement and crack propagation.
- With increasing fiber content, the soil–copper slag matrix becomes more stable and capable of resisting axial compressive stress. However, excessive fiber content may cause poor dispersion and fiber clustering, which can reduce the strength. Therefore, the fiber content corresponding to the maximum UCS value can be considered the optimum content for the selected copper slag proportion.

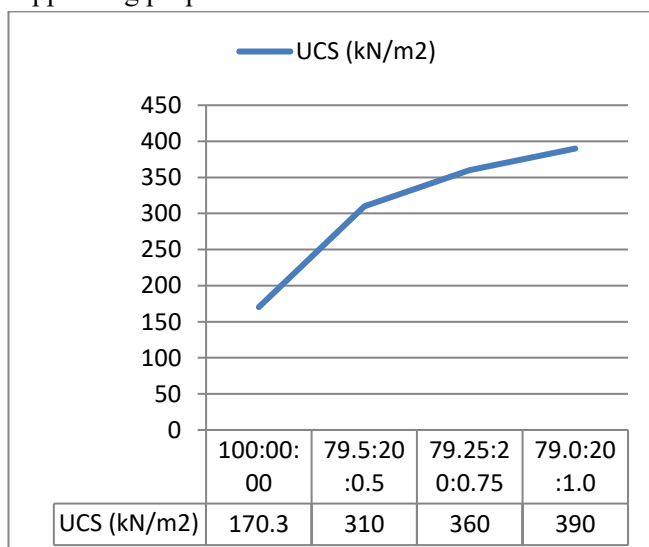


Fig:-6 Variations b/w UCS Values of Copper Slag and Nylon Fiber Mix with Soil

6. CONCLUSIONS

On the basis of above-obtained experimental results and discussions, the following conclusions can be drawn;

- In this study, a series of standard Proctor test, unconfined compression strength test and the California Bearing Ratio test was carried out to calibrate the effect of two stabilizers additives namely Copper Slag and Nylon Fiber on the clayey soil sample. The results showed that Copper Slag and Nylon Fiber could improve the UCS, California Bearing Ratio of clayey soil sample.
- The different percentages of Copper Slag and Nylon Fiber used in this study were 10%, 20% & 30% and 0.5%, 1.0% & 1.5%. Finally, the value of Nylon Fiber varies from 0.5 to 1.0% at the interval of 0.25% with the fixed quantity of Copper Slag 20% to clayey soil. The addition of the fixed quantity of Copper Slag 20% with changing the content of Nylon Fiber decreases the value of optimum moisture content and increase the value of maximum dry density.
- The optimum value of Copper Slag used in this research was 20% because the maximum value of UCS was found at 20%. The UCS value increases with an increase of Nylon Fiber content along with a fixed quantity of Copper Slag. It increased 2.29 times from the untreated soil.
- Based on the unconfined compression strength test results, the value of UCS increases from 170.30kN/m² to 390kN/m² with addition of copper slag and Nylon Fiber.
- The Maximum value of California Bearing Ratio test was found at copper slag 20% and Nylon Fiber 1.0%.

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