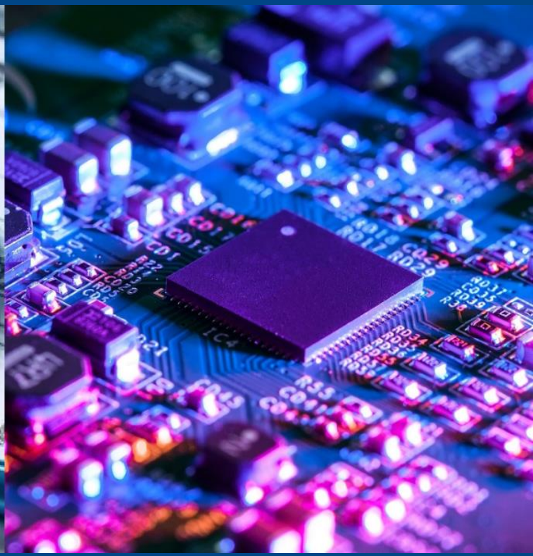
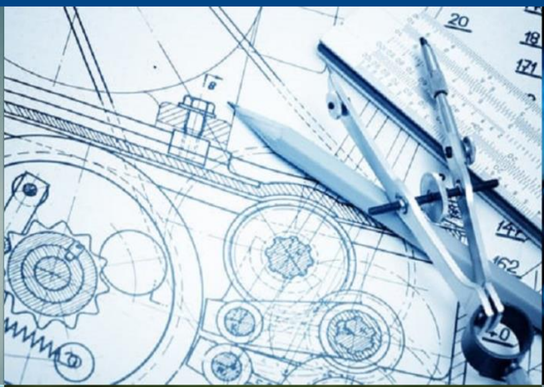
ISSN: 2582-7219

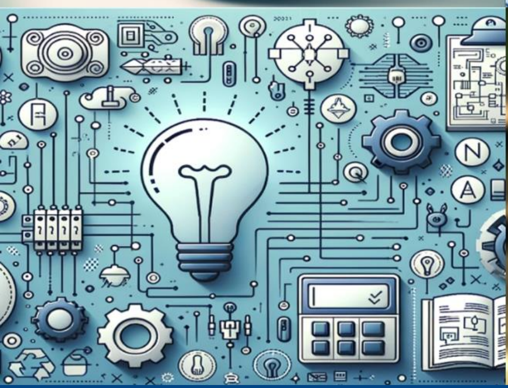




International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.206

Volume 8, Issue 4, April 2025

www.ijmrset.com ijmrset@gmail.com +91 6381 907 438 +91 63819 07438

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Smart Soil Engineering: A Waste-Based Stabilization Study and Optimization

Thasleema Nasrin [1], Nandhana PP [2], Athiq Bin Gafoor M [3], Muhammed Ansil Km[4], Fathima M [5], M U Sreelakshmi [6]

UG Student, Dept. of Civil Engineering, Royal College of Engineering and Technology, Akkikavu, Thrissur, Kerala, India[1-5]

Assistant professor, Dept. of Civil Engineering, Royal College of Engineering and Technology, Akkikavu, Thrissur, Kerala, India[6]

ABSTRACT: This project examines the effectiveness of using waste materials—such as glass, plastic, and construction debris (including crushed concrete and tile/marble waste)—for soil stabilization in regions of Kerala having unstable soils and instability. By focusing on different soil types, including clay, sandy (particularly coastal) and lateritic, soils, this study aims to explore sustainable approaches to enhance soil properties, reduce environmental impact, and minimize reliance on traditional stabilization methods. The project is structured into two phases: the initial phase involves collecting samples of targeted soils, waste materials and index property tests. The second phase will conduct engineering property test, soil stabilization studies and optimization will be done. Case studies of unstable soil areas in Kerala, p will be incorporated to recommend recovery techniques based on real-world conditions. A key project goal is developing an optimization program to identify the most effective material combinations and quantities for each soil type, providing a practical tool for soil engineers. This program will allow for data-driven, environmentally conscious recommendations, enhancing soil stability while re-purposing waste in an ecologically sustainable manner.

KEYWORDS: Soil stabilization, Optimization, Environmental Impact, Waste Repurposing, Soil Strength Enhancement

I. INTRODUCTION

As urbanization and environmental challenges grow, the construction industry is turning to sustainable solutions to reduce its environmental impact. Soil stabilization, which improves soil strength, durability, and load-bearing capacity, is crucial for foundations in roads, buildings, and infrastructure. Traditionally, materials like cement, lime, and bitumen are used, but they are costly and contribute to greenhouse gas emissions. Repurposing waste materials—such as plastic, glass, and construction debris—offers a more xeco-friendly and cost-effective alternative. This approach not only improves soil properties but also reduces landfill waste and pollution, aligning with the principles of a circular economy. By reducing the need for traditional stabilizers, waste-based stabilization presents a sustainable solution that meets the construction industry's growing demand for greener practices. Furthermore, using waste materials can lower construction costs while conserving natural resources like aggregates and cement. This innovative method promotes a shift toward more resilient and eco-conscious infrastructure. As sustainability becomes central to development, leveraging waste for soil stabilization paves the way for a more sustainable future in construction. Using waste materials for soil stabilization provides both environmental and economic benefits. Environmentally, it reduces pollution, lowers CO_2 emissions from cement production, and supports circular economy principles. Economically, repurposing waste cuts disposal and construction costs, benefiting both industries and governments. Waste-derived stabilizers offer local availability, reducing transportation costs and promoting a self-sustaining construction sector. Integrating waste materials aligns with sustainable construction principles by conserving resources, reducing waste, and protecting the environment.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)
(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

II. METHODOLOGY

Preliminary testing involves collecting samples of unstable soils and testing them to identify the properties causing instability. Stabilization testing follows, where selected waste materials are incorporated into these soils to assess their effectiveness in improving the identified instability-causing properties. Case studies will be conducted in Kuttanadu to understand the region's soil issues and recommend suitable recovery methods. Finally, a program will be developed to suggest the most effective waste material combinations and quantities for stabilizing each soil type, ensuring optimized solutions for improved soil performance.

III.TYPES OF SOILS USED

Silty Sandy Soil
Silty sandy soil is characterized by its large particles, excellent drainage, and quick drying properties, which can make it prone to erosion. However, its loose structure and low load-bearing capacity present significant challenges, making sandy soil unsuitable for infrastructure development unless it is properly stabilized. Without proper reinforcement, the soil's instability can lead to issues such as shifting foundations and reduced structural integrity.

Clayey Soil
Clay soil is characterized by its fine particles, high plasticity, and cohesion, which result in low permeability and excellent moisture retention. However, its high shrink-swell potential presents significant challenges, making clay soil prone to cracking, movement, and structural issues, particularly in foundations. These properties can lead to shifting and settling, causing potential damage to buildings and infrastructure.

Lateritic Soil

Lateritic soil is characterized by its reddish color, coarse texture, acidity, and good drainage, but it hardens when exposed to air, which can hinder plant growth. Its tendency to harden presents challenges for both cultivation and construction, as it reduces cohesion and increases the risk of erosion over time, making it difficult to maintain soil stability.

IV.STABILIZING MATERIALS

Plastic Waste
Plastic waste, often in the form of shredded or granulated pieces from post-consumer or industrial sources, is lightweight, durable, and non-biodegradable. While it raises environmental concerns, it proves useful in soil stabilization. When used in stabilization, plastic waste improves soil cohesion, reduces erosion, and reinforces soils without significantly increasing density.

Glass Waste
Crushed glass waste, finely ground to sizes similar to sand, is hard, chemically inert, durable, and possesses high compressive strength with strong rigidity. When used in soil stabilization, crushed glass increases soil strength, load-bearing capacity, and reduces permeability, enhancing compaction and resistance.

Construction Waste (Crushed Concrete and Tile/Marble Waste)
Crushed concrete, tile, and marble fragments, processed into coarse aggregate sizes, are dense, hard particles with high compressive strength. Concrete and tile provide rigidity, while marble is chemically stable. When used in soil stabilization, these construction wastes increase soil strength and compaction, enhancing resistance to erosion and supporting load-bearing applications

V. EXPERIMENTAL ANALYSIS & RESULTS OF DIFFERENT SOIL TYPES

Clay Soil
1. **Stabilization with plastic waste:**

The study on stabilization using plastic waste involved using polypropylene plastic bag strips with a width of less

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

than 2 mm, ensuring uniform distribution, with particles passing through a 2 mm sieve. The plastic content was varied at 0%, 0.5%, 1%, 1.5%, 2%, and 2.5% to determine its effect on the soil properties.

i. California Bearing Ratio (CBR)

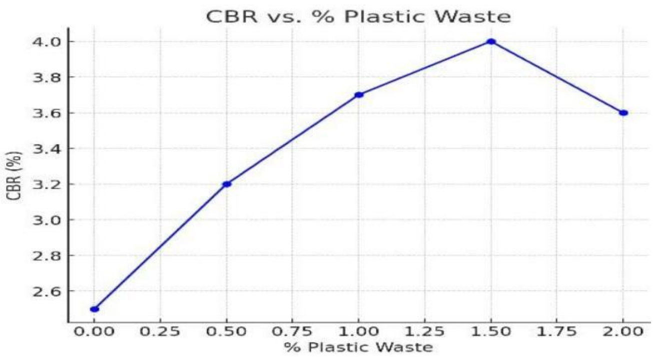


Fig 4.1: CBR vs Plastic Waste (%)

ii. Unconfined Compressive Strength (UCS)

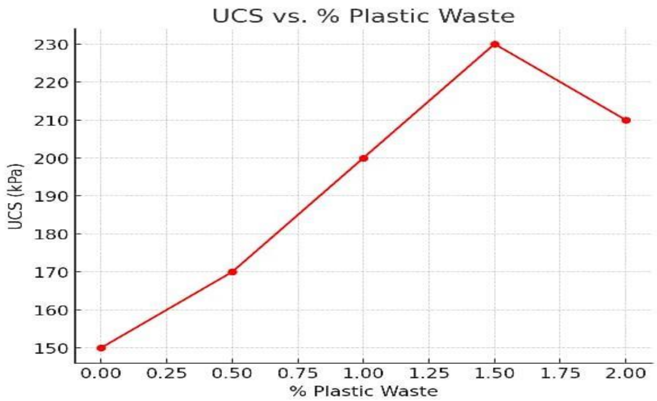


Fig 4.2: UCS vs Plastic Waste(%)

iii. Optimum Moisture Content (OMC)

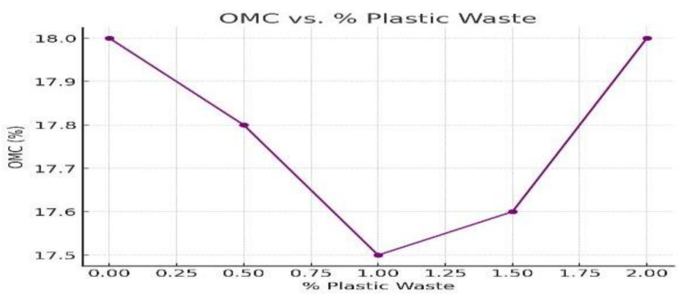


Fig 4.3: OMC vs Plastic Waste(%)

© 2025 IJMRSET | Volume 8, Issue 4, April 2025 |DOI:10.15680/IJMRSET.2025.0804388

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

iv. **Maximum Dry Density (MDD)**

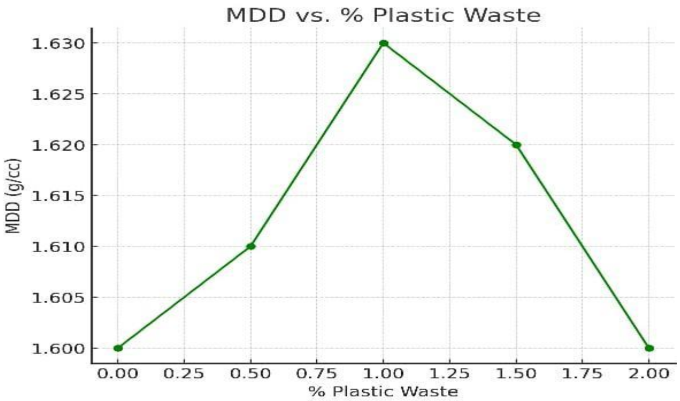


Fig 4.4: UCS vs Plastic Waste (%)

b) Analysis of Plastic Waste Stabilization Effectiveness:

The incorporation of waste materials such as plastic into soil stabilization results in improved load-bearing capacity and compaction, while also reducing plasticity. Optimal results were observed with a plastic content of 1.5%, which enhanced soil strength and stability at minimal cost. This approach effectively addressed critical issues like shrinkage and swelling, while also demonstrating a sustainable method for utilizing non-biodegradable wastes.

2. Stabilization with construction waste

The study focused on stabilization using crushed concrete and tile waste powder with a particle size of less than 75 microns, combined with 7% lime. The waste content was varied at 10%, 20%, 30%, and 40% to assess its impact on soil properties.

i. **California Bearing Ratio (CBR)**

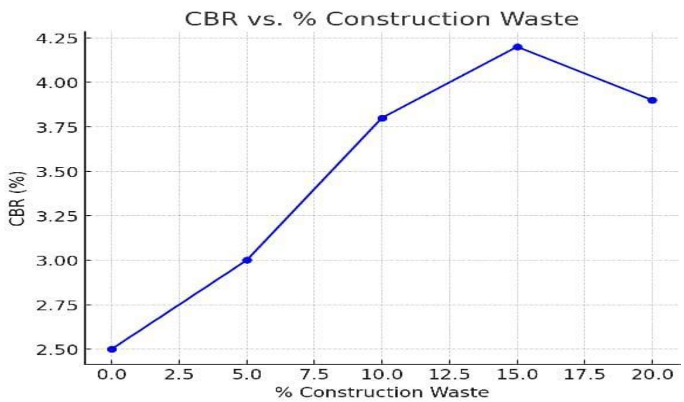


Fig 4.5: CBR vs Construction Waste (%)

© 2025 IJMRSET | Volume 8, Issue 4, April 2025 |DOI:10.15680/IJMRSET.2025.0804388

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

ii. Unconfined Compressive Strength (UCS)

Fig 4.6: UCS vs Construction waste (%)

iii. Optimum Moisture Content (OMC)

Fig 4.7: OMC vs Construction Waste (%)

iv. Maximum Dry Density (MDD)

Fig 4.8: MDD vs Construction Waste (%)

© 2025 IJMRSET | Volume 8, Issue 4, April 2025 |DOI:10.15680/IJMRSET.2025.0804388

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Construction waste significantly enhances soil strength compared to plastic waste, especially at 15%, improving stability for construction. The peak UCS and CBR values at 15% waste ensure reliable support for foundations and road bases.

Silty Sandy Soil

1. **Stabilization with construction waste**

The study focused on the use of crushed concrete and tile waste powder with a particle size of less than 75 microns, combined with 7% lime. The waste content was varied at 5%, 10%, 15%, and 20% to assess its effect on the soil.

i. **California Bearing Ratio (CBR)**

Fig 4.9: CBR vs Construction Waste (%)

ii. **Unconfined Compressive Strength (UCS)**

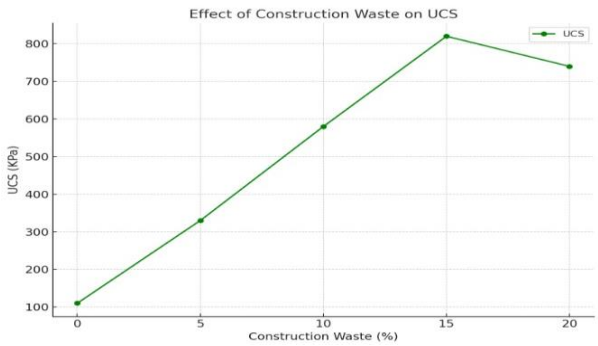


Fig 4.10: UCS vs Construction waste (%)

iii. **Optimum Moisture Content (OMC)**

Fig 4.11: OMC vs Construction Waste (%)

iv. **Maximum Dry Density (MDD)**

© 2025 IJMRSET | Volume 8, Issue 4, April 2025 |DOI:10.15680/IJMRSET.2025.0804388

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Fig 4.12: MDD vs Construction Waste (%)

Both CBR and UCS peak at 15% construction waste, indicating maximum effectiveness. However, excessive waste (>15%) reduces soil compaction and strength, disrupting the soil structure.

Laterite Soil

1. Stabilization with construction waste

The study focused on the use of plastic powder and glass powder as stabilizing agents. The waste content was varied at 0%, 4%, 8%, and 12% for both plastic and glass waste to assess their effects on soil properties.

i. California Bearing Ratio (CBR)

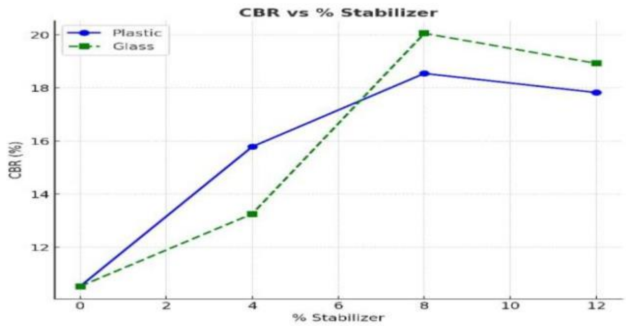
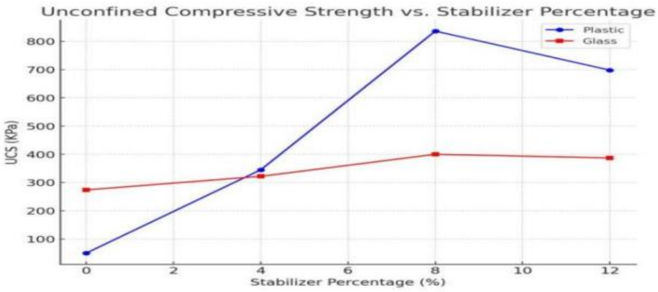


Fig 7.24: CBR vs Stabilizer (%)

ii. Unconfined Compressive Strength (UCS)



ig 7.25: UCS vs Stablizer Percentage (%)

iii. Optimum Moisture Content (OMC)

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

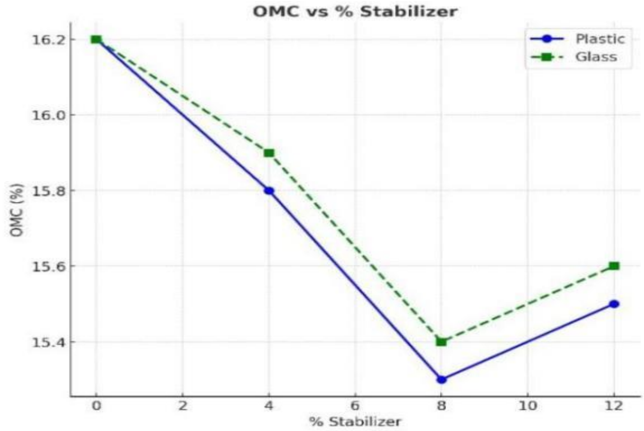


Fig 7.26: OMC vs Stabilizer(%)

iv. **Maximum Dry Density (MDD)**

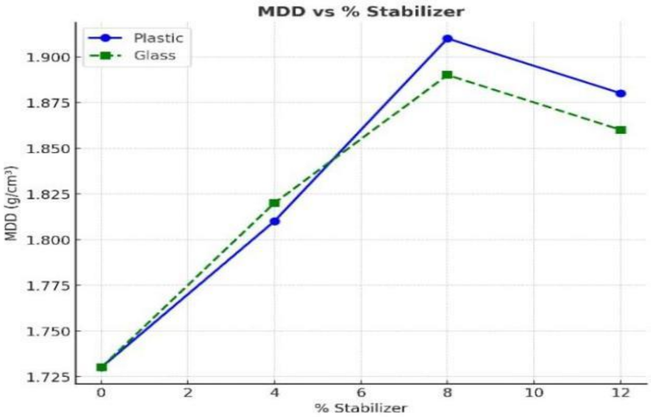


Fig 7.27: MDD vs Construction Waste (%)

CBR peaks at 8%, with plastic at 18.4% and glass at 20%, showing better performance with glass. UCS at 8% is higher for plastic (836 KPa) than glass (400 KPa), making plastic more effective. MDD increases up to 8% stabilizer, then slightly decreases, while OMC decreases. Inference: 8% is optimal, with glass improving CBR and plastic enhancing UCS.

V. OPTIMIZATION PROGRAM FOR SOIL STABILISATION

Different soils require specific stabilizers to achieve maximum strength, as each soil type has distinct characteristics that influence its performance. Manual testing of these stabilizers is often time-consuming and costly, making it inefficient for large-scale or repeated testing. The objective is to identify the most suitable stabilizer for a given soil type and intended purpose, while also determining the optimal percentage of stabilizer for achieving maximum strength. To streamline this process, users will input the soil type—such as Laterite, Silty Sandy, or Clay—and the intended purpose, whether it’s for road construction, earthen structures, or general use. Based on these inputs, the best stabilizer and its ideal proportion can be suggested to ensure the most efficient and durable outcome. This approach helps save time and resources, allowing for quicker decision-making and optimized soil stabilization without the need for extensive lab testing. By considering both the soil type and purpose, the system will provide tailored recommendations, ensuring that each project is executed with the most effective stabilizing materials. Furthermore, this method can significantly reduce costs by eliminating unnecessary trials and focusing only on the most promising solutions. Ultimately, the aim is to enhance the overall performance of the construction while minimizing environmental impact and resource wastage.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Input: Soil type, Purpose
Output: Displays best stabilizer and its optimum percentage

Initialisation*:*
1: Define variables for soil type and purpose.

2: User inputs the soil type and purpose.
3: Program fetches experimental data based on the entered soil type (e.g., CBR and UCS values).
4: Define weights based on the purpose:

a: Road Construction: Prioritize CBR value

b: Earthen Structures: Prioritize UCS values.
c: General Use: Balance between CBR and UCS values.

Process:
5: Evaluate each stabilizer based on the assigned weights and experimental data.
6: Calculate the impact of each stabilizer on the soil properties (CBR and UCS).
7: Identify the stabilizer with the highest impact.
8: Determine the optimum percentage of the stabilizer for the soil.
9: Display the best stabilizer and its optimum percentage.

Return: None

VI. CASE STUDY

The research focuses on Kuttanadu, Kerala, where the clay soil's high compressibility and low shear strength pose construction challenges. The study aims to determine if incorporating construction waste can improve soil stability. Laboratory tests will assess changes in soil properties after adding the waste material to enhance its suitability for construction.

Soil Composition & Classification:

Composition:
The research identified various soil types and stability challenges, with tests showing clay soil having a liquid limit of 68%, plastic limit of 30.5%, and plasticity index of 37.5%. This high plasticity indicates excessive water retention, making the soil highly compressible and weak in load-bearing capacity. Stabilization tests improved soil strength, and an optimization program was developed for different soil conditions. Future work will focus on a case study of Kuttanadu, Kerala, exploring waste-based stabilization methods.

Atterberg Limits
The research identified soil composition with clay content of 64%, silt at 30%, and sand at 6%, classifying it as CH (High Plasticity Clay). The high clay content leads to poor drainage, shrink-swell behavior, and low strength, necessitating stabilization for construction.

Table 5.1

Stabilizer (%)	OMC (%)	MDD (g/cm3)
0 %	30	1.73
5%	28.5	1.82
10%	27.2	1.84
15%	22.72	1.93
20%	26	1.89

MDD increases with stabilization up to 15%, improving soil density. OMC decreases initially, indicating better compaction efficiency.

Table 5.2

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Stabilizer (%)	CBR (%)	UCS (kN/m^3)
0 %	2.0	22.79
5%	2.9	27.35
10%	4.7	31.67
15%	6.1	33.94
20%	5.2	24.89

CBR increases significantly up to 15%, indicating improved load-bearing capacity. Beyond 15%, the drop suggests excessive stabilizer affects soil compaction.UCS improves with stabilization up to 15%, enhancing soil strength. At 20%, strength declines, indicating excess stabilizer reduces effectiveness.

1. Effectiveness Of Construction Waste Stabilisation on Kuttanad Soil:

The addition of stabilizer improved soil properties, with MDD peaking at 15% and OMC decreasing, indicating betterdensification. UCS and CBR values also improved, reaching their maximum at 15% stabilizer (UCS: 33.94 kN/m^2, CBR: 6.1%). Beyond 15%, strength declined, suggesting excessive stabilizer reduces efficiency. The improved soil is suitable for road subgrade layers and embankment stabilization, reducing settlement risks in Kuttanad

VII. CONCLUSION

The research on soil stabilization using waste materials identified key soil types and their stability challenges, providing a solid foundation for future studies. Preliminary tests on clay, laterite, and silty sand highlighted their instability and guided the selection of appropriate stabilization methods. Stabilization experiments with waste materials such as plastic, construction waste, and glass showed significant improvements in soil strength and engineering properties, including maximum dry density (MDD), optimum moisture content (OMC), California Bearing Ratio (CBR), and unconfined compressive strength (UCS).An optimization program was developed to recommend the most effective waste material combinations and quantities for stabilizing different soil types, improving efficiency and adaptability. A detailed case study in Kuttanadu, Kerala, demonstrated how construction waste could enhance soil stability, addressing challenges posed by soft, waterlogged soils in the region.

This research supports the adoption of sustainable, eco-friendly stabilization techniques, reducing dependence on conventional stabilizers like cement and lime. It promotes the circular economy by repurposing waste materials for soil improvement, offering a cost-effective solution to both soil instability and waste management. The findings also pave the way for collaboration between industries, researchers, and policymakers to implement waste-based stabilization practices on a larger scale. The research has practical applications in large-scale infrastructure projects, such as road construction and foundation stabilization, where it can improve durability, reduce maintenance costs, and extend the lifespan of structures. It provides a sustainable, low-cost alternative to traditional methods, especially in developing regions where access to high-quality construction materials is limited.

In conclusion, this study highlights the potential of waste materials for soil stabilization, offering a more sustainable, cost-effective, and durable approach to improving soil properties. It serves as a reference for future research and the integration of waste-based solutions into modern engineering practices, driving innovation in environmentally responsible construction and infrastructure development.

REFERENCES

[1] B. Shinde, A. Sangale, M. Pranita, J. Sanagle, and C. Roham, "Utilization of waste materials for soil stabilization: A comprehensive review," Progress in Engineering Science, vol. 2–3, p. 100009, 2024.

[2] M. F. Noaman, M. Haq, M. A. Khan, K. Ali, and H. Kamyab, "Geotechnical and microstructural analysis of high-volume fly ash stabilized clayey soil and machine learning application," Case Studies in Construction Materials, vol. 21, p. e03628, 2024.

[3] J. Wang, G. Chen, Y. Chen, Z. Ye, M. Lin, R. Su, and N. Hu, "Intelligent mixture optimization for stabilized soil containing solid waste based on machine learning and evolutionary algorithms," Journal of Cleaner Production, vol. 398, p. 136385, 2024.

[4] G. Gupta, H. Sood, and P. K. Gupta, "Economic and environmental assessment of industrial wastes stabilized clay and sand soil subgrades using experimental and theoretical approaches," Journal of Cleaner Production, vol. 396, p. 136372, 2024.

[5] J. Liu, B. Zhao, S. Zhang, L. Wu, C. Wang, Z. Ding, B. Che, and X. Wang, "Experimental study on preparation of solidified soil from residue of construction waste," Construction and Building Materials, vol. 349, p. 128733, 2024.

[6] E. Kasehchi, M. A. Arjomand, and M. H. A. Elizei, "Experimental investigation of the feasibility of stabilizing inshore silty sand soil using geopolymer based on ceramic waste powder: An approach to upcycling waste material for sustainable construction," Journal of Cleaner Production, vol. 397, p. 136383, 2024.

[7] F. Juveria, P. Rajeev, P. Jegatheesan, and J. Sanjayan, "Impact of stabilization on mechanical properties of recycled concrete aggregate mixed with waste tyre rubber as a pavement material," Construction and Building Materials, vol. 350, p. 128752, 2024.

[8] F. Cammelli, G. Tameni, and E. Bernardo, "Sustainable stabilization of waste foundry sands in alkali-activated glass-based matrices," Journal of Cleaner Production, vol. 395, p. 136350, 2024.

[9] M. H. Md Isa, S. Koting, H. Hashim, K. H. Mo, and S. A. Aziz, "Utilizing tile waste as an additive to enhance lime-based subgrade stabilization," Construction and Building Materials, vol. 348, p. 128720, 2024.

[10] M. A. Khodabandeh, G. Nagy, and A. Torok, "Stabilization of collapsible soils with nanomaterials, fibers, polymers, industrial waste, and microbes: Current trends," Journal of Rock Mechanics and Geotechnical Engineering, vol. 16, no. 1, pp. 123–140, 2024.

[11] U. Hasan, A. Chegenizadeh, M. A. Budihardjo, and H. Nikraz, "Experimental evaluation of construction waste and ground granulated blast furnace slag as alternative soil stabilizers," Geotechnical and Geological Engineering, vol. 34, no. 5, pp. 1707–1722, 2016.

[12] S. Islam, J. Islam, and N. M. R. Hoque, "Improvement of consolidation properties of clay soil using fine-grained construction and demolition waste," Heliyon, vol. 8, no. 10, p. e10876, 2022.

[13] M. Salim, I. S. Saiful Bahri, and Z. Md Yusof, "Mechanical performance of cement-stabilized soil containing recycled glass as a road base layer," Road Materials and Pavement Design, vol. 17, no. 3, pp. 615–628, 2016.

[14] A. G. Norozi, S. Kouravand, and M. Boveiri, "A review of using waste in soil stabilization," International Journal of Engineering Trends and Technology, vol. 21, no. 1, pp. 33–37, 2015.

[15] A. K. Sharma and P. V. Sivapullaiah, "Soil stabilization with waste materials based binder," Proceedings of the Institution of Civil Engineers - Ground Improvement, vol. 172, no. 3, pp. 178–187, 2019.

[16] N. H. Md Zain, N. A. Mohd Salim, I. S. Saiful Bahri, and Z. Md Yusof, "Experimental study using recycled waste tyre as sustainable clay soil stabilization," International Journal of Integrated Engineering, vol. 14, no. 5, pp. 122–129, 2022.

[17] P. T. Ravichandran, A. S. Prasad, K. D. Krishnan, and P. R. K. Rajkumar, "Effect of addition of waste tyre crumb rubber on weak soil stabilization," Indian Journal of Science and Technology, vol. 9, no. 5, pp. 1–5, 2016.

[18] K. Singh and M. Anupam, "Soil stabilization using plastic waste," in Proceedings of the Indian Geotechnical Conference, 2018, pp. 1–8.

[19] L. Kokila, G. Bhavithra, V. Hemapriya, C. Iniya, and P. Madhunigga, "Experimental investigation on soil stabilisation using rubber crumbs on expansive soil," World Journal of Research and Review, vol. 4, no. 4, pp. 16–19, 2017.

[20] C. C. Ikeagwuani and D. C. Nwonu, "Emerging trends in expansive soil stabilisation: A review," Journal of Rock Mechanics and Geotechnical Engineering, vol. 11, no. 2, pp. 423–440, 2019.

INTERNATIONAL JOURNAL OF

MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com