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# Durability Assessment of Stabilized Soil Plaster

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***Abstract: Water retention is a key property influencing the durability and performance of sustainable construction materials. Factors such as material composition, binder type, and porosity affect moisture retention, impacting workability, curing, and weather resistance. This study explores the role of natural stabilizers and additives in enhancing water retention while maintaining structural integrity. Understanding these properties helps optimize eco-friendly materials for improved performance in varying climates, supporting sustainable and resilient construction practices.***
***Keywords: Soil, M sand, lime and jaggery extract.***

## I. INTRODUCTION

Water absorption is a crucial property used to evaluate the capacity of a material to absorb and retain water under specific conditions. This characteristic plays a significant role in determining the material's durability, stability, and overall performance, particularly in applications exposed to moisture, humidity, or direct water contact. Several factors influence the water absorption capacity of a material, including the type of plastic or polymer used, the presence of additives, the surrounding temperature, and the duration of exposure. The composition and structure of the material dictate how it interacts with moisture, affecting its mechanical properties, dimensional stability, and long-term usability in various environments. By analyzing water absorption data, engineers and researchers can gain valuable insights into how different materials behave in humid or wet conditions. This information is essential for selecting appropriate materials for construction, packaging, marine applications, and other industries where moisture resistance is a critical factor. Understanding these properties helps in developing more durable and sustainable materials that can withstand environmental challenges while maintaining their functional integrity

## II. SPECIFIC OBJECTIVES

- To evaluate the water retention characteristics of mortar cubes with sustainable materials.
- To analyze how eco-friendly additives influence the water absorption rate.
- To assess the impact of water absorption on long-term durability in green construction.

## III. MATERIALS AND METHODS

Materials used for this study are laterite soil, M sand, lime and organic extract. Laboratory tests such as wet sieve analysis, hydrometer analysis and water absorption test were conducted to determine the water retention property of collected soil sample.

### *A. Laterite soil*

Laterite soil which is locally available is used for this project. The soil contains 34% sand, 18% clay and 48% silt. M sand is added to the mix due since the sand content is less in this type of soil. Soil is sieved through 4.75mm for maintaining the uniformity.

### *B. Lime*

Slaked lime powder is used for this study. The lime is sieved through a 600 µ sieve for uniformity.

### *C. M sand*

M sand of NO -1 P – SAND company is used for the study for maintaining uniformity. It is sieved through 2.36 mm throughout the study.

### *D. Organic extract of jaggery*

The extract is fermented for four days .5%,7% and 9% concentrations of each organic extract is used.

### *E. Mix Proportion*

65% of soil, 25% of M sand,10% lime and organic extract of 5%,7% and 9% concentrations according to the workability.

 

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TABLE I
Volume of Water for Workability

| Item | 5% concentration(ml) | 7% concentration(ml) | 9%concentration(ml) | Potable water(ml) |
|---|---|---|---|---|
| Jaggery | 278 | 280 | 286 | 270 |

*F. Method*

The specimens are dried in an oven after curing for 28 days and at a specific temperature and then placed in a desiccator to cool. Immediately upon cooling, the specimens are weighed. The material is then emerged in water at agreed upon conditions, often 23°C for 24 hours or until equilibrium. Specimens are removed, patted dry with a lint free cloth, and weighed.

Water absorption is expressed as increase in weight percent.

Percent Water Absorption= [(Wet weight - Dry weight)/ Dry weight] x 100

Fig 1 Water absorption of mortar cubes

TABLE 2
IS SPECIFIED CLASSIFICATION OF WATER ABSORPTION

| Water absorption (%) | Class |
|---|---|
| Less than 15% | 1st class |
| 15-20% | 2nd class |
| 20-25% | 3rd class |

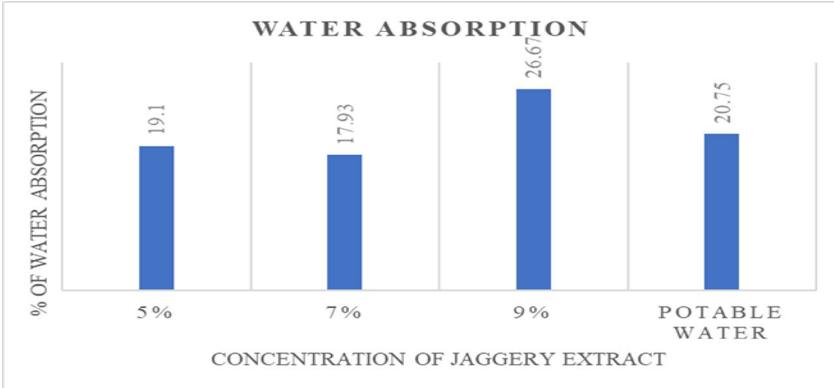
**IV. RESULTS AND DISCUSSION**

*1)* Water absorption for potable water cube
Dry weight, $W_1$ = 523.4 g, Wet weight, $W_2$ = 632g
Percent water absorption = 20.75%
As per IS specification, on the basis of water absorption, mortar cube is 3rd class block.

*2)* Water absorption for 5% concentration mortar cube
Dry weight, $W_1$ = 539g
Wet weight, $W_2$ = 642g
Percent water absorption = 19.1%
As per IS specification, on the basis of water absorption, mortar cube is 2nd class block

*3)* Water absorption for 7% concentration mortar cube
Dry weight, $W_1$ = 500.3g, Wet weight, $W_2$ = 590g
Percent Water absorption = 17.93%
As per IS specification, on the basis of water absorption, mortar cube is 2nd class block

*4)* Water absorption for 9% concentration mortar cube
Dry weight, $W_1$ = 505.8g
Wet weight, $W_2$ = 640.7g
Percent water absorption = 26.67%
As per IS specification, on the basis of water absorption, mortar cube is 3rd class block




Upon analyzing different mortar cubes, the potable water cube exhibited 20.75% water absorption, classifying it as 3rd class, which indicates high porosity and low strength. The 5% concentration mortar cube showed 19.1% water absorption, placing it in the 2nd class, suggesting improved durability. The 7% concentration mortar cube had 17.93% absorption, also falling into the 2nd class, indicating lower porosity and better performance. However, the 9% concentration mortar cube recorded 26.67% absorption, classifying it as 3rd class, revealing high porosity and poor quality.The results show a trend where water absorption decreases as the concentration increases up to 7%, but at 9%, it unexpectedly rises. The 7% concentration mortar cube exhibited the best performance, making it the most suitable for use, while the 9% concentration cube had the worst absorption, making it unsuitable for structural applications. To enhance durability and strength, mortar should be designed to minimize water absorption while maintaining workability. Further tests, such as compressive strength and permeability analysis, are recommended for a comprehensive evaluation.

## V. CONCLUSION

The study of water absorption in mortar cubes highlights its crucial role in determining durability and strength. The results indicate that as the concentration increases from potable water to 7%, water absorption gradually decreases, improving density and reducing porosity. However, at 9% concentration, absorption unexpectedly rises to 26.67%, suggesting excessive additives or improper mix proportions that negatively impact performance. The 7% concentration mortar cube, with the lowest absorption of 17.93%, proved to be the most durable and suitable for construction, while the 5% concentration cube, with 19.1% absorption, also performed well for moderate applications. In contrast, the potable water cube (20.75%) and the 9% concentration cube (26.67%) were classified as 3rd class, indicating high porosity and poor structural strength. The findings suggest that optimizing mix design is essential, with 7% concentration being the most effective for achieving better durability. Higher concentrations should be used cautiously, as seen in the 9% sample,where excessive additives likely increased porosity. Further testing, including compressive strength and permeability analysis, is recommended to validate these observations. Overall, selecting a mix with lower water absorption ensures better durability, strength, and long-term stability in construction applications.

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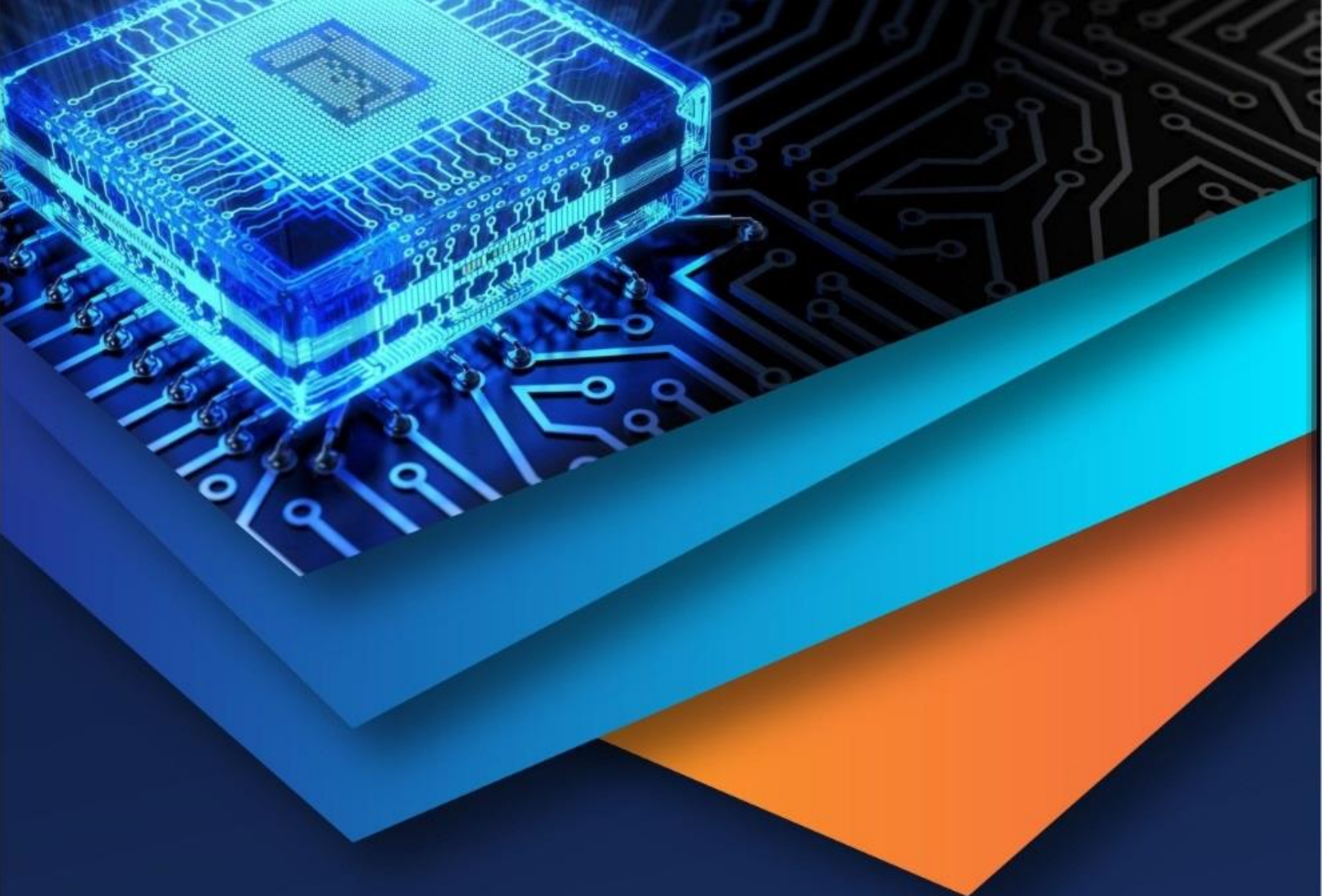


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