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Modification of Cellular Lightweight Concrete Blocks by using Additives

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ABSTRACT

Cellular Lightweight Concrete (CLC) is a recent material with cement-like properties, integrated with mechanically entrained foam in a cement-based slurry. Although CLC blocks are lightweight concrete blocks having good thermal insulation and water absorption properties, but they have low compressive strength issues. To counter this problem CLC blocks are modified with additives like Marble dust, Silica fume and Fly ash along with Magnetized water (which is 40% of weight of Cement + Fly ash). Since it has low strength, so study shows that use of magnetized water enhances strength properties of concrete. The samples undergo testing for compressive strength, water absorption, and thermal conductivity. The use of 5% marble dust and silica fume combined with magnetized water has the best impact on compressive strength. These results are obtained on 28 days curing time and can also be studied on 7 days and 14 days curing in future.

KEYWORDS: Cellular Lightweight Concrete, Marble Dust, Silica Fume, Fly Ash, Magnetized water

1 INTRODUCTION

Cellular Lightweight Concrete (CLC) is an innovative construction material resembling cement, incorporating manually entrained foam in the cement slurry. Due to growing demand in construction, CLC shows promise, particularly in non-load-bearing structural elements, offering reduced weight, improved insulation, and versatility. Commonly used as a boundary or partition wall, CLC can be strengthened with additives. In the construction industry, CLC is gaining significance, especially with the use of fly ash and silica fume, enhancing blended cement concrete quality. Foam generation involves specific ratios, affecting concrete density. Modified CLC blocks, incorporating additives like Marble dust, Silica fume, and Fly ash, along with Magnetized water, demonstrate improved strength properties. Tests on samples reveal that a combination of 5% marble dust and silica fume with magnetized water has the most positive impact on compressive strength.

2 LITERATURE REVIEW

The application of magnetized water in CLC Blocks is a recent development, explored by scholars Taghried Isam Mohammed and Rabab Mohammed Hamdan. They conducted tests on four concrete samples, three of which incorporated magnetized water, and one did not. Results from compressive strength and slump tests revealed that the magnetized water-enhanced samples

demonstrated improved workability, with a notable increase in compressive strength. The study suggested that utilizing magnetized water could enhance concrete workability by up to 400%, leading to a 3% reduction in block weight and a decrease in cement content. In addressing the scarcity of Ordinary Portland cement, Raghvendra and Prof. M. K. Trivedi proposed using marble dust as a substitute. This by-product not only improves concrete characteristics but also enhances compressive strength and workability. The use of marble dust in construction is environmentally friendly, as it mitigates heat of hydration, a potential environmental concern associated with cement.

3 METHODOLOGY

A research strategy serves as an effective approach to address consideration problems, involving an investigation into the methods employed in a study. Various improvements made by specialists in studying problems and their reasons are examined. Techniques like consideration, reviews/questionnaires, consultation, emphasis collections, tests and trials, and subordinate facts study are used to address specific issues.

Cellular Lightweight Concrete (CLC), also known as foam concrete, produces lighter blocks compared to traditional ones. Manufactured similarly to regular concrete under ambient conditions, CLC blocks have lower density, making them suitable for non-loading bearing structures with reduced compressive strength. Despite exhibiting good thermal insulation and water absorption properties, CLC blocks have low compressive strength. Further research is needed to enhance these properties, and the proposed additions aim to increase compressive strength in conventional CLC blocks.

3.1 Sample Casted

We will cast total 4 conventional blocks. After conducting a literature review, we found that the most effective ratio was 65% fly ash and 35% cement, resulting in an approximate 1:2 ratio (cement:fly ash). Different foam content percentages of 1.5%, 1.25%, and 1% will be tested with a 40% water-cement mix ratio. A total of 12 conventional CLC blocks will be cast, with four blocks for each composition. We keep the CLC composition percentages consistent but introduce specific additives to improve block compressive strength. This includes substituting 10% of the cement within the 35% portion with 65% fly ash and incorporating 40% magnetized water in the composition. The process considers different foam content percentages, namely 1.5%, 1.25%, and 1%.

3.2 Tests performed on CLC Blocks

Samples undergo three different types of test.

- Compressive Strength Test
- Water Absorption Test
- Thermal Conductivity Test

4 RESULTS AND DISCUSSION

The research focused on incorporating magnetized water, marble dust, and silica fume into CLC blocks instead of regular water, with a specific emphasis on examining the impact of magnetized water. The study aimed to investigate how magnetized water influences various foam compositions and diverse admixture ratios in CLC concrete blocks. The initial step involved conducting tests and analyzing results during the curing of samples over a 28-day period, aligning with the widely accepted belief that concrete requires 28 days to set and attains approximately 99% of its strength during this timeframe, as specified by ACI Code 318-19.

Water Absorption (%) = {(B – A)/A} X 100

A = Oven Dry Weight of Block

B = Wet Weight of Block

Table 1: Compressive Strength and Water Absorption of Conventional Block

Sr No.	Cement	Sand	Aggregate	Compressive Strength (kpa)	Water Absorption (%)
C	28%	28%	44%	8310.3	2.35

Table 2: Compressive Strength and Water Absorption of Conventional CLC Blocks

Sr No.	Fly Ash	Cement	Water Content	Foam Content	Compressive Strength (kpa)	Water Absorption (%)
A-1	65%	35%	40%	1.5%	1448.0	2.82
A-2	65%	35%	40%	1.25%	2418.6	1.92
A-3	65%	35%	40%	1%	2892.3	1.48

Table 3: Compressive Strength and Water Absorption of Modified CLC Blocks

Sr No.	Fly Ash	Cement	Silica Fume by wt. of Cement	Marble Dust by wt. of Cement	Foam Content	Compressive Strength (kpa)	Water Absorption (%)
B-1	65%	25%	10%	0%	1.5%	1267.2	8.4
B-2	65%	25%	7%	3%	1.5%	2429.7	7.5
B-3	65%	25%	5%	5%	1.5%	3871.4	5.8

B-4	65%	25%	3%	7%	1.5%	2498.6	7.7
B-5	65%	25%	0%	10%	1.5%	1232.7	8.9
B-6	65%	25%	10%	0%	1.25%	2142.8	6.61
B-7	65%	25%	7%	3%	1.25%	3980.0	5.36
B-8	65%	25%	5%	5%	1.25%	5770.2	4.30
B-9	65%	25%	3%	7%	1.25%	3660.4	5.34
B-10	65%	25%	0%	10%	1.25%	2020.1	6.87
B-11	65%	25%	10%	0%	1%	6500.3	4.75
B-12	65%	25%	7%	3%	1%	7810.3	3.22
B-13	65%	25%	5%	5%	1%	8210.2	2.61
B-14	65%	25%	3%	7%	1%	6920.9	3.25
B-15	65%	25%	0%	10%	1%	5639.9	4.70

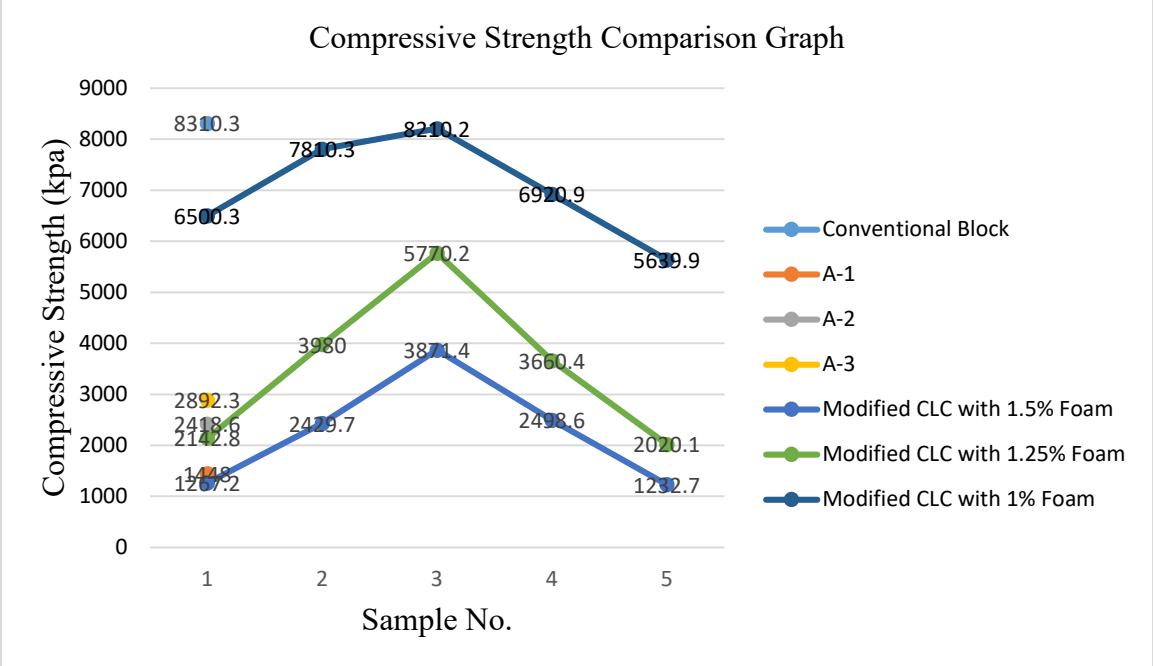

Figure 1: Compressive Strength Comparison Graph

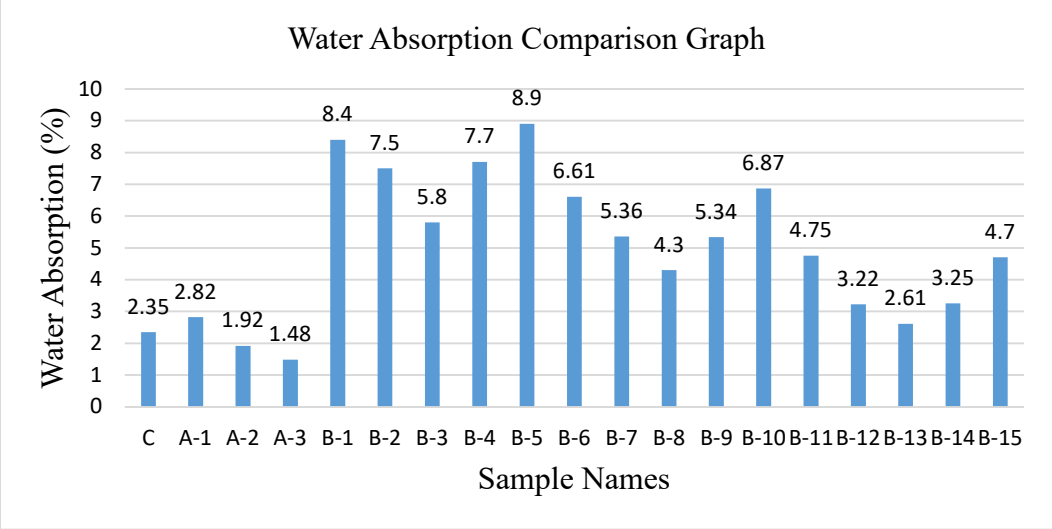

Figure 2: Water Absorption Comparison Graph

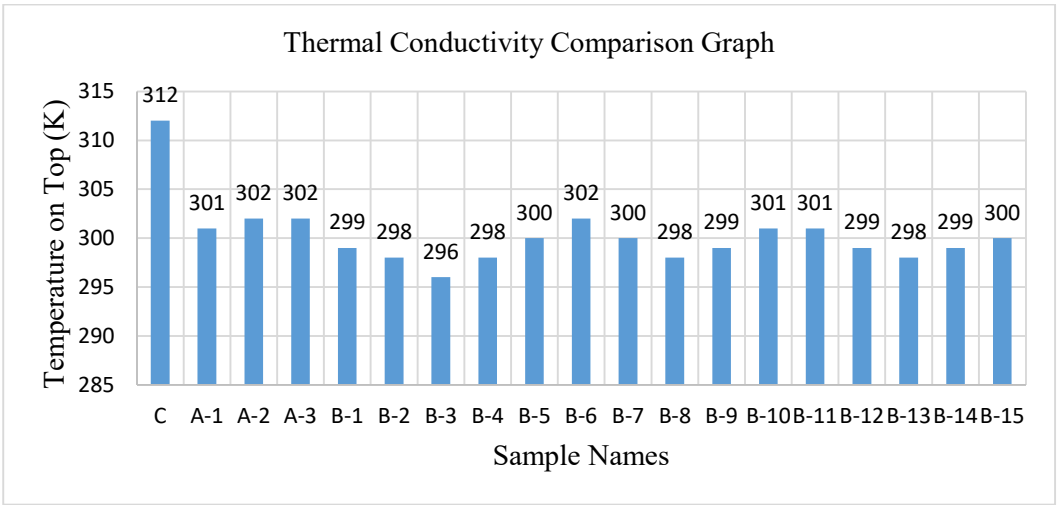

Figure 3: Thermal Conductivity Comparison Graph

5 CONCLUSIONS

Conclusions reveal that incorporating marble dust and magnetized water has a significant impact on the compressive strength of CLC blocks. These blocks also display notable thermal insulation and low water absorption. Specifically, CLC blocks prepared with magnetized water and marble dust (as a cement substitute) exhibit 2.8 times greater strength than those prepared with regular water and without marble dust. The optimal compressive strength values at different foam contents are 1190.8 psi (1% foam), 836.9 psi (1.25% foam), and 561.5 psi (1.5% foam). Corresponding water absorption rates are 2.61%, 4.3%, and 5.8%, while the maximum temperature differences for these foam contents are 39℃, 37℃, and 40℃. The most favourable results are obtained when

replacing 5% of cement with marble dust and 5% silica fume, coupled with the use of magnetized water. In conclusion, the study demonstrates that magnetized water, marble dust, and silica fume significantly contribute to the strength of CLC blocks.

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