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Effect of Magnetized Water on Mechanical Properties of Foam Concrete

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Abstract - *A lot of new inventions are being introduced in the construction industry these days. The effect of magnetized water is also being investigated. Many studies show that using magnetized water in concrete mixes improves its fresh and hardened properties when compared to regular water. Foam concrete has gained popularity among the various types of concrete used due to its thermal resistance and low self-weight. The purpose of this experimental study is to investigate the properties of foam concrete when magnetized water is used. The goal of this research is to create various mixes with magnetized water and investigate the fresh and hardened properties of foam concrete.*

Key Words: **Foam concrete, Magnetized water, Strength properties, Acid resistance, Thermal properties**

1. INTRODUCTION

A subfield of civil engineering called "concrete technology" focuses on the analysis and advancements of concrete. Concrete has long been recognised as one of the most important building materials. Studies are still being done to enhance the strength, durability, weight, fire resistance, and other qualities of concrete. Nowadays, a man may construct solid structures wherever he wants. Research is being done to find ways to use alternative methods to lighten concrete. reduction of dead loads, which reduces the need for foundations and reinforcement and improves thermal and fire resistance, and savings in site storage and processing of precast pieces. Reduced mass and better thermal and acoustic insulation capabilities of lightweight concrete, while preserving acceptable strength, are its benefits. One of the many benefits of that less weight is the lower energy requirement during construction. The ideal kind of lightweight aggregate to utilize will depend on the qualities of lightweight concrete. A light, weak aggregate can be utilized where there are few structural requirements but significant demand for thermal insulating features. This will produce concrete with rather low strength.

One technique for producing lightweight concrete is foam concreting. Foam concrete is a lightweight material with high strength. It is also an energy-saving material that is widely used in the construction industry. Its density ranges from 400 to 1600 kg/m3. Foam concrete is made by incorporating air bubbles into cement paste using performed foam. It is perfect for insulating floors and roofs, void filling, bridge approaches, embankments, and other structures because of its fire resistance, thermal and acoustical insulating qualities, etc. Foamed concrete is a low-density, highly workable substance that can contain up to 75% entrained air. It can be pumped and typically self-levels and compacts. For redundant voids like abandoned fuel tanks, sewer systems, pipelines, and culverts, foamed concrete is ideal, especially in places where access is challenging. It is an accepted method for restoring temporary road trenches. Foamed concrete is a good option for flat concrete roof insulation and sub-floor screeds due to its excellent thermal insulation qualities.

Foam can be added to the base mix or the base mix ingredients can be combined with a surface-active agent to create foam concrete. High flow ability, low self-weight, and superior thermal insulation are all characteristics of foam concrete. The stability of the foam is crucial for creating foam concrete. Foam concrete made with unstable foam may segregate and vary in density. The amount and kind of foam agent, the method of foam preparation, the water to cement ratio, and the curing technique all have an impact on foam stability, which makes it rather challenging to control. It may be possible to employ magnetized water to enhance the performance of foam concrete because water is essential to its fresh and hardened qualities. By continuously moving water through a magnetic field, magnetic water can be produced. The impact of magnetized water on the characteristics of concrete has been the subject of several studies in the past. It is common knowledge that adding magnetized water to the concrete mix can boost both the strength of the hardened concrete and the workability of new concrete.

1.1 Objectives of Study

- To research how magnetic water affects foam concrete.
- Based on the numerous studies that have already been conducted, do a comparison analysis of the usage of different foam concrete qualities.
- To create the concrete mix for concrete with magnetised water.

- To examine how using magnetised water affects the relative increase or decrease of strength attributes.

1.2 Scope of Study

In this work, the strength characteristics of magnetised water-mixed foam concrete are practically studied. The stability of the foam, compressive strength, and water absorption of the foam concrete created using magnetised water are examined in this study. These characteristics of foam concrete are reported to be affected by magnetic water. In this work, it will be examined whether the strength qualities of magnetised water-mixed concrete have increased or decreased by a certain proportion.

2. EXPERIMENTAL STUDY

2.1 Materials Used

PPC conforming to IS 4031:1996 (part 1) with 2.5 percent fineness, 33 percent consistency, and specific gravity 3 is used as the binding material in this study. Because foam concrete is a light weight material, M sand with particle sizes less than 600 microns is used as fine aggregates to ensure foam stability with the desired strength. For the preparation of foam, a highly viscous protein-based foaming agent with a pH of 7.5 that is completely soluble in water is used. Potable water and magnetized water are used in the concrete mix. Magnetized water is created by passing water through a magnetic field with a flow speed of 0.75m/s 2 times, 5 times, 10 times, and 15 times.

2.2 Preparation of Specimens

In a foam generator, the foaming agent and water are combined in a specific ratio to create the foam. Then the mortar mixture was made by mixing water with an equal amount of cement and sand. By adding foam produced by a foam generator to the mortar mixture to create a homogenous mix that is light weight and has good flowability, the pre-foaming method is used to create foam concrete. The mixtures are made using potable water and magnetized water that has been exposed to the magnetic field 2, 5, 10, and 15 times, respectively.

3. TESTS FOR FRESH AND HARDENED PROPERTIES

3.1 Foam Stability Test

To investigate the foam stability the prepared form is collected in a 1000ml graduated cylinder and the initial density of foam and density after 5minutes are noted. The difference in density indicates the stability of foam.

3.2 Slump Test

Workability of foam concrete is evaluated by a consistency test of fresh foam concrete using a mini slump cone apparatus.

3.3 Compression Test

Specimens for compression test are prepared using both potable water mixed foam concrete and magnetized water mixed foam concrete. Cubes of size 7.06×7.06×7.06 cm are prepared and has been cured for 7 days, 14 days and 28 days. Compressive strength of the cubes is determined using a compression testing machine with a capacity of 2000KN.

3.4 Water Absorption

The prepared specimens were cured for 28 days and then it is oven dried for 24hrs at 110℃ To prevent air from entering the void during immersion, the samples were waxed except for the bottom portion. The cubes original weights were measured, and they were placed in the container with their top faces in contact with the water, as cast. Cube weights in grams were recorded at 15, 60, 240 and 1440 minutes.

3.5 Drying Shrinkage

As the foam concrete is made without coarse aggregate, it has a serious problem with drying shrinkage. In order to measure the drying shrinkage a 40 mm×40 mm×160 mm specimen of each mix was casted. The specimen's two ends were fitted with spherical balls. A length Comparometer was used to measure length on the 3rd,7th,14th and 28th days. The percentage variation in length is indicates the shrinkage of tested specimen.

3.6 Acid Resistivity Test

Cubes of size 5×5×5cm were casted as specimens for acid resistivity test and were cured for 28 days. The specimens are immersed in 1 % of H_2SO_4 for 28 days. Another pair of specimens was immersed in water at the same time. The compressive strength after 28 days of immersion in water and acid were recorded.

3.7 Thermal conductivity

Foam concrete panels were casted for checking the thermal conductivity. The panels were oven dried after 28 days curing to remove moisture. Then they are tested for thermal conductivity using hot guarded apparatus. The temperature difference over the sample obtained from the thermocouple are noted to calculate the thermal conductivity of various specimens.

3.8 Sound Absorption

The sound absorption test was carried out using cylindrical specimen of diameter 5cm and 1.8cm thickness. The impedance tube apparatus is used to measure the sound absorption of specimen. Two microphones and an impedance tube are used to calculate the sound absorption coefficient.

4. RESULTS AND DISCUSSIONS

4.1 Foam stability

When the water passes through the permanent magnetic field 2, 5, 10 and 15 times, at constant flow speed of 0.75 m/s displayed the greatest stability compared to the specimens with potable water. As the number of magnetizing times increases, the maximum stability was obtained when the water is passed 10 times through the magnetic field. Finally, it can be concluded that the magnetized water has a positive impact on the foam stability of foam concrete.

4.2 Workability

Workability of 65-70% is obtained for foam concrete using potable water. The foam concrete prepared using magnetized water shows an increasing trend as the number times passing through the magnetic field is increased. Hence the magnetized water shows a positive impact on workability also.

4.3 Compressive Strength

The compressive strength of all foam concrete specimens with magnetized water is higher than that of the specimens with potable water at 7th day, 14th day and 28th day. This means the potable water after passing through a magnetic field has a positive impact on the compressive strength of foam concrete. The foam concrete with magnetized water shows an average 61%, 50% and 39% increment in compressive strength at 7th, 14th and 28th day respectively when compared to potable water mixed foam concrete.

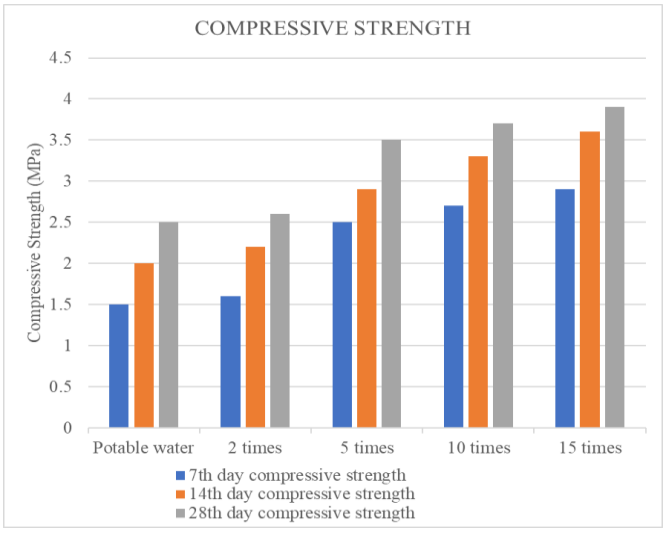

Chart -1: Compressive strength at 7th, 14th and 28th day

4.4 Water Absorption

When the water absorption of the foam concrete specimens using magnetized water and potable water after 28 days curing is analyzed, the specimen prepared using magnetized water has reduced water absorption than that of the potable water foam concrete specimen. This may be due to the reduction of pores in the structure of foam concrete specimens while the magnetized water is used.

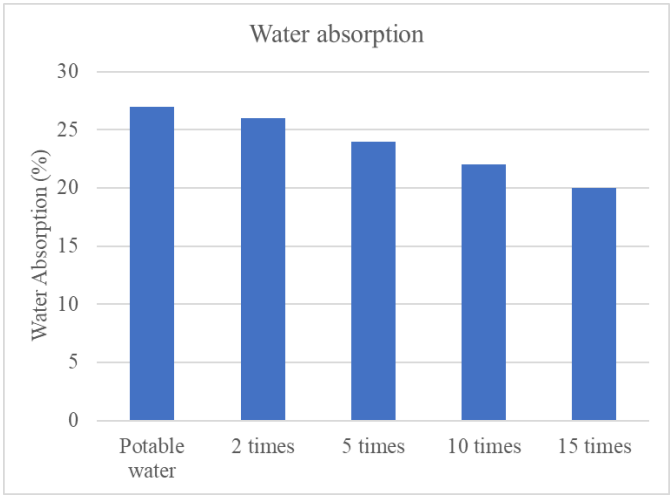

Chart -2: Water absorption after 28 days curing

4.5 Drying Shrinkage

The use of magnetized water improves the shrinkage resistivity of specimen at 3rd, 7th, 14th and 28th day. Chart-3 shows the impact of magnetized water on drying shrinkage on 3rd, 7th, 14th and 28th day.

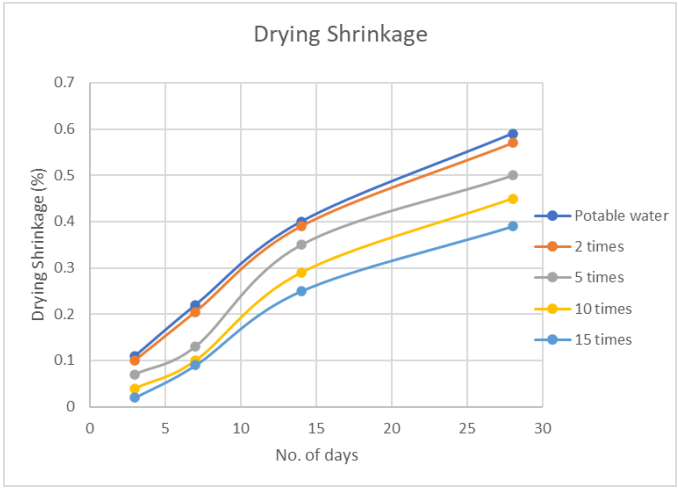

Chart -3: Drying shrinkage of foam concrete specimens

4.6 Acid Resistivity

The results show that the compressive strength of the specimen decreases when it is immersed in water or acid for 28 days. And the percentage decrease in strength of magnetized water mixed foam concrete specimen is smaller compared to the potable water mixed foam concrete specimen.

4.7 Thermal conductivity

The thermal conductivity of the specimen prepared with portable water is greater than the thermal conductivity of the specimen prepared with magnetized water.

4.8 Sound Absorption

The sound absorption shows an increasing tendency in magnetized water mixed foam concrete.

5. CONCLUSIONS

Research is done on the strength characteristics of foam concrete made with magnetized water. The use of this technology would aid in lowering the cost of building and maintaining RC structures, as well as in lowering the load on foundations for construction projects and making them more affordable. From this experimental study, the following conclusions can be drawn:

- When magnetized water is utilised in the preparation of foam concrete, the foam stability and workability enhance. When the water passes through the magnetic field more frequently at a constant speed of 0.75 m/s, it exhibits a rise in foam stability up to a factor of 10, after which it exhibits a minimal loss in foam stability. The more times that pass, the more workable it becomes.
- When compared to foam concrete that was combined with regular potable water, the compressive strength of foam concrete at the 7th, 14th, and 28th days increased by 61%, 50%, and 39%, respectively.
- Magnetized water foam concrete shrinks and absorbs water less than foam concrete mixed with potable water. Water absorption and shrinkage diminish as the number of times it passes through the magnetic field rises.
- In comparison to potable water mixed foam concrete, magnetized water mixed foam concrete has superior acid resistance. As more water travels through a magnetic field, the thermal conductivity of foam concrete diminishes.
- As magnetization increases, sound absorption rises. Thus, it is concluded that the various qualities of the constructions can be improved by using magnetized water in foam concrete.

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