



# “Experimental Study On Magnetized Water Used In Concrete”

<sup>1</sup>Prof. Borude Dhananjay A, <sup>2</sup>Aditya N Udage, <sup>3</sup>Aditya S. Autade, <sup>4</sup>Shubham S Dhapte, <sup>5</sup>Navnath Batule

<sup>1</sup> Assistant Professor, <sup>2</sup> BE Student, <sup>3</sup> BE Student, <sup>4</sup> BE Student, <sup>5</sup> BE Student

<sup>1</sup> Civil Engineering Department

<sup>1</sup> Adsul's Technical Campus, Chas, Ahilyanagar, Maharashtra.

**Abstract:** Concrete is one of the most widely used construction materials in the world, and its performance largely depends on the quality of water used during mixing and curing. Recent studies have indicated that magnetized water can improve the properties of concrete by altering the molecular structure of water, leading to better hydration of cement particles. This experimental study investigates the effect of magnetized water on the fresh and hardened properties of concrete. In this research, water was passed through a magnetic field to produce magnetized water and was subsequently used for concrete mixing. Concrete specimens were prepared using both normal water and magnetized water for comparison. Tests were conducted to evaluate workability, compressive strength, split tensile strength, and flexural strength at different curing periods. The results obtained from the experimental investigation were analyzed to determine the influence of magnetized water on concrete performance.

The findings indicate that concrete prepared with magnetized water exhibits improved workability and enhanced mechanical properties compared to conventional concrete. An increase in compressive strength, tensile strength, and durability characteristics was observed due to improved cement hydration and reduced water cluster size. The use of magnetized water also has the potential to reduce water consumption and improve the overall efficiency of concrete production.

Therefore, the study concludes that magnetized water can be considered a promising alternative to ordinary mixing water in concrete technology, contributing to the development of stronger, more durable, and sustainable concrete structures.

**Keywords:** Magnetized Water, Concrete, Compressive Strength, Workability, Cement Hydration, Sustainable Construction, Durability.

## INTRODUCTION

Magnetized water refers to water that has been subjected to a magnetic field, which proponents claim alters its properties. The idea is that the magnetic field can change the structure of water molecules, enhancing their solubility and potentially improving health benefits. Magnetized water is sometimes used in concrete production based on claims that it can enhance the properties of the concrete. Magnetized water in concrete refers to water that has been exposed to a magnetic field before being mixed into the concrete. The idea is that this exposure can alter the water's physical and chemical properties, potentially improving the performance of the concrete. Some studies suggest that the magnetization can last up to 24-48 hours.

(SCMs) are materials added to concrete to enhance its properties, improve sustainability, and reduce the carbon footprint associated with cement production.

**Fly Ash:** Fly ash is a fine, powdery byproduct of burning coal in power plants. It is collected from the flue gases using electrostatic precipitators or filters. Fly ash primarily consists of fine particles of minerals, including silica, alumina, and iron oxides. It is often used in construction, particularly in concrete, where it improves strength and durability while reducing the environmental impact of cement production. Additionally, fly ash can be used in soil stabilization, road construction, and even as a component in certain industrial processes.

**Baggash Ash:** Bagasse ash is a byproduct derived from the burning of bagasse, the fibrous residue left after extracting juice from sugarcane. It enhances the mechanical properties of concrete while promoting sustainability by recycling agricultural waste.

### Objectives of projects:

1. To find fiber reinforced, fly ash concrete compressive strength by using normal water and magnetized water at various curing age.
2. To find initial and final setting time of fiber reinforced, fly ash concrete by using normal and magnetized water
3. To find effect on workability of concrete

Sr. No	Description of Test	IS References	Result	IS Requirement
1	Fineness of cement	IS 269-1976	2.40%	<10%
2	Standard consistency of cement	IS 4031-1988	31%	26-33%
3	Setting time of cement	IS 269-1976		
	A) initial setting time		40 min	<30 min
	B) final setting time		584min	>600 min

4. To evaluate the properties of concrete by using NDT test.

## MATERIALS

### Material Properties:

#### Cement

Cement is a fine powder made from calcined limestone and clay, primarily composed of calcium silicates. It acts as a binder when mixed with water, sand, and aggregates to form concrete. There are several types of cement available in market. Cement production is energy-intensive and contributes to CO<sub>2</sub> emissions, prompting the exploration of sustainable alternatives and additives in construction. Ordinary Portland Cement (OPC) 53 Grade is a high-strength cement that achieves a compressive strength of 53 MPa in 28

days, making it ideal for heavy structural applications like bridges and high-rise buildings. Composed mainly of clinker and gypsum, it offers quick setting times and good resistance to chemical attacks. Conforming to standards like IS 12269 in India, OPC 53 Grade is preferred for projects requiring rapid strength gain and durability.

### Fine aggregate (sand)

Fine aggregate, or sand, acts like the glue in a concrete mixture, filling the gaps between larger stones and

Sr. No.	Description of test	IS References	Result	IS Requirement
1.	Fineness modulus	IS 2386 (part I)	3.6%	2-4%
2.	Moisture content	IS 2386 (part IV)	2.40%	< 5%
3.	Specific gravity	IS 2386 (part III)	2.60%	2.5-3%
4.	Silt Content	IS 2386 (part III)	3.38%	< 3%

helping to create a solid structure. Typically consisting of small particles from 0.075 mm to 4.75 mm in diameter, it can be sourced naturally from riverbeds or produced by crushing larger rocks. Just as grains of sugar help create the right texture in a cake, well-graded sand ensures optimal packing and stability in concrete. Its cleanliness and gradation are crucial for achieving the desired strength and durability in construction, making it an essential ingredient in building robust structures.

**Table : Properties of F.A.**

### Coarse aggregate

Coarse aggregate consists of larger particles, typically ranging from 4.75 mm to 20 mm or more, and is a fundamental component of concrete and asphalt mixes. Sourced from natural deposits like gravel or crushed stone, coarse aggregate provides bulk and strength to concrete, enhancing its load-bearing capacity. The size and shape of these particles influence the concrete's workability and durability; well-graded coarse aggregates help minimize voids, improving the overall performance of the mix. Additionally, they play a vital role in reducing shrinkage and cracking in hardened concrete. Proper selection and quality of coarse aggregate are crucial for achieving strong, durable, and resilient construction materials.

Sr. No.	Description of test	Result	IS Requirement
1.	Fineness modulus of coarse aggregates		
	20mm	4.28	6.75-8
	12.5mm	2.64	0.1-2
2.	Moisture Content		
	20mm	1.65	<2%
	12.5mm	1.88	<2%
3.	Water absorption		
	20mm	2.64	0.1-2%
	12.5mm	1.75	0.1-2%

**Table : Properties of C.A**

## MIX DESIGN OF M25 GRADE CONCRETE

### Step 1: Target mean compressive strength

Characteristics Strength =  $F_{ck} = 25 \text{ mpa}$  Target mean strength =

$$F'_{ck} = F_{ck} + 1.65 \times S$$

From IS 10262-2019;  $S = 3.5 \text{ N/mm}^2$

$$F'_{ck} = F_{ck} + 1.65 \times S = 25 + 1.65 \times 3.5 = 30.775 \text{ N/mm}^2$$

The higher value to be adopted

Target mean strength will be 30.775 MPa

### Step 2 : Approximate air content

From Table 3, the approximate amount of entrapped air to be expected in normal (non-airentrained) concrete is 1.0 percent for 20 mm nominal maximum size of aggregate.

### Step 3 : Selection of W/C ratio

From Fig. 1, the free water-cement ratio required for the target strength of 38.46  $\text{N/mm}^2$  is 0.5 for OPC 53 grade curve. This is lower than the maximum value of 0.6 present for 'moderate' exposure for plain concrete as per Table 5 of IS 456.

$0.5 < 0.56$  Hence adopt 0.5

### Step 4: Determination of water content

From Table 4, water content = 186 kg (for 120 mm slump) for 20 mm aggregate. Estimated water content for 120 mm slump =  $186 + [(8.4/100) \times 186] = 201.62 \text{ kg}$

**Step 5: Determination of cement content**

Water-cement ratio = 0.5

Cement content =  $201.62/0.50 = 403.24 \text{ kg/m}^3 \approx 405 \text{ kg/m}^3$

From Table 5 of IS 456, minimum cement content for 'moderate' exposure condition =  $300 \text{ kg/m}^3$ ,  $405 \text{ kg/m}^3 > 300 \text{ kg/m}^3$ , hence, O.K.

**Step 6: Determination of aggregate content**

From Table 5, the proportionate volume of coarse aggregate corresponding to 20 mm size aggregate and fine aggregate (Zone I) for water-cement ratio of 0.5

Volume of coarse aggregate = 0.64

Volume of fine aggregate =  $1 - 0.62 = 0.38$

**Step 7: Mix calculations**

Volume of concrete =  $1 \text{ m}^3$

Volume of entrapped air in wet concrete =  $0.01 \text{ m}^3$

Volume of cement =  $0.1406 \text{ m}^3$

Volume of water =  $\frac{\text{mass of water}}{\text{specific gravity of water}} \times \frac{1}{1000} = \frac{201.6}{1} \times \frac{1}{1000} = 0.201 \text{ m}^3$

Volume of aggregate =  $1 - 0.01 - 0.1406 + 0.201 = 0.6484 \text{ m}^3$

Mass of coarse aggregate =  $0.6484 \times 0.62 \times 2.74 \times 1000 = 1100.84 \text{ kg} \approx 1100 \text{ kg}$

Mass of fine aggregate =  $0.6484 \times 0.38 \times 2.65 \times 1000 = 652.93 \text{ kg} \approx 653 \text{ kg}$

**Step 8: Mix proportion**

Cement =  $405 \text{ kg/m}^3$

Water =  $201.65 \text{ Kg/m}^3$

Fine aggregate =  $653 \text{ kg/m}^3$

Coarse aggregate  $1100 \text{ kg/m}^3$

Free W/C ratio =  $0.5 \text{ kg/m}^3$

**Experimental Work:****Casting**

The performance of concrete is influenced by a proper mixing and good practice of mixing can lead to better performance and quality of the concrete. In the present study, total 48 cubes of M25 grade standard concrete cubes of size  $150 \times 150 \times 150 \text{ mm}$  were casted for determining the compressive strength for required number of days.

**Fig : Normal water**

Sr. No	Normal concrete	Flyash concrete	Fiber used concrete	Flyash + Fiber concrete
28 days	3	3	3	3
56 days	3	3	3	3

**Fig : Magnetized Water**

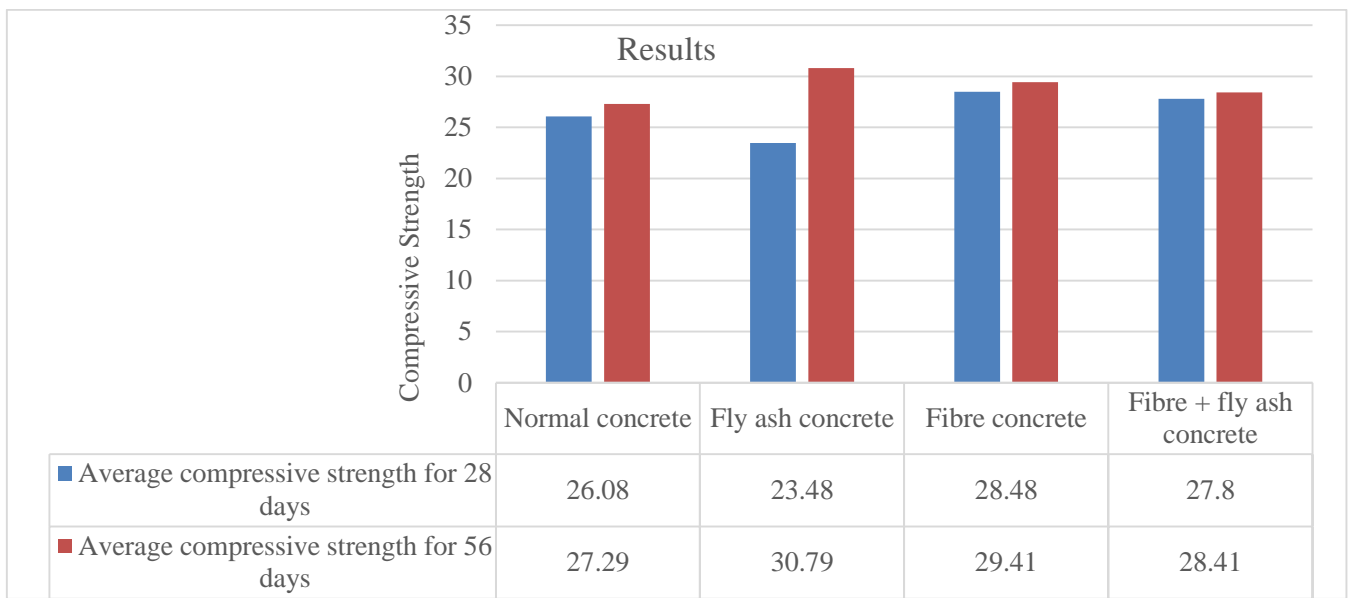
Sr.No	Normal concrete	Flyash concrete	Fiber used concrete	Flyash + Fiber concrete
28 days	3	3	3	3
56 days	3	3	3	3

**Compressive Strength Test:**

The compressive strength test of a concrete cube is a fundamental procedure used to evaluate the strength and durability of concrete, which is critical for ensuring the structural integrity of constructions. In this test, concrete cubes (typically 150mm x 150mm x 150mm in size) are prepared by pouring the freshly mixed concrete into molds, compacting it in layers, and allowing it to set for 24 hours. After demolding, the cubes are subjected to a curing process, usually in a water tank, for a specified period (commonly 7, 14, or 28 days), to allow the concrete to hydrate and gain strength. Once cured, the cubes are placed in a compressive testing machine that applies an increasing load until the concrete fails. The compressive strength is determined by dividing the maximum load applied at failure by the cross-sectional area of the cube. The result is typically expressed in N/mm<sup>2</sup> (or MPa). The compressive strength is usually tested at 7 and 28 days, with the 28-day test being the standard for evaluating the final strength of concrete. This test is vital for ensuring that the concrete mix used meets the required specifications and provides the necessary performance for structural safety and durability. It helps engineers predict the concrete's behavior over time and ensures compliance with building codes and quality control standards.

Type of concrete	Average compressive strength for 28 days (N/mm <sup>2</sup> )	Average compressive strength for 56 days (N/mm <sup>2</sup> )
Normal concrete	26.08	27.29
Fly ash concrete	23.48	30.79
Fibre concrete	28.48	29.41
Fibre + fly ash concrete	27.80	28.41

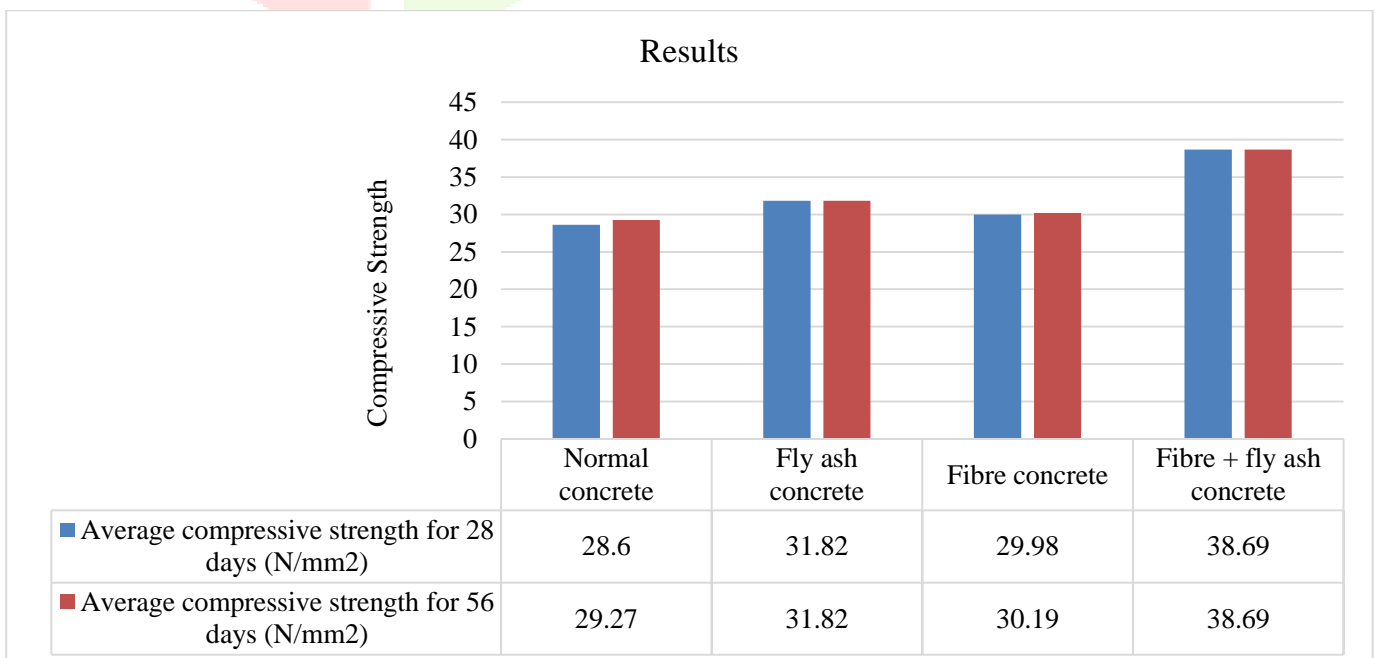
**Table : Test result of Compressive strength of concrete (Normal water)**



**Graph : Test result of Compressive strength of concrete**

Type of concrete	Average compressive strength for 28 days (N/mm <sup>2</sup> )	Average compressive strength for 56 days (N/mm <sup>2</sup> )
Normal concrete	28.6	29.27
Fly ash concrete	30.79	31.82
Fibre concrete	29.98	30.19
Fibre + fly ash concrete	37.18	38.69

**Table : Test result of Compressive strength of concrete (Magnetized water)**



**Graph : Test result of Compressive strength of concrete**

## CONCLUSION

From all test results following conclusions can be drawn

- The various properties of water when it becomes magnetized increases i.e. pH, Hardness.
- Workability test shows that the concrete using magnetized water is more workable than that normal concrete .
- Workability of concrete goes stable on adding a 0.5 percentages of polypropylene fibers And increasing mechanical strength of concrete.
- Compressive strength of cubes after 28 days and 56 days casted with magnetized water is 12.97% and 16.61% respectively higher than that of normal concrete. Also as polypropylene fibers increases the compressive strength slightly decreases.
- So finally we conclude that with the use of magnetized water in concrete work increases the Workability, Compressive strength, Split tensile strength, Flexural strength.

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