

# Comparative Study on Strength Enhancement of Concrete Using Magnetic and Normal Water

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**Abstract** - The most important challenge for concrete technologists is to improve the properties of concrete. In the last two decades, a new technology, called magnetic water technology, has been used in the concrete industry. In this technology, by passing water through a magnetic field, some of its physical properties tends to change and, as a result of such changes, the number of molecules in the water cluster, which causes a decrease in the surface tension of water, with an improvement in the workability and strength of concrete.

Magnetic treatment of water increases the ion solubility and pH. This technique is mostly used for the softening of water and, for the first time in this research, it has been adopted by the scientists for the production of concrete with improved strength. Some researchers hypothesize that magnetic treatment affects the nature of hydrogen bonds between water molecules which increases the pH and softens the water.

From the referred literature, it has been observed that the concrete made with magnetic water has higher slump values. Also in some cases, the compressive strength of the magnetic concrete samples was higher than that of the control concrete samples (up to 39%). The cement content can be reduced by 28% in the case of magnetic concrete. Similarly the test conducted on recirculated magnetic water shows change in pH value from 7.8 to 8.7 with increase in recirculation time. The hardness also reduced from 310 to 190 mg/lit due to recirculation of magnetic water. This study is aimed to compare the strength of concrete in Magnetic and Normal water concrete by performing tests like compressive strength, split tensile strength and flexural strength at the age of 7 and 28 days.

**Index Terms**— Magnetic Concrete, Magnetic field, Magnetic Water, pH, Recirculated water.

## I. INTRODUCTION

In general, adding certain chemicals while mixing concrete is practiced to alter the properties of concrete to obtain a concrete with desired property. But in most of the cases these admixtures are added to get concrete with increased strength. The chemicals that are required for increasing the strength will be rarely available in rural areas and it will cost more in case of large projects.

The usage of magnetic water while mixing concrete will increase compressive strength and also there will be higher workability for the same water cement ratio. Many

researchers proved that the scaling property and corrosion phenomenon in magnetic water is greatly reduced if the water is passed through an intense magnetic flux which in turn changes the physical structure of water molecules and softens the hard water. This softening intensity is based on the magnitude of flux induced. To achieve higher intensity and magnetization, water is made to recirculated by designing a setup with motor and auto transformer.

Magnetic devices include one or more permanent magnets, which induce changes and effects on ions and molecules. A magnetic field has a considerable effect on clusters of water molecules and causes the decrease of such a mass

## II. MATERIALS COLLECTION

### A. Objective

The main objective of our project is to increase the compressive strength and workability of the concrete without adding super plasticizers, plasticizers, chemical admixtures etc..., Instead of these, a new technology called adding the magnetized water in concrete to increase the compressive strength and workability in a economical and cheapest manner when compared to the above techniques.

### B. Strength Parameters

Compressive strength is obtained by conducting compression test on hardened concrete.

### Cube Specimens:

Cube which has the nominal size of 150mm x 150mm x 150mm are used for making samples using conventional concrete of Normal and Magnetic Water concrete specimens.

### Cylinder Specimens:

Cylinders of 150mm diameter and 300mm height are used for making samples using conventional concrete of Normal and Magnetic Water concrete specimens

### C. Magnetic Device

Magnetic fields are produced by the motion of charged particles. For example, electrons flowing in a wire will produce a magnetic field surrounding the wire. The magnetic fields generated by moving electrons are used in many household appliances, automobiles, and industrial machines. One basic example is the electromagnet, which is constructed from many coils of wire wrapped around a central iron core. The magnetic field is present only when electrical current is passed through the wire coils. Permanent magnets do not use an applied electrical current. Instead, the magnetic field of a permanent magnet results from the mutual alignment of the very small magnetic fields produced by each of the atoms in the magnet. These

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atomic-level magnetic fields result mostly from the spin and orbital movements of electrons. While many substances undergo alignment of the atomic-level fields in response to an applied magnetic field, only ferromagnetic materials retain the atomic-level alignment when the applied field is removed. Thus, all permanent magnets are composed of ferromagnetic materials.



**FIGURE I: MAGNETIC WATER FOR SLUMP**

### III. CONCRETE INGREDIENTS

#### A. Cement

Ordinary Portland Cement (53 Grade) cement was used for the present study and it is having a specific gravity of 3.14 and normal consistency 32% conforming to the requirements of IS: 12269-1987 specifications.

#### B. Fine Aggregate

River sand passing through IS 4.75 mm sieve was used as fine aggregate. The sand used having fineness modulus 3.237 and Water absorption of 1.93%.

#### C. Coarse Aggregate

The coarse aggregate of 20mm size was used in the study the aggregates were tested as per IS: 2386-1963 (I, II and III) specifications.

#### D. Normal Water

The water which if fit for drinking should be used for making concrete. The minimum water cement ratio is 0.3. The water should be clean and free from harmful impurities such as oil, alkali and acid etc.

#### E. Magnetic Water

The water which was subjected to high intense and focused magnetic field is called magnetic water.

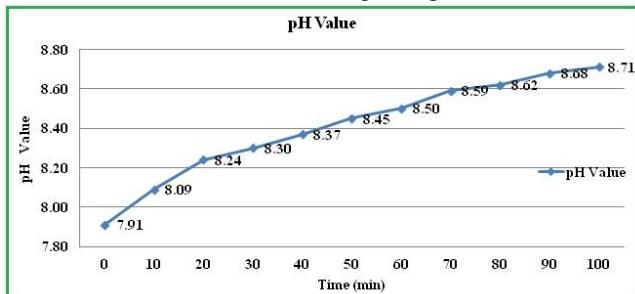
**TABLE I: PROPERTIES OF MAGNETIC WATER**

Sl No	Parameters	Experimental Value for Water Sample	Permissible Value (as per IS :456-2000)
	Chemical Examination		(as per IS :456-2000)
1	pH Value	8.71	Not to less 6.0
2	Hardness	190	Not to exceed 500 mg/l

### IV. EXPERIMENTAL TESTS

#### A. pH

The pH test is conducted for every ten minutes of recirculation of normal water through Magnetic devices.



**CHART I: EFFECT OF PH VALUE ON RECIRCULATION TIME**

This graph shows the change in pH value based on increase in recirculation time of magnetic water. Here the graph interprets the result, that increase in recirculating time will considerably increase the pH value. So the increase in pH value will change the nature of water from acidic to basic which decreases the corrosion rate.

#### B. Hardness

Hardness was originally defined as the capacity of water to precipitate soap. Hard water forms scale, usually calcium carbonate, which causes a variety of problems. Left to dry on the surface of glassware, silverware, and plumbing fixtures (shower doors, faucets and sink tops), hard water leaves unsightly scale, called water spots. Scale that forms on the inside of water pipes eventually reduces the water pipes' carrying capacity. Scale that forms within appliances, pumps, valves, and water meters causes wear on moving parts. The most commonly used units include grains per gallon (gpg), parts per million (ppm), and milligrams per liter (mg/L).

**TABLE II: EFFECT OF HARDNESS ON RECIRCULATION TIME**

S NO	RECIRCULATION TIME	HARDNESS
	(Min)	(mg/lit)
1	0	310
2	15	260
3	30	213
4	45	200
5	60	250
6	75	225
7	90	190

#### C. Slump Test

Slump test is a measurement of concrete workability. Table 3 shows that an increase between 10 to 35 % was achieved in slump when Magnetic Water is used. It can be explained by the fact that a more homogeneous lattice of new formations of hydrated cement minerals is developed when

mixed with Magnetic Water.

TABLE III: SLUMP TEST FOR CONCRETE WITH AND WITHOUT MAGNETIC WATER

S.No	TYPE OF WATER	SLUMP VALUE (mm)
1	NORMAL WATER	50
2	MAGNETIC WATER	58



FIGURE II: NORMAL WATER FOR SLUMP



FIGURE III: MAGNETIC WATER FOR SLUMP

#### D. Compression Test

The cube specimens are tested for compressive strength at the end of 28days.

$$f = P/A \text{ N/mm}^2$$

The results of the compressive strength tests on concrete cubes are shown in Table IV and Chart II

TABLE IV: COMPRESSIVE STRENGTH OF CUBES AT THE END OF 28 DAYS

TYPE OF WATER	COMPRESSIVE STRENGTH MPa			AVERAGE STRESS N / mm <sup>2</sup>
	TRIAL 1	TRIAL 2	TRIAL 3	
TAP WATER	27.30	27.25	27.45	27.33
MAGNETIC	38.20	38.05	38.10	38.12
AVERAGE INCREASE IN COMPRESSIVE STRENGTH			39.48 %	

From the above table it is clear that compressive strength of cubes using normal tap water is slightly greater than compressive strength of cubes using magnetic water, it's by 39.48 % increase.

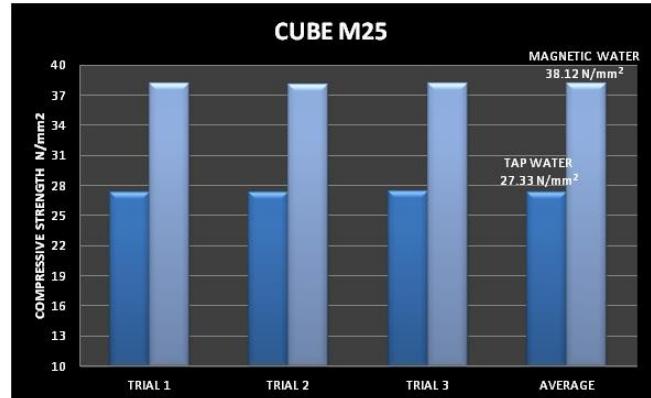


CHART II: COMPRESSIVE STRENGTH OF CUBES

#### E. Split Tensile Test

The cylinder specimens were tested for Split tensile strength at the end of 28days. The Tensile strength of the specimen was calculated by using the formula

$$\text{Tensile strength} = 2P/\pi LD$$

The results of the Split tensile strength tests on concrete Cylinders are shown in Table V and Chart III

TABLE V: SPLIT TENSILE STRENGTH OF CYLINDER AT THE END OF 28 DAYS

TYPE OF WATER	SPLIT TENSILE TEST N / mm <sup>2</sup>			AVERAGE STRESS N / mm <sup>2</sup>
	TRIAL 1	TRIAL 2	TRIAL 3	
TAP WATER	2.50	2.55	2.53	2.53
MAGNETIC	3.20	3.15	3.25	3.20
AVERAGE INCREASE IN SPLIT TENSILE TEST				26.48 %

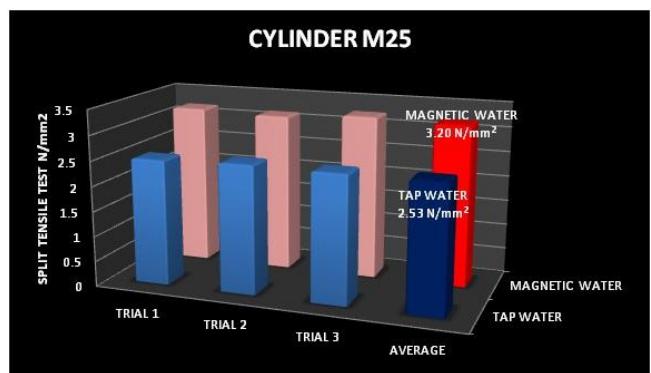


CHART III: SPLIT TENSILE STRENGTH OF CYLINDER

From the above Graph it is clear that Split tensile strength

of cylinder using normal tap water is slightly greater than Split tensile strength of cylinder using magnetic water, it's by 26.48 % increase

## V. CONCLUSION

Based on the experimental investigations concerning on the cube and cylinder of its compressive strength and split tensile strength of concrete, by Normal and Magnetic water of there observations and the following conclusions are drawn from the present study.

- [1] In this magnetic water technology the strength of concrete gets increase without adding any admixture or additives.
- [2] Compressive strength of concrete of cube at the end of 28 days for normal tap water and magnetic water are 27.33 N/mm<sup>2</sup> and 38.12 N/mm<sup>2</sup> respectively.
- [3] The average increase in the compressive strength is 39.48%.
- [4] With compared to the normal tap water and magnetic water concrete is higher in compressive strength.
- [5] Split Tensile strength of concrete of cylinder at the end of 28 days for normal and magnetic water are 2.53 N/mm<sup>2</sup> and 3.20 N/mm<sup>2</sup> respectively.
- [6] The average increase in the Split Tensile strength of concrete of cylinder is 26.48%.
- [7] With compared to the normal tap water and magnetic water concrete is higher in Split Tensile strength of concrete.
- [8] As the recirculation time increases the pH value increases but the power consumption is also a major factor to be considered.
- [9] So the recirculation is done for optimum time based on factors like duration, power consumption, pH value and hardness.
- [10] The main advantage in this method of increasing strength is that the magnet is available in different sizes and magnetic induction.

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