Increasing the Strength of Concrete Using Magnetized Water

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Abstract

The compressive strength and workability of the concrete by using magnetized water، have improved certain percentages depending on the process of the formation of this concrete. The experiments comprise the preparation of standard cubes from this concrete according to the standard ratios of ingredients and mixed with magnetized water, which was prepared by passing tap water through the devices of different magnetic strength in terms of Gauss. Then the factors affecting on some physical and mechanical properties were studied, and developed some methods to be tested and verified. To complete the scope of the present experimental results, the study was necessitated the preparation of similar cubes using ordinary tap water. Several experiments were conducted to determine the velocity of water through the magnetic field, which gave the highest value for the compressive strength, where it was up to 0.8 m / sec. It was also appeared from the tests for compressive strength of more than 63 cubic concrete mixed with magnetic water that there is an increase ranging between (10-22%) compared to the results of the control cubes, Where the highest increase up to 22% at the magnetic intensity equal to gauss.

Key words: magnetic water, concrete, magnetic field, compressive strength, slump.

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1. INTRODUCTION

Currently we are using different grades of concrete like M20, M25, M30, M35, M40 etc. The difference between strength of M30 and M35 is nearly 15%. But we come to cost the difference to produce 1 m3 is nearly INR 500. We have found a way in which by using the design mix of M30 we can extract the strength of M35 i.e. we have found a way to increase the current strength of concrete mix by nearly 15%. It will help to reduce the cost of the overall structure without compromising with the strength of the structure.

2. CONCEPT

The cement molecules undergo the process of hydration. When we use normal water the cement particles undergo hydration with small clusters of molecules. But when we use magnetized water, the particles are directly hydrated with individual molecules of water, due to which complete hydration of cement particles takes place. Due to this complete hydration, strength is gained.

2.1 Theory Related to the Project

We have used magnetized water in place of normal water.

2.1.1 Normal Water

Normal water contains H_2O molecules. These molecules are connected to each other via hydrogen bonds.

These bonds are shown in the figure 1

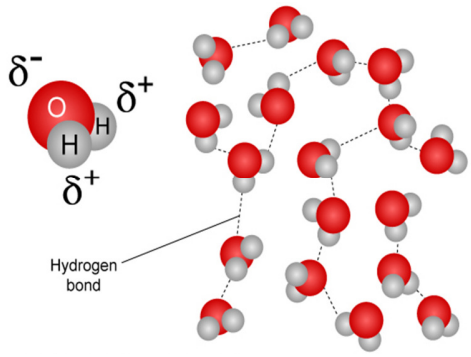

Figure 1 Joining of water molecules by hydrogen bond

Due to hydrogen bonding the water molecules are present in clusters in the sample.

2.1.2 Magnetised Water

Water is passed through a magnetic field of high intensity ranging between 0.25T to 0.75T.

Cement	Water	20 mm	10 mm	Fine Agg.
2 kg	172 kg	678 kg	522 kg	798 kg
1 kg	.55 kg	2.173 kg	1.673 kg	2.56 kg

Due to this the molecules are aligned in a certain direction.

The hydrogen bonding present in water breaks. Initially the water is present in cluster of molecules formed due to hydrogen bonding.

When passed through magnetic field the cluster breakdowns and single molecules are left as shown in figure 2 (a) & (b).

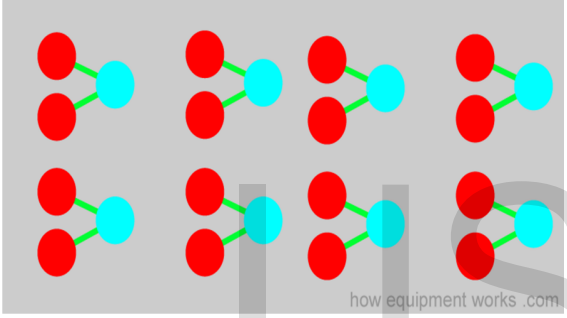

Figure. 2 (a) Magnetized water

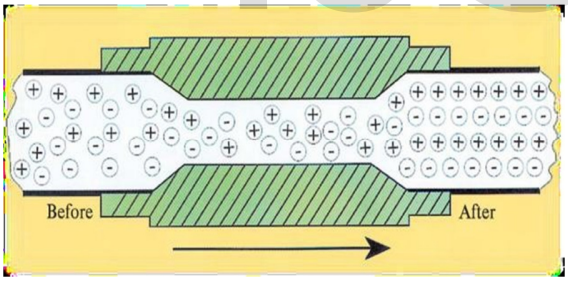

Figure. 2 (b) Magnetized water

Formation of Magnetic Water

The water used was prepared in a Car crushing factory in Amritsar.

The water was passed through the electro magnets producing the intensity of 0.5 Tesla using a plastic pipe.

The water passed at a rate of 10 cubic centimeters per second.

This intensity and discharge broke the present hydrogen bonds in water and water became magnetized.

Design mix for M20

M20 concrete mix was designed for moderate conditions using IS 456:2000

w/c = .55, OPC 43 grade.

Various samples of cubes were prepared for the above design mix using normal water and magnetized water.

Test results obtained were as follows:

Using Normal water

Concrete cubes of .15m x .15m x .15m were prepared and checked for 28 days compressive strength. The results were:-

ID. No.	Test Parameter	Unit	Observation
1	Compressive Strength	N/mm2	22.33
2	Compressive Strength	N/mm2	21.96
3	Compressive Strength	N/mm2	22.17
4	Compressive Strength	N/mm2	22.33

Using magnetic water

Concrete sample of .15m x .15m x .15m was prepared using magnetic water and the results of 28 day compressive strength were as follows:-

ID.No	Test Parameter	Unit	Observation
1	Compressive Strength	N/mm2	24.77
2	Compressive Strength	N/mm2	25.14
3	Compressive Strength	N/mm2	24.98

2.1.3 Industrial Production of Magnetic Water

- Using the concept of solenoid, magnetic water was prepared (Fig. 3 a & b).
- A box made of plywood/cardboard of dimension 0.5m x 0.5m x 0.5m was used with a wax coating inside it.
- This box is kept inside a cube of bricks.
- Copper wire of 20 gauge of about 10m.

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- An ac/dc converter was used to convert the AC voltage at home to DC voltage.
- Current of about 3 ampere and voltage of 19.5 V was obtained.
- With 100 number of turns of copper wire wrapped on a core was used.
- The water was passed inside the solenoid through PVC pipes at a constant rate of 10cc/s.

The water is stored in the water container of mixer to be used at site but since the container is made of metal we need to coat it with paraffin or wax as water starts losing its magnetization with contact of metal.

Figure 3 (a) Industrial Model Production of Magnetic Water

Figure 3 (b) Industrial Model Production of Magnetic Water

3. PRINCIPLE AND CALCULATIONS OF AN ELECTROMAGNET

An **electromagnet** (Fig. 4) is a type of magnet in which the magnetic field is produced by an electric current. The magnetic field disappears when the current is turned off. Electromagnets usually consist of a large number of closely spaced turns of wire that create the magnetic field.

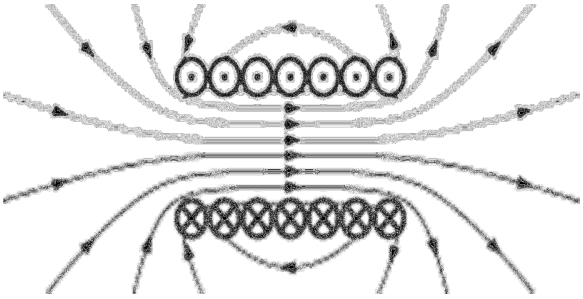

Figure 4. An electromagnet

Cement	Water	Fine Agg.	20 mm	10 mm
400 kg	186 kg	1047 kg	496 kg	329.6 kg
1 kg	.465 kg	2.62 kg	1.24 kg	.82 kg

The wire turns are often wound around a magnetic core made from a ferromagnetic or ferrimagnetic material such as iron; the magnetic core concentrates the magnetic flux and makes a more powerful magnet.

The main advantage of an electromagnet over a permanent magnet is that the magnetic field can be quickly changed by controlling the amount of electric current in the winding. However, unlike a permanent magnet that needs no power, an electromagnet requires a continuous supply of current to maintain the magnetic field (Fig 5 a & b).

Electromagnets are widely used as components of other electrical devices, such as motors, generators, relays, loudspeakers, hard disks, MRI machines, scientific instruments, and magnetic separation equipment. Electromagnets are also employed in industry for picking up and moving heavy iron objects such as scrap iron and steel.

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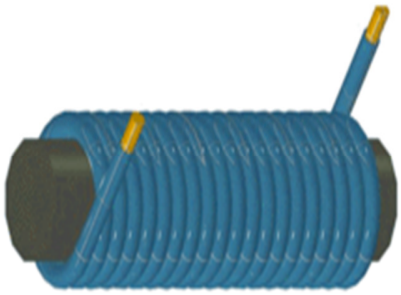

Figure 5 (a) Use of current to maintain the magnetic field

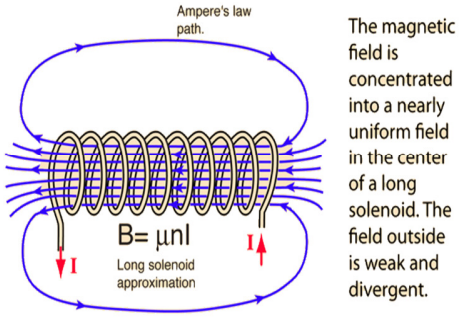

Figure 5 (b) Use of current to maintain the magnetic field

We need to take the following:-
Number of turns = 200
Permeability of core = 200
Gauge of coil = 20

Water type	Slump test value
Normal water	**65 mm**
Magnetized water	**70 mm**

Current rating = 3 A
Length of solenoid = 0.15 m

For the above data we will be able to obtain a magnetic field of 0.5 T

from the formula:-
B = (N * i * μ)/L

Mix Design for Preparing M30 Mix Sample

M30 concrete mix was designed for moderate conditions using IS 456:2000 and IS 10262.

w/c = .45, OPC 43 grade.

Various samples of cubes were prepared for the above design mix using normal water and magnetized water.

Test results obtained were as follows:

Using Normal water

concrete cubes of .15m x .15m x .15m were prepared and checked for 28 days compressive strength. The results were:-

ID .NO	TEST PARAMETER	UNIT	OBSERVATION
1	Compressive Strength	N/mm2	31.92
2	Compressive Strength	N/mm2	32.74
3	Compressive Strength	N/mm2	32.48

Using magnetic water

Concrete sample of .15m x .15m x .15m was prepared using magnetic water and the results of 28 day compressive strength were as follows:-

ID .NO	TEST PARAMETER	UNIT	OBSERVATION
1	Compressive Strength	N/mm2	36.73
2	Compressive Strength	N/mm2	36.92
3	Compressive Strength	N/mm2	37.41

Average compressive strength = 37.12 N/mm2

% increase in strength = (37.12 – 32.18)*100/32.18 = 15.35%

4. COMPARISON OF RESULTS OF SLUMP TEST

The slump test comparison results for normal and magnetised water for M30 mix are as follows:-

% increase = (70 – 65) * 100 / 65 = 7.69%

4.1 Split Tensile Strength

Concrete cylinders of 150mm diameter and 300 mm height were prepared and were tested for split tensile strength after 28 days :

% increase in strength = (3.094 – 2.8)*100/2.8 = 10.5%

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4.1.1 Results

- As seen from the above results the compressive strength of the sample using magnetized water is nearly 15% more as compared to sample made by using normal water.
- Increase in split tensile strength of concrete by nearly 10.5%.
- There is also an increase in workability of concrete.

4.1.2 Design Mix

- M30 w/c 0.45

cement	water	Fine Agg	20mm	10mm
400 kg	186 kg	1047 kg	496kg	329.6 kg
1 kg	0.465 kg	2.62 kg	1.24 kg	0.824 kg

- M35 w/c 0.45

cement	water	Fine Agg	20mm	10mm
444 kg	200 kg	838 kg	590.52 kg	390.72 kg
1 kg	0.450 kg	1.89 kg	1.33 kg	0.88 kg

4.1.3 Comparison between 1 m3 M30 and M35.

- Additional usage for nearly 44kg of cement for w/c 0.45 which costs nearly Rs 270.
- The amount of additional sand required is equal to the amount of coarse aggregate saved.
- The amount of labor requirement for 1m3 M35 is Rs 50 more than that for M30
- The amount of electricity in mixing and placing used is also more for M35 compared to M30.

4.2 Electricity Usage

P=V x i x power factor

Where,

P = power consumption

V = volts

i = current in amps

Hence, P = 19.5 V x 3 A x 0.8 = 46.8 watts

Hence in one hour it consumes nearly 0.0468 units of electricity.

And one pipe is able to drain 200 kg of water in nearly 33.33 minutes.

We can add at max 4 such pipes since we are not using large diameter solenoid.

4.3 Cost Reductions

- M 30 concrete mix when made using magnetized water can give strength nearly equal to M 35.
- Cost of production of 1 m3 M 30 equal to INR 6000 (approx).
- Cost of production of 1 m3 M 35 equal to INR 6400 (approx).
- Cost of magnetizing the water required to produce 1 m3 M30 is nearly equal to INR 0.1872 i.e. nearly 0.0234 units of electricity costing at INR 8 per unit. This is almost negligible.
- So we will be saving nearly **INR 400** in the production of M35.
- Similarly we can account cost factors for other concrete grades.

5. CONCLUSION

1. Increase in compressive strength of concrete.
2. Eco-friendly.
3. Cost reduction in production of concrete.
4. Reduction in amount of cement used by nearly 10%.
5. Reduction in annual production of carbon dioxide due to manufacturing of cement as less cement is needed for more strength.

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6. REFERENCE

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