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EFFECT OF MAGNETIC STRUCTURED WATER ON THE PROPERTIES OF POLYPROPYLENE FIBRE REINFORCED CONCRETE

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ABSTRACT: ***This experimental investigation shows the effect of magnetic structured water on the strength properties of magnetic water concrete with addition of polypropylene fibre and comparing the test results with conventional concrete with and without poly propylene fibres. Cubes and cylinders were cast by using normal water and magnetic structured water of different intensities (viz; 0.2T, 0.4T, 0.6T) and various percentages of polypropylene fibres (viz 0%, 0.2%, 0.4%, 0.6%, 0.8%, and 1.0%). Compression and split tensile tests were done on cubes and cylinders to obtain the optimum dosage of fibres. With the combination of fibre with normal water, the maximum compressive strength 40.89Mpa was obtained at 0.8% of fibre. It was found that the maximum compressive strength of 48.28MPa was obtained with a combination of 0.6%poly propylene fibre and magnetic structure water of intensity 0.6Tesla which is almost nearer to 50MPa.Whereas the maximum split tensile strength obtained with different combinations of polypropylene fibre, normal water and magnetic water cylinders were was found to be 2.83MPa was obtained with a combination of 0.8% polypropylene fibres and potable water. The maximum split tensile strength of 4.41MPa was obtained with a combination of 0.6%polypropylene fibres and magnetic structured water of intensity 0.6Tesla.***

KEYWORDS: ***Magnetic water, compressive strength, polypropylene fibre, split tensile strength, optimum dosage.***

I. INTRODUCTION

As it is known, water is the most familiar matter in nature but its molecular structure and physical properties changes under the action of external force. One of the most recent technologies to enhance concrete workability and compressive strength is using magnetized water instead of normal water with in the concrete mix. When water is subjected to the magnetic field the water clusters breaks down and size of the cluster decreases, by increasing in surface area of water per unit volume when compared to non-magnetic water. This technology has increased compressive strength up to 20% and more which makes it very important within concrete production and uses.

Concrete is weak in tension and less ductile. This can be overcome by reinforcing the concrete using polypropylene fibres. There is no need to alter the mix design to us this fibre, only two things have to be determined i,e., weight and length of the fibre to be add. Polypropylene contains short discrete fibres that are uniformly distributed and randomly oriented which increases its structural strength. Addition of short discontinuous fibres pays an important role in the improvement of mechanical properties of concrete. It increases elastic modulus, decreases brittleness, controls crack initiation and its subsequent growth and propagation.

2. OBJECTIVE

The main objectives of this experimental work are to study the behaviour of structured water on the properties of polypropylene fibre reinforced concrete. The different parameters considered under this experimental work are:

- To study the effect of magnetic structured water of various strengths on properties of hardened polypropylene fibre reinforced concrete.
- To study the effect of magnetic structured water of various strengths on properties of fresh polypropylene fibre reinforced concrete.
- To study the flexural behaviour of polypropylene fibre reinforced concrete cast with magnetic structured water of different strength.
- To study the difference in the strength of cubes and cylinders using the normal water and structural water with a curing period of 28 days.

3. MATERIALS

3.1 CEMENT: Ordinary Portland cement of 53 grade confirming to IS: 8112-1989 which was free from lumps, with a specific gravity of 2.93, standard consistency of 33% and initial setting time of 52 minutes are used.

3.2 FINE AGGREGATES: The sand used was locally procured and confirmed to IS: 383-1970. The fine aggregates belonged to grading zone II with a specific gravity of 2.527, bulk density of 1.678 kg/cubic meter, void ratio of 0.62, fineness of 3.4%.

3.3 COARSE AGGREGATES: Locally available coarse aggregates having the maximum size of 20mm for core and 10mm for cover was used with a specific gravity of 2.93 and 2.88 for 20mm and 10mm aggregate respectively.

3.4 NORMAL WATER: Potable water free from impurities was used for both mixing and curing.

3.5 STRUCTURED WATER: Water is subjected to magnetic field at different levels of magnetization of 0.2, 0.4, and 0.6 Tesla for duration of 24 hours, such that the molecular structure of water will be altered.

3.6 POLYPROPYLEN FIBRE: Polypropylene fibre is a thermoplastic polymer used in a wide variety of applications. It is mechanically rugged and resistant to many chemical solvents, bases and acids.

FIG.1:- polypropylene fibre

3.7 NEODYMIUM MAGNETS: A neodymium magnet the most widely used .It is a rare type of earth magnet, is a permanent magnet made from an alloy iron and boron .So it is in pure form its magnetism only appears at extremely low temperatures.

FIG.2:-Neodymium magnets with different magnetic power(0.2T,0.4T,0.6T)

4. EXPERIMENTAL STUDIES: Mix design was done for M_{25} grade of concrete the water cement ratio of 0.45 is used .The mix design was prepared based on 1:1.5:3

4.1 CASTING AND CURING OF SPECIMENS:

Moulds of standard dimension were taken ,cleaned properly and oil is applied on the inner surface of the moulds. The moulds are fixed with the base plate tightly such that no gap should be present between the plates of moulds .Concrete is taken from three to four random mixes and place into moulds in three layers, by corrpacting each layer by giving 25 blows with a tampering rod of 16 mm diameter .Then remove the excess concrete from top of mould and finish concrete surface with trowel and make the surface of concrete smooth. After casting, leave the moulds completely undisturbed for 24 hours .After ending the undisturbed period demould the specimen by loosing nuts and bolts. Immediately after removing, put the specimen in curing tank for 28 days .To avoid disturbance making on the specimen should be done.

5. TESTING AND RESULTS

The Compressive Strength and Split-Tensile strength tests were done on the specimen after completion of the curing confirming to IS: 516-1959.

COMPRESSIVE STRENGTH OF CUBES AND SPLIT TENSILE STRENGTH OF CYLINDERS.

Bearing surface of the test machine is cleaned.

The specimens in the machine placed in such a way that the load shall be applied to the opposite side of the cube cast .

The specimen is aligned centrally on the base plate of the machine.

The maximum load applied on the specimen was recorded.

Compressive strength = (Load in N/ Area in mm^2)

The concrete is weak in tension due to its brittle nature .Hence it is not expected to resist direct tension. So, concrete develops cracks when tensile force exceed its tensile strength. So, its necessary to determine the tensile strength of concrete to determine the load at which the concrete member cracks.

The cylinder placed horizontally between the loading surface of the testing machine

The Split-Tensile Strength is calculated using the formula

$Tsp = 2P/\pi DL$

Where, P = Applied Load

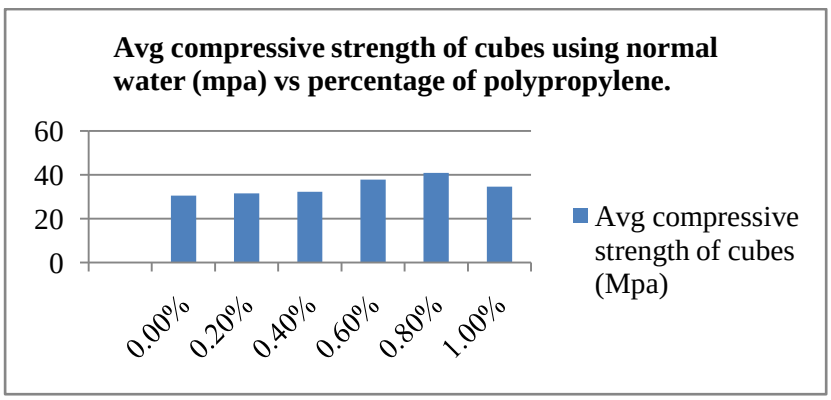
D = Diameter of the Specimen

L = Length of the Specimen

TEST RESULTS:-

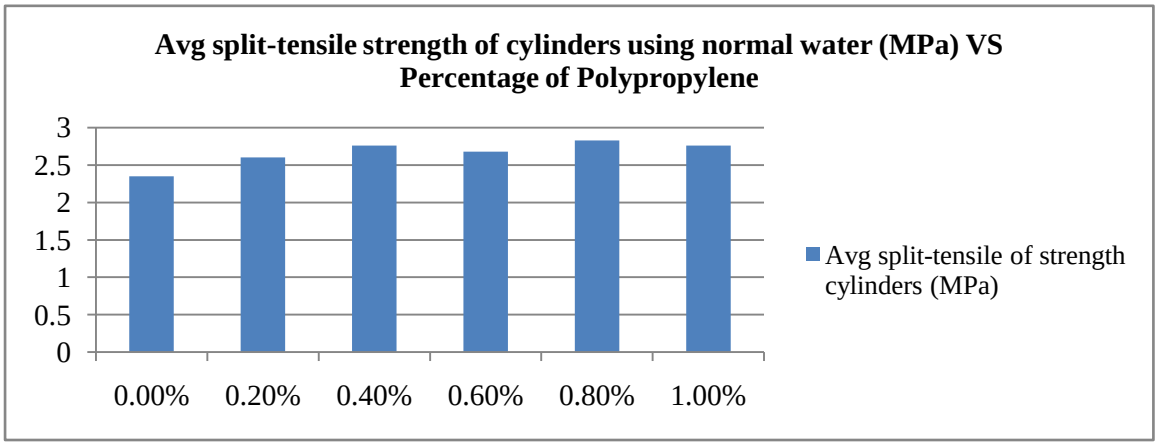
AVERAGE COMPRESSIVE STRENGTH OF CUBES WITH POLYPROPYLENE USING NORMAL WATER

Percentage of Polypropylene.	Avg compressive strength of cubes (MPa)
0.00%	30.5
0.20%	31.5
0.40%	32.2
0.60%	37.78
0.80%	40.89
1.00%	34.67



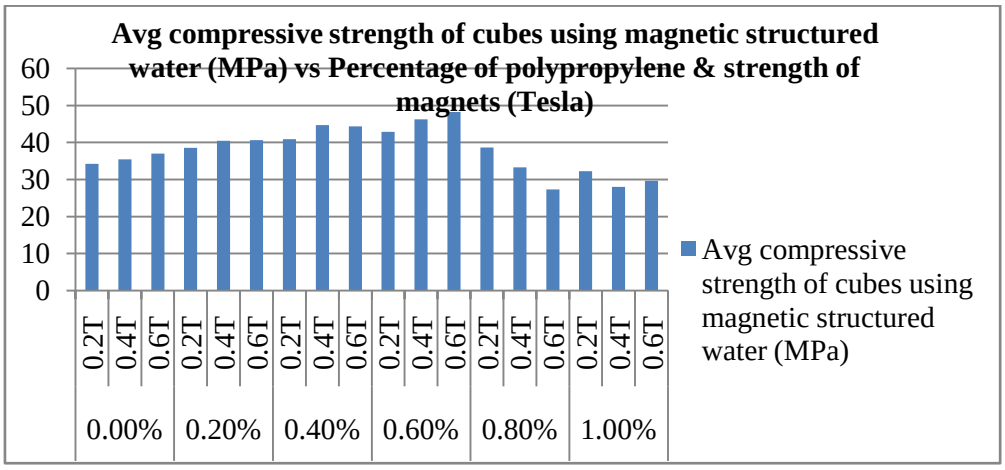
AVERAGE SPLIT-TENSILE STRENGTH OF CYLINDERS WITH POLYPROPYLENE USING NORMAL WATER.

PERCENTAGE OF POLYPROPYLENE.	AVG SPLIT-TENSILE OF STRENGTH CYLINDERS (MPa)
0.00%	2.35
0.20%	2.6
0.40%	2.76
0.60%	2.68
0.80%	2.83
1.00%	2.76



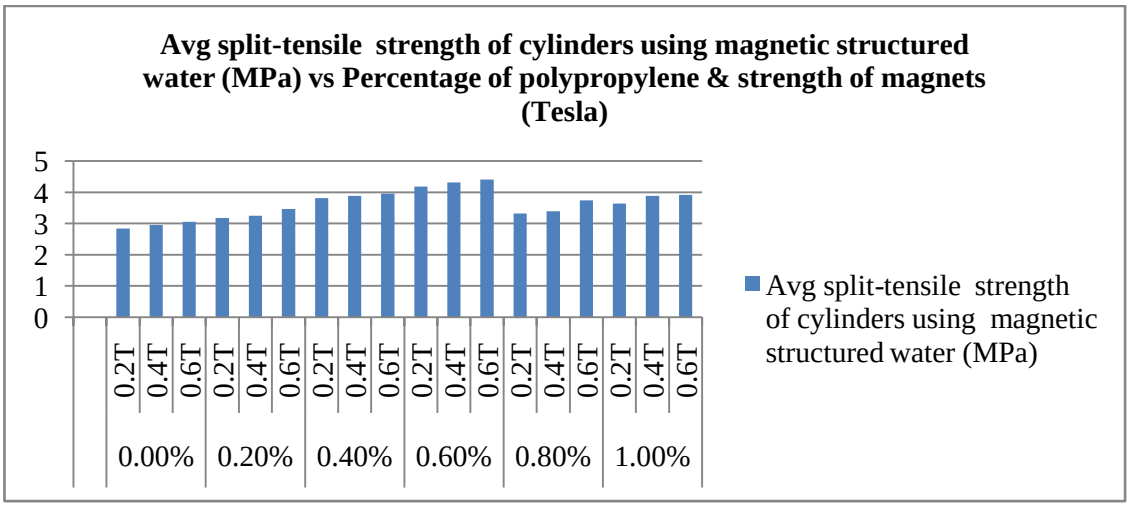
AVERAGE COMPRESSIVE STRENGTH OF CUBES WITH POLYPROPYLENE USING MAGNETIC STRUCTURED WATER .

Percentage of polypropylene.	Magnetic field strength	Avg compressive strength of cubes using magnetic structured water (MPa)
0.00%	0.2T	34.25
	0.4T	35.48
	0.6T	36.96
0.20%	0.2T	38.55
	0.4T	40.43
	0.6T	40.66
0.40%	0.2T	40.89
	0.4T	44.67
	0.6T	44.35
0.60%	0.2T	42.89
	0.4T	46.25
	0.6T	48.28
0.80%	0.2T	38.66
	0.4T	33.32
	0.6T	27.28
1.00%	0.2T	32.22
	0.4T	27.98
	0.6T	29.65



AVERAGE SPLIT-TENSILE STRENGTH OF CYLINDERS WITH POLYPROPYLENE USING MAGNETIC STRUCTURED WATER.

Percentage Of polypropylene.	Magnetic field strength	Avg split-tensile strength of cylinders using magnetic structured water (MPa)
0.00%	0.2T	2.84
	0.4T	2.95
	0.6T	3.05
0.20%	0.2T	3.18
	0.4T	3.25
	0.6T	3.46
0.40%	0.2T	3.81
	0.4T	3.88
	0.6T	3.95
0.60%	0.2T	4.18
	0.4T	4.31
	0.6T	4.41
0.80%	0.2T	3.32
	0.4T	3.39
	0.6T	3.74
1.00%	0.2T	3.64
	0.4T	3.88
	0.6T	3.91



CONCLUSIONS

- For M_{25} grade of concrete the maximum average compression strength of cubes by using normal water casting and polypropylene is 40.89 MPa ,at a curing period of 28 days.
- For M_{25} grade of concrete the maximum average compression strength of cubes by using magnetic structured water casting and polypropylene is 48.28 MPa, at a magnetic field strength of 0.6 Tesla,with normal water curing for 28 days.
- For M_{25} grade of concrete the maximum split tensile strength of cylinder by using normal water casting and polypropylene is 2.83MPa,at a curing period of 28 days.
- For M_{25} grade of concrete the maximum split tensile strength of cylinders by using magnetic structured water casting and polypropylene is 4.41 MPa, at a magnetic field strength of 0.6 Tesla,with normal water curing for 28 days.
- From the experimental investigation we can conclude that, the magnetic water used in concrete has the advantage of reducing the hardness of water depends upon its magnetic field intensity also increases the pH value.
- The use of magnetic water has the advantage that it has less scale deposition produced in pipes after long use. The concrete prepared by using magnetized water will be cost effective, environmentally accepted, sustainable and requires low maintenance for the devices.
- The main advantage of using magnetized water in concrete is that increment in the strength properties and also reduction in the cement content from 6 to 10 %. The compressive strength increased up to 23.85% and tensile strength increased up to 29.26%.By using polypropylene fibre, tensile strength of concrete can be increased and reduction of properties such as shrinkage and cracking resistance.

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