

Experimental Study on Strength Enhancement of Concrete by using Magnetic Water and Coconut Fiber

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Abstract – Concrete is most widely used materials in the infrastructure development. The most consequential challenge for the concrete construction is to improve the strength and durability of the concrete. Vast amount of NaCl is present in water. So it leads to corrosion over the steel in concrete. In addition the coconut fibers were used for the reduction at heat of hydration in the concrete. The new technology called magnetic water has been a part of making the concrete. By the use of magnetic water instead of normal water, it is found that compressive strength increases considerably. There are lots of methods to have magnetic water solution. Here we are using PERMAG (N406). It is generated by moving electrons which were used in inducing magnetic field in steel bar. PERMAG (N406) is entirely made up rare magnet at earth which is called neodymium. Almost the material constituents of coconut fiber were used. The usages of fiber are 0.5%, 1.0%, 1.5%. This coconut fiber is strong, light in weight. It reduce the thermal conductivity and also economical in nature. Based on the experimental study the combination of magnetic water with additional of coconut fiber that determine the maximum compressive, split tensile & flexural strength of concrete. Our expectation has proved that the result is positive.

Key words: Magnetic water; Permrag; Workability; strength.

1. INTRODUCTION

A) General

Concrete is most widely using material for construction. Production of cement causes lot of environmental pollution has been noticed one of major problems and quality of water plays a vital role in presentation of concrete. Impurities of water may hinder with setting of cement and it may affect the strength and durability. This chemical constituent actively participated in chemical reaction and affects the setting, hardening and strength development of concrete. For this alternative solution magnetic water is placed. The initial research and scientific testing regarding the application of magnetic field to concrete manufacturing at Russia since 1962 for military construction such as airports and jetties. This research was continued step by step in other Institutes, such as the VNLL Jelezobeton Research and Scientific Institute in Russia, and some positive results were found in this regard. Many researches proved

that the property of corrosion is greatly reduced when the water changes and turns to the magnetic flux. Magnetic fields are produced by motion of particles. The mechanism of action the magnetic field are divided in three major groups- colloidal, ionic, water hypotheses. We use ionic group as magnetic field. Hence here PERMAG (N406) is used for the production of magnetic water. It is present while electrical current is passing through wire coils. This magnet has high strength and with attractive force, additionally we add coconut fiber. The fiber extracted from the husk of a coconut which is commonly known as coir it is traditionally used in tropical regions of Asia, Africa, and South America. India is one of the largest countries in the production of coconut. The use of natural fibers is economical as compression of synthetic fibers.

B) Scope of study

The scope of study is to examine the properties of coconut fiber in concrete with the combination of magnetic water. The result obtained from this study is finding of the mechanical property by using the coconut fiber addition to magnetic water. The main objective for this project was to compare with the conventional concrete strength and strength enhancement by use magnetic water with additional of coconut fiber.

C) Materials involved

Cement- Ordinary Portland cement (OPC) of grade 53. Coarse aggregate- 20mm and downsize. Fine aggregate. Coconut fiber- strong, light in weight, reduces heat of hydration. Magnetic water is circulated about 1 hour by using PERMAG [20].

II. EXPERIMENTAL PROGRAMME

1. Cement

Ordinary Portland cement grade 53 which conform to I.S 12269-1987 was used. It must to develop appropriate strength.

Sl. No	Parameters	Experimental value	Permissible value as per IS:12269-1987
1	Specific gravity	3.10	3.15
2	Normal consistency	29%	26-33%
3	Initial setting time	35 mins	Min 30 mins
4	Final setting time	570 mins	Max 600 mins
5	Fineness	3%	Max 10%

2. Fine aggregate:

River sand was used as the fine aggregate which to conform to zone- 3 as per IS: 2386-1963.

Sl.No	Parameters	Experimental value	Permissible value as per IS:2386-1963
1	Specific gravity	2.6	3
2	Fineness modulus	3.23	Max 10
3	Water absorption	0.5%	Max 2%
4	Surface texture	Smooth	-
5	Fineness of cement	Zone - 3	-

3. Coarse aggregate:

Coarse aggregate are passing 20mm sieve and retained 10mm is tested as per IS: 2386-1963.

Sl.No	Parameters	Experimental value	Permissible value as per IS:2386-1963
1	Specific gravity	2.78	2.5 to 3%
2	Particle shape	Angular	-
3	Water absorption	1.2%	0.1 to 2 %
4	Crushing value	3.65%	30%
5	Impact value	12.90%	10 to 20%
6	Abrasion value	24%	Max 40%

4. Coconut fiber:

The physical properties of coir are shown below,

Sl.No	Parameters	Experimental value	Permissible value
1	Diameter of fiber	0.1mm	0.1-0.406 mm
2	Length of fiber	10mm	6-24 mm
3	Water absorption	2.99%	10%
4	Aspect ratio	100	200

5. Mix design:

The M25 grade mix design of concrete is taken as per IS: 10262-2009.

Cement (kg)	Fine aggregate(kg)	Coarse aggregate(kg)	Water (litre)
638.6	652.49	945.48	191.60

6. Preparation of magnetic water:

i. PERMAG (NEODYMIUM 406)

PERMAG is entirely made up of strong rare earth magnets called neodymium (N406). It is instrument used to induce the high intense and focused magnetic water. Its magnetic field intensity is 9000 gauss power. 10000 gauss power = 1 tesla, therefore magnetic flux density of PERMAG N406 is 0.9 tesla. It removes algae formation and prevents further growth of algae. It does not require electricity/ batteries/ chemicals.



Fig. no 1: PERMAG N406

ii. Setup process

In this process the water is recirculated for one hour to induce magnetic flux in the water by the action of applied magnetic field. This recirculated water is used for the casting of concrete specimens. The setup to achieve the above mentioned process includes Auto Transformer, 0.5HP general purpose motor, PERMAG N406. The auto transformer is used to reduce the supply voltage of the motor, this controls the flow of water. By this process the

hardness in the water is reduced, this enhances the resistance to corrosion of steel reinforcement.



Fig. no 2: Preparation of Magnetic Water

iii. Properties of magnetic water:

a) pH is the measure of activity of the hydrogen ion. The pH test is conducted for every ten minutes of recirculation. pH test is conducted for magnetically treated recirculated water.

Sl.No	Recirculation time (min)	pH value
1	0	6.78
2	10	7.2
3	20	7.5
4	30	7.8
5	40	8.2
6	50	8.4
7	60	8.55

b) 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. 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).

Sl.No	Magnetic water recirculation time (min)	Hardness (mg/lit)
1	0	310
2	15	250
3	30	215
4	45	180
5	60	230
6	75	230
7	90	180

III. Testing and result

A) FRESH CONCRETE TEST

1. Slump cone test

When the fresh concrete will flow to the sides and a sinking in height will takes place. This vertical settlement is called slump. Slump test is a measurement of concrete workability.

Sl.No	Type of concrete	Slump in mm	Workability
1	Normal concrete	40	Medium
2	Magnetized water with 0.5% coir	54	High
3	Magnetized water with 1% coir	50	High
4	Magnetized water with 1.5% coir	44	High

2) Compaction factor test:

Compaction issue check is adopted to work out the workability of concrete, wherever the traditional size of combination doesn't exceed 40mm and is primarily utilized in laboratory.

Sl.No	Conventional concrete test	Magnetic water of coconut fiber		
		0.5%	1%	1.5%
1	0.91	0.87	0.87	0.85

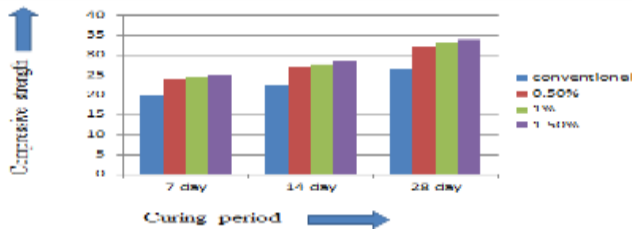
IV. HARDENED CONCRETE TEST

a) Compressive test:

This test was conducted as per IS 516-1959. The cubes of standard size 150mmX150mmX150mm were used to find the compressive strength of concrete. Specimens were placed on the bearing surface of CTM with the capacity of 200kN without the eccentricity and a uniform rate on loading is 140 kg/cm² per minute was applied until the failure of the cube. The maximum load was noted and the compressive strength was calculated. The compression strength in N/mm² = P/A. The test result of compressive strength is,

INDEX	7 th day	% Increase	14 th day	% Increase	28 th day	% Increase
Conventional concrete	19.95 N/mm ²	-	22.60 N/mm ²	-	26.75 N/mm ²	-
0.5%	23.94 N/mm ²	20.05	27.11 N/mm ²	19.95	32.14 N/mm ²	20.15
1%	24.60 N/mm ²	23.36	27.81 N/mm ²	23.05	33.06 N/mm ²	23.63
1.5%	25.03 N/mm ²	25.5	28.57 N/mm ²	26.40	34.03 N/mm ²	27.26

The graphical representation for compressive strength,

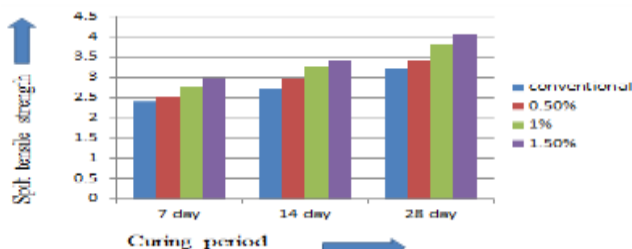


b) Split tensile strength:

The cylindrical specimens were tested for tensile strength at an age of 7 and 28 days. The specimen were submerged in clean fresh water in curing tank and kept until taking of just prior to test. The specimens are not allowed to become dry at any time until they have been tested. The specimens are tested immediately on removal from the water while they are still in a wet condition. Two specimens were tested for each percentage at 7 and 28 days and average of three was taken. The load was applied without shock and increased continuously until the resistances of the specimen to the increasing load which break down and not greater load have been sustained. The maximum load applied was recorded. Any unusual type of failure was noted. According to IS 5816-1999- tensile strength of concrete- method of test, the tensile strength was determined. The size of the specimen is 15cm diameter and 30cm height. The split tensile strength in $N/mm^2 = \frac{2P}{\pi LD}$. The test split tensile strength result are,

INDEX	7 th day	% Increase	14 th day	% Increase	28 th day	% Increase
Conventional concrete	2.4 N/mm ²	-	2.72 N/mm ²	-	3.2 N/mm ²	-
0.5%	2.54 N/mm ²	7	2.96 N/mm ²	8.88	3.41 N/mm ²	6.56
1%	2.75 N/mm ²	16.5	3.26 N/mm ²	20	3.8 N/mm ²	18.75
1.5%	2.97 N/mm ²	24	3.41 N/mm ²	25.1	4.06 N/mm ²	26.87

The graphical representation for split tensile strength.



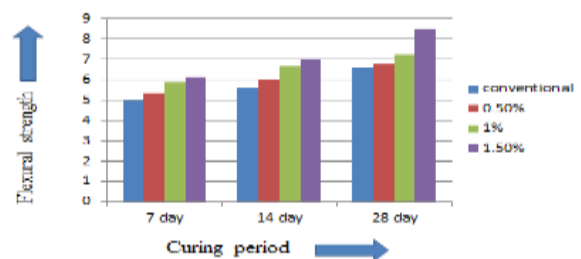
c) Flexural strength :

Flexural test is done on beams to find out the ultimate load, deflection and ultimate moment of the given beam section. Two-point load is given at a distance of L/3 from the support. The span of the beam specimen is 700mm and loads of equal magnitudes are applied at 400mm from either support to study the behavior of beam under pure flexure. The results are tabulated. The load at which the crack

initiates and load at which the specimens ultimately fail noted. The flexural strength in $N/mm^2 = \frac{Pl}{bd^2}$.

INDEX	7 th day	% Increase	14 th day	% Increase	28 th day	% Increase
Conventional concrete	4.97 N/mm ²	-	5.63 N/mm ²	-	6.63 N/mm ²	-
0.5%	5.32 N/mm ²	7.14	6.03 N/mm ²	7.14	6.78 N/mm ²	2.27
1%	5.89 N/mm ²	18.77	6.64 N/mm ²	18.03	7.22 N/mm ²	8.93
1.5%	6.11 N/mm ²	23.02	7.02 N/mm ²	24.78	8.5 N/mm ²	28.33

The graphical representation for flexural strength,



CONCLUSION

In this project we improve the strength of concrete by using magnetic water additional of coconut fiber. It is economic cost and ecofriendly. The specimens are casted not only by using magnetic water and also by coconut fiber. In this magnetic water technology the strength of concrete gets increase by adding admixture or additives like coconut fiber. The magnetic water technology gives less investment and it can be used for long period (in years). As the recirculation time is increases the pH value of magnetic water also increases from 6.78 to 8.5 in 60 Mins. It will improve the corrosion resistance in reinforced concrete structure. In addition to coconut fibers are added in the concrete is about 0.5%, 1% and 1.5% of its total weight of the concrete. The results obtained at 7, 14, 28 days the compressive strength of magnetic water additional coconut fiber concrete increased in the range of 20.18% to 27.26% when compared to conventional concrete. The split tensile strength and flexural strength of concrete are increased in the range of 6.5% to 26.8% and 2.27% to 28.33% at 28 days. The percentage of fiber content increases in concrete, the strength of concrete also increased. The benefit of this project are replacement of material, corrosion resistant, reduces the cement content about 5 to 10 % and also increases the workability of concrete with water/cement ratio 0.30. The concrete has proved that it can also be used for retrofitting technique which gives high strength then the unconfined specimens.

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