

EFFECT OF DIFFERENT TYPES OF WATER (STRUCTURED and NON STRUCTURED) ON STRENGTH OF M30 GRADE CONCRETE

Srujan Varma.K¹,A.Kalyan Sai²,L.Krishna Chaitanya³,U.Vijay Raj⁴

¹Assistant Professor of Civil Engineering,Kakatiya Institute of Technology &Science, Warangal, Telangana, India,

^{2,3,4} Civil Engineering scholars, Kakatiya Institute of Technology & Science, Warangal, Telangana, India,

Abstract—Increasing the compressive strength of concrete is an aim which most researchers are looking for, using various methods like fiber reinforcement in concrete mixture and usage of certain admixtures including super plasticizers to produce high strength of concrete. The cost of these methods are not comparable with their advantages, thus most researchers concentrate their attention on producing economical concrete with higher strength using new philosophies in design methods and through modern techniques. One such technique is using magnetic water (MW) in concrete. In this technology, by passing water through a magnetic field, some of its properties can change. Usage of magnetized water in concrete mixtures results in development of workability and compressive strength of concrete. Also, this processed water cause reduction in cement content required for specified compressive strength value. In this work it is proposed to study the effect of different types of water (Structured and Non Structured) on compressive strengths of different grades of concrete. The results of tests showed that, concrete made with magnetic water of intensity 0.6T (24Hrs) (magnetic concrete), has higher compressive strength values than those of Conventional Concrete cast with Non Structured Water.

Keywords— Magnetic Structured Water, Potable water, Distilled Water, Magnetic Water Concrete (MWC), Potable Water Concrete (NWC), Distilled Water Concrete (DWC), Magnetic Water Curing, Potable water curing, Curing Under Constant Magnetic Field.

I. INTRODUCTION

Concrete is the main and mostly used material in the world of construction due to its properties such as its mould ability, ease of availability of its materials, mechanical strength (compressive strength). To apprise with the knowledge of concrete, various innovative materials are adopted in it like chemical and mineral admixtures, fibres, super plasticizers etc to define the changes in its strength. The basic ingredients like cement, fine aggregate, coarse aggregate and water remain unaltered most of the time.

Water is a most principal component of concrete as it is wholly responsible for the chemical reaction with cement. Since poor quality of water shows adverse effects on the strength of concrete, it is very important to check the purity and quality of water. Generally, there exists potable water and distilled water, which are certainly used in construction. Apart from this, a typical type of water called Magnetic water is used here to study the performance of concrete for its strength properties.

When the water after subjected to magnetic field by using magnets of certain capacity, then it is called as magnetic field treated water or magnetic water. Water is a polar substance which tends to be attracted to each other by hydrogen bonds and forms clusters. In magnetic field, magnetic force can break apart water clusters into single molecules. Due to this, surface area of the water increases. Therefore the penetration of the water molecules into the cement particles increases. Hence, hydration can be done more efficiently which leads to increase in strength of concrete.

Not only increase in the compressive strength, there are also many advantages in concrete properties. Previous studies like N. Karuppasamy *et al* worked on concrete with magnetized water shows higher percentage increase of compressive strength than normal water concrete. The percentage efficiency of concrete samples cast and cured with magnetic water gives 20 % efficient than the conventional one. The main advantage of using magnetized water in concrete is that increment in the strength properties and also reduction in the cement content up to 11% compared with an conventional concrete. M.Gholizadeh and H.Arabshahi worked on concrete treated with magnetic water shows average compressive strength of samples has 23% more than that of samples made by ordinary water.

II. DETAILS OF STUDY

A. Materials Used:

- 1) *Cement*: The cement used is Ordinary Portland cement of 53 grade procured from local market. The properties of cement are listed in Table II.

TABLE I
 PROPERTIES OF CEMENT

Tests conducted	Cement
Specific gravity	2.89
Fineness	5%
Initial setting time	75 minutes
Final setting time	10 hours
Standard consistency	32%

- 2) *Fine Aggregate*: Fine sand procured from manair river bed located in Karimnagar, Telangana confirming to IS383-1970 and Zone-II was used.

- 3) *Coarse Aggregate*: Crushed granite of size 20 mm procured from local quarry was used in the investigation, The properties of Fine and Coarse aggregate are shown in Table I.

TABLE II
 PROPERTIES OF FINE AND COARSE AGGREGATES

Tests Conducted	Fine Aggregate	Coarse Aggregate(20 mm)
Fineness Modulus	3.25	7.32
Bulk Density	1.676 g/cc	1.52 g/cc
Specific Gravity	2.56	2.88
Percentage Of Voids	34.58%	47.10%
Void Ratio	0.528	0.89

- 4) *Types of water(structured and non- structured)*: Three different types of water are used in this investigation

- *Potable water*: Consumable water which contains some minerals and salts and free from suspended impurities and harmful micro-organisms.
- *Distilled water*: It is the purest form of water which is free from any contaminants and dissolved salts.
- *Magnetic water*: When water is exposed to constant magnetic field it exhibits changes in its certain properties. This type of water is called as magnetic water. It can be defined as structured water.



Fig.1 Picture showing preparation of magnetic water with neodymium magnets.

- 5) *Magnets*:

- Neodymium magnets of 0.6Tesla capacity are used in this work in the process of magnetization of water.

III. EXPERIMENTAL WORK

- A. *Mix proportions* :M30 grade design mix was made as per IS10262-2009 with 1:1.649:3.053 as proportions and 0.45 water cement ratio.
- B. *Preparation of Test samples*: Set of Cubes of standard size 150 mm x 150 mm x 150 mm and cylinders of Diameter 150 mm and height 300 mm were cast with three different types of water i.e; potable water, Distilled water and magnetic water(Potable water subjected to constant magnetic field of 0.6Tesla for 24 Hours), One set of test samples are cured with potable water for 28 days of age. Second set of test samples are cured with magnetic water and the third set of test samples are cured under constant magnetic field.
- C. *Curing under constant Magnetic Field*: Three non ferrous containers which can accommodate the test samples(cubes and cylinders) are fixed with neodymium magnets of intensity 0.6Tesla at an interval of 150mm on all the four sides(except top and bottom of the container). The magnets create a constant magnetic field upto 250 mm radius. Test samples are then placed in the container and potable water is poured in it. The test samples are cured for 28 days in constant magnetic field.
- D. *Testing* : Compressive strength test on cubes and split tensile strength test on cylinders are performed as per the guidelines provided in IS 516-1959. The test results are provided in Table III
- E. *Average compressive strengths obtained for different combinations of application of water (structured and non-structured) in concrete*:

Table IV

AVERAGE COMPRESSIVE STRENGTHS OF CUBES FOR M30 GRADE CONCRETE WITH DIFFERENT COMBINATIONS OF WATER (STRUCTURED AND NON-STRUCTURED)

Details of Test specimens	Average Compressive strength for 28 days of age N/mm ²
Cubes cast and cured with potable water	42.66
Cubes cast with Distilled water and cured with Normal water.	43.2
Cubes cast with Magnetic water and cured with potable water	52.44
Cubes cast with Magnetic water and cured with Magnetic water	53.11
Cubes cast with Magnetic water and cured under constant magnetic field	54.23

AVERAGE SPLIT TENSILE STRENGTH OF CYLINDERS OF M30 GRADE CONCRETE WITH DIFFERENT COMBINATIONS OF WATER (STRUCTURED AND NON-STRUCTURED)

Details of Test specimens	Average Split Tensile strength for 28 days of age N/mm ²
Cubes cast and cured with potable water	5.04
Cubes cast with Distilled water and cured with Normal water.	6.03
Cubes cast with Magnetic water and cured with potable water	6.15
Cubes cast with Magnetic water and cured with Magnetic water	6.55
Cubes cast with Magnetic water and cured under constant magnetic field	6.70

C. Pictures during execution of project work



Figure.2a. Picture showing testing of cubes under 100 T Compressive testing machine

2b. Figure showing the maximum load obtained on Compression testing machine for the cubes cast with magnetic structured water.



Figure.4 Cubes cast with magnetic water and cured with normal water.



Figure.5 Failure of test specimen.

IV.CONCLUSION

- The compressive strength of cubes cast with magnetic water and cured with potable water was found to be 52.44 MPa which is the highest when compared with cubes cast with potable water (conventional concrete) (i.e., 42.66 N/mm²) and distilled water (i.e., 43.2 N/mm²).
- The compressive strength of cubes cast with magnetic water and cured with magnetic water got the highest strength of 53.11 N/mm² when compared to the cubes cast with magnetic water and cured with potable water (i.e., 52.44 N/mm²).
- The concrete mixed with magnetic water and cured under constant magnetic field got higher strength upon all the different types of concrete with different applications of combinations of water.
- The highest strength obtained in this study is about 54.23 N/mm² which is also greater than the target strength of M30 grade of concrete (i.e., 38.25 N/mm²).
- The increase in compressive strength of M30 grade concrete under the influence of magnetic water mix and constant magnetic field curing is 80.76% when compared with characteristic compressive strength (fck) of M30 grade concrete.
- The highest split tensile strength of cylinders cast with magnetic water and cured under constant magnetic field was found to be 6.70 MPa which is 10 percentage higher than the cylinders cast with magnetic water and cured with magnetic water i.e; 6.55 MPa.
- The split tensile strength of cylinders cast with Magnetic water and Distilled water and cured with potable water was found to be 6.15 MPa and 6.03 MPa respectively which are 12.2% and 11.1% higher than the split tensile strength of cylinders cast with conventional concrete.
- Hence using Magnetic structured water for mixing can increase the strength of concrete and curing with magnetic water and curing under constant magnetic field can be adopted for better results.
- There was an 80.76% increment in the compressive strength of concrete under the influence of magnetic water mix and constant magnetic field curing when compared with characteristic compressive strength (fck) of M30 grade concrete.
- Hence, within the process of mixing and curing of concrete under the influence of magnetic water mix and constant magnetic field curing, the compressive strength of concrete is increased.
- This work can lay foot steps to the new era of concrete making materials.

REFERENCES

- [1] Krishna Murari, Arihant Jain, Aakash Laad, Krithi Chitrathsingh, 2017, "Effect of magnetic water on properties of concrete", International Journal of Engineering Science and Computing, Volume 7 Issue no.5, pp.11864-11866.
- [2] R.Malathy, N.Karuppaswamy, S.Baranidharan, 2017, "Effect of Magnetic water on mixing and curing of M25 grade concrete", International Journal of ChemTech Research Volume 10 Issue no.11, pp131-139.
- [3] Mr.K.J.Kucche, Dr.S.S.Jamkar, Dr.P.A Sadgir, 2015, "Quality of water for making concrete", International Journal of Science and Research Publications, Volume 5 Issue no.1 ISSN 2250-3153.
- [4] B. Siva Konda Reddy, Vaishali G. Ghorpade and H. Sudarsana Rao, 2014, "Influence of Magnetic Water on Strength Properties of Concrete", Indian Journal of Science and Technology, Volume 7 Issue no.1, ISSN: 0974-6846.
- [5] M. Gholizadeh and H. Arabshahi, 2011, "The effect of magnetic water on strength parameters of concrete", Journal of Engineering and Technology Research, Volume 3 Issue no.3, pp 77-81.
- [6] IS 456:2000, Indian standard plain and reinforced concrete-code of practice (fourth revision).
- [7] IS 10262:2009, Indian standard concrete mix proportioning-guidelines (first revision).
- [8] IS 383:1987, "Specification for Coarse and Fine Aggregates from Natural Sources for Concrete (Second Revision)", Ninth Reprint, September 1993, Bureau of Indian Standards, New Delhi, India.
- [9] IS: 12269-2013, "Indian Standard specifications for 53 grade of cement", Bureau of Indian Standards, New Delhi, India.
- [10] IS 516-1959, Indian standard methods of tests for strength of concrete.