

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 i.e. To increasing the compressive strength of concrete and to get more workable concrete at less water content. So various methods are used to increase strength such as Use of fibre reinforcement, Use of fly ash, Use of epoxy polymer and polymer concrete, Use of high range of water reducing super plasticizers etc. These methods increase strength but are very costly. So our aim is to produce economical concrete with higher strength. Till now Normal water is used for mixing different ingredients of concrete. This paper finds new technology called magnetic water technology has been used in mixing and curing of concrete. As per this technology, by passing water through a magnetic field, some of its physical properties tends to change which causes decrease in the hardness of water, with an improvement in the workability and strength of concrete when compared to use of Normal water in concrete. Strength tests conducted on this magnetic water concrete showed encouraging results and one can easily replace normal water with magnetic water for mixing and curing of concrete.

Keywords: Compressive strength, Flexural strength, Hardness, Magnetic water, Normal water.

I. INTRODUCTION

Concrete is a composite material that made up of aggregate, cement, and water. The role of aggregate is a filler material as it is chemically inert. Meanwhile, the mix of cement and water form the cement paste required to bind the aggregate together. Usually, Normal water is recommended to produce concrete as it does not cause side reactions that may interfere with the hydration process. As a twenty percent by weight of cement, water is required for the hydration of the cement. Extra amount of water (from 15% to 20% by weight of cement) is required to provide space for the cement hydration products. The final water cement ratio is the most critical factor affects the production of durable and consistent concrete as high water cement ratio (w/c) severely reduces the concrete strength, while low water cement ratio (w/c) produces unworkable concrete. Therefore, attempts have been made to increase the specific surface area of water and the effects of increased surface area are studied on the workability and compressive strength of concrete. Magnetising the water is found to be helpful in increasing the specific surface area of water, thereby increasing the rate of hydration.

II. EXPERIMENTAL DETAILS

Experimental program has been designed to compare the strength appraisal (& days and 28 days) by replacing normal water with magnetic water for both casting and curing. This paper focuses on the use of M25 grade of concrete as The IS 456:2000 recommendations with a target mean strength mean compressive strength of 31.6 N/mm².

A) MATERIALS USED

- 1) **CEMENT** : For the present investigation ordinary Portland cement-43 grade have been used. The cement was tested according to IS 8112-1989.

Table 1. Physical properties of cement

Sr No	Description of test	Results
1.	Fineness of cement (residue on IS sieve No.9)	2%
2.	Standard consistency of cement	30-25 %
3.	Setting time of cement	
	Initial setting time	40 min
	Final Setting time	10 hrs
4	Compressive strength of cement	
	7days	33
	28 days	43

- 2) **AGGREGATE:-** Fin aggregate is locally available river sand. Coarse aggregate of 10 mm and 20 mm size is used.

Table 2: physical properties of Fine aggregate

Sr no	Property	Fine aggregate	Coarse aggregate
1	Particle shape, size	Round,4.75 mm	Angular, 10mm & 20mm
2	Fineness modulus	2.96	20 mm-7.4 and 10 mm 6.57
3	Silt content	1.6%	6.57
4	Specific Gravity	2.64	2.84
5	Water absorption	-	0.40%

- B) **PREPARATION OF MAGNETIC WATER:** For the preparation of magnetic water the instrument was set up as shown if figure fitted the inlet of electromagnet instrument is attached to the outlet of water pump and the outlet of electromagnet to the inlet of permanent magnet instrument. Both the magnets are attached in series to each other as per the manual. The inlet of water motor and outlet of permanent magnet instrument is made to receive and collect water in the same water tank respectively. This process of recirculation of water through magnetic instrument was done for the minimum duration of 2 hour each day with a discharge of 900 Lt/hr at a Gauss of 12000. The magnetic water prepared for curing purpose was also used at the time of preparation of concrete mix.



Fig 1. Setup of magnetic water conditioner

C) TEST CONDUCTED ON WATER

The water sample used for project was locally available for construction on site with TDS of 450.

Table 4: physical properties of water

Sr no	Parameters (ppm)	Normal water	Magnetic water	% increase or decrease	Remark
1.	pH determination	7.39	8.06	9.06% increase	Increase in PH
2.	Hardness	326	280	16.42% decrease	Decrease in hardness

D) **MIX DESIGN:** In the present investigation work the effect of magnetized water on workability and strength properties on M25 grade of concrete is carried out. The Indian standard mix design procedure is adopted (i.e., IS: 10262-2009) in the present investigation to arrive the mix proportions for M25 grade of concrete.

Table 5: Mix design of M25 grade

Water	Cement	Fine aggregate	Coarse aggregate
186	372	767.39	1094.31
0.5	1	2.06	2.94

E) RESULTS AND DISCUSSIONS:

- 1) **WORKABILITY:** Properties of fresh concrete were mainly judged by workability by slump test. Slump test is performed to check the workability and consistency of the fresh concrete. Slump test as per IS: 1199 – 1959 is followed. The workability test has been taken for both Normal water and Magnetized water.



Fig 2. A) Normal water slump

B) magnetic water slump

Fig 2.B shows that the workability is improved when using MW (Magnetized Water) in concrete. Using NW in concrete, slump (25 mm) is achieved while using MW in concrete slump (110 mm) is achieved in 0.5 w/c ratio. There is drastic increase in workability when we use magnetic water in concrete.

2) **COMPRESSIVE STRENGTH OF CONCRETE:** This is the important test which gives an idea about all the characteristics of concrete and strength in compression. By this single test one judge that whether concreting has been done properly or not. For cube test we have used 150mm x150mm x 150mm size specimens. The testing is Perform after 7 days and 28 days curing with both magnetic water and normal water . For testing of cubes compressive testing machine is used. . The compressive Strength of concrete cube was determined based on IS: 516 – 1959.

Table 6: Compressive test result of 7 days

Sr no	Casting and curing technique	Beam no	Compressive strength at 7 days	Avg. compressive strength	% increase Compared with NW
1	NW casting and NW curing	NW1	12.8	13.16	--
		NW2	13.77		
		NW3	12.93		
2	MW casting and MW curing	MW1	19.02	18.37	39.58 %
		MW2	17.8		
		MW3	18.3		
3	NW casting and MW curing	NW7	15.4	15.24	15.8 %
		NW8	14.9		
		NW9	15.73		
4	MW casting and NW curing	MW7	17.2	17.14	30.24 %
		MW8	17.42		
		MW9	16.8		

Fig 3: Graphical comparative for compressive strength of cubes for 7 days

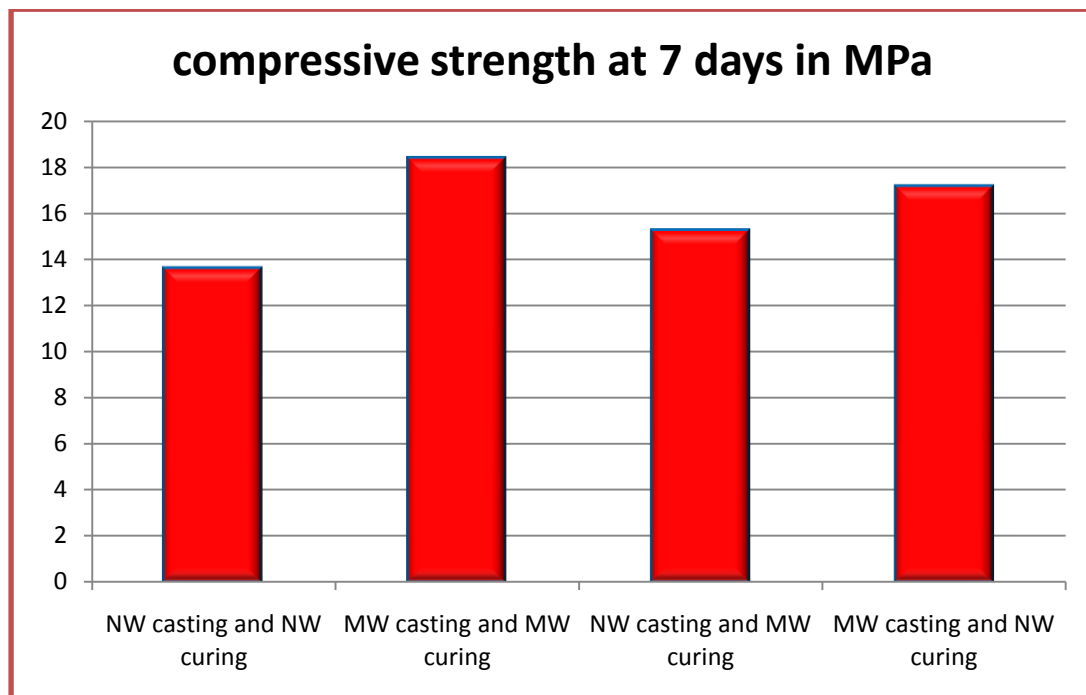
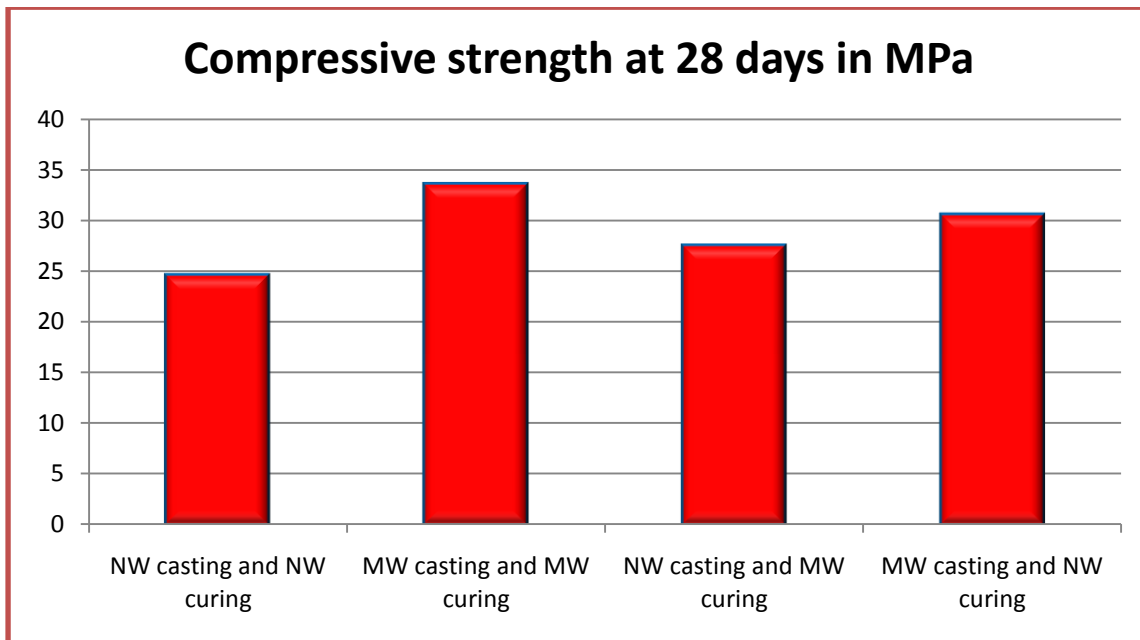


Table 7: Compressive test result of 28 days

Sr no	Casting and curing technique	Beam no	Compressive strength at 7 days	Avg. compressive strength	% increase Compared with NW
1	NW casting and NW curing	NW1	12.8	13.16	--
		NW2	13.77		
		NW3	12.93		
2	MW casting and MW curing	MW1	19.02	18.37	39.58 %
		MW2	17.8		
		MW3	18.3		
3	NW casting and MW curing	NW7	15.4	15.24	15.8 %
		NW8	14.9		
		NW9	15.73		
4	MW casting and NW curing	MW7	17.2	17.14	30.24 %
		MW8	17.42		
		MW9	16.8		

Fig 4: Graphical comparative for compressive strength of cubes for 28 days



3) **FLEXURAL TEST OF CONCRETE:** Flexural test is done on beams to find 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. For beam test we have used 100mm x 100mm x 500mm size specimen. Flexural strength test is performed after 7 days and 28 days curing. For flexural testing Universal testing machine is used. The Flexural Strength of concrete Beam was determined based on IS: 516 – 1959.

Table 8: Flexural test result of 7 days

Sr no	Casting and curing technique	Beam no	Compressive strength at 7 days	Avg. compressive strength	% increase Compared with NW
1	NW casting and NW curing	NW1	12.8	13.16	--
		NW2	13.77		
		NW3	12.93		
2	MW casting and MW curing	MW1	19.02	18.37	39.58 %
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3	NW casting and MW curing	NW7	15.4	15.24	15.8 %
		NW8	14.9		
		NW9	15.73		
4	MW casting and NW curing	MW7	17.2	17.14	30.24 %
		MW8	17.42		
		MW9	16.8		

Fig5: Graphical comparative for Flexural strength of Beams for 7 days

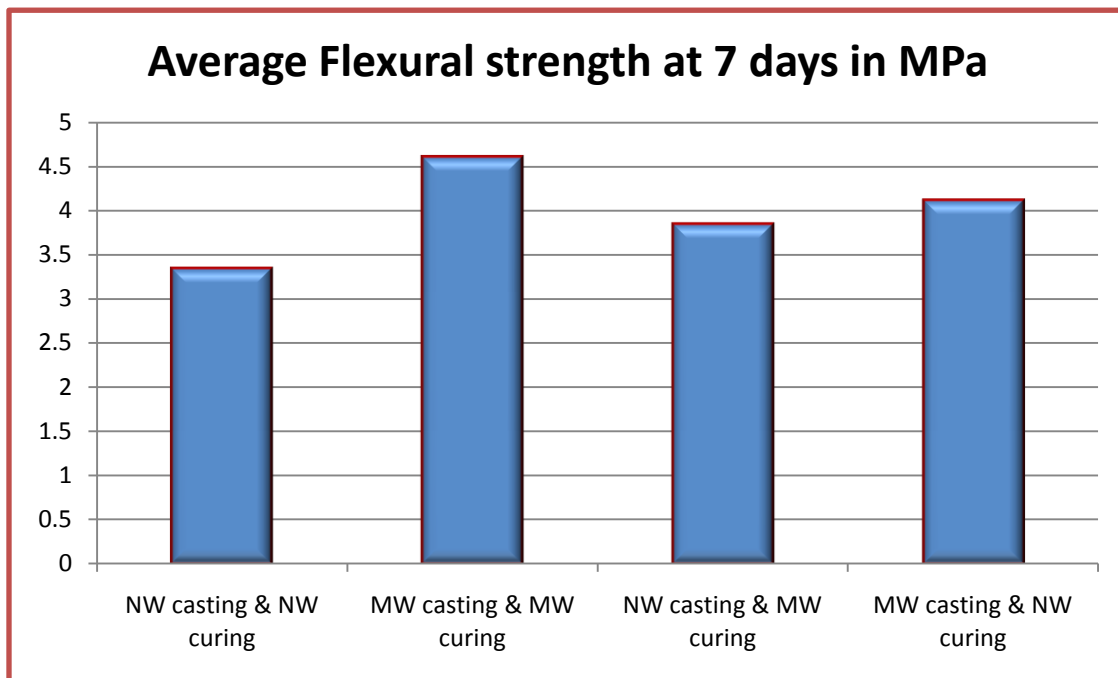
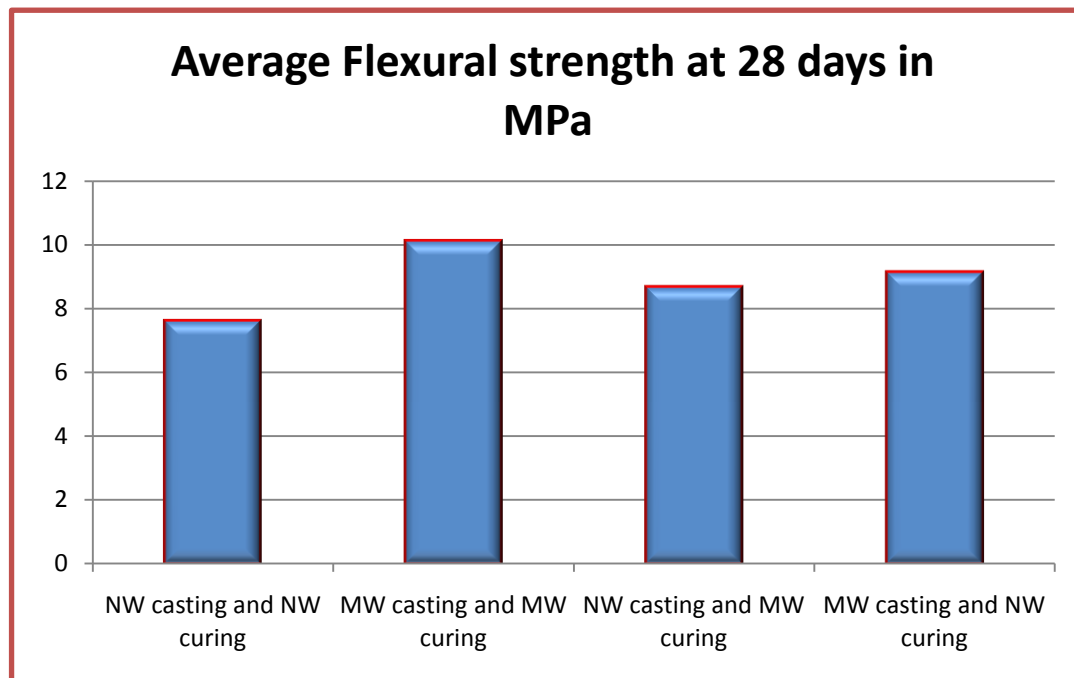


Table 9: Flexural test result of 28 days

Sr no	Casting and curing technique	Beam no	Compressive strength at 7 days	Avg. compressive strength	% increase Compared with NW
1	NW casting and NW curing	NW1	12.8	13.16	--
		NW2	13.77		
		NW3	12.93		
2	MW casting and MW curing	MW1	19.02	18.37	39.58 %
		MW2	17.8		
		MW3	18.3		
3	NW casting and MW curing	NW7	15.4	15.24	15.8 %
		NW8	14.9		
		NW9	15.73		
4	MW casting and NW curing	MW7	17.2	17.14	30.24 %
		MW8	17.42		
		MW9	16.8		

Fig6: Graphical comparative for Flexural strength of Beams for 28 days.



CONCLUSIONS

- 1) Compressive strength of concrete at 7 days increases by 39.58 % and that of 28 days increases by 36.36 % when treated and cured with magnetic water.
- 2) Flexural strength of concrete at 7 days increases by 37.72 % and that of 28 days increases by 32.76 % when treated and cured with Magnetic water.
- 3) It is advisable to use magnetic water for casting and curing of concrete in construction industry.
- 4) The underground water that is brackish in nature can also be made soft by using magnetic treatment and can be made suitable for construction purpose.
- 5) Eliminates the use of any known admixtures and supplementary materials.
- 6) One time investment for life time operation.
- 7) It treats water physically not chemically. So No use of recurring chemicals or salts or filters.
- 8) It increases solubility of water so improvement in workability.
- 9) Treated water surface tension will be low compared to non- treated water.
- 10) Fully automatic operation. No manual interference.
- 11) Ecofriendly.

REFERENCES

- [1.] M.S Shetty “Concrete Technology Theory and practice” S.Chand Publications, 2005
- [2.] Craig Andrew McMahon, 2009 “Investigation of the quality of water treated by Magnetic fields” In fulfillment of the requirements of Courses ENG4111 and 4112 Research Project Towards the degree of Bachelor of Engineering (Environmental), University of Southern Queensland, Faculty of Engineering and Surveying, Australia.



- [3.] Dr. V.L.Shah and Dr. S.R.Karve, "Limit State Theory & Design Of Reinforced Concrete" Structures Publications, 2010
- [4.] Gabrielli, C., Jaouhari, R., Maurin, G. and Keddad, M. "Magnetic water treatment for scale prevention", *Wat. Res.*, 35(13), pp. 3248-3259 (2001).
- [5.] H. Arabshahi, 2010 "The Effect of Magnetic Water on Strength Parameters of Concrete" *An International Journal of Chemistry*, Vol.1 (1), pp. 30-35.
- [6.] IS: 10262-2009, recommended guidelines for concrete mix, bureau of Indian standards, New Delhi.
- [7.] IS: 516-1959, Indian standard methods of test for strength of concrete, bureau of Indian Standards, New Delhi.
- [8.] J. D., Donaldson, "Magnetic Treatment of Fluids -- Preventing Scale." *Finishing*. 12, (1988), Pages (22-32).
- [9.] L. A. Huchler, P. E. Mar, 2002 "Non-Chemical Water Treatment System: Histories, Principles and Literature Review" *International Water Conference, IWC-02-45*, Pittsburgh, PA.
- [10.] L., J., Lipus, Krope, and L. Garbai, "Magnetic Water Treatment for Scale Prevention". *Hungarian J. Ind. Chem.* 22, (1994), Pages (239-242).
- [11.] L. Wang, S. Zhao, 2008 "Laboratory Studies on the Properties of Cement-Based Materials With Magnetic Water" *Indian Concrete Journal*, Vol. 82, No. 9, pp. 17-27.
- [12.] Saddam, M. Ahmed, 2009 "Effect of Magnetic Water on Engineering Properties of Concrete" *Al-Rafidain Engineering*, Vol.17, No.1, pp.71-82.
- [13.] State Construction Committee of Russia, "Application of Magnetic Fields in National Economy", Issued No.1058, October, (1993).
- [14.] S. O., Mirumyants, E. A. Vandyukov, and R. S. Tukhvatullin, "The Effect of a Constant Magnetic Field on the Infrared Absorption Spectrum of Liquid Water". *Russ. J. Phys. Chem.* 46, (1972), Page (124).