

Effect of Mixing and Curing Concrete with Magnetically Treated Water on its Compressive Strength

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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 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) for manufacturing of Concrete. In this technology, by passing water through a magnetic field, some of its physical properties change and as a result of such changes, the number of molecules in the water cluster decrease from 13 to 5 or 6, which causes a decrease in the bond angle in water molecular structure and increases the surface area of water in unit volume and which enhances the hydration of cement. In this project work, the effects of magnetic water on properties of concrete such as compressive strength have been studied. The results of tests showed that, M30 grade concrete mixed with magnetic water (MWC), has higher compressive strength values than those of control concrete (up to 65%). Investigation on the use of magnetic water for curing of concrete samples is also carried out. It is concluded that the use of magnetic water for mixing and curing concrete is effective in enhancing the properties of concrete. However, a method is to be developed for producing the magnetic water in large sale to take this new technology to in-situ concrete works with a cost-effectiveness.

Keywords: magnetic water concrete, workability, high performance concrete, compressive strength, mixing and curing water.

1. INTRODUCTION

The most important challenge for concrete technologists is to improve the properties of concrete. In the last two decades, in Russia and China, a new technology, called magnetic water technology, has been used in the concrete industry. In this technology, by passing water through a magnetic field, some of its physical properties change and, as a result of such changes, the number of molecules in the water cluster decrease from 13 to 5 or 6, which causes a decrease in the water surface tension. Using magnetized water in concrete mixtures causes an improvement in the workability and compressive strength of concrete. Also, this processed water causes a reduction in the cement content required for the specified compressive strength value. Magnetized water is

found to be promising in producing concrete with good fresh and hardened properties. However, limited numbers of researches were conducted to define and ensure the influence of the water magnetization on the concrete properties. The present work is an experimental study that aims to give more confidence for the designer to use magnetized water in concrete production and to get its benefits. Nan Su (2002) explained the increase of the compressive strength of cementitious materials with magnetized water by the morphology of hydration products such as C-S-H gel, ettringite, and mono-sulfate hydrate of pastes mixed with magnetized water similar to those mixed with tap water. However, larger CH crystals with distinctive hexagonal plates were observed for pastes mixed with tap water. The molecules of tap water tend to agglomerate with each other and form clusters. The larger CH plates, which packed in the transition zone, could be produced after cement has reacted with these clustered water molecules. The CH crystals in hydrated paste tend to be smaller water molecules of magnetized water reacted with cement. The magnetic field changes the features and distribution of water molecules, which enhance the combined strength among the components in the concrete, thus the density of the concrete containing magnetized water is increased. The capability of bearing destruction effect is enhanced for the concretes containing magnetized water relative to that of pure water. The concrete containing the magnetized water distorts not easily, or it is able to prevent its distortion relative to that of pure water under action of the loaded pressure. This means that magnetized water improves the quality of the concrete in a certain extent.

2. OBJECTIVES OF THE PRESENT WORK

The aim of this work is to study the effect of usage of magnetic water for mixing and curing of concrete and to observe the compressive strength property of M30 grade concrete. The usage of magnetic water in the concrete not only improves hardened properties through enhanced hydration but also have better performance due to formation of dense CSH gel inside concrete.

3. EXPERIMENTAL INVESTIGATIONS

Experimental investigations are carried out in five phases, as:

1. To study the use of magnetic field treated water in mixing of concrete and its effect on fresh properties.
2. To study the effect of magnetic field exposure time on compressive strength of concrete and to find out optimum exposure time for producing magnetic water.
3. Strength related investigations on M30 grade normal concrete mixed with normal water and magnetic water
4. To investigate the use of magnetic water for curing of normal concrete mixed with normal water and magnetic water.

4. PREPARATION OF MAGNETIZED WATER

In the present investigation work, the rounded magnets of magnetic strength 985 Gauss are used.



Fig. 1: Magnets used for magnetizing water

Magnetic water is obtained by placing water over the magnet. A beaker of water is placed over the magnets for a period of 24 hours to obtain magnetic water. During this time magnetic flux passes through the water changing the specific surface area of water which is called as magnetized water. Three different types of magnetic water can be prepared namely: 1) North pole water 2) South pole water 3) North-

South pole water or mixed pole magnetized water. North Pole and South Pole water can be prepared using respective magnets. Whereas mixed pole water is prepared by mixing equal quantities of north and South Pole waters.

5. TEST RESULTS AND DISCUSSIONS

The purpose of the present study is to investigate the effect of magnetic field exposure time on structure of water and to find the optimum time for exposing water to magnetic field also which pole water would be effective and in turn the effect of this water on workability and strength properties of normal concrete of M30 grade.

5.1 Effect of Magnetic Field Exposure Time

To find the effect of magnetic field exposure time on workability and strength properties of normal concrete of M30 grade, standard concrete cubes (150mm x 150mm x 150 mm) were casted by using Normal water, North pole water, South pole water and Mixed pole water (50% NP water + 50% SP water) with different magnetic field exposure time starting with 1h, 2hr up to 72 hours of exposure time. Workability by slump test and compressive tests are conducted for compressive strength of concrete at 28 days.

5.1.1 Workability

To know the effect of magnetic water on workability of concrete of M30 grade mixes were casted with different water like Normal water (NWC), North pole water (N) (MWC-N), South pole water (S) (MWC-S) and Mixed pole water (N+S, 50% NP water + 50% SP water) (MWC-N+S or NS) and for each mix slump test is carried out. The test results of slump test are presented in Table 1.

Table 1: Workability of concrete (Slump Value in mm) with and without magnetic water

Normal water concrete (NWC) Slump Value in mm	Magnetic water concrete (MWC) Slump Value in mm			
	Time in Hours (h)	N pole	S pole	N+S pole
50	1	51	51	68
50	2	51	51	68
50	3	52	52	69
50	4	52	52	69
50	5	52	52	80
50	6	53	54	82
50	12	55	56	88
50	18	59	59	90
50	24	63	65	98
50	36	63	65	98
50	48	63	65	98
50	60	63	65	98
50	72	63	65	98

In NWC mixes, Superplasticizer is added in required quantities obtained during trail mixes of mix proportions to

achieve required workability where as in MWC-NS, superplasticizer is not required to achieve required workability. The results of the quantitative measurements and visual observations showed that concrete mix with usage of mixed pole water was showing very slight increase of slump value. All the mixes had good flow ability and there were no signs of bleeding as well as segregation.

We can interpret the increasing of slump of concrete made with magnetized water as the phenomenon of magnetically activated water, produces a lot of the same polarity as the ingredients of concrete mix, and a lot more of the smaller water clusters. These can cause better dispersion of fine cement particulates. So workability can be increased considerably using magnetic water which eliminates the use of super plasticizer or mineral admixtures such as fly ash to enhance workability of concrete.

5.2.3 Effect of magnetic field exposure time on compressive strength of concrete

To determine the efficient pole water to be used in the concrete for mixing the ingredients and to find the optimum exposure time of water to the magnetic field. Concrete cubes of (150mm x 150mm x 150 mm) were casted with different pole orientations and with hourly exposed water to the magnetic field and compressive tests were done on this cubes after 28 days. The test results are shown in Table 2.

Table 2- 28 days Compressive Strength of concrete mixed with normal and magnetized water to determine optimum magnetic field exposure time

Normal water concrete(NWC) Compressive Strength N/mm2	Magnetic water concrete(MWC) Compressive Strength N/mm2			
	Time in Hours(h)	N	S	N+S
38.2	1	39.1	33.4	37.0
38.2	2	39.5	33.6	37.0
38.2	3	40.0	42.0	46.7
38.2	4	43.7	42.1	48.0
38.2	5	44.0	44.9	50.1
38.2	6	49.4	47.1	52.3
38.2	12	51.5	50.3	56.9
38.2	18	55.0	54.1	60.0
38.2	24	55.5	57.3	63.0
38.2	36	55.6	57.5	63.3
38.2	48	55.7	57.6	63.4
38.6	60	55.8	57.8	63.3
38.6	72	55.0	57.2	63.5

Based on the Compressive strength tests on concrete made on Normal water and different magnetic pole water. It can be concluded that the N+S pole water is good for magnetic water concrete with optimum magnetic field exposure time of 24 hours. As discussed the main reason for increase in strength of MWC is use of altered structured water in mixing of concrete, due to which the surface area of the water increases

and which enhances the hydration process in cement results in more products in hydration compared to NWC. This increased formation of hydration products makes the concrete micro-structure very dense and porosity of this new concrete decreases a lot.

5.3 Influence of Magnetic Water on Strength properties of concrete if used for mixing concrete.

This investigation is carried out to study strength properties of M30 grade of normal water concrete (NWC) and magnetic water concrete (MWC-NS) cured in normal water at 7, 14 and 28 days. Magnetic water with N+S poles with 24 hours exposure to magnetic field was considered in mixing various ingredients of concrete. The compressive strength under axial compression on completion of 7, 14 and 28 days as per IS: 516-1999“Method of test for strength of concrete” is shown in Fig. 1.

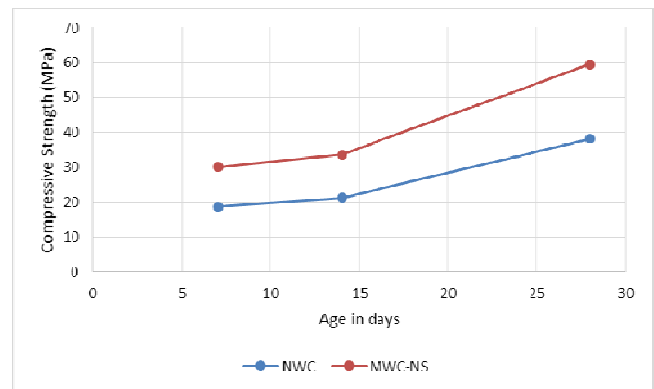


Fig. 1: Compressive Strength development in NWC and MWC-NS

It is observed that with the addition of magnetic water for mixing in concrete, at 28 days there was significant increase in compressive strength by 64.9%. The increase in strength of concrete is due to more hydration of cement in MWC, which fills up the pores in the concrete making the concrete microstructure dense.

5.4 Influence of Magnetic Water on Strength properties of concrete if used for curing of concrete

This investigation is carried out to study the effect of, use of magnetic water in curing of concrete, for which the compressive strength of M30 grade of normal water concrete (NWC) and magnetic water concrete (MWC-NS), cured in magnetic water at 28 days are compared. Magnetic water with N+S poles with 24 hours exposure to magnetic field was used as curing water in this study. The Table 3 shows compressive strength of M30 grade concrete cured in magnetic water.

Table 3: Shows compressive strength of M30 grade concrete cured in magnetic water

Compressive strength of M30 grade Concrete in MPa						
Age in days	NWC			MWC		
	Normal Water	Magnetic Water	%	Normal Water	Magnetic Water	%
	curing	Curing	increase	curing	Curing	increase
28	38.2	45.3	18.60	63.0	68.2	8.3

It is observed that in NWC with the use of magnetic water for curing of concrete showed an increase at early stages of hydration and after 28 days this increase is found to be very small. The actual percentage increase in compressive strength when magnetic water is used for curing normal and magnetic water concrete at 28 days is found to be 18.61% & 8.3% respectively.

6. CONCLUSIONS

Based on the results reported in this research work and key findings during the experimental investigations, the following conclusions can be drawn:

1. Studies conducted on water which is exposed to magnetic field indicates that the magnetic field exposure on water brings about internal molecular changes in water and increases surface area of water in unit volume.
2. When water is exposed to different poles of the magnet. The Mixed pole water (i.e 50% of North Pole water +50% of South Pole water) is giving good results in compressive strength and Surface area of structured water compared to that of individual pole water.
3. The workability of mixed pole magnetic water concrete is slightly more compared to normal water concrete.
4. For usage of MW as mixing water in concrete, 24 hours of magnetic field exposure time to water is found to be optimum.
5. Use of magnetic water in concrete eliminates the use of superplasticizers and supplementary materials to enhance workability.
6. When magnetic water is used for mixing M30 grade concrete, SP can be eliminated because magnetized water provides desired workability and enhanced strength. So for similar workability as that of NWC, water content can be reduced in magnetic water concrete (MSW-NS).

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REFERENCES

- [1] 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.
- [2] H. Afshin, M. Gholizadeh, and N. Khorshidi, 2010 "Improving Mechanical Properties of High Strength Concrete by Magnetic Water Technology" Transaction A: Civil Engineering. Vol. 17, No.1, pp. 74-79.
- [3] H. SafayeNikoo, 2007 "The Study of Velocity and Frequency of Passing Water through a Magnetic Field and its Effect on The Compressive and Tensile Strength of Concrete " 3rd International Conference on Concrete & Development, CD07-001, pp. 987-998.
- [4] An- Tai Ma, 2007 "Effect of Magnetic Water on Engineering Properties of Self- Compacting Concrete with Waste Catalyst" A thesis submitted to Institute of Construction Engineering, National Yunlin University of Science & Technology in Partial Fulfillment of the Requirements for Degree of Master of Design in Construction Engineering, Taiwan, Republic of China.
- [5] Saddam, M. Ahmed, 2009 "Effect of Magnetic Water on Engineering Properties of Concrete" Al-Rafidain Engineering, Vol.17, No.1, pp.71-82.
- [6] H. Arabshahi, 2010 "The Effect of Magnetic Water on Strength Parameters of Concrete" An International Journal of Chemistry, Vol.1 (1), pp. 30-35.