

Utilization of Magnetized Water in Concrete – A Review

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Abstract

In recent times, cement have got modified for various purposes by adding suitable admixtures and/or additives. One such modern focus is magnetization of water or cement. Enriching magnetic properties of concrete can augment the absorption of cement by electromagnetic waves. Also, several research works have been carried out to improve the workability, reduce shrinkage cracks, minimization of superplasticizer dosage and enhancement of strength of concrete employing magnetized water in place of ordinary water used in concrete. By magnetizing the water used for mixing concrete, the total hydration cycle can be improved which results in enhancing the strength of concrete. Further, it is found that the level of magnetization of water impacts the workability and power of the concrete. Few researchers have focused the applications of magnetized cement to improves the concrete properties. Magnetization of cement is done using nano particles and few metallic based admixtures like copper slag, Hard magnetic powder etc. This paper includes the review of literatures based on magnetized water in concrete. It is observed that more studies are vital to understand the internal structural changes that occur as a result of magnetization and its effect in mechanical characteristics of concrete.

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1. Introduction

It is known that normal water contains H₂O molecules which are connected to each other through hydrogen bonding. The water molecules are found in clusters due to hydrogen bonding i.e., arbitrary motion. To align these molecules in uniform direction, the water is subjected to a high intensity magnetic field ranging between 0.25 T to 0.75 T. The magnetization process breaks the water molecule clusters, then the single particles are aligned in a uniform direction as shown in Figure 1. The effect of magnetized water varies with magnetic power. But the reduction in cement content, increase in workability etc. is found to be more pronounced in magnetized water which results in green concrete by nearly 10% reduction in the amount of cement used can be achieved.

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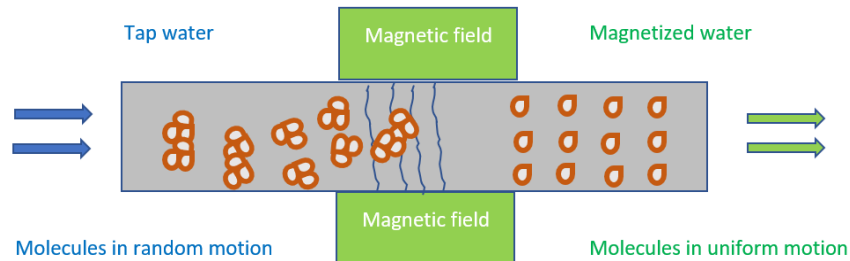


Fig. 1. (a)

(b) second picture.

first picture;

2. Literature Reviews

Taghried Isam et al (2017)^[1], investigated workability and compressive strength due to the supplement of magnetized water in concrete. In this exploration study, “the influence of magnetized water on workability and compression behaviour of concrete was studied, in order to obtain effective concrete with high resistance and at a reduced cost. Data was collected from previous studies and earlier research works. The magnetized water was prepared using a system comprising magnetic treatment. Four types of blends were prepared, three with and one without magnetized water. Cement reduction of 12.5 % and 25 % was imposed on the last two mixes with magnetized water. Slump and compressive strength tests were carried and it learned that concrete produced by the magnetic technology is easy to operate without affecting the compressive endurance of concrete. It was also found that magnetized water increases the compressive resistance of concrete while cement is demoted by up to 25 %”.

Saddam M. Ahmeda and Dina F. Manar (2021)^[2] assessed the impact of magnetic field (static) treatment on active concrete and water reduction potential. In this research, experimental searches were did to assess the ideal method of magnetic treatment for the mixes and provide guidelines to use in the concrete mix design. “About six magnetic flux densities (25, 50, 100, 200, 400 and 500 Milli Tesla) were judged. More than 180 specimens were contemplated in the experimental agenda. The fresh mix was segregated into two portions; the first portion was untreated, and the other passed across a magnetic field. The mechanical properties were investigated. Experimental results clearly displayed an evident increase in the compressive strength of the concrete mixes up to 16 %. The workability was escalated by about 7 – 26 % and the highest workability was recorded for treatment of 400 mT flux density. Splitting tensile strength, flexural and bond slip strength were also competent when the magnetic treatment is carried out for the fresh mixes, also all treated specimens showed significant ductile behaviour. This finding pointed that the water reduction potential can be employed and commended maintaining alike workability when the magnetic treatment is performed for mixes. The characteristics of resulted concrete improved in terms of compressive and tensile strength in about 29 % and 27 % respectively. However, with these advantages, the existing study can be considered as the first step towards production of fresh treated mixes which confirms the use of magnetic field treatments to the concrete mixes during production and placing”.

Zena K. Abbas et al (2022)^[3], studied strength enhancement in concrete by using magnetized water in normal and Self-Compacted Concrete. “The main objective of this effort was to adopt environmentally approachable technology with improved results. The Magnetic Water (MW) treatment system technology can be manipulated in concrete blend production instead of Potable Water (PW) to advance both workability and strength. Two categories of blends, control concrete of grades 25 and 35 MPa and the self-compacted concrete (SCC) of 35 MPa grade. The concrete

mixes having MW as a substitute of PW of M25 showed improvement in a compressive strength of 15.1, 14.8, and 10.2% for 7, 28, and 90 days, correspondingly. For M35 grade, an upgrade of 13.6, 11.5, and 9.1% was gained for 7, 28, and 90 days in turn. The mixture of SCC showed the ultimate improvement up to 16.2, 15.8, and 12.4% for 7, 28 and 90 days correspondingly. The effect of MW is substantial for 7 days when related to 28 and 90 days. An increase in the content of water to powder material portrays more efficiency of MW, while the combined effect of MW and superplasticizer in SCC showed the best development with less water content for 35 MPa grade”.

Shivam Singhal and Dr. Sanjeev Gill (2017)^[4], improved the strength of concrete employing Magnetized Water.

“The cube strength and workable property of concrete paying magnetized water was enhanced for selected percentages subject to materialization process of this concrete. The experiments encompass the preparation of control/nominal cubes from this concrete according to the typical ratios of ingredients and mixed with MW, which was set by allowing tap water through the devices of diverse magnetic strength in terms of Gauss. Then the factors affecting physical and mechanical properties were learnt and developed some methods to be checked and verified. To complete the scope of the trial results, the study necessitated the preparation of similar cubes via ordinary tap water. Copious experiments were done to establish the velocity of water across the magnetic field, which afforded the top value for the compressive strength, i.e., upto 0.8m/sec. It was materialized from the examinations for of more than 63 cubic concrete mixed with MW that there is an increase ranging between 10 and 22% of compressive strength equated to the results of the nominal cubes”.

Saddam M. Ahmed (2009)^[5], investigated the influence of Magnetic Water on engineering properties of concrete. “This research explores the effect of MW on compressive strength and degree of workability of concrete. Results disclose that the compressive strength of concrete samples made with magnetic water adds 10 to 20% more than that of the tap water trials. In this search, an increase in compression value of concrete is arrived when the magnetic strength of used water is 1.2 T, and 0.71 m/s is the water current velocity that passes via magnetic field. It is also found that magnetic water improves the workable property of fresh concrete”.

R. Malathy et al (2017)[6], investigated the consequence of Magnetic Water on mixing and curing of M25 grade concrete. “This study interests the analysis of impact of magnetic water on the workable property and compressive strength of concrete. The water is magnetized firstly with the help of 0.5HP motor having a 0.8 T magnet at its inlet pipe. Both the physical and chemical properties of water were studied. Concrete samples were cast and cured via magnetic water and conventional water in four diverse cases. About 48 concrete cubes were cast and tested for 7, 14, 21 and 28 days correspondingly. The main reach of the study is to enhance the qualities of water as per standards and decrease the water cement ratio thereby lowering the consumption of cement and curing ages”.

Abdullah Mansuri and Anand Patel (2020)^[7] presented a novel approach of saving the cement content employing magnetized water in concrete designs for building developments. “This research also provides a clearer understanding of the process of Magnetic structured water as mixing water very professionally in hydration for improving properties of concrete. The approach saves the performance of concrete by adding magnetized water all through mixing distinctive materials of concrete. It was deduced that for 10% and above cement saving, and by magnetized

water for concreting, up to 1 bag cement and an sum of Rs.370/- can be saved. When used for large quantity of concreting this material and cost saving can be sill increased”.

Malathy Ramalingam et al (2022)^[8] increased the properties of concrete by Magnetic Field Treated Water (MFTW). “This examines the standards of water quality over physiochemical analysis, such as Electrical Conductivity (EC), Total Dissolved Solids (TDS) , pH and Viscosity with the MW at diverse exposure time 60 min for MW60, 45 min for MW45, 30 min for MW30 & 15 min for MW15 and one at constant exposure (MWI). Experimentations were conceded to gauge the fresh, hardened, and microstructural behavior of concrete made with MW using a permanent magnet of PERMAG (N407) under a field intensity of 0.9 Tesla. In addition, optical properties such as X-ray Diffraction (XRD) and Ultraviolet (UV) absorption were considered for the MW60 mix to warrant water magnetization. Thermo Gravimetric Analysis(TGA), and Scanning Electron Microscopy (SEM) were done for NWC and MWC to compute the hydrated products. From the results, it was perceived that the magnetic influence on water characteristics indicated substantial advances in the concrete properties with the increase in exposure level. There were increases of 25.6% and 24.1% in workable property and compression values correspondingly, for MW60 mix referred to Normal Water Concrete”.

B. Siva Konda Reddy et al (2014)^[9] analyzed the use of magnetized water for mixing and curing of concrete. “The effect of usage of magnetic water in mixing and curing of concrete were assessed. This research work found a new process of applying this potable water by magnetizing which can be manipulated in mixing and curing of concrete. Strength tests supervised on this magnetic water concrete (MWC) exhibited promising results and one can easily interchange normal water with magnetic water for mixing and curing of concrete. It was observed that normal water concrete cubes and cured in magnetized water (MW) exhibited very modest increase in compressive strength judged to MW casted cubes cured in MW at very early phases of hydration”.

Wasim Barham, Ammar AL-Maabreh et al (2021)^[10] assessed the effect of magnetic water usage as a substitute of tap water in estimating the mechanical properties of concrete exposed to raised temperatures. “Specimens were subjected to temperatures of 25°C, 200°C, 400°C and 600°C. The experimental results demonstrated that magnetic water greatly altered the mechanical properties of concrete. Samples cast and cured with magnetic water show extraordinary compressive, flexural and splitting tensile strength in comparison with normal water specimens at all temperatures. The relative strength range amongst the two types of water used was 110 to 123% for compressive strength and 110 to133% for splitting tensile strength. For the center point loading examination, the relative flexural strength range was 118 to140%. The use of magnetic water in concrete mixing influence to a more complete hydration process. It was found that the introduction of concrete to high temperatures had a considerable stimulus on concrete mechanical properties. Samples trained with magnetic water showed greater compressive strength at all temperature amounts. The addition of magnetic water for casting and curing concrete enhances the compressive strength up to 23%”.

Arihant Jain et al (2017)^[11] investigated the authenticity of magnetic water also known as magnetic field treated water (MFTW) on strength assessments made with magnetic water. “Test variables incorporate the magnetic strength of water and curing age. Conclusions disclose that the compressive strength of concrete models mixed with magnetic water is superior than those prepared with normal water. The compressive strength development of concrete prepared with magnetic water is more substantial at an early age. At magnetic strength of treated water of 1T,

the best result was accomplished for water absorption and porosity. The highest value for sorptivity was at magnetic strength of treated water is of 0.9T”.

Saeid Ghorbani et al (2018)^[12] explored the consequences of magnetized water on the durability and mechanical functioning of concrete block pavers. “Five combines were accomplished with magnetized water subjected to permanent magnetic fields of 10, 20, 40, and 80 times at a fixed speed of 2.25 m/s. Compression, splitting tensile & flexural strengths, resistance to sulfuric acid, water absorption, and Scanning Electron Microscopy (SEM) analyses were supervised. The mechanical strength tests results showed a substantial positive effect of exercising magnetized water”.

S Venkatesh et al (2020)^[13] performed an investigational study on the influence of magnetized water on mechanical properties of concrete. “This learning involves the exploration of magnetized water effects on the workability and strength properties of concrete. Two diverse strengths of magnets of 0.986 and 2 T were used to magnetize in static treatment process. The water subjected to magnetic field is used in concrete on replacing ordinary water it results to increase the workability and mechanical properties of the concrete. The compression, split tension and flexural strength tests were carried out using magnetized (24 hours) water in the making of concrete. Concrete finished with magnetized water possess higher strength than concrete made with ordinary water. The extent of this study is to improve the characteristics of water according to the standards and decrease the water-cement ratio which reduces the utilization of cement content and porosity of the concrete”.

Ali Abdulmohsen Khamees Al-Malik et al (2020)^[14] investigated the outcomes of employing magnetic water as mixing water in concrete on required cement content, workability and compression strength. “Concrete mixes were finished employing magnetic field treated water and judged with regular concrete mixes done with non-magnetized water. The extreme enhancement of compression strength was attained at the highest magnetic field intensity used, which was 1.3 T. Compressive strength enhancement was found to be more considerable at early ages. It was also noticed that similar levels of workability and 28th day compression strength were attained with 7.5% reduction of cement content for the samples finished with magnetized mixing water as compared to those finished with standard non-magnetized water”.

Temple Nwofor and C.H. Azubuike (2020)^[15] “determined the optimal magnetic exposure period for magnetic water concrete, concrete strength and to estimate the ideal time for exposing water to magnetic field, for which maximum compressive strength of concrete will be achieved. In this research, water was exposed to magnetic field of 336mT per magnet for extents of 12, 18, 24, 36, and 96 hours, after which this magnetized water was employed to accomplish concrete. The results acquired were checked against control trials made with normal water. Based on this research, there was a substantial rise in compressive strength when compared to standard concrete by 6.5% at 7days and 17% at 28 days from 12hours of magnetization duration till 24 hours which was found to be optimum exposure time because no significant increase in the strength of the concrete was observed after that time. Magnetic water concrete (MWC) also afforded a superior value of slump than Normal Water Concrete (NWC), hence established that MWC possesses higher degree of workable than NWC”.

3. Summary

Incorporation of magnetized water in concrete is found to yield better results in terms of strength, workability, reduction in cement content and superplasticizer, minimization of shrinkage cracks etc. There is a scope for magnetization of cement also to improve the said characteristics.

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