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A Review on the Effect of Magnetized Water in Concrete

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Abstract
In this review, the effect of magnetized water on the workability and strength properties of the concrete behavior is discussed. In construction industry, concrete is used due to its competence to attain cast in any form and shape. The properties of concrete such as strength and durability are also altered by accommodating changes in the ingredients of concrete. There numerous admixtures that are utilized to enhance the strength of concrete. But by some means admixtures are not available in rural areas and cost of that admixtures are also high to use in massive projects. The engineering properties of concrete like compressive, tensile and flexure strength are enhanced using magnetized water in concrete than concrete made with ordinary water. The magnetized water has different mechanical, electromagnetic, and thermodynamic properties compared to potable water. The main objective of this review is to discuss an eco-friendly technology with enhancing engineering properties of concrete.

***Keywords*- Concrete, magnetized water, workability, strength properties.**

INTRODUCTION

Water utilization is rising as the population and human needs grow. The modern industrialized sector has come in 2nd of 20 % of water utilization after the agricultural sector which represents 70% of the water used. Water used in concrete production plays a requisite role in the concrete mix. The main role of water in concrete mix is primarily in the hydration process of cement and provide appropriate curing period to attain the preferred strength. Generally in the production of concrete usually tap water or drinking water is used to avoid the presence of impurities. According to global study, in concrete production practice there is more than one billion tonnes of water is consumed each year. However, if magnetic water (MW) is used instead, water molecules can easily penetrate into the cement particles, allowing a more complete hydration process to occur and enhancing the mechanical strength of concrete. By replacement of admixtures, using magnetized water (MW) is a novel technique for improving the workability, compression, and tensile strength of concrete. The using of the magnetized water (MW) has promising potentials in saving water amount used in concrete construction.

Magnetized water

When water passes through a magnetic flux it is known as magnetized water. Water changes in certain physical properties and chemical properties when subjected to magnetic field. The water is passed through a magnetic field of high intensity ranging between 0.25T to 0.75T. Water is transparent in nature and considered as homogenous mixture comprise of two hydrogen atoms are bonded to a single oxygen atom. The structure of water is aligned in one direction after magnetization, and the molecule sizes change after the bond angle changes, therefore viscosity and surface area increases by magnetization, hence the hydration rate increases. The hydrogen bonding present in water breaks. Initially the water is present in cluster of molecules formed due to hydrogen bonding. When passed through magnetic field the cluster breakdowns and single molecules are left.

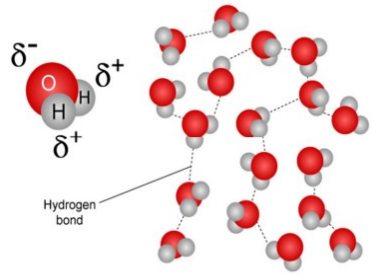

Fig-1. Joining of water molecules by hydrogen bond

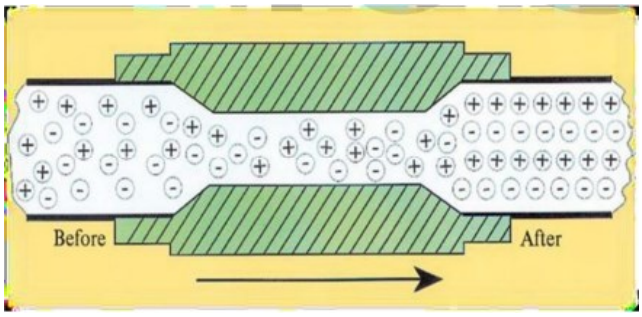

Fig-2. Magnetized water

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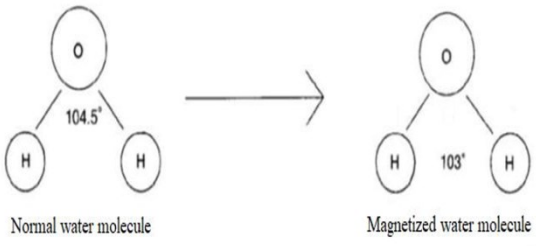

Fig-3. Structure of water molecule from Tap water to Magnetized water.

Work Done in Similar Field

Taghried Isam Mohammed Abdel-Magid, Rabab Mohammed Hamdan- The aim of this paper is to the study of the effect of magnetized water on workability and compressive strength of concrete was studied, soon get operative concrete with high resistance and at a lower cost. Data were collected from previous studies and researches. The magnetized water was prepared using the magnetic treatment system. Four concrete mixes were prepared, one without magnetized water and three with. Cement reduction of 12.5 we attempt to 25 would it not absolutely was imposed on the last two mixes with magnetized water. Slump and compressive strength tests were distributed on all four mixes and it absolutely was revealed that concreteproduced by the magnetic technology is easy to figure without affecting the compressive resistance of concrete. it absolutely was also found that magnetized water increases the compressive resistance of concrete while cement is reduced up to 25 %.

Ashish Dagadu Amate, Sanika Sanjay Bhosale- The aim of this paper is to the study of the effect of magnetized water on workability and compressive strength of concrete was studied, in order to obtain operative concrete with high resistance and at a lower cost. The water after passing through magnetic flux is named magnetized water (MW). The magnetized water was prepared by using electromagnetic field (EMF) and permanent circular magnet. This is done by passing water through magnetic flux for 180 minutes. Some properties of magnetized water like conductivity, TDS, and pH were studied. This experiment was conducted at 25 gauss and 250 gauss magnetic flux strength.

M Gholizadeh, H Arabshahi- The aim of this paper is to look at the effect of magnetic water on concrete parameters. Strength parameters of concrete are studied for over 104 concrete samples, including the normal water and magnetic samples (made by magnetic water), with slump and compressive strength experiments. supported slump experiments, magnetic samples were 7 centimeters quite non-magnetic group and therefore the average compressive strength of samples made by magnetic water was 23% quite that of samples made by ordinary water. The experimental results show the advantages of magnetic samples in concrete industry thanks to increase in plasticity, the efficiency and quality of concrete boosts as compared with nonmagnetic samples.

Hassan Karam and Osama Al-Shamali- In this research they need studied the magnetic water has been utilized in different fields like agriculture, health care, constructions, dairy production, and oil industries. Concrete mixes designed were prepared using water (TW) and another set of concrete mixes designed of a similar proportion were also prepared using magnetized water (MW) within the laboratory to organize the testing specimens. Assessment of the Concrete strength was performed to figure out the effect of using magnetized water. The compression parameters included the mechanical properties and so the consistency of fresh concrete. The change in water natural phenomenon and thus the positive results of the concrete evaluation is evidence of the positive effect of using magnetized water in preparing concrete.

R. Malathy and N. Karuppasamy- In this paper they investigated the influence of magnetic water on the workability and compressive strength of concrete. The water is initially magnetized with the assistance of 0.5hp motor having a 0.8 T magnet at its inlet pipe. Both the physical and chemical properties oh water is to be studied. Concrete samples are then prepared and cured with magnetic water and ordinary water in four different cases. About 48 concrete cubes are casted for M25 grade and tested for 7, 14, 21 and 28 days respectively. the foremost scope of the study is to boost the qualities of water as per standards and reduce the water cement ratio thereby reducing the consumption of cement content and curing days.

Saddam M. Ahmed- In this paper they investigated the influence of magnetic water on compressive strength and workability (consistence) of concrete. Results show that the compressive strength of concrete samples prepared with magnetic water increases 10-20% over that of the faucet water samples. within the present study, increasing in compressive

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strength of concrete is achieved when the magnetic strength of water is 1.2 T, and velocity of water current that passes through flux is of 0.71 m/s. it's also found that magnetic water improves the workability (consistency) of fresh concrete.

E. Poornima and P. Sivakumar- In this research they need studied the magnetic treatment of water increases the ion solubility and pH. this system is usually used for the softening of water and, for the primary time during this research, it's been adopted by the scientists for the assembly of concrete with improved strength. Some researchers hypothesize that magnetic treatment affects the character of hydrogen bonds between water molecules which increases the pH and softens the water. it's been observed that the concrete made with magnetic water has higher slump values. Also in some cases, the compressive strength of the magnetic concrete samples was beyond that of the control concrete samples (up to18%). The cement content are often reduced by 28% within the case of magnetic concrete. results of our project shows increase in compressive strength of concrete around 20% for non-recirculated magnetic water specimen and it ranges 25% just in case of recirculated magnetic water specimens. Similarly, the test conducted on recirculated magnetic water shows change in pH value from 7.8 to 8.7 with increase in recirculation time. The hardness also reduced from 310 to 190 mg/lit because of recirculation of magnetic water.

Arihant Jain and Aakash Laad- In this paper they investigated the effect of magnetic water also referred to as field of force treated water (MFTW) on compressive strength, water absorption, porosity and sorptivity on samples prepared with magnetic water. MFTW was obtained by passing through a field of force. Test variables included the magnetic strength of water and curing age. Results show that the compressive strength of concrete samples mixed with magnetic water is over those prepared with normal water. The compressive strength increase of concrete prepared with magnetic water is more significant at early age. the most effective result achieved for water absorption and porosity were obtained at magnetic strength of treated water is of 1T.

S Venkatesh1 and P Jagannathan- This experimental study involves the examination of magnetized water on the workability and strength properties of the concrete. The water is magnetized in static treatment process with two different strengths of magnets with 0.986 and 2 Tesla. The water exposed to magnetic flux is employed in concrete on replacing ordinary water it results to extend the workability and mechanical properties of the concrete. The compressive, split tensile and flexural strength tests was carried using 24hour magnetized water in production of concrete. Concrete made with magnetized water possess higher strength than concrete made with ordinary water. The extent of the study is to boost the character of the water in line with the standards and reduce the water-cement ratio thereby reduce the use of cement content and porosity of the concrete.

V.S.S.Kaushik and V.R.N.V.D.Pavan- In this paper they investigated the feasibility of magnetized water in concrete mixes. Concrete is that the most vital engineering material and therefore the addition or replacement of a number of materials may change the strength parameters of the concrete. In recent years lots of research work has been allotted so as to get more durable and long-term performance of concrete structures within the dynamic environment. An experimental program is about up to check the effect of magnetized water with variation of your time period of water placed in flux. The laboratory investigation included measurement of compressive strength and flexural strength. The results of this investigation indicate a general improvement in mix properties with the introduction of magnetized water within the concrete mix.

Work done in similar field by using different materials

Abdolkarim Abbasi Dezfouli (Concrete containing met kaolin and magnetized water) - In this study, laboratory tests at early and hardened state including temperature change, slump, liquidity examination, water absorption, specific gravity of concrete, electrical strength test (indicating permeability and corrosion rate), and compressive strength test on samples with 0, 10, 15 and 20 percent cement-substituted MK at 7 and 28 days of age were tested on 15cm cube specimens. The results showed that the addition of 10% cement substitute MK in slump test, 15% cement substitute MK in compressive strength test, and 20% cement substituent MK in electrical resistance test had the highest values and 15% cement substitute MK in concrete weight density test. 20% of cement-substituted MK in the experiment showed the lowest water absorption percentage compared to other mixes designs. Microscopic analysis shows the more durable MK replacement in comparison with normal concrete.

Nan Su, Chea-Fang Wu (Concrete containing fly ash and magnetized water) – In this study, investigates the workability and compressive strength of mortar and concrete, which were mixed with magnetic field treated water (MFTW) and contained fly ash. MFTW was obtained by passing tap water through a magnetic field. Test variables included the magnetic strength of water, fly ash content in place of cement, water-to-cementitious material ratio (W/CM) and curing age. Results show that the compressive strength of mortar samples mixed with MFTW is higher than those prepared with tap water. The best compressive strength increase of concrete is achieved when the magnetic strength of treated water is of 0.8 and 1.2 T. The compressive strength increase of concrete prepared with MFTW is more significant at early age.

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Shivam Singhal, Abhishek Tiwari and Anuj Kumar (Concrete containing silica fume and GGBS with magnetized water)- In this study, the experiments contain the preparation of standard cubes from this concrete according to the standard ratios of ingredients, admixtures and mixed with magnetized water, which was prepared by passing normal water through the devices of different magnetic strength in terms of Gauss. To complete the scope of the present experimental results, the study was constrained the preparation of similar cubes utilizing ordinary tap water. It was also appeared from the tests for compressive strength of concrete mixed with magnetic water and GGBS that there is an increase ranging between (30-35%) compared to the results of the control cubes.

Mostafa M. Keshta, Mohamed M. Yousry Elshikh, Mosbeh R. Kaloop, Jong-Wan Hu, Ibrahim Abd ELMohsen (Concrete containing volcanic ash and magnetized water) - In this study deals with developing a sustainable concrete using VA, as a supplementary cementitious material, and assesses their characteristics with and without using a magnetic field. Five ratios of VA (0, 5, 10, 15 and 20 %) as a replacement of cement were used to prepare thirty mixes. Magnetized water (MW) was generated using two different intensity values, 1.6 and 1.4 Tesla (T), to assess different magnetization methods. In the current study, five different MW methods were carried out based on the water pass direction and speed using a designed device. The results show that: (1) VA is thermally stable up to 800 °C, (2) The best ratio of VA for producing volcanic concrete is 5 % with tap water and MW, (3) The long direction and high speed of water through 1.6 then 1.4 T (which generate more friction between water and inner surface of pipes) is the best to produce more influence MW for volcanic concrete; this method improved pH of used water by 12.6 %, (4) The workability of volcanic concrete increases by about 15 % with MW, (5) Compressive strength of concrete is improved by 24 % at 7 days with 5 % VA and tap water, (6) Compressive strength increases with MW and 5 % VA up to 22 % and 33 % at 7 and 28 days, respectively. The results reveal that volcanic concrete characteristics are associated with the thermal stability of VA and the improved pH of used water.

S. Bharath1 and S. Subraja (Concrete containing copper slag with magnetized water)- In this study they researched the advantages of using magnetized water within the production of concrete are found significant within the present study. This paper describes the experimental study conducted by casting 150 copper slag concrete samples prepared with water and magnetized water to research the influence of magnetized water on the compressive strength, flexural strength and split durability of concrete which contained copper slag. Water used for mixing the concrete was felt a flux of 1 Tesla. The decrease within the physical phenomenon of water after magnetization was found to be 7.77%. the share of replacement of cement with copper slag was 0%, 10%, 15%, 20% and 30%. The results indicate that there was a rise within the compressive strength of concrete by 4-18% when mixed with magnetized water compared with the concrete mixed with tap water. Similarly, the split tensile and also the flexural strength of concrete mixed with magnetized water was increased 6-17% and 5-10% respectively over that of control mix. it absolutely was also determined that workability of magnetized water concrete containing copper slag was increased up to 50%. The microstructure of copper slag concrete prepared with magnetized water have great deal of C-S-H compared with water. it had been observed that concrete with 85% cement + 15% copper slag shows the most strength parameters as compared with other concrete mixes.

Tariq Alkhrissat (Concrete containing polyethylene fiber insertion and magnetized water) - This study focuses on analyzing water quality standards using physiochemical analysis, such as electrical conductivity (EC), pH, and total dissolved solids (TDS) using the MW at various magnetizations (0.9 Tesla (MW0.9), 0.6 Tesla (MW0.6), 0.3 Tesla (MW0.3). Tests were carried out to assess the fresh, hardened, and microstructural behavior of concrete created with magnetic water (MW) using techniques for microstructural characterization such as Fourier-transform infrared spectroscopy (FT-IR). According to the findings, the magnetic influence on water parameters improved significantly with increasing magnetic intensity. As compared to regular water concrete, the MW0.9 mix increased workability, compressive strength and splitting tensile strength by 9.2%, 32.9%, and 34.2%, respectively, compared to normal water concrete (NWC).

Ben U. Ngene, Oluwarotimi Michael Olofinnade, Chidiebere E. Agomo (Concrete containing recycled waste glass aggregate and magnetized water) - Concrete use is fundamental to most infrastructural development plan of humanity today. This underscores the need to understand the strength characteristics of concrete made with crushed glass aggregate as partial replacement for fine aggregate and mixed with magnetic field treated water (MFTW). This study investigates the mechanical properties of concrete mixes prepared and cast into cubes of varying constituents such as concrete mixed with normal water, concrete mixed with MFTW, concrete with varying degree of crushed glass as replacement of fine aggregate from 15 to 45% with or without MFTW. The cubes were thereafter crushed after 7, 14, 28 and 56 days of curing to determine their compressive and tensile strengths. From the results obtained, it was observed that the

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optimum percentage partial replacement of sand with crushed glass aggregate is 15% to attain a suitable using MFTW in the mixing of the concrete. At this percentage replacement, it was observed that both the compressive and tensile strengths of the concrete mixed with MFTW improved by 25-30% relative to the conventional concrete. The study therefore recommend the use of MFTW in place of normal water in concrete production and use especially when partially replacing fine aggregate with crushed glass aggregate.

CONCLUSION

The strength studies shows that MWC also behaves likes a NWC in strength development i.e., developing very high strengths at early ages and less strength at later ages. The addition of MW the compressive strength of concrete showed very significant increase in early stages of hydration and at 28 days this increase is around 55% and at 360 the final increase in the compressive strength is around 52%.The increase in compressive strength attributes to the enhanced hydration process in MWC due to availability of more surface area of water for hydration process. iv. The split tensile strength increase is about 12.5% in MWC at 28 days and 365 days. v. Similarly the flexural strength increase is about 21% at 28 days of curing, this further increased to 29% at 365 days in MWC. vi. The Impact resistance increased in case of MWC, The impact strength increase is nearly 45%. In impact test it is observed that there is a significant improvement in first crack strength and ultimate strength in MWC because of more hydration and dense micro structure of MWC increases the resilience and strain relieving capacity MWC. This resilient character provides the excellent impact resistance and dissipates dynamic loading better than normal concrete. The increase in number of blows up to failure for MWC indicates its high energy absorption capacity which in turn enhances the increased impact resistance. vii. Radiography test conducted on the concrete specimens with and without MW shows that the Pores/flaws are less in MW concrete specimens.

REFERENCES-

1. Taghried Isam Mohammed Abdel-Magid, Rabab Mohammed Hamdan, Abeer Abdelrahman Bukhari Abdelgader, Effect of magnetized water on workability and compressive strength of concrete, International Conference on Analytical Models and New Concepts in concrete and Masonary Structures AMCM (2017).
2. Raad Hoobi Irzooki, Ammar Saleem Khazaal, Zaid Imad Mohammed, Magnetic Water Effect on Concrete Properties of Canal Lining, International Journal of Engineering & Technology, 7 (4.20) (2018) 194-199.
3. Saddam M. Ahmed, Effect of Magnetic Water on Engineering Properties of Concrete,AL-Rafidian Engineering,Volno-17,(2009).
4. Nan Su,Yeong-Hwa Wu, Chung-Yo Mar,Effect of magnetic water on the engineering properties of concrete containing granulated blast-furnace slag, Cement and Concrete Research 30 (2000).
5. Arihant Jain, Aakash Laad, Kirti Chitrarth Singh, Krishna Murari, Effect of Magnetic Water on Properties of Concrete,IJESC, Vol no-7, Issue no-5,(2017).
6. B. Siva Konda Reddy, Dr.Vaishali G Ghorpade, Dr.H.Sudarsana Rao, effect of magnetic field exposure time on workability and compressive strength of magnetic water concrete, International Journal of Advanced Engineering Technology (2013).
7. M Gholizadeh and H Arabshahi, The effect of magnetic water on strength parameters of concrete, Journal of Engineering and Technology Research Vol. 3(3), (2011).
8. Ali Yadollahpour, Samaneh Rashidi, Zohre Ghotbeddin, Mostafa jalilifar and Zohreh Rezaee, Electromagnetic Fields for the Treatments of Wastewater: A Review of Applications and Future Opportunities, Journal Of Pure And Applied Microbiology, Vol. 8(5), (2014).
9. Saeid Ghorbani, Mostafa Gholizadeh and Jorge de Brito, Effect of Magnetized Water on the Mechanical and Durability Properties of Concrete Block Pavers, Materials, (2018).
10. Chikoti Sateesh, Design of Concrete Mix By Using Treated Magnetized Waste Water, International Research Journal of Engineering and Technology (IRJET), Vol no- 04, Issue no-10,(2017). Fu, W.; Wang, Z.B. The New Technology of Concrete Engineering; The Publishing House of Chinese Architectural Industry: Beijing, China, 1994. (In Chinese)
11. Afshin, H.; Gholizadeh, M.; Khorshidi, N. Improving mechanical properties of high strength concrete by magnetic water technology. Sci. Iran. Trans. A Civ. Eng. **2010**, 17, 74–79.
12. Araghi, H.J.; Nikbin, I.M.; Reskati, S.R.; Rahmani, E.; Allahyari, H. An experimental investigation on the erosion resistance of concrete containing various pet particles percentages against sulfuric acid attack. Constr. Build. Mater. **2015**, 77, 461–471.
13. Nambiar, E.K.; Ramamurthy, K. Sorption characteristics of foam concrete. Cem. Concr. Res. **2007**, 37, 1341–1347.
14. Wang, Y.; Zhang, B.; Gong, Z.; Gao, K.; Ou, Y.; Zhang, J. The effect of a static magnetic field on the hydrogen bonding in water using frictional experiments. J. Mol. Struct. **2013**, 1052, 102–104.
15. Jeffrey, G.A. An Introduction to Hydrogen Bonding; Oxford University Press: New York, NY, USA, 1997.
16. Li, R.; Jiang, Z.; Yang, H.; Guan, Y. Effects of ions in natural water on the ^{17}O NMR chemical shift of water and their relationship to water cluster. J. Mol. Liq. **2006**, 126, 14–18.
17. Mohseni, E.; Tang, W.; Cui, H. Chloride diffusion and acid resistance of concrete containing zeolite and tuff as partial replacements of cement and sand. Materials **2017**, 10, 372.
18. Li, Z.J.; Leung, C.; Xi, Y.P. Structural Renovation in Concrete; CRC Press: London, UK, 2009.
19. Siad, H.; Lachemi, M.; Sahmaran, M.; Hossain, K.M.A. Effect of glass powder on sulfuric acid resistance of cementitious materials. Constr. Build. Mater. **2016**, 113, 163–173
20. Allahverdi, A.; ŠKVÁRA, F. Acidic corrosion of hydrated cement based materials. Ceram.−Silikaty 2000, 44, 152–160.