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STRENGTH, PERMEATION AND NANO STUDIES ON FLY ASH BASED MAGNETIC WATER CONCRETE

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ABSTRACT

The usage of concrete is growing with the exploding scope of construction industry. This called for the extensive production and usage of cement. Among all the ingredients of concrete, cement has deleterious effects on environment. As the usage of concrete is inevitable, pre-emptive measures should be taken to reduce the usage of cement in concrete while maintaining the same engineering properties. To address this cause, research has been carried out on various constituents and parameters of concrete which lead to the realization of new construction materials and practices. But the scope of effects on concrete caused by altering the properties of water has long been neglected. On account of this obscurity, this can be potential area of interest. When water is magnetized, it exhibits structural changes which increases the specific surface area of water. When this magnetized water is used in concrete instead of normal water, it is found that the compressive strength increases considerably. This additional strength attained by the usage of magnetized water can be used to address the need to reduce cement usage. In this attempt to reduce the usage of cement, fly ash which has immense potential to be used in construction industry, can be used to replace cement in concrete to a considerable extent when magnetic water is used.The present research work is carried out to investigate the effect of Magnetic Water on the Compressive strength, Permeation properties and Nano studies on fly ash based magnetic water concrete (M30 & M40 grade). Examine the effect of magnetic water on compressive strength, Permeation

1. INTRODUCTION

1.1 CONCRETE IN CONSTRUCTION INDUSTRY

Construction industry is one of the major industries in all countries both in terms of economy and affecting environment. In construction industry, concrete and metal (mostly steel) are majorly used. Concrete is primarily used building material. Concrete is an artificial stone-like material used for various structural purposes. It is made by mixing a binding material (as cement) and various aggregates (inert materials), such as sand, stone chips, brick chips, pebbles, gravel, shale, etc., with water and allowing the mixture to harden by hydration. Approximately four tonnes of concrete is produced for every person on the planet. Concrete is the second most consumed entity after water. This extreme use of

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concrete is in regard to the various advantages provided by it.

1.2 MAGNETIC WATER CONCRETE

In this magnetic water concrete the concrete is manufactured with magnetised water while mixing. The magnetised water is prepared by keeping the water on round magnets taken from scientific store. This phenomenon is based on magnetic therapy in the medical field.

1.3 MAGNETIC THERAPY

Magnetic Therapy is a natural method used to relieve pain, restore energy and enhance sleep. It has proven to be a safe, effective, economical, and simple to use form of alternative therapy. Magnetic therapy is thousands of years old yet holds great promise for the future.

Since the 1960s, clinical studies in the United States have shown magnetic therapy to be an effective method for relieving pain and discomfort. Japan and many eastern European countries have conducted hundreds of studies for over 30years, and researches continue to find that it provides tremendous benefits for a wide range of conditions. Physicians in the United States using magnetic therapy in their practices have reported many case histories showing positive benefits for their patients as well.

1.4 BENEFITS OF MAGNETIC THERAPY

Magnets have been scientifically proven to enable the body to regain its self- healing electromagnetic balance naturally. Strong evidence suggests that magnetic therapy may help to:

- Restore natural energy
- Increase blood circulation
- Prevent or reverse infection
- Promote metabolic processing of toxins
- Relieve pain

2 .LITERATURE REVIEW

A brief view of the important aspect of the available literature pertaining to magnetic water usage for various applications are presented in this chapter

S.D.S Karunanayaka (2007) studied the effect of Electromagnetism on potable water and waste water .The operating principle of magnetic filtration or separation is based on the interaction of electromagnetic field with the materials under test. Technical water system (TWS) configuration has been analyzed to determine the system characteristics. Three field trials and some laboratory experiments have been reported in this report. Finite element software has been used for the analysis of magnetic field distribution of the TWS system and also for magnetic separation modeling.

Nan Su, Chea-Fang Wu (2003) investigated that the compressive strength and workability of mortar, which is mixed with magnetic water and granulated blast-furnace slag (GBFS). The test variables included the magnetic strength of water, the content of GBFS in place of cement, and the water-to-binder ratio (W/B). Results show that the compressive strength of mortar samples mixed with magnetic water of power increased 9–19% more than those mixed with tap water. It is also found that magnetic water improved the fluidity of mortar, and the degree of hydration of concrete.

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Ashrae (2002) investigated the physical water treatment (PWT) method which is a non-chemical method of water treatment utilized for the purpose of scale prevention or mitigation. The present research is limited to recirculating open cooling water system, where the circulating water is repeatedly exposed to the PWT device.

Maria Eugenia Garcia Harbour (1998) investigated the effects produced by the action of Magnetic fields in water in the presence of real solutions under the same magnetic field. Different intensities of applied field and concentrations of solutions were investigated with reproducible effects using intensity magnetic field in the range of 180 Oe, with solutions at concentrations between 2.0 and 2.5 mol/L. She studied variations in surface tension and other physicochemical properties chemical change, such as electrical conductivity, vapor pressure, the boiling and freezing temperatures, and absorption Area IR (ATR).

3. MATERIALS AND METHODS

3.1 MATERIALS USED

The following materials are used in the present investigation. A brief description is given below regarding the materials used.

1. Cement
2. Magnets
3. fine aggregate
4. coarse aggregate
5. Magnetized water
6. Normal water
7. Fly ash

3.1.1 CEMENT Locally available 53 grade ordinary Portland cement (OPC) of Ultratech brand has been used in the present investigation for all concrete mixes. The cement used was fresh and without any lumps. The cement thus procured was tested for physical and chemical requirements in accordance with IS 12269-1987(21).

Figure 1. Ultra Tech Ordinary Potland Cement 53 Grade

The results obtained are as follows:

Table 3.1 Physical properties of OPC used

S.No	Properties	Test Results	Requirements as per IS :12269-1987
1	Normal consistency	30%	--
2	Specific gravity	3.02	--
3	Initial setting time	55 min.	Not less than 30 min.
	Final setting time	565min.	Not more than 600 min.
4	Soundness by Le Chatelier	2 mm	Not more than 10 mm
5	Fineness of Cement	3%	Less than 10%
6	Compressive Strength	54.7 MPa	53 Mpa

3.2 METHODS

Mix proportions for M30 and M40 grades of concrete have been arrived at by preparing appropriate trial mixes. Using the mix proportions so obtained for M30 and M40 grades samples are prepared. The test for workability has been performed using slump cone test. Later cubes are cast and tested for compressive strength up to 60 days.

3.2.1 MIX DESIGN

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The material quantities obtained as per mix design method, (i.e., IS:10262-2009) arrived in trial mix are given in Tables as per mix proportion 1:2.32:2.256:1.504:0.55. The quantities of materials required per one cubic meter of concrete. The detailed mix design procedure of M 30 & M40 grades of concrete is given in Appendix

Table `3.2.Concrete proportion quantities per 1m3

S. No	Grade	Materials (Kg/m3)				Water/cement
		Cement	Fine Aggregate	Coarse Aggregate	Water	
1	M 30	355	704	1144	170.5	0.48

4. EXPERIMENTAL PROCEDURE

4.1 General

The main objective of the present experimental investigations is to obtain specific experimental data, which helps to understand the Magnetic water concrete and its strength characteristics.

4.2 Compressive Strength

4.2.1 Introduction

This investigation is carried out to study the compressive strength of M30 grade concrete of normal water and magnetic water used concrete at 7,14,21,28 and 60 days.

4.2.2 Test methodology

Among the various strengths of concrete, the determination of compressive strength has received a large amount of attention because the concrete is primarily meant to withstand compressive stresses. Generally cubes are used to determine the compressive strength. The cubes are usually of 100 × 100 × 100 mm size. In the present investigation the standard 100 × 100 × 100 mm cubes are used to determine the compressive strength. The compressive strength test procedure is given below.After the required period of curing, specimens are removed from the curing tank just before testing and cleaned to wipe off the surface water.

Figure 2. Compression Testing Machine

4.3 Permeation Properties

4.3.1 General

Permeability is the most crucial internal factor in concrete durability. The permeability dictates the rate at which aggressive agents can penetrate to attack the concrete and the steel reinforcement. Water penetrability is defined as the degree to which a material permits the transport gases, liquids or ionic species through it. Water can be harmful for concrete, because of its ability to leach calcium hydroxide from the cement paste, to carry harmful dissolved species such as chlorides or acids into the concrete, to form ice in large pores in the paste, and to cause leaching of compounds from the concrete. Water absorption, sorptivity and water permeability measurement are some methods to determine the water penetrability of

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concrete. An Auto clam permeability apparatus method used for determining water permeability of concrete in the present investigation utilizes Darcy's Law for Non steady flow so as to relate water permeability to the rate of water flow under a pressure head.

4.3.2 Test methodology

This test follows the Clam permeability test which was developed originally to determine the coefficient of permeability of concrete on site. In the Auto Clam permeability test, a 50 mm internal diameter metal base ring is glued onto the surface of concrete and after saturating the test area by ponding water in the ring for 24 hours, the rate of penetration of water through the test area at a constant pressure head of 25 psi (1.72 bar) is measured. The measurements are taken for 15 minutes. Capillary pores filled with water require relatively high pressures to cause flow through them and, hence, the pressure used in the test may cause flow through only relatively big pores.

Figure 3. Auto Clam Concrete Water Permeability Test Setup.

5 .RESULTS AND DISCUSSIONS

This research investigates the influence of magnetic water on strength, permeation and Nano studies on fly ash based magnetic water concrete (M30, M40). Two types of water are used in this study, which are normal water and mixed pole magnetized water (N+S), the results of which are presented in this chapter.

5.1 EFFECT OF MAGNETIC WATER ON COMPRESSIVE STRENGTH:

The results of the compressive strength at 7,14,21,28 and 60 days M30 grades of Normal water concrete (NWFC) and Magnetic Water concrete (MWFC) are tabulated in Table 5.1.

Table 5.1 Compressive strength of NWFC and MWFC in N/mm2 (M30)

S. No.	Age in Days	NWFC	MWFC	% increase
1	7	16.11	22.25	38.1
2	14	22.62	25.5	12.73
3	21	28.97	32.1	10.8
4	28	38.8	45.9	18.3
5	60	43.8	51.74	18.13

Table 5.2 Compressive strength of NWFC and MWFC in N/mm2 (M40)

S. No.	Age in Days	NWFC	MWFC	% increase
1	7	26.33	28.3	7.5
2	14	32.11	37.01	15.3
3	21	37.7	42.9	13.8
4	28	41.3	50.4	22.03
5	60	51.03	56.81	11.3

The cube compressive strengths of concrete with and without magnetic water at 7,14,21,28 and 60 days are given in Table 5.1 & Table 5.2.It is observed that with the addition of Magnetic water for mixing in concrete showed increase by 38.1% & 7.5 5 in cube specimens at 7 days, and at 28 days there was significant increase by 18.3% and

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22.03 % in M30 & M40 respectively. The increase in strength of concrete is due to more hydration of cement in MWFC, which fills up the pores in the concrete making the concrete microstructure dense.

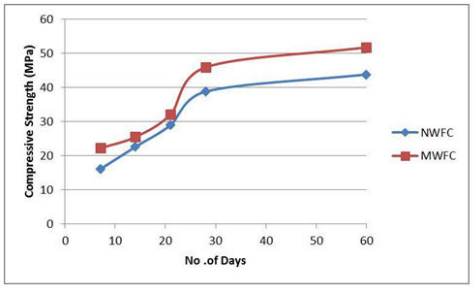

Figure 5.1 Compressive strengths for N.W.F.C and M.W.F.C for M30 grade concrete

5.3 X-Ray Diffraction Analysis:

Powder diffraction patterns are typically plotted as the intensity (Counts per second) of the diffracted X-rays vs. the angle 2θ. By measuring the 2θ values for each diffraction peak, we can calculate the d-spacing (the distance between the diffracting planes) for each diffraction peak. By using Debey-Scherrer's we can calculate the average size of the particle, from the above equation as and values are constant in the present XRD studies, it is clear that the size of the particle is inversely proportional to the base width of the XRD peaks.

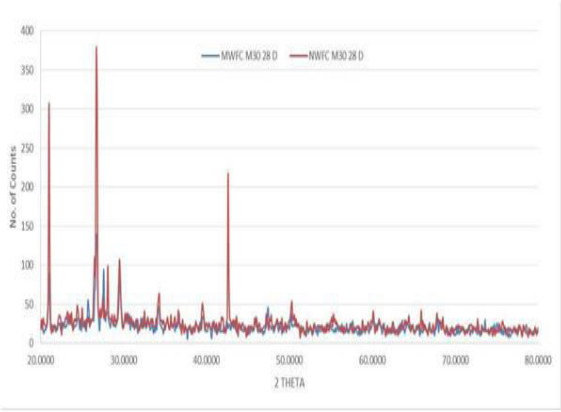

Figure 5.9 X-ray powder Diffraction Analysis for MWFC and NWFC at 28 Days (M30 Grade)

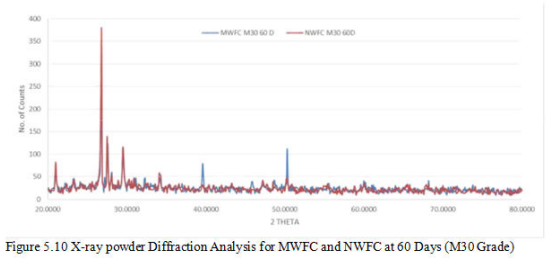

Figure 5.10 X-ray powder Diffraction Analysis for MWFC and NWFC at 60 Days (M30 Grade)

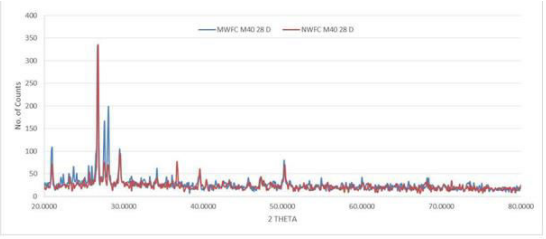

Figure 5.11 X-ray powder Diffraction Analysis for MWFC and NWFC at 28 Days (M40 Grade)

6. CONCLUSIONS & FUTURE SCOPE

6.1 CONCLUSIONS:

In this investigation the influence of magnetic water on Compressive strength, Permeation properties and Nano studies on concrete. For this the magnetic water of 985 gauss strength is used. The conclusions obtained from this work are as follows:

 The Compressive strength of Magnetized water concrete is more than Normal water concrete by 38.1%, 12.7%, 10.8%, 18.3% and 18.1% of M30 Grade at 7, 14, 21, 28 and 60 Days respectively.

 The Compressive strength of Magnetized water concrete is more than Normal water concrete by 7.5%, 15.3%, 13.8%, 22.03% and 11.3% of

 M40 Grade at 7, 14, 21, 28 and 60 Days respectively.

 Auto Clam water permeability test shows that MWFC specimens were less permeable than the NWFC the reason is that the use of Magnetized water has improved pore structure due to formation of Dense gel structure subsequently reduction in the

porosity of the concrete which substantially reduces the permeability of the concrete.

 The XRD patterns, it is very clear that the peak width is very small for Magnetic water compared to normal water has large peak width.

 Thermo gravimetric analysis of MWFC samples improved by 2% and 6% for M30 grade and by 3% and 4% for M40 grade when Magnetic water is used instead of Normal water for preparing concrete at 28 and 60 Days respectively.

6.2 SCOPE FOR FUTURE WORK

The same investigation of influence of magnetic water on workability and strength properties and Durability of concrete can be extended by varying the magnetic strength. Methods can be designed to produce magnetic water on large scale The present investigation can be extended to make different types of concrete. The present investigation can be done by using micro silica/ Nano clay instead of fly ash.

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