EXPERIMENTAL INVESTIGATION ON STEELFIBRE REINFORCED 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. 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 strength of concrete.Magnetic treatment of water increases the ion solubility in the water, and pH. Magnetic treatment changes the mode of calcium carbonate precipitation such that circular disc- shaped particles are formed rather than the dendritic (branching or tree-like) particles observed in non treated water. This technique is mostly used for the softening of water and, for the first time in this research, it has been used by the scientists for the production of concrete. Some researchers hypothesize that magnetic treatment affects the nature of hydrogen bonds between water molecules. Concrete made with magnetic water has higher slump values. Also in some cases, the compressive strength of the magnetic concrete samples was higher than that of the control concrete samples. The cement content can be reduced by 28% in the case of magnetic concrete.

CHAPTER 1 INTRODUCTION

1.1 GENERAL

In general, adding certain chemicals while mixing concrete is adopted to alter the properties of concrete and to obtain a concrete with desired property. But in most of the cases these admixtures are added to get concrete with increased strength. The chemicals that are required for increasing the strength are rarely available in rural areas and cost more in case of large projects. The usage of magnetized water while mixing concrete will increase compressive strength and also there will be higher workability for the same water cement ratio. Many researchers proved that the scale formation is greatly reduced if the water is passed through an intense magnetic flux which in turn changes the physical structure of water molecules and softens the hard water. This softening intensity is based on the magnitude of flux induced. To achieve higher intensity and magnetization, water is made to recirculate by designing a setup with motor andauto transformer.

1.2 HISTORY OF MAGNETIZED WATER CONCRETE

The Initial research and scientific testing regarding the application of a magnetic field to concrete manufacturing were commenced in Russia in 1962 for military constructions such as airports and jetties. This research was continued step by step in other institutes, such as the VNLL Jelezobeton Research and Scientific Institute in Russia, and some positive results were found in this regard. Magnetic devices include one or more permanent magnets, which induce changesand effects on ions and molecules.

A magnetic field has a considerable effect on clusters of water molecules and causes the decrease of such a mass.

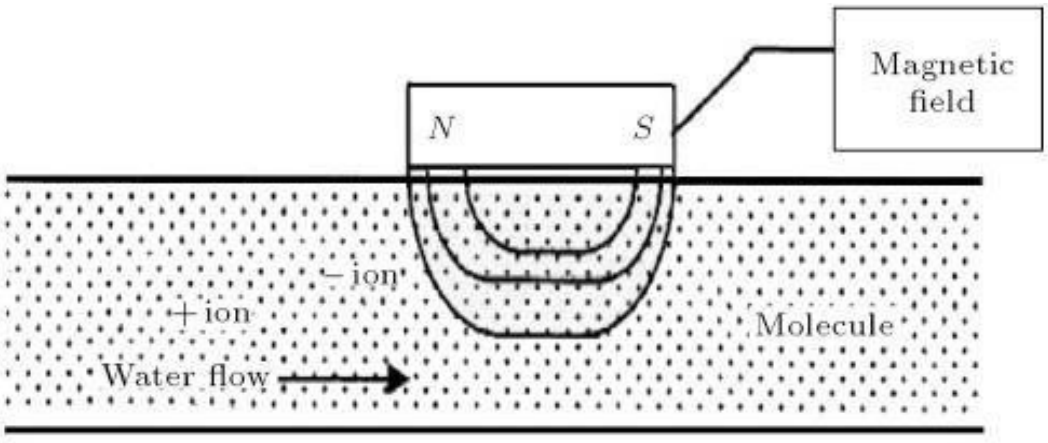


Fig.1.1 EFFECT OF A MAGNETIC DEVICE WITH PERMANENT IONSPASSING THROUGH ITS MAGNETIC FIELD

1.3 MAGNETIC DEVICE

Magnetic fields are produced by the motion of charged particles. For example, electrons flowing in a wire will produce a magnetic field surrounding the wire. The magnetic fields generated by moving electrons are used in many household appliances, automobiles, and industrial machines. One basic example is the electromagnet, which is constructed from many coils of wire wrapped around a central iron core. The magnetic field is present only when electrical current is passed through the wire coils.

Permanent magnets do not use an applied electrical current. Instead, the magnetic field of a permanent magnet results from the mutual alignment of the very small magnetic fields produced by each of the atoms in the magnet. These atomic-level magnetic fields result mostly from the spin and orbital movements of electrons. While many substances undergo alignment of the atomic-level fields in response to an applied magnetic field, only ferromagnetic materials retain the atomic-level alignment when the applied field is removed. Thus, all permanent magnets are composed of ferromagnetic materials.

Fig.1.2 MAGNETIC DEVICE

1.4 MAGNETIC WATER

The water which was subjected to high intense and focused magnetic field is called magnetic water. More than one hundred relevant articles and reports are available in the open literature, so clearly magnetic water treatment has received some attention from the scientific community. The reported effects of magnetic water treatment are varied and often contradictory. The Australian Fluid Energy mentions that the molecule groups of magnetic water differ from molecule groups of ordinary water in having lower degree of consolidation, and the molecules volume is more uniform. The activation of magnetic field on water depends on three conditions according to Huchler et al,

- Magnetic flux density.
- Duration of exposing water to magnetized field (velocity ofwater current).
- The amount of exposing water to the field

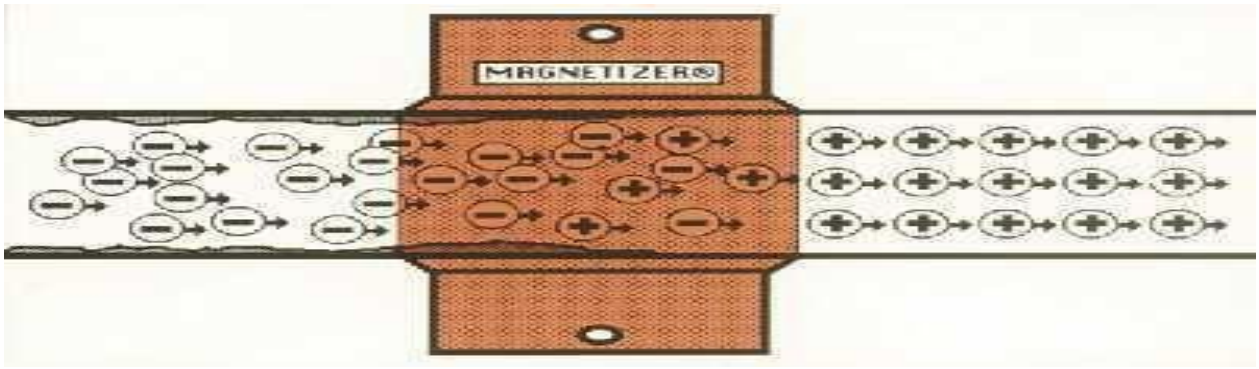
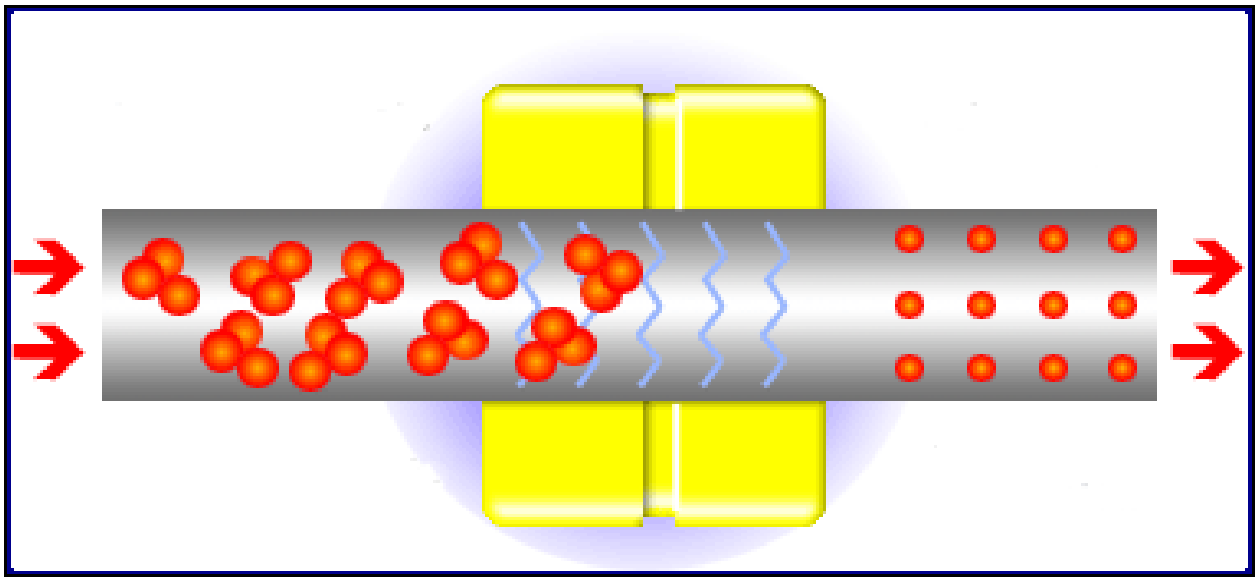


Fig.1.3 PROCESS OF MAGNETIZING OF WATER



1.5 STEEL FIBRE REINFORCED CONCRETE

The presence of micro cracks in the mortar-aggregate interface is responsible for the inherent weakness of plain concrete. The weakness can be removed by inclusion of fibres in the mixture. Different types of fibres, such as those used in traditional composite materials can be introduced into the concrete mixture to increase its toughness, or ability to resist crack growth. The fibres help to transfer loads at the internal micro cracks. Such a concrete is called fibre-reinforced concrete (FRC), and the FRC in which Steel fibres are used is called Steel fibre-reinforced concrete (SFRC).

One of the important properties of steel fibre reinforced concrete (SFRC) is its superior resistance to cracking and crack propagation. As a result of this ability to arrest cracks, fibre composites possess increased extensibility and tensile strength, both at first crack and at ultimate, particular under flexural loading; and the fibres are able to hold the matrix together even after extensive cracking. The net result of all these is to impart to the fibre composite a pronounced post – cracking ductility which is unheard of in ordinary concrete. The transformation from a brittle to a ductile type of material would increase substantially the energy absorption characteristics of the fibre composite and its ability to withstand repeatedly applied, shock or impact loading.

Fig.1.4.STEEL FIBRES

1.6 OBJECTIVES

- To Study the Flexural behaviour of Reinforced concrete using magnetizedwater.
- To Study the Flexural behaviour of concrete with added Steel fibres.
- To Study the performance of both conventional concrete and Conventional
- concrete with added steel fibres when magnetized water is added duringmixing.

1.7 SCOPE

- The Physical strength of the concrete is enhanced due to addition of magnetized water.
- The use of magnetized water helps in retaining concrete in a workable state for a longer time without any addition of super plasticizers.
- Many researchers proved that the scale formation is greatly reduced if the water is passed through an intense magnetic flux which in turn changes thephysical structure of water molecules and softens the hard water.

CHAPTER 2 LITERATURE REVIEW

2.1 GENERAL

The previous work on Magnetized water Concrete shows a wide range of variation to the conventional concrete. Some of the literature reviews are collectedand they are listed below.

2.2 LITERATURE

Abdullah Mansuri et al (2020), Investigated on the Analyze Cost Aspect By Using Magnetized Water In Concreting For Construction Projects When cement and water are mixed with sand and coarse aggregate the resulting product is called concrete. Till now, potable water is used for mixing different ingredients of concrete. In this study, a new method of using this potable water by magnetizing it has been implemented.The magnetic water has been used in different fields like agriculture, health care, construction, dairy production, oil industries, etc.In present study the aim is to improve the quality of water as per standards reducing the water/cement ratio there by reducing the consumption of cement content.Properties of water are to be studied for pH, Total hardness, and Total dissolved solids (TDS).Test to be conducted on concrete are workability and compressive strength while imposing different variations in cement reduction andcarrying out their cost analysis.

Aishwarya Kharde et al (2020), Studied on Influence of Magnetized Water on Steel Fibre Reinforced Concrete. The magnetized water (water supposed to 3hrs to 4hrs of magnetization) is used in concrete. The magnets having Gauss strength of 4500 are used. The physical properties of magnetized water such as pH and hardness are studied. The effect of magnetized water on the properties of concrete such as compressive strength, split tensile strength, flexural strength and durability of concrete are studied. This study also aims to find the optimum percentage of Reliance Recron 3s polypropylene fibres in magnetizedwaterconcrete.

Saeid Ghorbani et al (2020), Evaluated on Effect of magnetized mixing water on the fresh and hardened state properties of steel fibre reinforced self- compacting concrete .The objective of this research is to investigate the effect of magnetized water on the fresh and hardened properties of self-compacting concrete (SCC) reinforced with different ratios of steel fibres. For this purpose, a total of 12 mixes were produced with different contents of steel fibres (0%, 0.35%, 1%, and 1.65% by volume of concrete) and the mixing water passed through a permanent magnetic field (with a strength of 0.65 T), 1 and 15 times, at a flow speed of 0.75 m/s. Slump flow, V-funnel, compressive strength, splitting tensile strength and flexural strength tests, as well as a statistical analysis, were conducted. The results of the workability, compressive strength, splitting tensile strength and flexural strength tests indicate that the SCC mixes are considerably enhanced by magnetizing the mixing water. Finally, a novel evolutionary programming technique called multi-expression programming was used to generate mathematical models.

N Muthu Prakash et al (2019), Studied on Effect of Magnetic Water in Strength of Concrete .Concrete is the most widely used man-made building material on the planet. The reaction of OPC with water results in hydration process, which glue the reacting cement particles together to form a hardened cement paste.When cement & water are mixed with sand and coarse aggregate the resulting product is called concrete. Till now potable water is used for mixing different ingredients of concrete. Here we involves the investigation of influence of magnetic water on the workability and compressive strength of concrete. The water is initially magnetized with the help of magnet and also we magnetize the primary treated dye waste water. Both the physical and chemical properties of

water is to be studied. The main scope of the study is to improve the qualities of water as per standards and reduce the water cement ratio thereby reducing the consumption of cement conten. Results show that the compressive strength of concrete samples mixed with magnetic water is higher than those prepared with normal tap water.

Rawaa Al-Safy et al (2019), Investigated on Utilization of magnetic water in cementitious adhesive for near surface mounted crpf strengthening system. Cement-based adhesive (CBA) is used as a bonding agent in Carbon Fibre Reinforced Polymer (CFRP) applications as an alternative to epoxy-based adhesive due to the drawbacks of the epoxy system under severe service conditions which negatively affect the bond between the CFRP and strengthened elements. This paper reports the results of, an investigation carried out to develop two types of CBA using magnetized water (MW) for mixing and curing. Two magnetic devices (MD-I and MD-II), with different magnetic field strengths (9000 and 6000 Gauss) respectively, were employed for water magnetization. Different water flows with different water circulation times in the magnetizer were used for each device. Compressive and splitting tensile strength tests of the magnetized CBA (MCBA) were conducted for different curing periods (3. 7, 14, 21 and 28 days) using MW. It was found that MW treatment increases the strength of CBA. The highest strength was obtained for MCBA samples when MD-I was used at a low flow rate (F = 0.1 m3/hr) for 15 mins of circulation time (T). The latter was found to positively affect MCBA properties when T was increased from 15 min to 60 mins. Prediction of the compressive and tensile strength values are also studied in this paper using genetic programming, the models showed good correlation with the experimental data.

YK Sabapathy et al (2019), Studied on A Study On Influence Of Magnetic Water On The Strength Characteristics Of Concrete. In the near future it is expected that in civil engineering, structures will have to be constructed with the

concept of sustainable development through the optimal use of raw materials with low impact to the environment and also at a reasonable cost.Therefore, researchers are always finding new ways to improve the use of raw materials in concrete which in turn improves sustainability. This led to the use of magnetic water in concrete. The use of magnetic water in concrete is an evolving technique being used by concrete technologists and engineers in the aim of producing high workable concrete.Thus, the influence of magnetic water on the strength properties of concrete were examined.The magnetic water was produced in the laboratory using a simple setup. Concrete cubes were made with magnetic water and tested. The results show that there is an increase in the compressive strength of concrete compared to the concrete with ordinary water. Also, there is a reduction in the use of cement when the cubes were made with magnetic water for the specified compressive strength. Also, the slump values of concrete made with magnetic water were found to be higher than the concrete samples made with ordinary water

R Harsha et al (2018), Studied on Experimental Study on the Use of Magnetized Water in Concrete with MSand as Fine Aggregate. Water plays an important role in the concrete preparation. It plays an important role in workability and strength of concrete. A new technology known as magnetized water is used to increase the workability and strength of concrete.The magnetized water technology initiated in Russia and China for agricultural and other medical values and now it extends its application in construction industry. Magnetized water is prepared by passing the normal tap water through a magnetic field When water passes through the magnetic field some of the physical properties of water changes. The water clusters are broken due to magnetic field and which will increase the water activity. In this study magnetized water used for both mixing and curing. Different tests were conducted on four mixes. The results obtained shows that

workability is higher for mix with magnetized water.The compressive strength is higher for the mix which used magnetized water for both mixing and curing.

Majid Gholhaki et al (2018), Studied on The effect of magnetic water on strength parameters of Concrete. The main objective of this study was to assess engineering properties of self-compacting concrete (SCC) incorporating magnetic water and silica fume, metakaolin, rice husk ash and fly ash (10% and 20% by weight of cement). The fresh properties were investigated by means of slump flow, T50, V-funnel, L-box and visual stability index (VSI). At hardened state, compressive strength was evaluated at the ages of 7 and 28 days and mixes were cast to assess the 28-day splitting tensile strength development and also durability characteristics of concrete were tested for water absorption test at the age of 28 days. Results indicate that magnetic water and pozzolanic materials in SCC can improve the self-compatibility criteria in terms of flowability and viscosity. Furthermore, SCC mixture containing magnetic water and 20% of silica fume can be considered as an optimum mix design at the age of 28 days where compressive strength and splitting tensile strength increased up to 49% and

41%, respectively and the value of water absorption decreased up to 55%. Moreover, magnetic water can reduce the amount of high range water reducer (HRWR), required for SCC, up to 45%.

Arihant Jain et al (2017), Investigated on Effect Of Magnetic Water On Proporties Of Concrete. This research investigates the effect of magnetic water also known as magnetic field treated water (MFTW) on compressive strength, water absorption, porosity and sorptivity on samples prepared with magnetic water. MFTW was obtained by passing through a magnetic field. 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 higher than those prepared with normal tap water. The compressive strength increase of concrete prepared with magnetic water is more significant at early age. The best

result achieved for water absorption and porosity were obtained at magnetic strength of treated water is of 1T. The best result for sorptivity was obtained at magnetic strength of treated water is of 0.9T.

Huinan Wei et al (2017), Investigated on Influence of Magnetic Water on Early Age Shrinkage Cracking of Concrete. This research investigates the shrinkage cracking of concrete, which were mixed with magnetic water. Magnetic water was obtained by the independent designed magnetizing equipment. Ring-test method and flat-test method were used to test early-age shrinkage cracking of concrete. Results show that the strain rate factor (α) and the total cracking area of unit area (c) of concrete were decreased when used magnetic water, which means the early-age shrinkage cracking resistance of concrete mixed with magnetic water is improved than those mixed with tap water. The best increase in early- age shrinkage cracking resistance of concrete is achieved when the magnetic strength is 260 mT and the length of magnetic field is 280 mm. Additionally, the compressive and split strength of concrete mixed with magnetic water increased greatly. It is also found that the length of magnetic field have direct effect on thegrowth of concrete strength.

Korrapati Anil Kumar (2017), Studied on Study on Properties of Concrete using Recron 3s Fiber. The aggregates both fine and coarse are bonded together by the cement and mixed with water to form concrete. The concrete has become so popular and indispensable because of its inherent in nature brought a revolution in applications of concrete. Concrete has unlimited opportunities for innovative applications, design and construction techniques. Its great versality and relative economy in filling wide range of needs has made it very competitive building material. In this present investigation workability, strength properties of concrete with Recron 3s fiber in proportions of 0%, 0.2%, 0.3% and 0.4% is

studied for M25 and M40 grade concrete cubes, cylinders and prisms.Recron3s Fiber Reinforcement Systems can provide a solution to Recron 3s fibers are engineered micro fibers with a unique "triangular" cross-section, used in secondary reinforcement of concrete. It complements structural steel in enhancing concrete's resistance to shrinkage cracking and improves mechanical properties such as flexural/split tensile and transverse strengths of concrete along with the desired improvement in abrasion and impact strengths. The Recron Polyester fibers and Polypropylene fibers. The present investigation is to study the workability parameters of M25 and M40 grades of concrete using slump cone test, Compaction factor test, and Vee-bee time test. For strength parameters, each grade of concrete for each proportion, cubes, cylinders, prisms were casted for 7days, 28days, 56days and 91 days strength.

R. Malathy et al (2017), Studied on Effect of Magnetic Water on Mixing and Curing of M25 Grade Concrete. This study involves the investigation of influence of magnetic water on the workability and compressive strength of concrete. The water is initially magnetized with the help 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 main scope of the study is to improve the qualities of water as per standards and reduce the water cement ratio thereby reducing the consumption of cement content and curing days

Siddharth Pednekar et al (2017), Investigated on Experimental investigation of Properties of Concrete Cast in Magnetised Water. Magnetic water has been used in different fields like agriculture, health care, dairy production, and oil industries. Recent research exhibits that Magnetised Water can be used in concrete to improve the properties of concrete like Compressive strength, workability, tensile strength etc.In the present study effect of Magnetised Water on Strain of Concrete of different grades is studied experimentally.Compressive strength tests carried out on Cubes & Cylinders cast with Normal Water & Magnetised Water Based on the experimental results conclusion is drawn. Conducting tests on Concrete specimens cast in M20, M25 & M30 grades of concrete Strength tests conducted on this magnetic water concrete (MWC) showed encouraging results and one can easily replace normal water with magnetic water for mixing of concrete.

T.Manjupriya et al (2016), Investigated on Experimental Investigation on Strength and Shrinkage Properties of Concrete Mixed with Magnetically Treated Water. The most important challenge for concrete construction is to improve the performance of concrete. Till now potable water is used for mixing different ingredients of concrete. This paper finds new technology called magnetic water technology has been used in making concrete. As per this technology, by passing water through a magnetic field, some of its physical properties tends to change and, as a result of such changes, the cluster size in water molecules breaks down due to decrease in the bond angle between the hydrogen atoms, which causes decrease in the hardness of water, with an improvement in the workability and strength of concrete when compared to use of potable water in concrete. It also has an advantage that the quantity of cement content in concrete mix can be reduced when the magnetized water is used in concrete. Some of the most beneficial claimed water applications from magnetically treated water include improvement in scale reduction in pipes and enhanced crop yields with reduced water usage. Strength tests conducted on this magnetic water concrete showed encouraging results and one can easily replace normal water with magnetic water for mixing of concrete. Drying shrinkage properties has been studied and that results are compared with specimen mixed with potable water.

R.Shanthini et al (2016), Investigated on Reinforced Concrete Using Magnetized Water With Steel Fibres .The compactness and water impermeability of the concrete mixed with magnetized water in different degrees are studied in this thesis.The test indicates the difference of impermeability between magnetized water concrete added with steel fibers and conventional concrete at condition of same strength.This experiments comprise the preparation of standard cubes according to standard ratios of ingredients mixed with magnetised water. The water which is subjected to high intense and focused magnetic field is called magnetized water. Concrete prepared using magnetized water is called magnetized water concrete. The use of magnetized water in concrete results in increase of compressive strength and also increase in workability of concrete without addition of any super plasticizers. One of the important properties of steel fibre reinforced concrete (SFRC) is its superior resistance to cracking and crack propagation. As a result of this ability to arrest cracks, fibre composites possess increased extensibility and tensile strength, both at first crack and at ultimate, particular under flexural loading; and the fibres are able to hold the matrix together even after extensive cracking. The net result of all these is to impart to the fibre composite a pronounced post – cracking ductility which is unheard of inordinary concrete.

B.Siva Konda Reddy et al (2014), Investigated on Influence of magnetic water on strength properties of concrete .It is expected that in the near future, the civil engineering community will have to produce structures in harmony with the concept of sustainable development through the use of high-performance materials with low environmental impact that are produced at a reasonable cost. Magnetic water concrete, synthesized from the normal materials used for manufacturing of concrete, provides one route towards this objective. This paper presents the effect of addition of magnetic water on workability, strength and mechanical properties of concrete

tested show-encouraging results, and one can easily replace normal water with magnetic water by which quantity of cement used in any concrete mix reduces and can be made as new Eco-friendly construction material for future decades. **M Gholizadeh et al (2011),** Studied on The effect of magnetic water on strength parameters of Concrete. A machine was designed for magnetic water treatment and its application on the ions contained in water has been investigated to examine the effect of magnetic water on concrete parameters. He studied strength parameters of concrete for more than 104 concrete samples, including the non magnetic samples (made by ordinary water) and magnetic samples (made by magnetized water), with slump and compressive strength experiments. Based on slump experiments, magnetic samples were 7 centimeters more than non- magnetic group and the average compressive strength of samples made by magnetic water was 23% more than that of samples made by ordinary water.The experimental results show the advantages of magnetic samples in concrete industry because of increase in plasticity, the efficiency and quality of concrete boosts in comparison with non-magnetic samples..

H.Afshin et al (2010), Investigated on Improving Mechanical Properties of High Strength Concrete by Magnetic Water Technology. the production of magnetic water, a magnetic treatment device 0(made in Germany) has been used. This device mostly is used for the softening of water and, for the first time in this research, it has been used by the authors for the production of concrete.The results of tests showed that, in most cases, concrete made with magnetic water (magnetic concrete), has higher slump values than those of control concrete (up to 45%). Also in some cases, the compressive strength of the magnetic concrete samples was higher than that of the control concrete samples (up to 18%). Also, in some cases, with the same slump and compressive strength, cement content can be reduced by 28% in the case of magnetic concrete.

H.Banejad et al (2009), Studied on The effect of magnetic field on water hardness reducing. Magnetic field intensities of zero Tesla (as a witness), 0.05 Tesla, 0.075 Tesla and 0.1 Tesla were examined. Also, the amounts of water influent were about 4lit/h and 30lit/h. With doing examination by 3 times and analyze the results with SAS software, have shown that changing magnetic field intensity, amounts of water influent, and also together influence there factors, have significant effects at level of 99 percent on reducing of water hardness. In the other way, for finding their mechanisms, analyzes done by X ray. Calcium carbonate exists in two forms, calcite and aragonite. But the main form of sediment is calcite. Results showed that amount of aragonite in compare with calcite, by attention to situation, increased 70 percent to 99.99 percent and ratio between calcite/aragonite had a main reducing.

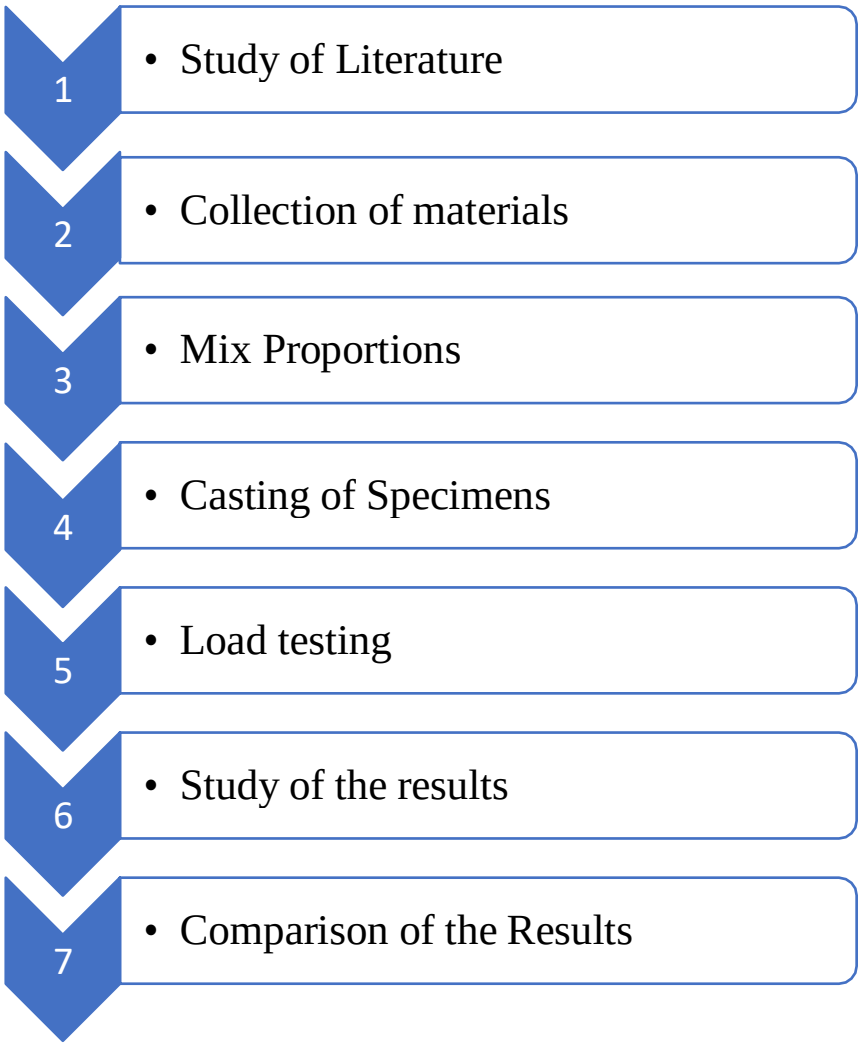
Mohamed Abdel-Raouf et al (2009), Investigated on Properties of Concrete Incorporting Magnetized Water. Mixing water plays a major role in determining concrete workability, strength, and durability. Previous work has indicated that magnetizing the mixing water can introduce some improvements in concrete workability and strength when the level of magnetization is well adjusted. However, there is a scarcity of data on the impact of water magnetization on concrete properties, particularly its durability and long-term properties. There are no data available either on the impact on concrete performance of storage of magnetized water before mixing. In this work, concrete mixtures were made with water-to-cementitious material ratios of 0.35 and 0.45 with and without admixtures. Water was incorporated at levels of magnetization of 0, 0.1, 0.2, 0.3, and 0.4 tesla. A set of concrete mixtures was made with freshly magnetized water, and another set of mixtures was made with magnetized water that was left in storage for 3 days. Testing included unit weight, air content, slump, slump retention, compressive strength, modulus of rupture, water permeability, rapid chloride permeability, chemical soundness, and abrasion resistance. Results reveal that magnetized water enhances concrete workability although the enhancement varies according to mix parameters. Some indications of improvements in concrete durability were also observed. Yet reduction in concrete mechanical properties was recorded in several mixtures. Care should be taken in selecting the magnetic field to ensure minimal negative impacts. A detailed assessment is needed to evaluate the feasibility of magnetized-water concrete, which may have merit, particularly for concrete mixing plants.

Saddam M. Ahmed et al (2008), Studied on Effect of Magnetic Water on Engineering Properties of Concrete. In this Report, Influence of magnetized water on compressive strength and workability (consistence) of concrete is also carried out. It is concluded that the compressive strength of concrete samples prepared with magnetized water increases 10-20% more than that of the tap water samples. Also increase in compressive strength of concrete is achieved when the magnetic strength of water is 1.2 Tesla, and velocity of water current that passes through magnetic field is of 0.71 m/s. Magnetized water improves the workability(consistency) of fresh concrete.

2.3 SUMMARY OF LITERATURE

From the literature, It is observed that the water passing through magnetic field reveals a higher pH value and decrease in the hardness of water. The use of magnetized water is found to improve compressive strength to a considerable extent without adding any admixtures. Also this increases workability without addition of super-plasticizers. It enhances the quality of concrete. Also the steel fibre usage in concrete to exhibit good mechanical properties of the concrete.

CHAPTER 3 METHODOLOGY AND MATERIALS



Flow chart for methodology and materials

3.1 PERMAG (NEODYNIUM 406)

- PERMAG is entirely made up of strong rare earth magnets calledNeodymium (N406).
- It is the instrument used to induce the high intense and focused magnetic field
- Its magnetic field intensity is 9000 gauss power.
- 10000 gauss power= 1 Tesla, therefore magnetic flux density of PERMAGN406 is 0.9 Tesla.
- It removes algae formation and prevents further growth of algae.
- It does not require electricity / batteries / chemicals.
- It requires no maintenance & replacement of parts.

Fig.3.1 PERMAG N406

3.2 CEMENT PROPERTIES

Cement is the important binding material in concrete. Pozzolana Portland cement is the common form of cement. It is basic ingredient of concrete, mortar and plaster. It consists of mixture of oxide of calcium, silicon and aluminum. Cement of various strengths is available. Depends on the requirement of concrete, it is to be chosen.The properties of cement were tested and their values are given in table 3.1

Table 3.1 Physical Properties of cement

Sl. No	Particulars	Test Results
1	Normal consistency	30%
2	Initial setting time	41min
3	Final setting time	8 hrs.
4	Specific gravity	3.12
5	Fineness of cement	3%

3.3 COARSE AGGREGATE

The materials which are retained on 4.75mm sieve are called coarse aggregate. The broken stone is generally used as a coarse aggregate. The nature of work decides the maximum size of the coarse aggregate. Locally available coarse aggregate having the maximum size of 20 mm was used in the present work. According to IS 383:1970 coarse aggregate maximum 20mm coarse aggregate is suitable for concrete work. But where there is no restriction 40mm or large size maybe permitted.

Table 3.2 Physical Properties of coarse aggregates

SI. No	Description	Test results
1	Specific Gravity	2.78
2	Water absorption	0.6%
3	Impact Strength	23.7%
4	Crushing strength	25.2%
5	Fineness modulus	6.98

3.4 FINE AGGREGATE

The fine aggregate conforming to zone -2 according to IS: 383 were used. The specific gravity of the sand used was 2.67. The sand obtained was sieved as per IS sieves (i.e. 4.75mm, 2.36 mm, 1.18 mm, 600µ, 300µ, and 150µ).

Table 3.3 Physical Properties of fine aggregates

SI.No	Description	Test results
1	Fineness Modulus	2.1
2	Specific Gravity	2.52
3	Water Absorption	1%

3.5 WATER SAMPLE

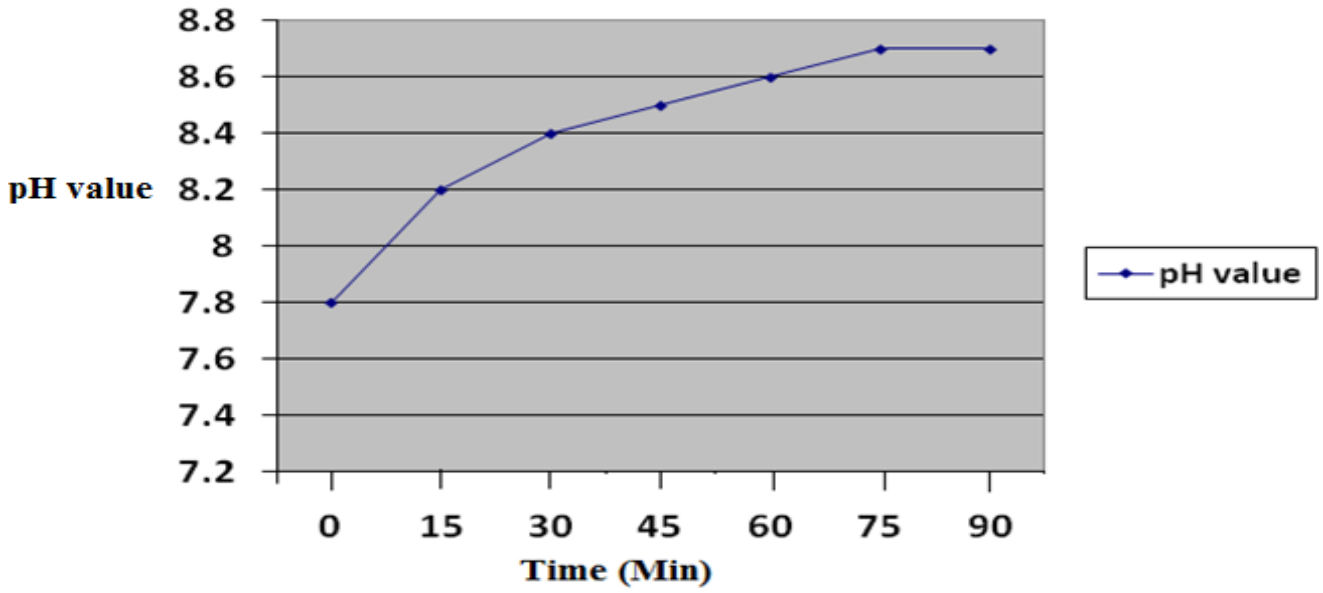
3.5.1 pH TEST

pH is the measure of activity of the hydrogen ion. The pH test is conducted for every fifteen minutes of recirculation. pH test is conducted for magnetically treated - recirculated water and normal tap water, the results are shownbelow.

Table No 3.4 Effect of pH value on Recirculation Time

Sl. No	Magnetic Water RecirculationTime (Min)	pH Value
	0	
2	15	8.2
3	30	8.4
4	45	8.5
5	60	8.6
6	75	8.7
7	90	8.7

Here the graph interprets the result, that increase in recirculating time will considerably increase the pH value, so the increase in Ph value will change the natureof water from acidic to basic which decreases the corrosion rate



ED WHEN WATER PASSING THROUGHPERMAG

3.5.2 HARDNESS TEST

Hardness was originally defined as the capacity of water to precipitate soap. Hard water forms scale, usually calcium carbonate, which causes a variety of problems. Water samples are also tested in laboratory for the hardness. Samples are taken at regular time intervals while passing through magnetic flux and are tested for their hardness. Hardness of water is found out by titrating the sample water against EDTA solution using ammonia as buffer solution and Ferrochrome Black Tea as indicator. The values observed are shown in Table 4.5. The same is also represented graphically in Fig.4.3 for better understanding of the behavior

Table 3.5 Hardness observed at regular interval

Sl.No	Magnetic Water	Hardness(Mg/Lit)
1	0	310
2	15	260
3	30	213
4	45	200
5	60	250

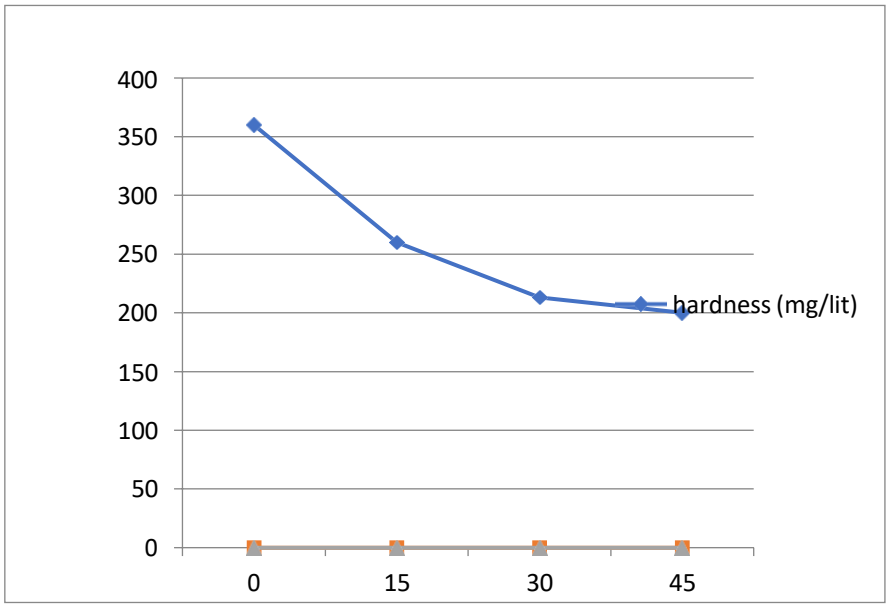


Fig 3.3 VARIATION OF WITH DURATION OF APPLIED MAGNETICFLUX

The above table shows variation of hardness (in mg/lit) with change in recirculation time. As the recirculating time increases hardness decreases, which shows that induction of magnetic flux in water changes the property of hardness.

3.6 STEEL FIBRES

Steel fiber with hooked ends is made using high-quality low-carbon steel wire. This kind of high-performance steel fiber, are with the characteristics of the high tensile strength, good toughness, low prices. The product is widely used in concrete strengthening.The physical properties of steel fibre used in present work are tabulated in Table 3.5

Table No 3.6 Physical properties of steel fibre

Sl.No	Characterstics	Properties
1	Specific gravity	7.8
2	Type	Crimpled end
3	Length	12.5mm
4	Diameter	1mm
5	Aspect ratio	45

3.7 MIX PROPORTIONS

Mix design is carried out as per provision of IS:10262 (1982). The details of mix design are presented in Appendix-A. The design is arrived at isgiven here.

- Water cement ratio - 0.45
- Mix ratios - 1 : 1.56 : 2.7
- Steel fibre - 1.5% (Volume of concrete)

3.8 MAGNETICALLY TREATED AND RECIRCULATED WATER SYSTEM SYSTEMATIC DESIGN

3.8.1 EXPERIMENTAL SETUP USING PERMAG

In this process the water is circulated for 40 minutes in the magnetic field using PERMAG to induce magnetic flux in the water. This Recirculated water is used for the casting of concrete specimens. The setup includes an autotransformer, 0.5HP general purpose motor and PERMAG. The autotransformer is used to reduce the supply voltage of the motor from 230V to low volt. This controls the flow of water in the setup. By this process the hardness in the water is reduced. The setup adopted for the magnetic treatment of water is shown in Fig.3.4

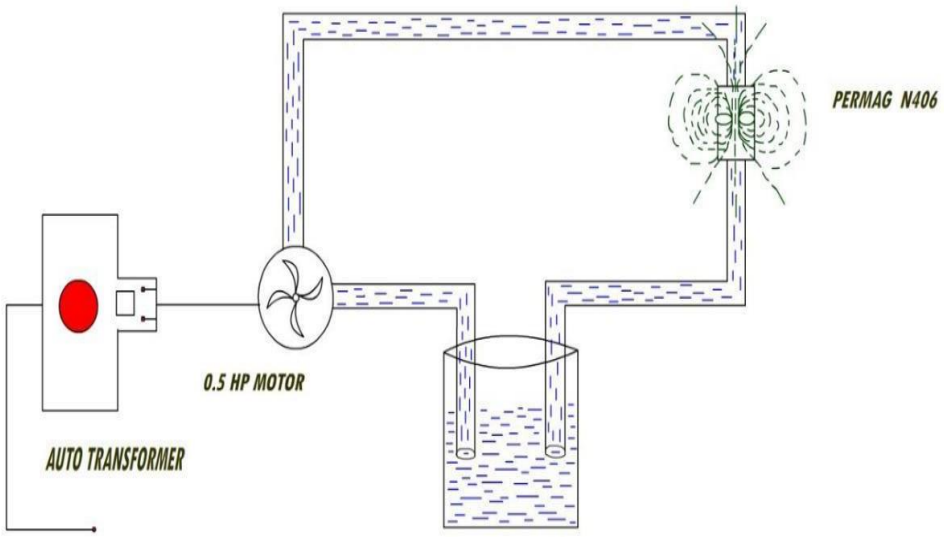


Fig.3.4 SCHEMATIC SETUP TO PRODUCE MAGNETIZED WATER

3.8.2 WORKING OF PERMAG

When the 'PERMAG' units are fitted on a pipeline, the water flowing through the pipe line is subjected to the intense, focused magnetic field. The strong magnetic field, affects the physical structure of the minerals, thereby altering their shape. The minerals continue to remain in the water, but now, the altered physical state prevents the minerals from exhibiting hardness, thus the water becomes soft. Water transforms from a liquid to ice, to a vapour state (and vice versa), thus exhibiting 3 distinct physical states, while it is still the same chemical. 'PERMAG' performs in a similar manner, by changing the physical state of the minerals, while maintaining their chemical state. These physically changed minerals do not stick to any surface but remain suspended in the water in an inactive state and thus exhibitthe soft nature of water.

3.8.3 DESCRIPTION OF THE SETUP

The Designed recirculation set up shown above consists of a motor (0.5 HP) which performs the action of lifting water from the container and the water is allowed to flow through the magnetic flux which is fixed around the pipe. This process of lifting water from the container and allowing it to flow through the magnetic flux is repeated for 40 minutes. By doing so the effect of flux induction will be more in water so that the hardness in water reduces more. Literature indicates that the flow velocity should be around 0.6-1.0 m/s and so the instrument named auto-transformer is used in the setup to reduce and maintain the flow velocity within the range specified.

3.9 EXPERIMENTAL STUDY

3.9.1 GENERAL

For experimental study, cubes are cast and test results are tabulated. Compressive strength tests are performed on cube samples. 8 No.of cubes are cast to study the Compressive Strength.

3.9.2 CUBE SPECIMEN

Cube of size 150×150×150 mm is used for making samples using conventional concrete and MW concrete specimens with and without addition of steel fibres.

3.9.3 TESTING OF SPECIMENS

Testing of specimens are done after 28 days of curing. Compression tests are performed on cube specimen.

3.9.4 COMPRESSION TEST

Concrete is primarily meant to withstand compressive stresses. Cubes of size 150 ×150×150 mm are used in the present work. The mould is applied with oil for lubrication. Concrete is laid in the mould in a layer up to some height and compacted with tamping rod for conventional concrete. In this way, the concrete is laid in three layers and the procedure is repeated. The next step is vibration on a vibrating machine. The above procedure is the same for all the mixes with different percentage of admixture replacement and without vibration. The cubes are cured for 14 and 28 days. After 14 and 28 days of curing, the cubes are tested in a Compression Testing Machine (CTM).

Compression Strength of concrete = Load applied on the Cube Specimen

Gross Area of the cube

Fig 3.5 COMPRESSION TEST ON CUBES

CHAPTER 4 RESULTS AND DISCUSSION

4.1 GENERAL

Test results of water sample, cubes are tabulated and discussed.

4.2 WATER SAMPLE RESULTS

The water sample tested indicates an increase in pH value. This reduction in acidic nature of water could be attributed to the reduction of corrosion reinforcement when magnetized water used in concrete. Also reduction in hardness of water is achieved when water is passed through the magnetic field. Hence the mechanical strength of concrete is increased by reduction of hardness and increase in pH value of water.

4.3 COMPRESSIVE STRENGTH RESULTS

Table 4.1 and 4.2 shows compressive strength of CC and MWC without and with addition of steel fibres respectively.

Table 4.1 Compressive strength of concrete without addition of steel fibres

DESCRIPTION	7 DAYS	14 DAYS	28 DAYS
CC	26.5N/mm^2	28.2 N/mm^2	30.1 N/mm^2
MWC	29.4 N/mm^2	31.2 N/mm^2	33.55 N/mm^2
% Increase	8.25	9.62	10.28

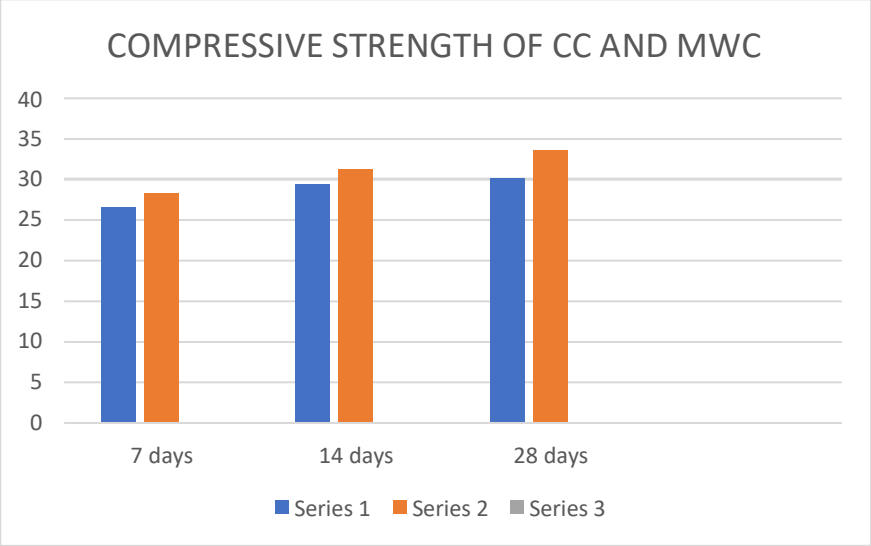


Fig. 4.1 COMPRESSIVE STRENGTH OF CC AND MWC

Table 4.2 Compressive strength of concrete with addition of 1.5% steel fibres

DESCRIPTION	7 DAYS	14 DAYS	28 DAYS
CC with 1.5% of steel fibre	32.75 N/mm^2	33.18 N/mm	33.65 N/mm^2
MWC with 1.5% of steel fibre	35 N/mm^2	36 N/mm^2	36.58 N/mm^2
% Increase	7.36	7.83	8.0

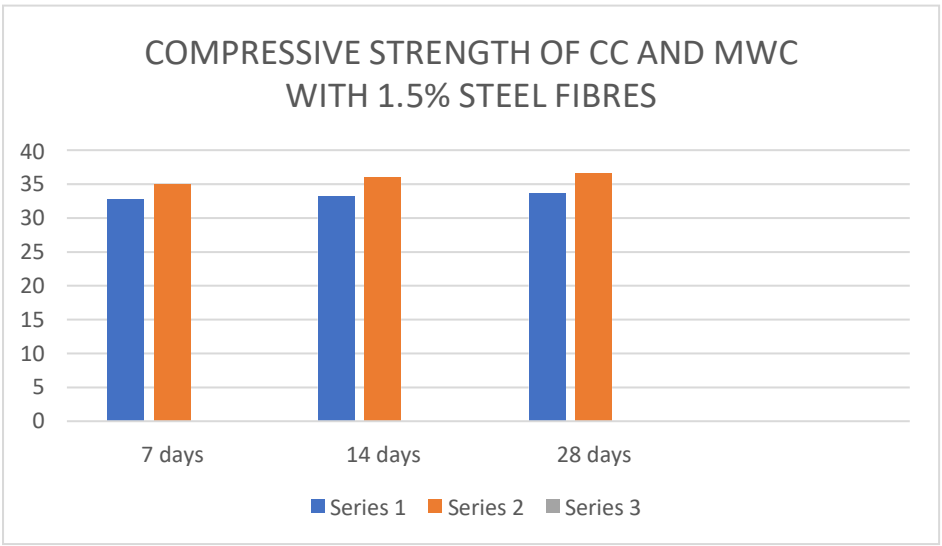


Fig. 4.2 COMPRESSIVE STRENGTH OF CC AND MWC WITH 1.5%STEEL FIBRE

4.4 PERFORMANCE COMPARED TO CONVENTIONAL CONCRETE

Table 4.3 Performance compared to conventional concrete in terms of %

DESCRIPTION	COMPRESSIVE STRENGTH
MWC	10.28
CC with 1.5% Steel fibre	10.55
MWC with 1.5% Steel fibre	17.7

CHAPTER 5 CONCLUSIONS

5.1 GENERAL

The usage of magnetized water results in increase in compressivestrength, of concrete when the power of magnet is about 9000 gauss power (0.9T).

5.2 CONCLUSIONS

Circulating the water through magnetic flux for 40 minutes, Increased Ph value of water from 7.8 to 8.7. The hardness of water is observed to reduce from 310 mg/lit to 200 mg/lit after 40 minutes of circulation through PERMAG. The use of magnetized water in concrete increases compressive strength.The use of steel fibres (1.5%) in conventional concrete and magnetized water concrete increases compressive strength.The compressive strength of MWC is increased by 10.30%, respectively when compared to conventional concrete. Addition of 1.5% steel fibres in CC gives an increase of 10.55% for the compressive strength respectively compared to CC. Addition of 1.5% steel fibres in MWC gives an increase of 17.7% for the compressive strength compared to CC.

APPENDIX AMIX DESIGN AS PER IS 10262:1982

Grade of concrete	: M25
Type of cement	: PPC 53 grade
Size of aggregate	: 20mm
Minimum cement content	: 320 kg/m^3
Maximum cement content	: 450 kg/m^3
Maximum water cement ratio	: 0.45
Exposure condition	: Moderate
Specific gravity of cement	: 3.12
Specific gravity of coarse aggregate	: 2.78
Specific gravity of Fine aggregate	: 2.52

Target strength

Fck = fck + 1.65s

From table 1 (IS 10262;1982) , s= 4 N/mm^2

=25 + 1.65 x 4

=31.6 N/mm^2

Selection of water cement ratio

From Table 5 of IS: 456-2000, maximum water cement ratio = 0.55 (Mildexposure) Based on an experience, a water cement ratio of 0.45 can be adopted.

Selection of Water content

From Table-2 (IS 10262; 1982) Maximum amount of water = 186 litresWater content =186+ 3/75 x 186

= 193 lit

Calculation of cement content

Cement content = 193 = 428 kg/m^3

0.45

428kg/m^3> 350 kg/m^3, Adopt 420 kg/m^3

Volume of Coarse aggregate and fine aggregate

a) Concrete = 1m^3

b) Volume of cement = [420/3.12] x [1/1000] = 0.138m^3

c) Volume of water = [193/1] x [1/1000] = 0.193 m^3

d) Volume of all in aggregate = a – (b + c)

= 1 – (0.138 + 0.193)

= 0.669 m^3

e) Volume of Coarse aggregate = 0.669 x 0.61 x 2.78 x 1000 = 1134 kg/m^3

f) Volume of fine aggregates = 0.669x 0.39x 2.51 x 1000

= 654 kg/m^3

MIX PROPORTIONS:-

Cement	: 420 Kg /m^3 .
Fine Aggregate	: 654 kg/ m^3 .
Coarse Aggregate	: 1134 kg/ m^3.
Water	: 193 litres.
Ratio	: 1:1.56:2.7

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