CHAPTER_1
INTRODUCTION

NEED FOR THE STUDY

The most important challenge for concrete technologists is to improve the properties of concrete. To increasing the compressive strength of concrete and to get more workable concrete at less water content are the aim of which the most researchers are looking for so they are using various methods such as

1. Use of fiber reinforcement
2. Use of fly ash
3. Use of epoxy polymer and polymer concrete.
4. Use of high range of water reducing super plasticizers etc.

The cost of these methods is not comparable with their advantages. So it is required to concentrate on producing economical concrete with higher strength. Water is an important ingredient of concrete as it actively participates in chemical reaction with cement. Since it helps to form strength giving cement gel, the quantity and quality of water is required to be studied. So there is a need to do the necessary research on modification of water to increase the strength and quality of concrete.

Concrete is a composite material that made up of aggregate, cement, and water. The role of aggregate is a filler material as it is chemically inert. Meanwhile, the mix of cement and water form the cement paste required to bind the aggregate together. Usually, tap water is recommended to produce concrete as it does not cause side reactions that may interfere with the hydration process. As a twenty percent by weight of cement, water is required for the hydration of the cement. Extra amount of water (from 15% to 20% by weight of cement) is required to provide space for the cement hydration products. The final water cement ratio is the most critical factor affects the production of durable and consistent concrete as high water cement ratio (w/c) severely reduces the concrete strength, while low water cement ratio (w/c) produces unworkable concrete.

Therefore, attempts have been made to increase the specific surface area of water and the effects of increased surface area are studied on the workability and

compressive strength of concrete. Magnetising the water is found to be helpful in increasing the specific surface area of water, thereby increasing the rate of hydration.

1.1 PROBLEM OVER THE WORLD

Water is basic need of human and other living things. It is also required for farming cleaning & industrial purpose. Water scarcity already affects every continent. Around 1.2 billion people, or almost one-fifth of the world's population, live in areas of physical scarcity, and 500 million people are approaching this situation . Another 1.6 billion people, or almost one quarter of the world's population, face economic water shortage. Water scarcity is among the main problems to be faced by many societies and the World in the XXI century. Water use has been growing at more than twice the rate of population increase in the last century, and, although there is no global water scarcity as such, an increasing number of regions are chronically short of water. Large water is required for construction activities. It is required to use available water effectively. Generally there are following main purposes which require large amount of water:

i. Domestic Purpose

ii. Farming Purpose

iii. Industrial Purpose

iv. Construction Purpose

So, economical water treatment is needed.

1.2. SCOPE OF MAGNETIZED WATER IN VARIOUS FIELDS.

1.2.1 Health benefits of magnetized water

Magnetized water reduces excess acidity and bile in the digestive system. It helps to regulate the movement of the bowels expelling all accumulations of poisonous matter. The use of magnetic water in treatment of urinary and kidney disorders like kidney stones have shown encouraging results. Magnetized water is also very beneficial for nervous disorders and treatment of blood pressure, especially low blood pressure. It gives a soothing and slightly sedative effect to the nerves, aids in clearing clogged arteries, and normalizes the circulatory system. Magnetized water is effective in the treatment of asthma, bronchitis, colds, coughs and certain types of fevers. Magnetized water has been used as an external aid for washing

swollen and sore eyes, wounds, eczema spots, etc. for quicker healing. In all types of eye infections, north pole magnetized water has healing and anti-biotic type properties.

1.2.2. PHYSICAL BENEFITS OF MAGNETIZED WATER:-

1.2.2.1. SALINITY

Magnetic treatment of saline irrigation water can be used as an effective method for soil desalinization. The application of a magnetic field on water decreases the hydration of salt ions and colloids, having a positive effect on salt solubility, accelerated coagulation and salt crystallization (Hilal and Hilal, 2000). Field experiments conducted in Egypt showed that, sandy loam soil pots irrigated with normal highly saline water of an electrical conductivity value of 8.2 mohs/cm retained salts compared to pots irrigated with magnetized saline water (Hilal and Hilal, 2000). The study showed that MW increased leaching of excess soluble salts, lowered soil alkalinity and dissolved slightly soluble salts (Hilal and Hilal, 2000).

1.2.2.2. pH

Joshi and Kamat (1966) and Busch et al. (1985) have observed pH changes with the application of a magnetic field to water. Parsons et al. (1997) confirmed a decrease in pH in a study using sodium hydroxide to stabilize pH at 8.5 then applying magnetic treatment to the solution. In this study, the magnetically treated water required up to 2.5 times more sodium hydroxide compared to the controls to stabilize pH. pH has been shown to decrease from 9.2 to 8.5 after magnetic treatment in a system with Ca(OH)2 (Ellingsen and Kristiansen, 1979), where the degree of the reduction was dependent on the strength of the magnetic treatment. Busch et al.(1985) showed an initial decrease in pH from 7.0 to 6.5, that was followed by an increase in pH with time from 7.5 – 8.0.

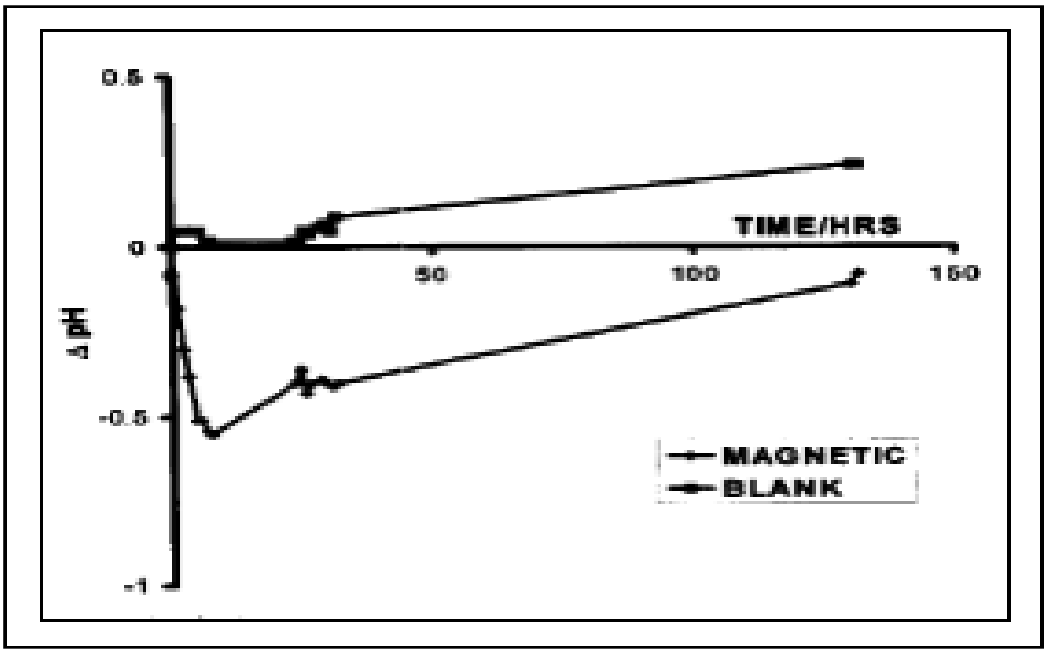


FIGURE 1.1 CHANGE IN pH VS. DURATION

1.2.2.3. SCALE REDUCTION

Magnetic treatment directly influences the carbonate equilibrium in water, leading to the formation of calcium carbonate (CaCO3) particles in solution that they cannot precipitate on pipe walls and other equipment. Particles are carried downstream in pipe flow and are later removed with filtration. Patented in 1945 (Vermeiren) MW can be used to prevent and remove scale and is currently common global use of MW. Mineralized coatings inside pipes and water containers have been found to reduce with the use of a magnetized water system (Lin and Yotvat, 1990). Barrett and Parsons (1998) attribute scale reduction to the effect of MW on CaCO3 particles by suppressing nucleation and accelerating crystal growth. The mechanics of how magnetic treatment interacts with calcium carbonate in solution is still unknown, and further investigation must be completed.

In Gehr et al. (1995), the precipitation of CaSO4 was investigated and found that magnetic treatment induced precipitation of gypsum crystals (CaSO4.2H2O). But also found that if magnetic treatment were to be an effective treatment for scale prevention it would most likely reduce precipitation on solid surfaces and encourage crystallization. Additionally,

Parsons et al. (1997) showed that solution pH is reduced by the introduction of a magnetic field, and that this change in pH directly affects scale growth.

Magnetic water treatment for the prevention of scale is accomplished by passing water through a strong magnet that is installed on or in a feed line. Then when the water is later heated, either in a heat exchanger or a boiler, it has lost its tendency to precipitation scale onto the hot surfaces and the deposits that do form have a looser texture that is easily removed (Herzog et al., 1989). Parsons et al. (1997) showed a 48% reduction in scale using MW, and Busch (1997) recorded a 22% reduction.

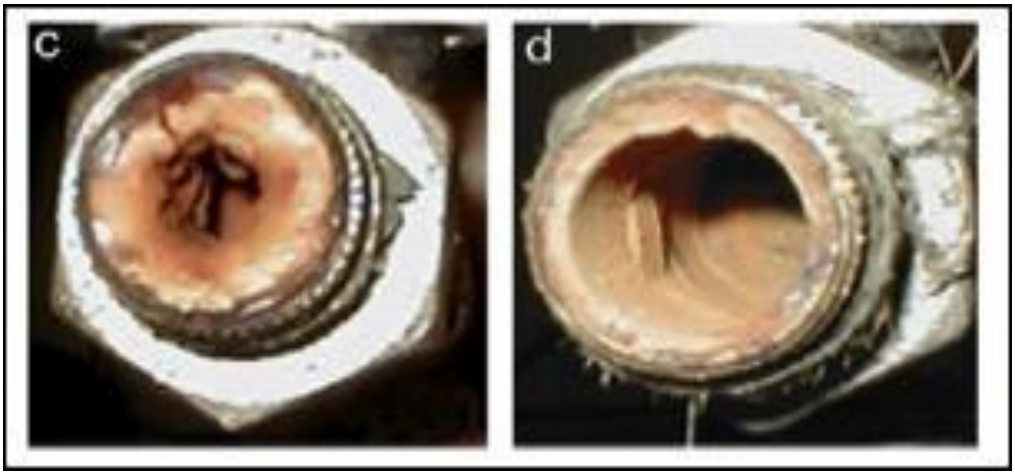


FIGURE 1.2. (C) STEEL PIPE WITH SCALE FROM UNTREATED WATER; (D) SIMILAR PIPE WITH LITTLE SCALE FROM MAGNETICALLY TREATED WATER.

Swimming pool water quality can be improved by the addition of a clamp on magnetic device on the circulation system. The magnetic device can prevent and remove scale build up at the water line in the pool and filtration system, and allow for chlorine levels to be reduced by one-half (Kronenberg, 1993). With an efficiency rating of 20-40%, clamp on magnetic treatment devices can remove old scale deposits and prevent the formation of new deposits (Kronenberg, 1993).

The U.S. Department of Energy reported that a thin film (1/32in) of scale in a heat exchange surface can increase energy consumption by 8.5%, and scale of up to 1/8in increases energy consumption by 25% (U.S. DOE, 1998). It was estimated that scale removal in Britain cost £ 1billion/year in the early 1990's (Smith, 2003). The installation of magnetic treatment

devices for water softening equipment for the removal or prevention of scale has been shown to generate significant energy savings, even with the initial capital to invest in the technology.

Magnetic water treatment creates additional collisions of ions that precipitate CaCO3, and it changes the free gas content in water that leads to improved crop yields. These mechanisms create many applications for the use of MW, with the use of MW having the potential to become more commonly used in the irrigation of crops, as drinking water for livestock and to prevent and remove scale build-up in hydrologic infrastructure. With many studies showing increases in crop yields and healthier animals as a direct result of using MW, the science behind magnetic treatment is still poorly understood. There are many scientific journal articles that have reported positive effects of using MW, but reported results often have low reproducibility and inconsistences. It's best for farmers to try the technology on their irrigation system and see the results based on their unique variables.

1.3 SOLUTION FOR THE PROBLEM

Positive effect of magnetically treated water is observed in various fields mentioned in topic number 1.2. Moreover the magnetic treatment of water proves to be an economical way to reduce hardness of large quantity of water as compared to the other methods that induce high investment in removal of hardness. So, it is decided to study the effect of magnetically treated water on concrete.

Besides the increase in compressive strength magnetic treatments is cheap and chemical-free, there are also other advantages of preparing concrete with magnetic water. First, it reduces the amount of cement used. Moreover, it does not require the addition of chemical admixture, thus avoiding environmental pollution, but there is little firm evidence of its effectiveness in domestic situations. Effective treatment has mainly been observed in industrial situations where there is constant cycling of water through the device .The treatment only claims to alter the effective hardness of water; no solutes (such as calcium or magnesium) are removed from the water by the process.

INTERNATIONAL REVIEW SUGGESTS THAT SOME POTENTIAL LIES IN THIS RESEARCH AREA.

i. As less research is found in this field in India, this will be the beginning of research in this field. Success of this project will lay a new path for research work in concrete technology.
ii. There will be tremendous scope for further research work in this field., Effect of magnetic water can be studied with change in water cement ratio, with admixtures, and adhesive, high strength concrete, high performance concrete, permeability, durability.
iii. In city like Dhule water available can be efficiently use for construction work.
iv. Strength of concrete can be increased with less cement and water will reduce cost of concrete and save natural resources.

1.4 OBJECTIVE OF DISSERTATION

1. The main objective is to improve the workability and strength of concrete by using magnetized water
2. To increase compressive strength and workability of the concrete without adding super plasticizer or chemical plasticizer.
3. To study the effects of magnetic treatment on properties of water.
4. To study the effect of pH and hardness of water on concrete.
5. The objective of this research is tried to achieve through the study the various literature survey and by performing the actual experiment.

1.5 SCOPE OF DISSERTATION

The scope of the research is limited to study of effect of magnetic treatment and normal water and curing process with the help of NW and MW.

A. Properties of Water

To find out the effect of magnetic treatment on properties of water the testing of water samples was done before & after the treatment. There are many properties which can be taken into account, but due to limitations of time the scope was limited to following tests:

i. Determination of hardness of water (TDS).

ii. Determination of pH of water.

B. Curing process of cubes and beam.

To find out the effect of NW curing and MW curing on properties of Concrete.

C. Properties of concrete.

1. Properties of Fresh Concrete

To find out the effect of magnetically treated water on workability of concrete only following two tests were taken into account.

i. Slump Cone Test

ii. Compacting Factor

2. Properties of Hardened Concrete

There are many tests to determine properties of hardened concrete e.g. Compressive Strength, Split Tensile Strength, Flexural Strength, Impact Strength and Fatigue Strength. But due to some limitations only following test was decided to be considered at the end of 7 day and 28 days.

i. Compressive strength of concrete.

ii. Flexural strength of beam.

CHAPTER_2

LITERATURE REVIEW

Prior to initiation of the test of the magnetic water treatment device, a complete literature search was done to identify key test parameters and operational constraints. There are many types of nonchemical water treatment devices which are widely accepted within the engineering community for being predictably effective in a given application and set of operating conditions. These devices include technologies such as filters, separators, de-aerators, reverse osmosis, cathode protection and electro-dialysis among others. These devices all perform in a predictable and reliable fashion under a given set of conditions. The principles on which they operate are well understood and can be easily explained, and their performance under a given set of circumstances can be accurately gauged before they are selected for a specific application. However, the same cannot be said about catalytic, electrostatic, electrolytic, electronic and magnetic water treatment devices. Many researchers are working on the effect of use of magnetic water and normal water in concrete. Many research papers have been published/ presented in National/ international conference/journals/proceeding. Some of them were studied and reviewed as follows.

2.1 RESEARCH DONE BY VARIOUS RESERCHES

2.2.1 H. Arabshahi [1] - This paper presents the Effect of Magnetic Water on Strength Parameters of Concrete. The water used for this experiment consist of drinkable water with two different states, ordinary and magnetic. The samples prepared had the same condition in construction materials, grading and kind of cement. The slump test and compressive test were conducted to determine strength parameters. This paper concluded that by using magnetic water plasticity of concrete increases. The results of slump experiments show that magnetic field has a considerable effect on clusters of water molecules which means water molecules scattered more from each other. This causes participation of water molecules in cement hydration reaction. So, cement particles are scattered inside concrete mix in form of complex of molecules and hydration reaction initially take place in surface of cement particles. Therefore, a soft layer of hydration reaction products forms on cement particles that prevents from penetration of water molecules to material bulk Concrete made by magnetic water, in

comparison with concrete made from plastic substances has several advantages such as its low expense, limitation of added substances, high durability of the machine without decrease in its magnetic energy. Also there is no need for repair, service or any other operations. The magnetic water used in this experiment increased the average compressive strength of samples by 23% more than that of samples made by ordinary water. The experimental results have also show the advantages of magnetic samples in concrete industry because of increase in plasticity, the efficiency and resistant in comparison with nonmagnetic samples.

2.2.2 Saddam Ahmed [2] - This paper presents the effect of Magnetic Water on Engineering Properties of Concrete. It is found that the magnetic treatment of water increased the ion solubility in the water and PH. It is found that the electrical charges on calcium carbonate particles were significantly affected by the application of a magnetic field. Further, the magnitude of the change in particle charge increased as the strength of the applied magnetic field increased. This can be explained by the fact that a more homogeneous lattice of new formations of hydrated Cement minerals is developed when mixed with magnetized water. Increased compressive strength of concrete by this process leads to an extra effect of saving cement, additives and thermal energy when magnetized water is used in concrete, for which compressive strength is vital. Even when compressive strength is the main factor for concrete, statistically relevant confirmation of increasing cement's plasticity when it is prepared using magnetic water. Plasticity levels depend on the qualities of cement glue and since magnetic treatment influences glue's qualities, then the level of concrete's plasticity changes, when using magnetic water for kneading of cement. this paper concluded about the strength of concrete prepared with magnetized water increased by 10 to 20 Percent, when the magnetic flux density was (1.2 Tesla). The use of magnetic water increased workability and strength; it's a good phenomenon, since conventional increase in workability by adding water leads to a decrease in strength of concrete. The velocity of water current about 0.71m/s and time treatment of 4.5 sec./litre are the best characteristic treatment of water which is more suitable for preparing fresh concrete.

2.2.3. Nan Su* [3] - This paper specifies the effect of magnetic water on the engineering properties of concrete containing granulated blast-furnace slag. Water content has a significant effect on engineering properties of concrete. When water flows through a magnetic field at a constant speed, it becomes magnetized and it is known as magnetic water.

Magnetization increases negative ionic hydration, thus intensifying the damaging effect on the water crystal structure with respect to concrete mixing. The mixing process involves passing the water through the magnetic field, followed by the addition of coarse and fine aggregates, cement, and GBFS. The operation is easy and has great potential for application in concrete pre-mixing plants and building construction. This paper concluded about the compressive strength of concrete with GBFS substitution is higher than that containing no GBFS. At the same age, this increase in compressive strength becomes more significant with increasing GBFS substitution percentage. Similarly, with the same amount of GBFS added, the increase in compressive strength will become more prominent with increasing age. The extent of increase is dependent on the magnetic field strength of water.

2.2.4 M.E. Botello-Zubiate [4] – This paper develops the interest on influence of magnetic water treatment on the calcium carbonate phase formation and the electrochemical corrosion behaviour of carbon steel. It is believed that magnetic water treatment decreases the hardness of water and avoids scale formation and that it is good health. Magnetic water treatment becomes an alternative to resolve the scale formation problem in pipes and hot-water systems. The efficiency of magnetic treatment is reported to last from tens of minutes to hundreds of hours, and reported that drawing water through a magnetic field increases the aragonite/calcite ratio in the deposit with a 99.9% probability level. As the normal water passes through strong magnetic field the scale forming calcite particles get breaks down to small needle shaped aragonite particle which do not cause hardness. This paper concludes that The research concludes that the normal water when treated under the influence of magnetic field causes less hardness as compare to hardness caused by normal water. This is because change in $CaCO_3$ particles state from calcite to aragonite.

CHAPTER_3

STUDY OF METHODS OF MAGNETIZATION AND MAGNETICALLY TREATED WATER

Non-chemical water treatment devices were first proposed as a means of scale control in 1865. In 1873, A.T. Hay received the first US patent for a water treatment device that employed a magnetic field [9]. Today, many of these devices are commercially available. Some employ one magnet, some two or more. In some, the magnet is located inside the pipe through which the treated water flows; in others the magnet is placed outside of the pipe. Although the variety of devices on the market may seem nearly infinite, most can be classified into four basic types.

3.1 HISTORY OF MAGNETISED WATER

According to Brower (2005), case histories of the success of magnetically treated water date back to 1803. The magnetic effect was first recorded when there was a notable difference in the texture of the mineral accumulation inside of soup and laundry kettles [8]. These kettles were placed over fires and large stones were placed in the bottom to keep them from swinging in the windy weather. Reportedly, two of the five kettles, which were all made from the same cast iron metal, did not have hard scale formation. Instead, they had a soft, powdery substance which was brushed off easily.

It was later found that the two of the five rocks used to stabilize the kettles in the wind were lodestones which are natural magnetic rocks. According to the Marshutz et al (1996) Michael Faraday was the first researcher who seriously dug into magneto chemistry beginning in 1863 [10]. From 1890 and onwards, the subject of magnetically treating water had become extremely controversial, and was labelled "gadgetry" and "not sustainable under scientific scrutiny". A company called Solavite, based in France, began to market a MTD in 1936. In the Eastern Bloc Countries, particularly Russia, increased research and applications of MTDs began after the Second World War.

This was largely due to the fact that the U.S.S.R did not have the chemical expertise or funding to treat their water chemically like that in the U.S.A. (Lobley, 1990) Marshutz(1996) reports that in 1954 the Federal Trade Commission filed a complaint against the Evis Manufacturing Company, which manufactured an early magnetic water conditioner

. They charged the company with unfair competition and false advertising by its competitors. Following extensive hearings, the complaint was dismissed two years later. Experiments and studies in the west increased after numerous successful applications of MTDs came out of the U.S.S.R. By the 1990's, many credible institutions were researching the topic with mixed results. Today, there are numerous varieties of MTDs for sale, ranging from $100 up to $10000. The controversial debate over the effectiveness of magnetised water is still undecided.

There have been many successful industrial applications of MTDs in the west, including systems for NASA, yet the treatment has not been released mainstream or accepted by the Water Quality Association (Federal Technology Alert, 1996). "If you look at the publications and split them down the middle, you would find that anything written outside of the U.S. generally favours magnetic water treatment, while anything you read on the subject written inside the U.S. tends to be questionable," explains Donald McClellan of MC2 Resource Management, a distributor for the Descal-A-Matic Corp as cited in (Marshutz,1996).

3.2 GENERATION MAGNETIC FIELD IN MAGNETIC WATER CONDITIONER (MWC)

3.2.1 MAGNETIC WATER CONDITIONER

Magnetic Water Conditioner is a device is a device which is used to treat water under the influence of magnetic field. The MWC device used in this experimental investigation was made up of two parts as follows

i. Permanent Magnet Instrument

ii. Electromagnetic Instrument

The two parts are attached in series to each other the functions of each parts are as explained below

i. Permanent Magnet Instrument

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 [8]. 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 [6]. Thus, all permanent magnets are composed of ferromagnetic materials. The most commonly used ferromagnetic elements are iron, cobalt, and nickel.

In this instrument, an arrangement was made such that water can be recirculated which is used for casting and curing process. a high power bar magnet that can produce the magnetic field of around 12000 Gauss was used. This high power magnet is fitted in cylindrical pipe with half inches diameter inlet and outlet facility.

ii. Electromagnetic Instrument

The electromagnet 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.

The machine simply works based on the electromagnetic induction principle which was introduced by Michael Faraday in 1832. This law states that when a AC current pass through a long straight conductor a magnetising force, H and a static magnetic field, B is developed around the wire. If the wire is then wound into a coil, the magnetic field is greatly intensified producing a static magnetic field around itself forming the shape of a bar magnet giving a distinct North and South pole. The magnetic flux developed around the coil being proportional to the amount of current flowing in the coils windings as shown. If additional layers of wire are wound upon the same coil with the same current flowing, the static magnetic field strength will be increased and therefore, the magnetic field strength of a coil is determined by the ampere turns of the coil with the more turns of wire within the coil the greater will be the strength of the static magnetic field around it. Figure 3.2.1, shows the line of magnetic fields which is generated from the coil.

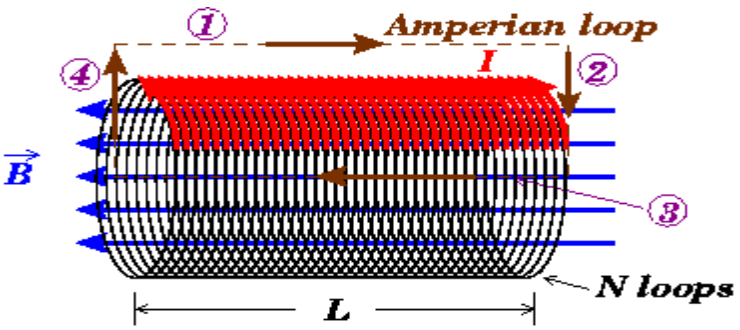


FIGURE 3.1 MAGNETIC FIELD GENERATOR

The line inside the coil is distributed uniformly and this refers to uniform field, thus each. The line inside the coil is distributed uniformly and this refers to uniform field, thus each field between rolls of the coil ignores others and the field out of the coil is so weak and not uniform, the increase in the length of coil leads to much more uniform magnetic field inside the coil. The identified coil is obtained when the rolls are closed with each other's and the length of the coil is much more than its radius, in this case the outer magnetic field will be so weak compared with the magnetic field inside the coil.

The Ampere's formula used to find the magnetic field inside the coil is as follows:

β = (μ N x I) / L

Where:

β: magnetic field, measured in tesla.

μ: magnetic constant (known as the permeability of vacuum) has the exact value {4π*10-7N/A2, (Newton per ampere squared, or in henrys per meter) in SI units}.

N: total number of rolls in coil (non dimensional).

I: current in wire, measured in amperes

L: length of the coil, measured in meter.

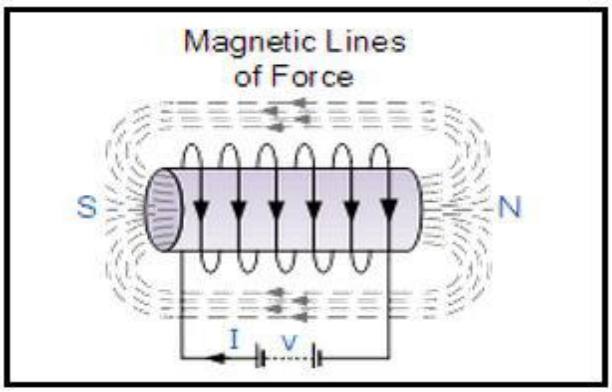


FIGURE 3.2 ELECTROMAGNETIC INDUCTIONS THROUGH AIR-CORE HOLLOW COIL

3.3 PRINCIPLE OF MAGNETIZED WATER

Natural water contains micro and macro particles of organic and inorganic natures along with different ions, zoo- and phytoplankton, and micro bubbles (Bogatin et al., 1999). Magnetic treatment of water is based on the principle of "magneto hydrodynamics", where; electrical energy is added to charged particles in water that contains ions and small solid particles with electrostatic charges by a magnetic field. The energy is produced by the momentum of the particles and remains attached to the particles as surface energy (Gehr et al., 1995).

Magnetic treatment works on the principle that as water passes through a magnetic device a Lorentz force is exerted on each ion which is in the opposite direction of each other. The redirection of the particles increases the frequency of collisions between ions of opposite sides, combining to form a mineral precipitate or insoluble compound (Gholizadeh et al., 2008). Calcium carbonate precipitates out of solution as a sludge and can be easily removed from the system since it will not adhere to pipe walls

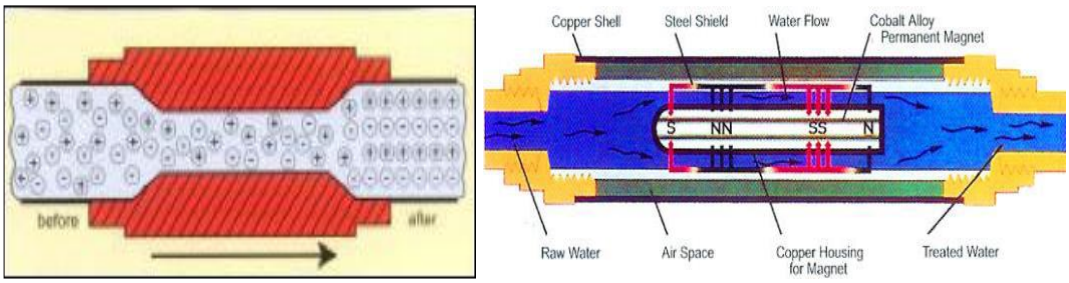


FIGURE 3.3 CONFIGURATION OF IONIC PARTICLES IN A MAGNETIC CONDITIONER

The application of a magnetic field to natural water can enhance degassing by 25-30%, caused by local dehydration of surface micro bubble films and a decrease in pressure in the

centre of vortices resulting in an increase in free gas bubbles that can then be released into the open air (Bogatin et al., 1999). This degassing increases permeability in soil, resulting in an increase in irrigation efficiency.

When a magnetic field is applied to water the molecular structure becomes more stable and the ability to form hydrogen bonds is enhanced. Magnetizing water can increase the number of hydrogen bonds by 0.34% (Chang & Weng, 2006). In the same study, the researchers verified results of decreased surface tension and increased viscosity with the application of a magnetic field on water.

Applying a magnetic field to natural water causes a redistribution of flow energy because of a momentum change of charged particles. All the particles and ions are electrically charged such that when magnetic fields are introduced convection and induced currents cause the liquid to spin. This movement then effects changes in gas content and the amount of salt crystallization centres in the water (Sherkliff, 1965). The quick change of the magnetic field in a properly designed magnetic apparatus loosens hydrate layers and films in a moving liquid, thus enabling coagulation and coalescence (Bogatin et al., 1999). McMahon (2009) summarizes that in order for water to be properly treated magnets should have a strength reading of approximately 3000 Gauss, the solution should be passed through the device more than three times, that all piping should be steel, copper or PVC II and the orientation of the magnets should be alternating.

3.4 MAGNETIZATION OF WATER & EFFECT OF MAGNETIC TREATMENT ON WATER MOLECULES

Magnetic water or liquids can be made in several ways. Water can be magnetized as it moves through the water pipe or by applying a magnet to a container of liquid. If water is treated while moving through the pipe it will be fully magnetized as it comes out of the pipe. If a large container of still water is treated with magnets it will require several hours to become full magnetize. As the whole layers of water or all the molecules of water require time to come in contact with magnetic field.

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. Proposed magnetic field effect on hydrogen bonds between water molecules and found some exchange which happened in the properties of water such as light absorption, surface tension and pH.

The activation of water treatment using magnetic field depends on three conditions.

1. Magnetic flux density.
2. Duration of exposing water to magnetized field (velocity of water current).
3. The amount of exposing water to the field.

3.4.4 CHEMICAL MOLECULE FIGURE OF MAGNETIC WATER:

A substance is said to be magnetized when its constituent molecules or structural elements can be aligned in a definite direction by the influence of an external magnetic field. In a liquid or in a gas, this can only happen to molecules that possess an odd number of electrons. Water, H2O, contains 10 electrons, so it is not attracted to or oriented by a magnet. In fact, water is diamagnetic; it is actually repelled by a magnet, although so weakly that sensitive instrument is needed to observe this effect. Figure.3.4.1 (A) shows structural group of water molecules. Figure.3.4.1 (B) shows water molecules which consist of one oxygen molecule and two hydrogen molecules bonded as an isolated triangle with its upper angle is 105º.

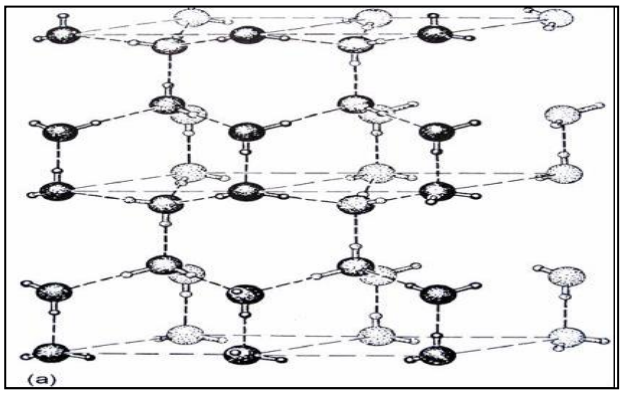


FIGURE 3.4. (A) STRUCTURAL GROUPS OF WATER

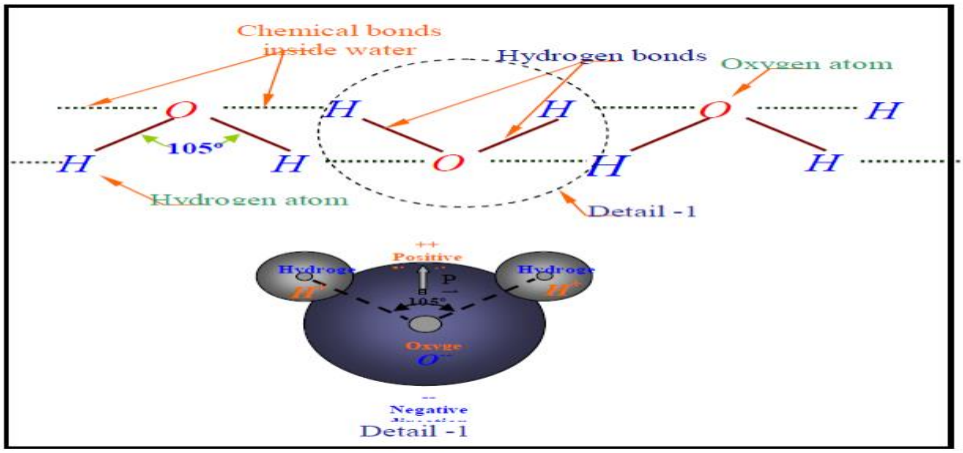


FIGURE 3.4. (B) WATER MOLECULE

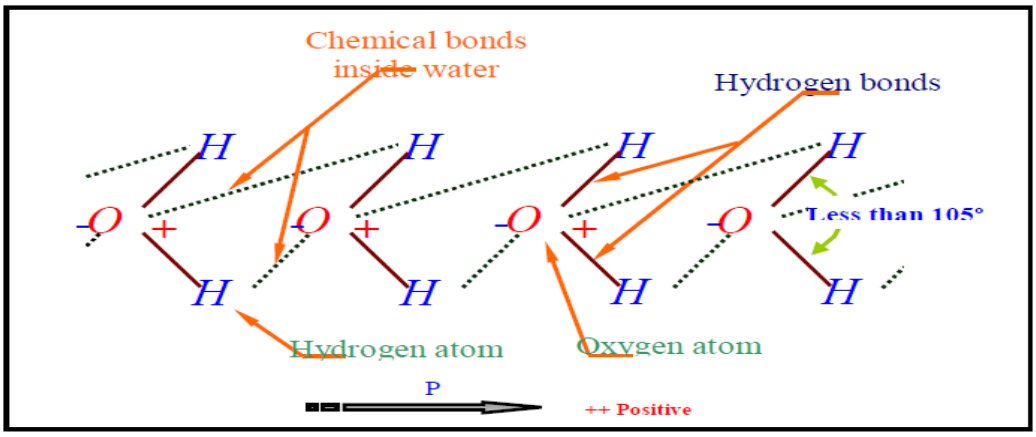


FIGURE:-3.4. (C) DIRECTIONAL ARRANGEMENT OF WATER MOLECULE UNDER EFFECT OF MAGNETIC FIELD.

Generally, when water is subjected to a magnetic field, the water molecules will arrange in one direction as shown in Figure.3.4.1 (c) This mode of arrangement is caused by relaxation bonds, and then the bond angle decreases to less than 105º, leading to a decrease in the consolidation degree between water molecules, and increase in size of molecules. For these reasons, the viscosity of magnetic water is less than viscosity of normal water. This change in water molecules composite causes a change in permeability pressure, surface tension, pH and electric conduction.

3.5 REACTIONS AND MECHANISMS

Magnetization leads to reduced adsorption of active e surface substances at the interface between water and cement. This in turn affects the hydration process and the hardening of cement. In the mixing of water and cement, hydration reaction will first take place on the surface of the cement particles. A thin layer of hydration products is thus formed on the cement particles, which hinders further hydration of the cement particles, thus preventing the development of mechanical strength of the concrete. However, if magnetic water is used instead, water molecules can easily penetrate into the cement particles, allowing a more complete hydration process to occur and enhancing the compressive strength of concrete.

CHAPTER_4

METHODOLOGY OF PROJECT

A mix of concrete is designed using locally available materials. All required material including cement, coarse aggregates and fine aggregates as per IS code specifications.

STEP 1:**Test on Materials**

In this step testing of cement sample and coarse and fine aggregate are carried out.

The following test are carried on cement sample-

i) Fineness test

ii) Standard consistency test

iii) Initial setting time test

iv) Final setting time test

v) Compressive test

The following test are carried on coarse and fine aggregate sample-

i) Fineness modulus test

ii) Specific gravity test

iii) Water absorption test

STEP 2: Testing of properties of water

iv) Determination of pH of tap water and magnetic water.

v) Determination of hardness of magnetic water and tap water.

STEP 3: Mix Design Calculation

Mix design is carried out by using Indian Standard method.

STEP 4: Casting and curing plan for project

Casting of cubes to be done with M25 grade of concrete and to compare the effect of magnetic water, this grade of concrete cubes and beams are to be prepared by both Normal (portable) water and magnetized water. Total 24 cubes and 24 beams need to be casted of nominal size as per IS code method. The prime aim of this experimental work is to study the effect of study the effect of normal water and magnetic water casting and its strength appraisal without adding any admixtures in the concrete.

TABLE 4.1 CASTING PLAN FOR PROJECT

Mix designation: M25 Cubes and beam

		NORMAL WATER CASTING	MAGNETIC WATER CASTING

SR NO	AGE OF DAYS	NORMAL WATER CONCRETE CURING	MAGNETIC WATER CONCRETE CURING	NORMAL WATER CONCRETE CURING	MAGNETIC WATER CONCRETE
1	7	3	3	3	3
2	28	3	3	3	3

Total 48 test specimens are to be casted and tested

STEP 5: Testing of cube and beam specimen

Compressive strength and Flexural strength of Concrete by NW and MW

STEP 6: Result and Graphical Analysis

STEP 7: Conclusion

CHAPTER_5

EXPERIMENTAL INVESTIGATION

5.1 THE MATERIALS AND METHODS IN MAKING CONCRETE MIXES ALONG WITH THEIR VARIOUS PROPERTIES HAVE BEEN LISTED BELOW.

The IS 456:2000 recommends the minimum strength of concrete to be used in civil construction is M 25 and the nominal mix ratio suggested is 1:1:2 with a target mean strength mean compressive strength of 31.6 N/mm2.This paper focuses on use of magnetic water in mixing and curing of M 25 grade concrete.

5.1.1 Cement –

Strength development of concrete will depend on both cement characteristic and cement content. The choice of Portland cement for MWC is extremely important. 43-Grade ordinary Portland cement is used for this study.

5.1.2 Water and water-cement ratio

The single most important variable in achieving MWC is the water-cement ratio. MWC produced by conventional mixing technologies are usually prepared with water-cement ratios in the range of 0.4 to 0.6 , and their 28 days compressive strength is about 20 to 40 MPa. The water cement ratio used in this project is 0.5.

5.1.3 Aggregates

Maximum size of coarse aggregate is 20mm used for this study and natural sand of river bed is used confirming to grading zone II of Table 4 of IS 383 were procured from Maharashtra.

5.2 PRELIMINARY TESTING

In the preliminary testing includes Fineness modulus of coarse and fine aggregate, specific gravity of coarse and fine aggregate and Water absorption test of coarse and fine aggregate

.

5.2.1 Fineness Modulus of Fine Aggregate

The fineness modulus represents the massed average size of the sieve on which the material retained the finest aggregate. The fineness modulus means the sum of the cumulative percentage mass which is retained on the sieves specified by IS Method.

Table 5.1 Results of sieve analysis (Fine aggregate)

Sr. No.	Sieve size (mm)	Weight Retained in gm	% of wt. Retained	Cumulative % Retained	% passing
1	4.75	34	3.4	3.4	96.6
2	2.36	84	8.4	11.8	88.2
3	1.18	200	20	31.8	68.2
4	600 µ	308	30.8	62.6	37.4
5	300 µ	264	26.4	89	11
6	150 µ	87	8.7	97.7	2.3
7	Pan	14	-	-	
	Total	1000		296.3	
Fineness Modulus =				2.96	

5.2.2 Fineness Modulus of Coarse Aggregate

Table 5.2 Results of sieve analysis (Coarse aggregate)

Sr. No.	Sieve size (mm)	Weight retained in gm	% of wt. Retained	Cumulative % Retained	% Passing
1	40	-	-	-	-

2	20	1780	35.6	35.6	64.4
3	10	3215	64.3	99.1	9
4	4.75	5	0.1	100	
5	Total	5000			
Fineness Modulus =				7.40	

5.2.3 Specific Gravity of Fine Aggregate

The specific gravity of an aggregate gives valuable information on its quality and properties. The higher the specific gravity of an aggregate, the harder and stronger it will be.

5.2.3.1 Specific gravity of sand by Pycnometer method

The Pycnometer method can be used for determination of the specific gravity of solid particles of both fine grained and coarse grained soils. The specific gravity of solids is determined using the relation:

Where

M1 = Mass of Empty Pycnometer,

M2 = Mass of the Pycnometer With Dry Soil

M 3= Mass of the Pycnometer And Soil And Water,

M4 = Mass of Pycnometer Filled With Water Only

G= Specific Gravity of Solids.

Fig 5.3.4. Pycnometer bottle

Table 5.3 Results of Specific Gravity (Fine aggregate)

Sr. No.	Particulatars	Test I	Test II	Test III
		Mass in Kg		
1	Mass of empty dry bottle (M1)	0.640	0.634	0.634
2	Mass of bottle + Dry sand (M2)	1.578	1.442	1.600
3	Mass of bottle + Dry sand + Water (M3)	2.266	2.154	2.210
4	Mass of bottle + Water (M4)	1.660	1.658	1.682
5	Specific gravity (G)	2.82	2.58	2.39
6	Avg Specific gravity (G)	2.60		

Average specific gravity =2.60

5.2.3.2 Specific gravity of coarse aggregate by density basket method

5.2.3.2.1 Equipments

- A balance or scale of capacity not less than 3 kg, readable and accurate to 0.5 g and of such a type and shape as to permit the basket containing the sample to be suspended from the beam and the weighed in water.
- A well ventilated oven thermostatically controlled to maintain a temperature of 100 ^{0}C to 110 ^{0}C.
- A wire basket of not more than 6.3 mm mesh or a perforated container of convenient size.
- A stout water tight container of convenient size.
- Two dry soft absorbent cloths each not less than 75×45 cm
- A shallow tray of area no less than 650 cm2
- An air tight container of capacity similar to that of the basket

Fig 5.2.3.2 Density basket

5.3.5.2 Procedure

- Take 2 kg of aggregate. Sample larger than 10mm
- Wash the sample thoroughly to remove finer particle and dust.
- Place the sample in a wire basket and immerse it in distilled water at a temperature between 22 ^{0}C and 32 ^{0}C with a cover of at least 5 cm of water above the top of the basket.
- Remove the entrapped air by lifting the basket containing the sample 25 mm above the base of the tank and allowing it to drop per second, care being taken to see that the sample is completely immersed in water during the operation.
- With the sample in water at a temperature of 22 ^{0}C-32 ^{0}C (W1).
- Remove the basket and aggregate from water and allow to drain for a few minutes.
- Empty the aggregate from the basket to a shallow tray.
- Immerse the empty basket in water jolt 25 times and then the weight in water (W2).
- Place the aggregates in oven at a temperature of 100 ^{0}C to 110 ^{0}C for 24+-0.5 hours.
- Remove it from the oven and cool it and find the weight. (W3)

5.3.5.3 Calculations

$$\text{Apparent Specific Gravity} = \frac{\text{Weight of a substance}}{\text{weight of an equal volume of water}}$$

$$= \frac{W3}{(W3-(W1-W2))}$$

Specific gravity of given coarse aggregate = 2.84

5.2.4. WATER ABSORRPTION TEST

Water absorption test for coarse aggregate, fine aggregate(sand).

Results of water absorption

Particulates (gms)	Aggregates	Sand
Wet wt.(w1)	2.800	0.585
Dry weight	2.00	0.581
Water absorption= {(W1-W2)/W2}	0.40%	0.54%

5.3. TEST PERFORMED ON WATER

5.3.1 TDS Meter:

A TDS Meter is a device which indicates the Total Dissolved Solids (TDS) of a solution, i.e. the concentration of dissolved solids in it. Since dissolved ionized solids such as salts and minerals increase the conductivity of a solution, a TDS meter measures the conductivity of the solution and estimates the TDS from that.

As the per the scope of the project have used water which was locally available at construction site with TDS of 450. Portable Handheld TDS Meter (HM Digital) was purchased in order to measure the TDS concentration of water on the site itself.

FIGURE 5.1 HM DIGITAL PORTABLE HANDHELD TDS METER SHOWING READING OF 441 PPM

5.3.2 LABORATORY TEST ON WATER SAMPLE

The water samples which were obtained from the construction sites were tested for their physical & chemical properties. A Potable water sample of TDS 450 was used for the project. This water samples were then treated with the help of MTD for the duration of two hours. To calculate the change in quality & properties of water after magnetic treatment.

1. Determination of Hardness of Water
2. Determination of pH of Water

5.3.2.1 DETERMINATION OF HARDNESS OF WATER SAMPLES

Test procedure is in accordance to IS: 3025 (Part 22) - Reaffirmed 2002

5.3.2.1.1 Introduction

Water that has high mineral content is known as hard water. Hard water contains bicarbonate, chlorides and sulphates of calcium and magnesium.

When treated hard water with soap, it gets precipitated in the form of insoluble salts of calcium and magnesium. Hardness of water is a measure of the total concentration of the calcium and magnesium ions expressed as calcium carbonate

FIG 5.2 DETERMINATION OF HARDNESS OF WATER (TITRATION WITH EDTA) (A) ONGOING TITRATION (B) TITRATION APPARATUS

FIG 5.3 (A) CHEMICALS USED IN THE PROCESS OF TITRATION (B) TITRATION END POINT

5.3.2.1.2. Chemicals used:

1. EDTA
2. EBT (Indicator)
3. Hardness Buffer

4.8.1.3. Procedure: Part I

1. Fill the burette with EDTA solution of known normality
2. Take 25ml of distilled water in conical flask
3. Add 5 mg of buffer
4. Add 2-3 drops of EBT Indicator
5. Titrate with EDTA Solution in burette
6. Measure volume of EDTA consumed i.e. X ml
7. End Point: Red Wine to Blue

Part II

1. Fill the burette with EDTA solution of known normality
2. Take 25 ml of water sample in conical flask
3. Add 5 mg of buffer
4. Add 2-3 drops of EBT Indicator

5. Titrate with EDTA Solution in burette
6. Measure volume of EDTA consumed i.e. Y ml
7. End Point: Red Wine to Blue

5.3.2.1.3 Observation & Results:

Table 5.4 Observation and results of hardness of water

water Sample	Normal Water			Magnetically Treated Water			decrease in Hardness
	X Ml	Y ml	TDS mg/lit	X ml	Y ml	TDS mg/lit	Percent (%)
TDS 450	0.6	27.32	326	0.9	23.9	280	16.42%

5.3.2.1.4 Calculations:

Hardness in mg/l as CaCO3= $\frac{(X-Y)x50xNx1000}{\text{Volume of Water sample}}$

Where, X= Consumption of EDTA for Distilled water sample

Y= Consumption of EDTA for water sample

N= Normality of EDTA Solution i.e. 6.10x10-3N

50= Equivalent weight of CaCO3

Sample Calculations:

Hardness in mg/l as CaCO3 = $\frac{(X-Y)x50xNx1000}{\text{Volume of Water sample}}$

$= \frac{(27.3-0.6)x50x6.1x(10-3)x1000}{25}$

= 326 mg/lit.

5.3.2.1.4 Conclusion:

Magnetic treatment on water reduces the hardness of water by 16.42 %.

5.3.2.2 DETERMINATION OF PH OF WATER SAMPLES

Test procedure is in accordance to IS: 3025 (Part 11) - Reaffirmed 2002

5.3.2.2.1 Introduction

The term pH refers to the measure of hydrogen ion concentration in a solution and defined as the negative log of H+ ions concentration in water and wastewater. The values of pH 0 to a little less than 7 are termed as acidic and the values of pH a little above 7 to 14 are termed as basic. When the concentration of H+ and OH– ions are equal then it is termed as neutral pH.

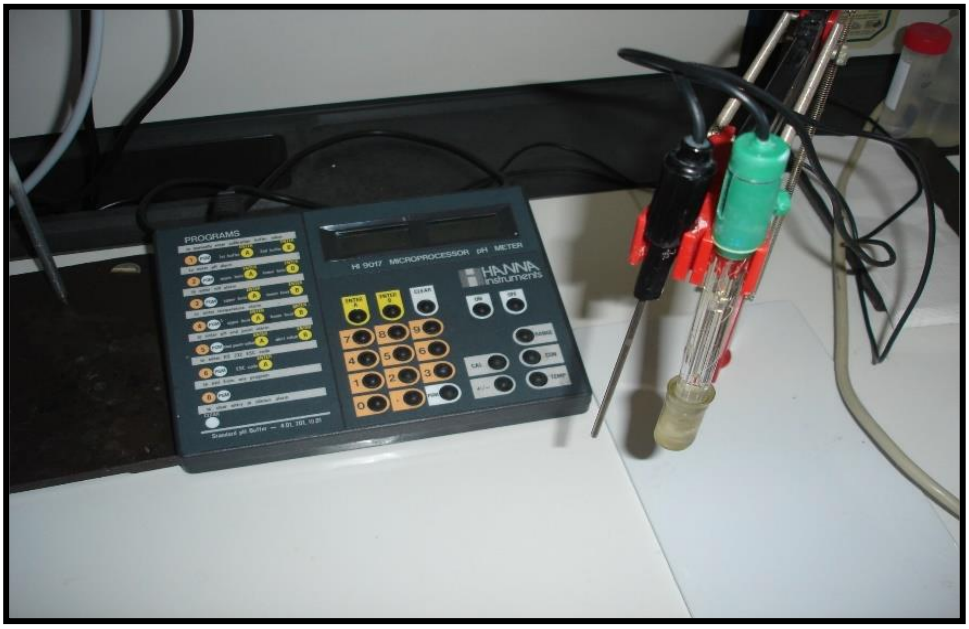


FIGURE 5.4 PH METER APPARATUS

5.3.2.2.2 Apparatus Required

1. pH meter
2. Standard flasks
3. Magnetic Stirrer
4. Funnel
5. Beaker
6. Buffers Solutions of pH 7.0
7. Distilled Water

5.3.2.2.3 Procedure:

1. Take 100 ml of Buffer solution in the beaker
2. Wash the sensor of the instrument with distilled water
3. Dip the sensor of the pH meter in the beaker
4. Using the buffer solutions calibrate the instrument to pH 7.
5. Now place the electrode in the beaker containing the water sample and check for the reading in the pH meter. Wait until you get a stable reading
6. Note down the reading as the pH of the sample.

5.3.2.2.4 Observations & Results:

TABLE 5.5 OBSERVATION OF pH OF WATER

Water Sample	Temperature °°C	Normal Water	Magnetically Treated Water	Increase in pH Percent (%)
TDS 450	27	7.39	8.06	9.06 %

5.3.2.2.5 Conclusion:

Magnetic treatment on water increases the pH of water by 9.06%.

5.4 SETTING UP OF INSTRUMENT

The preparation of magnetized water was the main aim behind setting up of instrument. It took a lots of efforts to find out the way to magnetize the water. I have gone through several research papers related to magnetization of water and came to the conclusion that water is diamagnetic substance but when water comes under the influence of high magnetic field of strength around 12000 gauss, it can be magnetized. Thus it was decided to recirculate the water used for casting and curing through magnetic field for 2 hour each day with discharge rate of 900lt/hr until concrete samples have achieved sufficient strength for curing period of 28 days.

In this regard I also took help from various industrialist people to find the most economical way to prepare magnetic water. And at last Mr. Girish Chandane of M/S Autofill Systems- Kharghar, Navi Mumbai helped me to design the machine as per the requirement. He has designed two instruments for the experiment work. The detailed specifications of machines that have been used for experimental work are given in chapter 3, section 3.2.

5.5 PREPARATION OF MAGNETIC WATER

For the preparation of magnetic water the instrument was set up as shown if figure fitted the inlet of electromagnet instrument is attached to the outlet of water pump and the outlet of electromagnet to the inlet of permanent magnet instrument. Both the magnets are attached in series to each other as per the manual. The inlet of water motor and outlet of permanent magnet instrument is made to receive and collect water in the same water tank respectively. This process of recirculation of water through magnetic instrument was done for the minimum duration of 2 hour with a discharge of 900 Lt/hr at a guass of 12000. each day. The magnetic water prepared for curing purpose was also used at the time of preparation of concrete mix.

Fig 5.5 PREPARATION METHOD OF MAGNETIC WATER

5.6. Mix Design Calculation

DESIGN STIPULATIONS

- Characteristics Strength of Concrete Specified : 25 N/mm²
- Maximum Size of Aggregate To Be Used : 20 mm
- Desired Workability of Concrete : 25-75 Slump
- Exposure Condition Specified : Moderate
- Degree of Quality Control Expected To Be Exercised At Site : Good

5.6.1. TEST DATA ON MATERIALS

- Specific gravity of cement (OPC) : 3.15
- Specific gravity of coarse aggregates : 2.84
- Specific gravity of fine aggregates : 2.64
- Water absorption for coarse aggregates : 0.40%
- Water absorption for fine aggregates : 0.54%
- Free (Surface) moisture for coarse and fine aggregates : Nil

5.6.2. Mix Design

STEP -1 : TARGET MEAN STRENGTH

The 28-day Target Mean Strength (fck) as Calculated Using Following Formula:

$(Fck) = fck + 1.65 \times \sigma$

Where: Fck = 28 -day characteristic compressive strength of concrete

σ = standard deviation of compressive strength of concrete samples

Table 5.6 Standard Deviation

Grade of Concrete	Assumed Standard Deviation (N/mm^2)
M10	3.5
M20	4.0
M30 M35 M40 M45 M50 M55 M60	5.0

(Ref: Table 1 IS : 10262-2009 or Table -8 of IS : 456 -2000)

Standard deviation : 4 N/mm^2 (for Good Control)

Target Average 28 days compressive strength of concrete:

$= 25 + 1.65 \times 4$

$= 31.6\ N/mm^2$

STEP -2: SELECTION OF W/C RATIO

Minimum cement content, maximum water –cement ratio and minimum grade of concrete for different exposure with normal weight aggregate of 20 mm nominal maximum size

Table 5.7 For selection of water / cement ratio

Sr no	Exposure	Plain concrete			Reinforced concrete		
		Minimum cement content kg/m3	Maximum free water-cement ratio	Minimum grade of concrete	Minimum cement content kg/m3	Maximum free water-cement ratio	Minimum grade of concrete
1	Mild	220	0.6	--	300	0.55	M20
2	Moderate	240	0.6	M15	300	0.5	M25
3	Severe	250	0.5	M20	320	0.45	M30
4	Very severe	260	0.45	M20	340	0.45	M30
5	Extreme	280	0.4	M25	360	0.4	M40

(Ref:TABLE –5 OF IS 456-2000)

Water-cement ratio selected is 0.5 for Moderate Exposure condition.

STEP -3: SELECTION OF WATER CONTENT

Table 5.8 Selection of water content

MAXIMUM WATER CONTNET PER CUBIC METRE OF CONCRETE FOR NOMINAL MAXIMUM SIZE OF AGGREGATE		
Sl No.	Nominal Maximum Size of Aggregate (mm)	Maximum Water Content (kg)
i)	10	208
ii)	20	186
iii)	40	165

(Ref: TABLE –2 OF IS 10262: 2009)

From Table 5.6.3 maximum water content = 186 kg

(for 25 to 50 mm slump range) for 20 mm aggregate.

STEP -4: CALCULATION OF CEMENT

W/C ratio = 0.5

Cementitious content= 186/ 0.5 **= 372 kg/cum**

Water Content= 158kg/cum

From Table 5 of IS: 456-2000

Minimum cementitious content for 'Moderate' exposure condition = 300 kg /m3

372 kg/m3 > 300 kg/m3 **hence ok**

STEP 5: PROPORATION OF VOLUME OF COARSE AGGREGATE AND FINE AGGREGATE CONTENT

From Table 6, volume of coarse aggregate corresponding to 20mm size aggregate and fine aggregate (Zone II) for Water cement ratio of 0.5

STEP 6 : PROPORATION OF VOLUME OF COARSE AGGREGATE AND FINE AGGREGATE CONTENT

For pumpable concrete the value should be reduced by 10% Therefore

volume of coarse aggregate = 0.638 x 0.90 = 0.57

Volume of fine aggregate content = 1 – 0.57 = 0.43

STEP -7 : MIX CALCULATIONS

The mix calculations per unit volume of concrete shall be as follows:

a) Volume of concrete = 1 m3

b) Volume of cement = $\frac{Mass\ of\ cement}{Sp\ Gr\ of\ Cement} X \frac{1}{1000}$

= $\frac{372}{3.15} X \frac{1}{1000}$

= 0.118m3

c) Volume of water = $\frac{Mass\ of\ Water}{Sp\ Gr\ of\ Water} X \frac{1}{1000}$

= $\frac{186}{1} X \frac{1}{1000}$

= 0.186 m3

d) Volume of entrapped air = 2%

= 0.02 m3

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

= 1- (0.118 + 0.186 + 0.02)

= 0.676 m3

Mass of Coarse Aggregate = (e) x vol. of coarse aggregate x sp. Gravity of coarse aggregate x 1000

= 0.676 x 0.57 x 2.84 x 1000

= 1094.31/m3

Mass of Fine Aggregate = (f) x vol. of fine aggregate x sp. Gravity of fine aggregate x 1000

= 0.676 x 0.43 x 2.64 x 1000

= 767.39 kg/m3

MIX PROPORTIONS FOR TRAIL NO 1. (For 1 Cu.m)

Table 5.9 Final Mix Design

Water	Cement	Fine aggregate	Coarse aggregate
186	372	767.39	1094.31
0.5	1	2.06	2.94

Table 5.10 Quantity of constituent materials as per mix design and size of cube, beam, cylinder (For 24 cube and 24 beams)

Specimen and size	Total quantity including wastage (kg)	Cement for 24 nos	Fine aggregate for 24 nos	Coarse aggregate for 24 nos
Cube size (0.15m X 0.15m X 0.15m)	8.91	36 kg	74.52 kg	98.64 kg
Beam size (0.1m X 0.1X 0.5 m)	13.2	55.2 kg	114.264 kg	151.25g

5.7 PROPERTIES OF MATERIALS USED

5.7.1 Physical properties of cement and natural aggregates.

Testing of materials was carried out in the laboratory, confirming to relevant IS procedure and the result are shown below.

a) Cement (43 grades)

Table 5.11: Physical properties of cement

SR.NO	DESCRIPTION OF TEST	RESULTS
1	Fineness of cement (residue on IS sieve no. 9)	2%
2	Standard consistency of cement	30-25%
3	Setting time of cement	
	a) Initial Setting time	40 minute
	b) Final Setting time	10 hr.
4	Compressive strength of cement	
	b) 7 days	**33 N/mm^2**
	c) 28 days	**43 N/mm^2**

b) Fine aggregate-

Table 5.12: Physical properties of Fine aggregate

SR.NO	DESCRIPTION OF TEST	RESULTS
1	Particle shape, Size	Round, 4.75mm
2	Fineness modulus	2.96
3	Silt content	1.60%
4	Specific Gravity	2.64
5	Water absorption	1.00%

c) Coarse aggregate-

Table 5.13: Physical properties of coarse aggregate

SR.NO	DESCRIPTION OF TEST	RESULTS
1	Particle shape, Size	Angular, 10mm and 20mm
2	Fineness modulus of 20mm aggregate	7.4
3	Fineness modulus of 10mm aggregate	6.57
4	Specific Gravity	2.84
5	Water absorption	0.40%

5.8 EXPERIMENTAL PROGRAM

5.8.1 Measurement of ingredients

All cement, sand, coarse aggregates (20mm and 10 mm) were measured with electronic weigh balance having accuracy 5gm. The water was measured with measuring cylinder of capacity 1 lit. Capacity accuracy up to one gram.

5.8.2 Mixing of concrete

1. The cement and fine aggregate were mixed on a water tight none-absorbent platform in dry state before addition of water until the mixture is thoroughly blended and is of uniform colour.
2. The coarse aggregate and mix with cement and fine aggregate until the coarse aggregate is uniformly distributed throughout the batch.
3. Normal water was added and mixed until the concrete appears to be homogeneous and of the desired consistency.
4. Similarly mix with magnetic water was prepared.
5. Materials were purchased in bulk quantity .
6. Cement was used from single lot and same month of manufacture to ensure accurate results.

Figure No 5.6 MIXING OF CONCRETE INGREDIENTS

5.8.3 WORKABILITY

At every batch of mixing the concrete slump was measured and recorded with slump cone apparatus as per IS: 1199 – 1959.

5.8.3.1 Observations and result

Hardness(TDS) mg/l	Slump for Normal water	Slump for magnetic water	Increase in slump
TDS 450	2.5 cm	11.0 cm	8.5 cm

FIG NO 5.7 A) NORMAL WATER SLUMP **FIG5.7 B) MAGNETIC WATER SLUMP**

5.8.3.2.Conclusion:

The slump of concrete mix prepared by magnetic water increases, so workability of concrete increases if magnetically treated water is used.

5.9. CASTING

Moulds were cleaned and oiled from inside for smooth remoulding. The concrete was filled in the mould in layers.

FIGURE NO 5.8 CASTING OF BEAM AND CUBE MOULDS

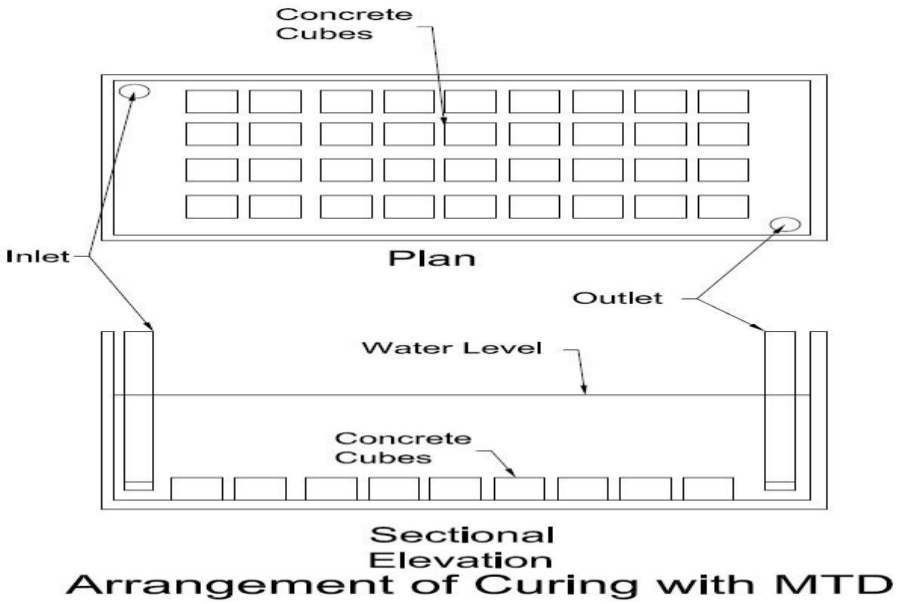
5.10. COMPACTION

Moulds were cleaned and oiled from inside for smooth remoulding. Concrete was mixed thoroughly and placed in the mould in three layers and compacted by hand. It was compacted till concrete woes out of mould.

FIGURE NO 5.9 COMPACTION

5.11 Curing

M-25 grade concrete cubes casted with normal water and magnetic water were cured in curing tank for 28 days.



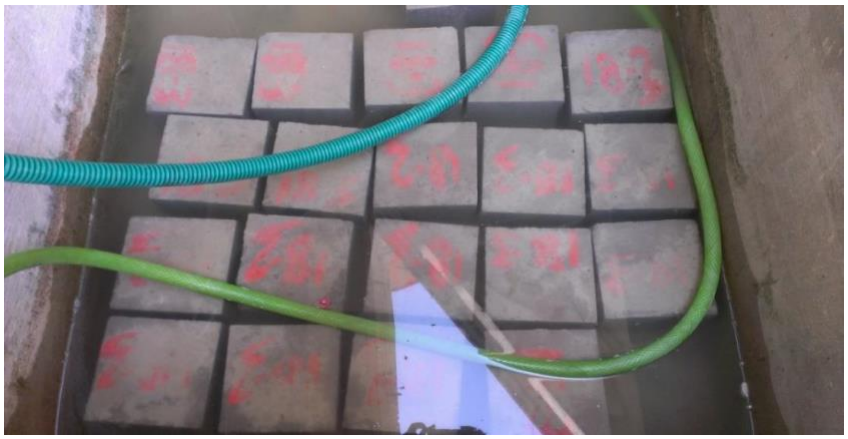


FIG 5.10 CURING DONE WITH MW

5.11.1 Precautions

The water used curing with normal water should be tested every 7days and the temperature of water must be at 27+-2oC. And the water used for magnetic curing should be recirculated under the influence of magnetic field for at least two hours each day for 28 days period of curing .

5.12 DEMOULDING OF SPECIMENS

The plain cement concrete specimens were demoulded after 24 hours of casting wet concrete and kept in water tank for curing. Concrete specimens were remoulded after 48 hours of casting wet concrete and kept for water curing at 28 days.

5.13. TEST CARRIED OUT ON SPECIMENS

5.13.1 COMPRESSIVE STRENGTH ON CUBES:

This is the utmost important test which gives an idea about all the characteristics of concrete. By this single test one judge that whether concreting has been done properly or not. For cube test we have used 15cm x15cm x15cm size specimens. The testing is Perform after 7 days and 28 days curing with both magnetic water and normal water . For testing of cubes compressive testing machine is used.

Procedure for determination of compressive strength.

a. The specimen was removed from water after specified curing time and was wiped out for excess water from the surface.

b. The dimension of the specimen were taken to the nearest 0.2m.

c. The bearing surface of the testing machine was properly cleaned.

d. The specimen was placed in the machine in such a manner that the load can be applied to the opposite sides of the cube cast.

e. The specimen was centrally aligned on the base plate of the machine.

f. Then movable portion was gently rotated by hand so that it touches the top surface of the specimen.

g. The load gradually applied without shock and continuously at the rate of 140kg/cm2/minute till the specimen fails

h. The maximum load was recorded and note any unusual features in the type of failure.

The compressive strength of specimen was calculated by the following formula:

$$Fck = \frac{Pc}{A}$$

Where Pc = Failure load in compression, KN
A = Loaded area of cube, mm^2

FIG NO 5.11 COMPRESSIVE TEST

5.13.2 FLEXURAL TEST OF CONCRETE

Flexural strength also known as modulus of rupture, a mechanical parameter for brittle material, is defined as a materials ability to resist deformation under load. The flexural strength represents the highest stress experienced within the material at its moment of rupture. It is measured in terms of stress given by symbol σ. For beam test we have used 10cm x10cm x50cm size specimen.. Flexural strength test is perform after 7 days and 28 days curing. For flexural testing Universal testing machine is used.

Procedure for determination of flexural test.

1. The specimen stored in water shall be tested immediately on removal from water after 7 days and 28 days respectively
2. The test specimen shall be placed in the machine correctly centred with the longitudinal axis of the specimen at right angles to the rollers.
3. The bed of the testing machine shall be provided with two steel rollers, 38 mm in diameter, on which the specimen is to be supported, and these rollers shall be so mounted that the distance of L/3 from end support of 10 mm size specimen.
4. All rollers shall be mounted in such a manner that the load is applied axially and without subjecting the specimen to any torsional stresses or restraints.
5. The load shall be applied at a rate of loading of 400 kg/min for the 15.0 cm specimens and at a rate of 180 kg/min for the 10.0 cm specimens.

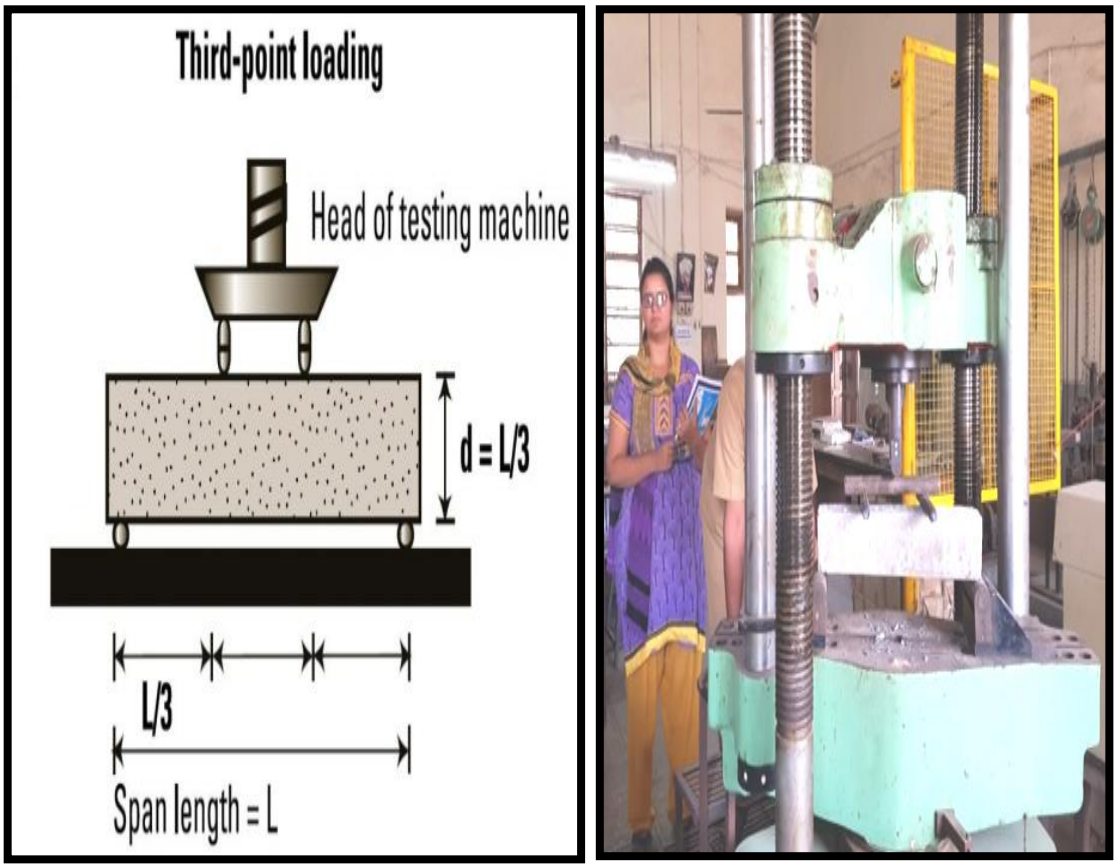


FIGURE NO: 5.12 FLEXURAL TEST

The Flexural strength of specimen was calculated by the following formula:

$$F_b = \frac{PL}{BD^2}$$ (when a > 20.0cm for 15.0cm specimen or > 13.0cm for 10cm specimen)

Where,

a = the distance between the line of fracture and the nearer support, measured on the center line of the tensile side of the specimen

B = width of specimen (cm)

D = failure point depth (cm)

L = supported length (cm)

P = max. Load (kg).

CHAPTER_6
RESULTS

6.1TABULAR AND GRAPHICAL FORM RESULTS OF COMPRESSIVE TEST

Table 6.1 (a) : Compressive strength test results for cubes of 7 day strength.

Sr no	Casting and curing technique	Beam no	Compressive strength (MPa)	Average compressive Strength (MPa)	% increase Compared with NW
1	NW casting and NW curing	NW1	12.8	13.16	--
		NW2	13.77		
		NW3	12.93		
2	MW casting and MW curing	MW1	19.02	18.37	39.58 %
		MW2	17.8		
		MW3	18.3		
3	NW casting and MW curing	NW7	15.4	15.24	15.8 %
		NW8	14.9		
		NW9	15.73		
4	MW casting and NW curing	MW7	17.2	17.14	30.24 %
		MW8	17.42		
		MW9	16.8		

Fig 6.1 (a) : Graphical comparative for compressive strength of cubes for 7 days

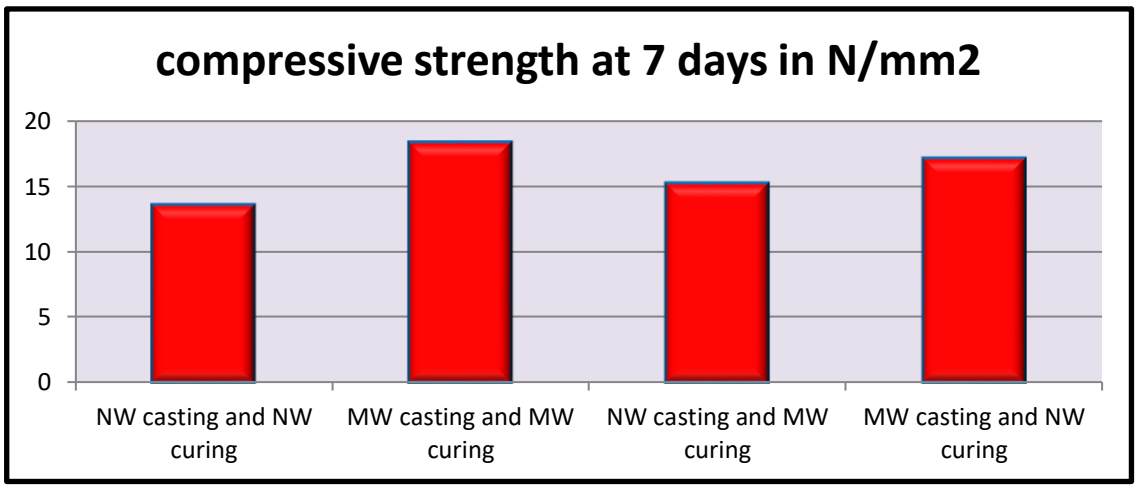
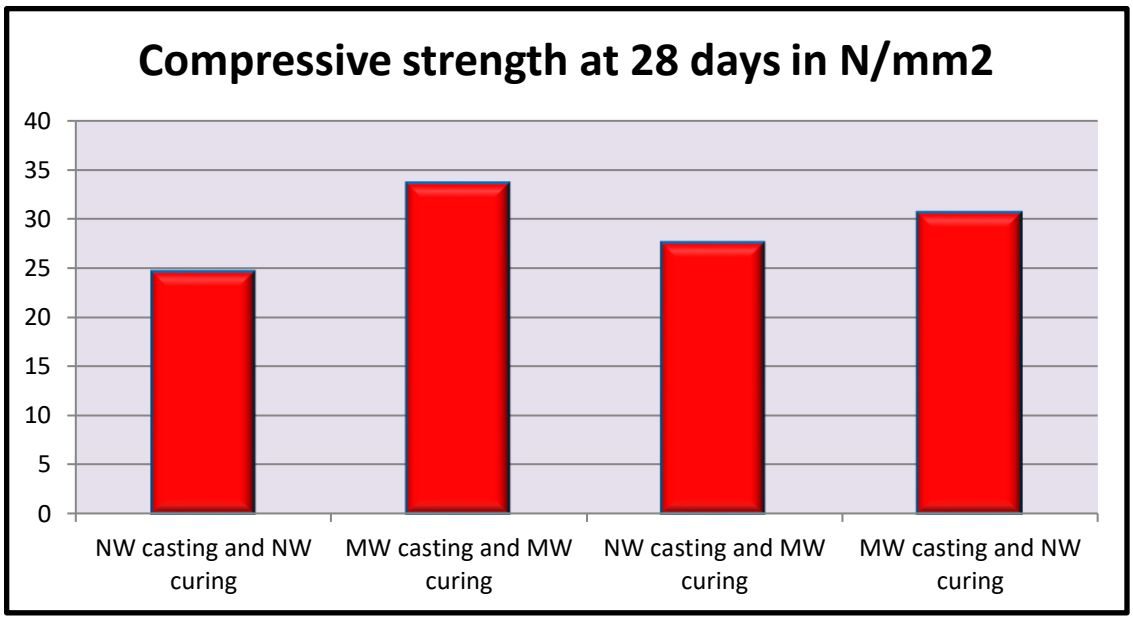


Table 6.1 (b) : Compressive strength test results for cubes of 28 day strength.

Sr no	Casting and curing technique	Beam no	Compressive strength (MPa)	Average compressive Strength (MPa)	% increase Compared with NW
1	NW casting and NW curing	NW4	24.44	24.61	--
		NW5	23.71		
		NW6	25.68		
2	MW casting and MW curing	MW4	34.93	33.56	36.36%
		MW5	33.10		
		MW6	32.67		
3	NW casting and MW curing	NW10	26.94	27.52	10.30 %
		NW11	27.77		
		NW12	27.86		
4	MW casting and NW curing	MW10	31.6	30.57	22.57 %
		MW11	30.53		
		MW12	29.60		

Fig 6.2 (b): Graphical comparative for compressive strength of cubes for 28 days



6.2. TABULAR AND GRAPHICAL FORM RESULTS OF FLEXURAL TEST

Table 6.2 (a): Flexural strength test results for cubes of 7 day strength.

Sr no	Casting and curing technique	Beam no	Flexural strength at 7 days	Avg. Flexural strength	% increase Compared with NW
1	**NW casting and NW curing**	NW1	3.3	3.34	--
		NW2	3.55		
		NW3	3.175		
2	**MW casting and MW curing**	MW1	4.6	**4.6**	**37.72 %**
		MW2	4.85		
		MW3	4.35		
3	**NW casting and MW curing**	NW7	4.175	3.84	**14.94 %**
		NW8	3.775		
		NW9	3.575		
4	**MW casting and NW curing**	MW7	4.1	**4.11**	23.05 %
		MW8	4.45		
		MW9	3.8		

Fig 6.2(a) : Graphical comparative for Flexural strength of beams for 7 days

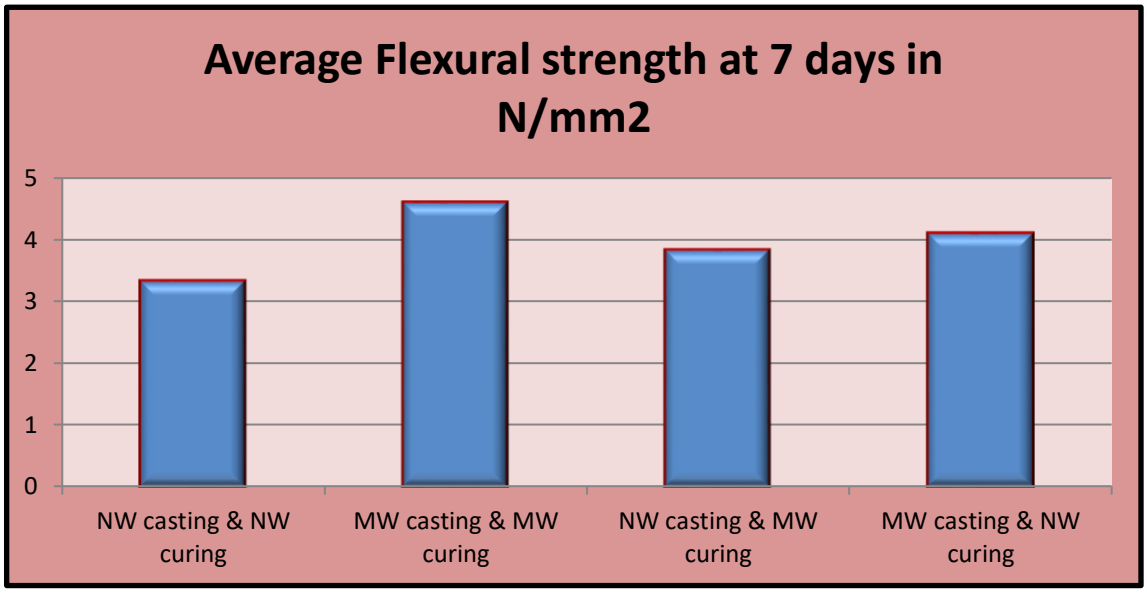
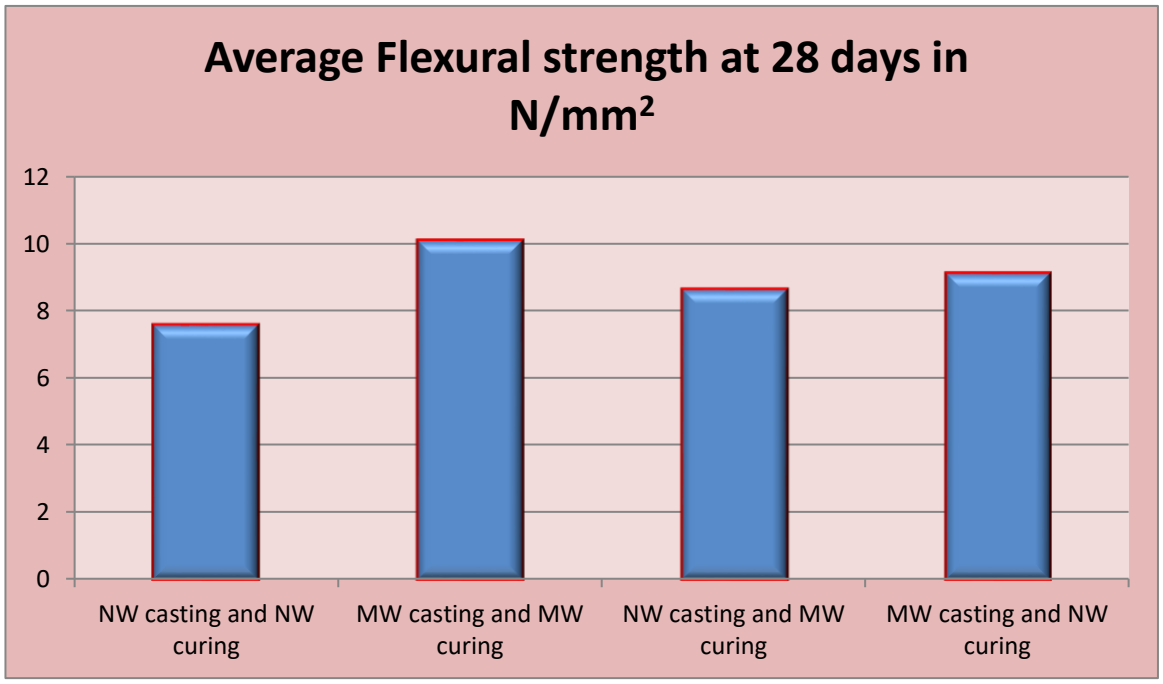


Table 6.2 (b): Flexural strength test results for cubes of 28 day strength.

Sr no	Casting and curing technique	Beam no	Flexural strength at 7 days	Avg. Flexural strength	% increase Compared with NW
1	**NW casting and NW curing**	NW4	7.625	7.6	--
		NW5	8.05		
		NW6	7.125		
2	**MW casting and MW curing**	MW4	9.875	**10.09**	**32.76%**
		MW5	10.05		
		MW6	10.345		
3	**NW casting and MW curing**	NW10	8.975	8.65	**13.81%**
		NW11	8.55		
		NW12	8.45		
4	**MW casting and NW curing**	MW10	9.025	**9.115**	19.93%
		MW11	8.84		
		MW12	9.48		

Fig 6.2(b) : Graphical comparative for Flexural strength of beams for 28 days



CHAPTER_7

CONCLUSION AND FUTURE SCOPE

7.1 CONCLUSION

1. After magnetic treatment favourable changes occur in magnetically treated water
    a. pH of Water**:** Magnetic treatment on water increases the pH of water by 9.06 %
    b. Hardness of water: Magnetic treatment on water decreases hardness of water by 16.24 %.
2. The slump of concrete mix prepared by magnetic water increases by 8.5 cm , so workability of concrete increases if magnetically treated water is used.
3. With the help of magnetic water we can get more workable concrete at lower water cement ratio. Compressive strength of concrete at 7 days increases by 39.58 % and that of 28 days increases by 36.36 % when treated and cured with magnetic water.
4. Flexural strength of concrete at 7 days increases by 37.72 % and that of 28 days increases by 32.76 % when treated and cured with Magnetic water.
5. It is advisable to use magnetic water for casting and curing of concrete in construction industry.
6. The underground water that is brackish in nature can also me made soft by using magnetic treatment and can be made suitable for construction purpose.
7. Eliminates the use of any known admixtures and supplementary materials.
8. One time investment for life time operation.
9. It treats water physically not chemically. So No use of recurring chemicals or salts or filters.
10. It increases solubility of water so improvement in workability.
11. Treated water surface tension will be low compared to non- treated water.
12. Fully automatic operation. No manual interference.

7.2 FUTURE SCOPE

Due to modernisation and innovations in construction industries the demand for high strength concrete is increased day by day. In today's modern life the buildings with more than 100 storey are required in modern societies. And building such skyscrapers need high level of attention on materials and concrete. So it is a need of new techniques and methodology for concrete mixing and design.

Hence to enhanced or to improve the properties of concrete characteristics by applying new methodology of concrete mixing that was to replace normal water with magnetic water.

In building construction, factories, electricity transmission towers etc. where there will be requirement of more compressive strength than conventional concrete, this concept is right choice.

For long span R.C.C. beams where the requirement of more flexural strength is necessary then the concrete with magnetic water gives the best results.

CHAPTER_8

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