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COMPARITIVE STUDY ON CONCRETE MATERIALS USING NORMAL AND MAGNETIZED WATER

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Abstract -*The most consequential challenge for the concrete construction is to improve the strength and durability of the concrete. The huge amount of salt and mineral content is present in water. It leads to affect the durability of concrete structure and also life spans of structure are reduced. In the last 20 years, 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 tend to change and as a result of such changes, the number of molecules in the water cluster is breakdown into small, which causes a decrease in the surface tension of water, with an improvement in the workability and strength of concrete. The magnetic treatment affects the nature of hydrogen bonds between water molecules which increases the pH and softens the water. Due to the smaller size of molecules, the water layer surrounding the cement is thinner than normal water molecules, here these water molecules influence the water absorption with lower percentage. These projects are examined that to compare the properties of normal water and magnetized water on laboratory test. The test conducted on recirculated magnetic water shows modification in pH value. The hardness also reduced due to recirculation of magnetic water. The reduction of the amount of salt and mineral content in water will improve resistance to corrosion excessively.*

Key Words: *Magnetic field*, *Magnetic Water*, Recirculated water, *pH*, *Hardness.*

1. INTRODUCTION

Concrete is most widely using material for construction. Production of cement causes lot of environmental pollution has been noticed one of major problems and quality of water plays a vital role in presentation of concrete. Impurities of water may hinder with setting of cement and it may affect the strength and durability of concrete. This chemical constituent actively participated in chemical reaction and affects the setting, hardening, durability and strength development of concrete. For this alternative solution magnetized water is placed. Magnetized water doesn't mean water has acquired magnetic strength but that it has been subjected to a magnetic field which is found to change certain properties of water is shown in fig1.1 [15]. The mechanism of action the magnetic field are divided in three major groups- colloidal, ionic, water hypotheses. These projects select ionic group as magnetic field. Hence here PERMAG (N406) is used for the production of magnetic water [14].

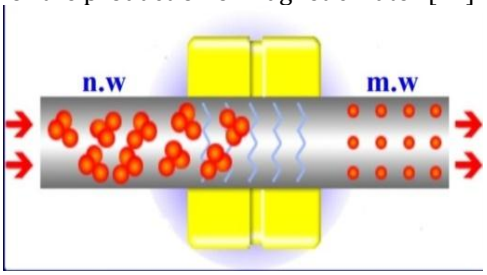


Fig -1:Effect of Magnetic Field on Water Molecules

The structure of water is aligned in one direction after magnetization, and the molecule sizes change after the bond angle changes from 105^0 to 103^0[15]. It leads to a higher viscosity was performed due to the broken hydrogen bonds after magnetization and also the water layer surrounding the cement is thinner than normal water molecules [23]. Therefore less water demand which that has positive result of hardened concrete properties. The usage of magnetic water while mixing concrete will increase durability, compressive strength and also there will be higher workability for the same water cement ratio [20].

Many researchers tested that the scaling property and corrosion development in magnetic water is greatly reduced if the water is passed through an intense magnetic flux which in turn changes the physical structure of water molecule and softens the hard water [18]. This softening intensity is predicted on the magnitude of flux induced. To achieve higher intensity and magnetization, water is made to recirculate by designing a setup with motor and auto transformer [16].

1.1 RESEARCH OBJECTIVE

The main objectives of this research are

- To determine the engineering properties of material using magnetic water
- To examine the effects of magnetic water on properties of concrete.
- To check the gaining of compressive strength of concrete for 28 days using NW and MW.

2. MATERIALS COLLECTION

2.1 MAGNETIC DEVICE

Magnetic fields are formed by the motion of charged particles. For example, electrons flowing in a wire will make a magnetic field surrounding the wire. The attractive fields generated by moving electrons are used in many domestic appliance, automobiles, and industrial machines. One basic example is that the magnet, which is made from several coils of wire wrapped around a central iron core. The magnetic field is present only while electrical current is passed through the wire coils.

Permanent magnets don't use an applied electrical current. Instead, the magnetic field of a permanent magnet results from the mutual position of the very small magnetic fields created by each of the atoms within the magnet. These atomic-level magnetic fields results from the spin and orbital movements of electrons. While several 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. As a result, all permanent magnets are composed of ferromagnetic materials. Here these paper to use PERMAG (N406) for production of magnetized water.

PERMAG is entirely made up of strong rare earth magnets referred to as atomic number 60 (N406). The magnetic field intensity is 10,000 gauss power and 10000 gauss power= 1 Tesla, therefore magnetic flux density of PERMAG N406 is 1 Tesla.

Fig -2: Permag N406

2.2 CONCRETE INGREDIENTS

Cement: The cement used throughout this work was Ordinary Portland cement of 53 – grade was used as it satisfied the requirements of IS and results have been tabulated [11].

Fine aggregate (sand): M sand passing through IS 4.75 mm sieve was used as fine aggregate. The sand used having Water absorption of 1.93% and specific gravity of 2.60 [14].

Coarse aggregate (gravel): The coarse aggregate of 20mm size was used in the study the aggregates were tested as per IS specifications [9].

Water: The water that if suitable drinking ought to be used for making concrete. The minimum water cement ratio is 0.3. The water ought to be clean and free from harmful impurities like oil, alkali and acid etc.

2.3 EXPERIMENTAL SETUP

Magnetically treated and recirculated water system

In this method the water is recirculated for one hour to induce magnetic flux within the water by the action of applied magnetic field. This recirculated water is applied for the casting of concrete specimens. The setup to achieve the above mentioned process includes Autotransformer, 0.5HP General purpose Motor, Permag N406. The autotransformer is employed to scale back the provision voltage of the motor, this controls the flow of water within the setup. By this method the hardness within the water is reduced, this enhances the resistance to corrosion of steel reinforcement.

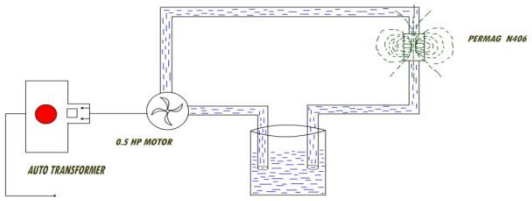


Fig -3:Magnetically Treated and Recirculated Water Setup- Schematic Design

3. PRE-EXPERIMENTAL INVERSTIGATIONS

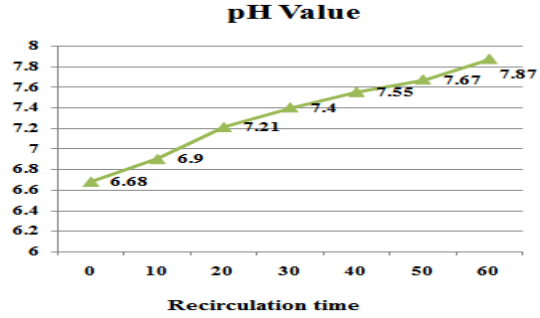
3.1 Physical properties of water

1. **pH test**

The pH test is conducted for every ten minutes of recirculation of normal water through Magnetic devices.

Table 1: pH value of Normal & Magnetic water.

S no	Magnetic water Recirculation Time (Mins)	pH Value
1	0	6.68
2	10	6.90
3	20	7.21
4	30	7.40
5	40	7.55
6	50	7.67
7	60	7.87



Graph 1: Effect of pH Value on Recirculation Time

This graph shows the change in pH value based on increase in recirculation time of magnetic water. Here the

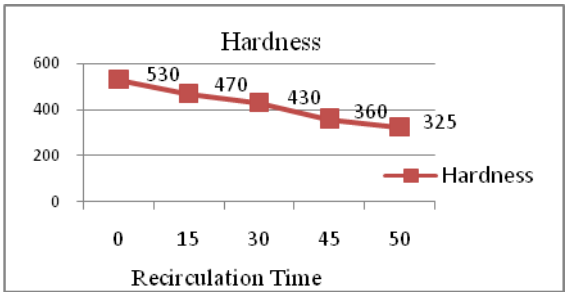
graph interprets the result, that increase in recirculation time will considerably increase the pH value. So the increase in pH value will change the nature of water from acidic to basic which decreases the corrosion rate.

2. Hardness test

Hard water is nothing but water with excess of some minerals. Calcium & Magnesium ions are the largest part common ions that make the water hard. For construction purpose always soft water is preferred and if Iron content is slightly high it will affect the wall that is cracking can be seen on the wall and if hard water is used for curing purpose then the problems can be seen after some years.

Table 2: Effect of Hardness on Recirculation Time

S no	Recirculation Time (Min)	Hardness(mg/lit)
1	0	530
2	15	470
3	30	430
4	45	360
5	60	325



Graph 2: Effect of Hardness on Recirculation time

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

3. Permanent Hardness test

Hard water forms scale, usually $CaCo_3$ which causes various problems. As the recirculation time increases hardness decreases by passing of magnetic flux in water.

Table 3: Effect of Permanent Hardness on Recirculation Time

S no	Recirculation Time (Min)	Hardness(mg/lit)
1	0	450
2	15	425
3	30	390
4	45	385
5	60	365

4. Determination of Total solids and suspended solids

Total solids and suspended solids are determined as residue left after evaporation and drying of the unfiltered sample.

Table 4: Amount of total and suspended solids

S no	Time (Mins)	Total solids (mg/lit)	Dissolved solids (mg/lit)
1	0	700	650
2	60	500	420

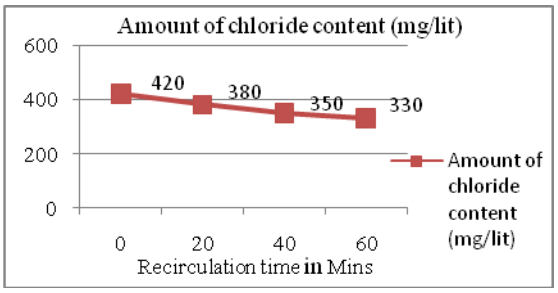
The presence of impurities in water for concrete mix leads to decrease in structural properties of concrete such as strength and durability to a large extend.

5. Determination of Chloride content

Chloride may be present in the fresh mix or may penetrate from external source into concrete.

Table 5: Determination of Chloride in Water

S no	Recirculation Time (Min)	Amount of chloride content (mg/lit)
1	0	420
2	20	380
3	40	350
4	60	330



Graph 3: Determination of Chloride content

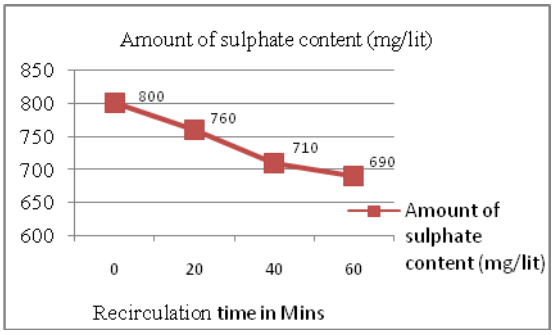
Excessive amount of chloride will destroys the reinforcing steel and initiate corrosion of steel. It affects the strength and durability of structure as well as attacking the steel reinforcement.

6. Determination of Sulphate content

Sulphate attack on concrete is a chemical breakdown mechanism where sulphate ions attack components of cement paste(C-S-H gel formation). This process decreases the durability of concrete by varying the chemical nature of cement paste, and of the mechanical properties of the concrete.

Table 6: Determination of Sulphate in Water

S no	Recirculation Time (Min)	Amount of sulphate content (mg/lit)
1	0	800
2	20	760
3	40	710
4	60	690



Graph 4: Determination of Sulphate content

3.2 Physical properties of materials:

1. Physical properties of cement

Physical properties of cement are specific gravity, consistency, initial and final setting time etc. The following tests were conducted to assess the engineering properties of the samples.

Table 7: Physical properties of cement

S no	Properties	Results	
		NW	MW
1	Specific gravity	3.10	
2	Standard consistency	31%	29%
3	a) Initial setting time	30 Mins	45 Mins
	b) Final setting time	510 Mins	570 Mins

2. Physical properties of fine aggregate

The sizes of the M-sand are less than 4.75mm Physical properties of fine aggregate are specific gravity, and water absorption.

Table 8: Physical properties of fine aggregate

S no	Properties	Results	
		NW	MW
1	Specific gravity	2.60	2.63
2	Water absorption	0.5%	

3. Physical properties of coarse aggregate:

The size of the aggregate is 20mm.

Table 9: Physical properties of coarse aggregate

S no	Properties	Results	
		NW	MW
1	Specific gravity	2.70	2.78
2	Water absorption	0.5%	

3.3 Mix calculations

Table 10: M25 grade of mix proportion quantities per cubic meters [7].

S no	Materials	Kg/m³
1	Cement	638
2	Fine aggregate	615
3	Coarse aggregate	1135
4	Water	192

4. EXPERIMENTAL INVERSTIGATION:

4.1 Slump cone test

Slump test is a measurement of concrete workability. Table 11 shows that an increase between 10 to 35 % was achieved in slump when Magnetic Water is used. It can be explained by the fact that a more homogeneous lattice of new formations of hydrated cement minerals is developed when mixed with Magnetic Water.

Table 11: Slum test for concrete with and without magnetized water

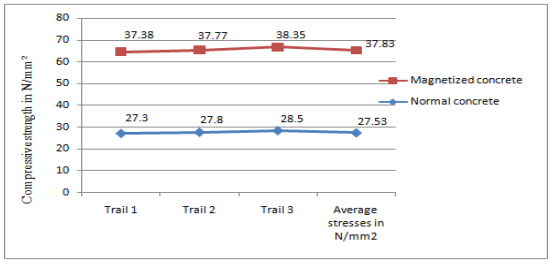
S no	Type of water	Slump value
1	NW	50-100 (W/C-0.45)
2	MW	75 (W/C-0.30)

4.2 Compressive test

The cube specimens are tested for compressive strength at 28days [8]. f = P/A N/mm2 the results of the compressive strength tests on concrete cubes are shown in Table 12.

Table 12: Compressive strength of cubes at the end of 28 days

Type of concrete	Compressive strength in Mpa			Average stresses in N/mm²
	Spc 1	Spc 2	Spc 3	
NWC	27.30	27.80	28.50	27.53
MWC	37.38	37.77	38.35	37.83



Graph 5: Compressive strength of cubes

From the above table it is clear that compressive strength of cubes using normal tap water is slightly greater than compressive strength of cubes using magnetic water, it's by 37.41 % increase.

5. CONCLUSIONS

In this experimental investigations results, were obtained to comparing the physical properties of normal water and magnetized water on environmental laboratory.

1) As the recirculation time is increases, when the pH value of magnetized water also increases from 6.68 to 7.87 about 1 hour.
2) The hardness also reduced from 310 to 190 mg/lit due to recirculation of magnetic water. And also the total solids, sulphate and chloride content are reduced from 700 to 500 mg/lit, 800 to 690 and 338 to 192 mg/lit.
3) The workability of concrete is increases, when the slump value of magnetized water is 50mm with water/cement ratio 0.30.

4) Compressive strength of concrete of cube at 28 days for normal water and magnetic water are 27.33 N/mm2 and 38.12 N/mm2 respectively.
5) The average increase in the compressive strength is 37.41%. With compared to the normal water and magnetized water concrete is higher in compressive strength.
6) The recirculation period is increases, and then the salt and mineral content are reduced. In this technology, greatly achieve the strength of concrete without adding any chemicals. And it is one of the cost-effective and ecofriendly technologies.

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