Study on Effect of Magnetic Field Treated Water on Fresh and Hardened Concrete Properties

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***Abstract*- This study involves the investigation of magnetic water on the workability, consistency, compaction factor and compressive strength of concrete. The water is magnetized with the help of 0.5hp motor having an intensity of 0.9 Tesla at its inlet pipe. Both the physical and chemical properties of normal water and magnetic water have to be studied. Concrete samples are then prepared by using magnetic water and ordinary water for mixing and cured with ordinary tap water. The concrete cubes are casted for M20 grade and tested for 7, 14, 21 and 28 days respectively. The main scope of the study is to improve the qualities of normal tap water as per Indian standards after magnetisation and to reduce the water cement ratio thereby reducing the consumption of cement content and curing days.**

***Index terms*- Magnetic Water, Workability, Compressive Strength, Curing Ages**

I.INTRODUCTION

Magnetized water does not mean water has obtained the magnetic strength instead there will be change in certain properties of water. Water is not homogeneous at Nano scale but exist as clusters (1). In general each cluster contains 100 water molecules at room temperature. But when subjected to magnetic field, magnetic force can break down the water clusters into smaller ones, thus the activity of water is improved(2). Due to the decrease of molecules there will be more active participation of water molecules in the cement hydration reaction. In magnetic water, water layer around the particle will be thinner than normal water (3). Many researches have conducted to detect the properties of concrete prepared by magnetic water. When magnetic water is used for concrete preparation an improvement in workability and the mechanical properties have been identified (4). By light spectrum, the bond angle of magnetic water decreases from 105^0 to 103^0 because the magnetic field squeezes the bond closer. Due to this the electric field of H2O contracts, so increases the solubility of water (5). Magnetic water has an effect on fresh concrete quality which will lead to a better quality of hardened concrete. Adding more water in concrete makes it workable but unfortunately reduces the strength of concrete (6).the viscosity of magnetic water is lower than that of normal water. This change in water molecules causes a change in permeability pressure, surface tension which improves some properties in concrete (6 to 9). Water exposed to the magnetic field of mixed pole (N+S) will gives good flow ability and zero sign of indication for bleeding and segregation (10,12). The magnetic water has an ability to reduce the hardness of water and increase in efficiency of flow of water. The use of magnetic water in concrete for mixing and curing, showed encouraging results in the properties of concrete. The use of this water in concrete has high density and less water absorption when compared to normal water concrete by which the usage of cement content in concrete can be reduced without affecting the properties of concrete (13).

A. Magnetic Water

In 1980s the magnetic water effect on water was discovered by Pop Haydn. At the earlier age, this technology was used mainly in many countries which have very little chemical industry, like Russia, China etc., who all reported the successful use of magnets in treating water for irrigation, industry and home use. This new technology was used in concrete industry during the year of 2000 at Taiwan. The magnetization procedure of the water is simple without energy consumption when a permanent magnet is used. A permanent magnet can be installed on a water tube system, resulting in no further energy requirements for water magnetization. This green technology is zero energy consumption and clean. There are two main ways of making MW have been reported. The

first is to pass water through a MF and the other is using a static magnet near a certain volume of water.

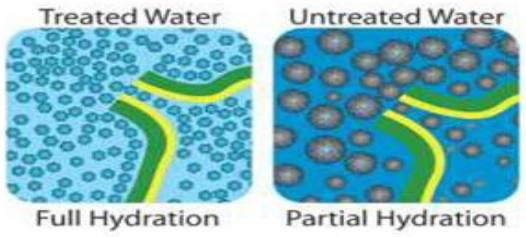

Fig.1 Hydration process

The MF strength and the time of magnetization have a great impact on the properties of MW. At Nano scale, the water occurs as larger clusters, with each cluster having 13-15 water molecules. In presence of magnetic field, water clusters are broken into single molecules or smaller cluster with 5 – 6 water molecules in it. Due to less in size the MFTW can easily penetrate the core region of the cement particles which improves hydration and thereby improving strength of concrete samples as shown in Fig. 1.

II. MATERIAL PROPERTIES

A. Cement

Ordinary Portland cement of 53grade confirming to IS 269-1967 was used throughout the investigation. The specific gravity of cement is 3.15 and fineness modulus of 8%. The initial setting time of cement is 35 minutes and consistency is 31%.

B. Sand (Fine aggregate)

Sand used was locally produced .River sand conformed to IS 383-1970.The sand was first sieved through 4.75mm sieve to remove any particles greater than 4.75mm .Fine aggregate test was done according to as per IS: 2386-1963.The specific gravity is 2.71 and water absorption of 3 %.The fine aggregate comes under zone II with fineness modulus 2.85 %.The Bulk density of the fine aggregate is 1450kg/m3.

C. Natural coarse aggregate

The material retained on sieve of 4.75 mm was termed as coarse aggregate. The aggregate was tested as per Indian standard specification IS 2386-1967 and its property is studied as per IS 2386 and given in table 1.

Table 1 Physical Properties of Natural Aggregate

S.no.	Properties	Natural aggregate
1.	Specific gravity	2.85
2.	Bulk density	2886 kg/m^3
3.	Water absorption	2.19%

D. Chemical properties of water

The normal tap water was used in this experimental study for the purpose of mixing and curing of concrete. The properties of water were tested as per the BIS specifications and shown in the table 2.

Table 2 Chemical Properties of Water

S No	Test	Before Magnetization	After Magnetization	Permissible limits
1.	pH	7.6	8.0	6.5 to 8.5
2.	Total Hardness	240 mg/l	68.33 mg/l	< 600mg/l
3.	Chloride (Cl)	77.47 mg/l	67.47 mg/l	< 500mg/l
4.	Sulphate (S0)	134 mg/l	115 mg/l	< 200mg/l
5.	Iron	01 mg/l	0.1mg/l	< 1 mg/l
6.	Suspended matter	100 mg/l	50mg/l	<2000mg/l

E. Mix proportions

With water cement ratio of 0.5 proportion of concrete should be selected to make the most economical use of available materials to produce concrete required quality. The mix design M20 grade concrete is 1:1.82:3.10

III. EXPERIMENTAL SET-UP

The specimens were cast and tested as testing procedures, after they were taken from curing pond and wiped off the surface water, as per IS 516-1959.

A. Workability Test

B. Slump test is the most commonly used method of measuring consistency of concrete. Slump test as per IS: 1199:1959 is followed.

C. Compaction factor test

This set-up consists of upper, lower hopper and cylinder. Test as per IS: 1199:1959 is followed. The compacting factor is defined as the ratio of the weight of partially compacted concrete to the weight of fully compacted concrete.

D. Vee bee consist meter test

It is used to determine the consistency of concrete using a Vee-Bee Consisto meter, test as per IS: 1199:1959. The time taken for this is noted with a

stop watch recorded in seconds is referred as Vee-bee degrees.

E. Compressive Strength Test

Compression test is performed as per IS: 516-1995. Cubes of size 150mm×150mm×150mm were casted and the specimen was made to cure after 28 days it is test under compression testing machine.

IV. RESULTS AND DISCUSSION

A.The effect of MFTW on fresh concrete samples

1) Workability:

The workability test has been taken with W/C 0.4, 0.45, 0.5 by using magnetic water and normal potable water. Fig. 2 represents the workability of concrete using magnetic water and normal potable water. Fig. 2 illustrates the effect of magnetized water on slump in concrete. Slump was recorded to increase as expected with the increase in w/c ratio for concrete mixed with normal water. Increase in slump was recorded for the same w/c ratio when magnetized water was used. As can be seen from Fig. 2, slump amplified by approximately 40 % and 30 % for w/c ratios 0.4 and 0.45 respectively when magnetized water was used with respect to normal water mixes. While slump only improved 25 % for w/c ratio 0.5 in magnetized water mix compared with normal water mix. Using normal water in concrete, slump of 100mm was achieved in 0.5 w/c ratio, but preparing with magnetic water, slump value of 100mm is achieved for 0.45 w/c ratio. Hence cement content can be reduced up to 12%. This is due to more active participation water molecules. Water which occurs as clusters, with 13 to 15 number of water molecules cannot enter into cement particles, but after magnetic treatment, the water cluster size reduces to 5 to 6 in numbers, so effective utilisation of water molecules takes place. This leads to reduction in water by usage of magnetized water.

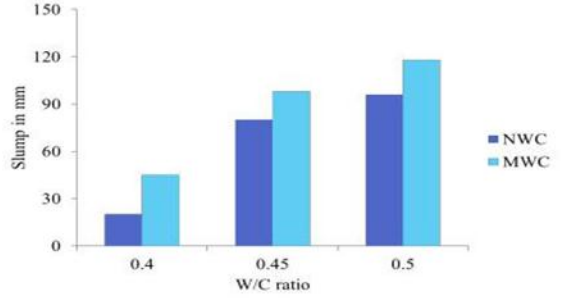

Fig. 2 Effect of MFTW on different W/C of concrete

2) Compaction factor test:

Fig. 3 shows the compaction factor test results. Generally, higher values of compaction factor are recorded for the concrete prepared by using magnetic water than normal water. The magnetic water concrete shows a decrease in percentage of 35% than mixes using normal water. Magnetic water with w/c ratio 0.5 shows increase in compaction factor which has maximum slump than other mixes. This is because of dispersion effect of MFTW on cement clusters on fresh concrete properties is more efficient than tap water.

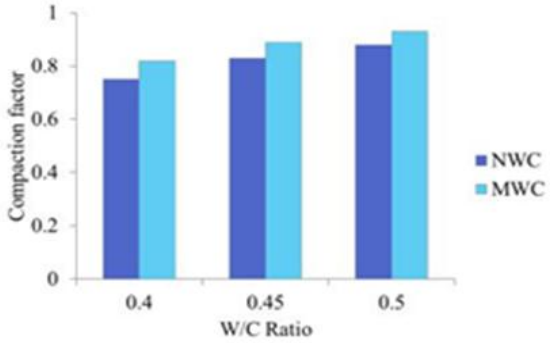

Fig. 3 Compaction factor of normal and magnetic water concrete

3) Vee bee consistometer test:

Figure 4 shows the consistency of concrete tested by Vee-bee consistometer test. The test results have showed that the vee bee degree expressed in seconds shows a decrease in time when prepared by magnetic water than normal water concrete mixes. From this we can understand that mix with W/C ratio 0.5 shows decrease in time decreases due to increase in slump.

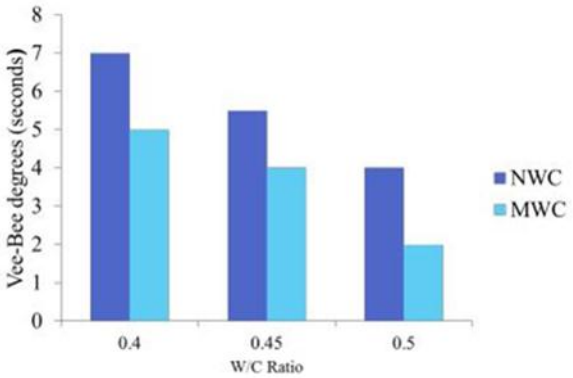

Fig. 4 Consistency of normal and magnetic water concrete sample

B. Concrete sample

1) Effect of MFTW of compressive strength of concrete sample:

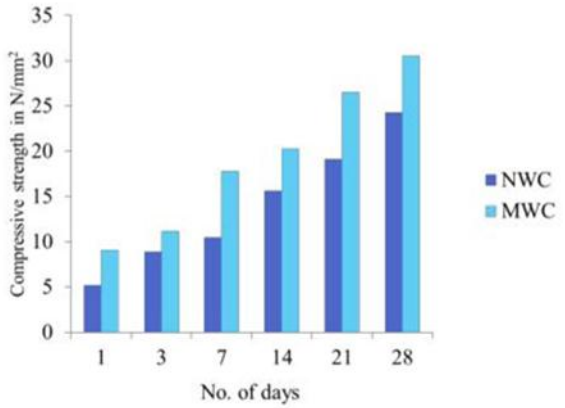

Fig. 5 Compressive strength in N/mm2 of normal and magnetic water concrete

Figure 5 shows that sample of concrete prepared with magnetic water and cured with normal water shows encouraging results, than sample of concrete prepared and cured with normal water. Target mean strength is achieved with concrete sample prepared with magnetic water at 21 days itself. It is observed that there is significant increase in strength by 41% for magnetic water mix than normal water mix. As the curing days increases there is an increase in strength. It shows; while hydration of the magnetic water concrete, more water penetrate the core region of cement particles due to less cluster size. This results in early attainment of strength and reduces curing days. This also leads to early removal of from work

2) Effect of ages on concrete samples:

The effect of age on the compressive strength of concrete with W/C ratio 0.5 can be shown in figure. Concrete sample prepared with normal water and magnetic water all shows an increase in compressive strength with longer curing ages. It is observed that addition of magnetic water showed that significant increase in percentage of strength at early ages by 12% and 23% at 3 and 7 days compared with normal water.

V. CONCLUSION

The use MFTW with intensity of 0.9T can improve the workability of slump up to 58%, compaction factor of 35% and decrease in vee bee seconds for magnetic water when compared to normal water. The magnetized water provides early removal of form work and ecofriendly. All concrete samples prepared with tap water and with MFTW show a similar trend of increase in compressive strength with longer curing ages. The compressive strength of magnetic water shows an increase of 22% than normal water concrete. The concrete prepared with magnetic water shows a higher increase in percentage during early ages of 1, 3 and 7 days. The advantage of magnetic water over normal water is increase in strength parameter and reduction of cement content up to 12%.

VI. ACKNOWLEDGMENT

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