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Effect of Magnetic Field Polarized Water with Partial Replacement of Silica on Concrete

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ABSTRACT The magnetic water has been used in different fields like agriculture, health, constructions, etc. Concrete mixes designed were prepared using tap water (TW) and another set of concrete mixes designed of the same proportions were also prepared using magnetized water (MFPW) in the laboratory to prepare the testing specimens. Assessment of the Concrete strength was performed to determine the effect of using magnetized water. The compression parameters included the mechanical properties and the consistency of fresh concrete. The change in water surface tension and the positive results of the concrete evaluation is evidence of the positive effect of using magnetized water in preparing concrete. This research deals with the workability, compressive strength of concrete mixed with magnetic water containing Silica as partial replacement of cement at 7% & 10% respectively at curing age of 7 days, 28 days, 60 days & 90 days. Magnetic water was taken by passing tap water through magnetic field of 0.4 Tesla. More mixes were prepared to check the optimum results and the mix used was 65% cement 25% fly ash and 10% Silica using tap water and MFPW. Portland cement properties of Concrete have also been evaluated. This research gives an idea to understand the effect and have an overlook of silica induced fumes with magnetic field polarized water in Concrete. Also we had found that the initial surface absorption reduces as the percentage of silica induces fumes with MFPW increases. The optimum results for durability were found at 10% silica replacement using MFPW.

KEYWORDS— Magnetic field polarized water, silica, flyash, compressive strength.

I. INTRODUCTION

Concrete is a revolutionary material, it hardened quickly into a changeless mass. Concrete is generally free from internal thrust and elongation i.e. taken to create any shape of structure. Concrete is foremost recommended construction material in practice. To get a strength imparting concrete silica induced fumes is made in to use in past years. Silica induced fumes contain very small size particle which act as cement gel grain once get interacted with water and same get enhanced by use of magnetic field polarized water. To produce magnetic field polarized water, magnetic device contain one or more permanent magnet. These permanent magnets have properties which induce effects on ions and water molecule cluster when passed through a magnetic field.

Such a decrease of molecule from 13 to 5 or 6 as shown in figure a). lead to increase in cement hydration

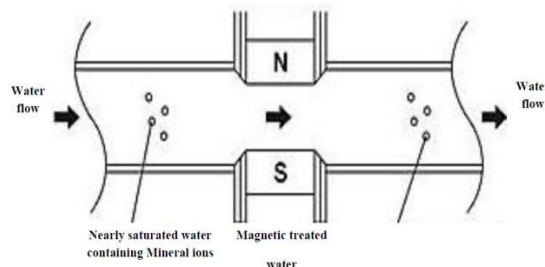


Fig a). Water flow through magnetized field

II. NEED AND DEVELOPMENT OF MFPW

Being a civil engineer it is our prime motive to produce structures in harmony with the consideration of sustainable development by using high performance materials with low effects on environment. Magnetic polarized water concrete incorporate from the normal materials used for manufacturing of concrete provides one route towards this objective. This research tells us the effect of addition of magnetic polarized water on performance such as workability, strength and mechanical properties of concrete. Many tests shows reassuring results such as one can easily replace normal tap water with magnetic polarized water according to quantity of cement used in any concrete mix, and can be made as new eco-friendly construction material for future decades [46]. Increasing the performance of concrete mix with respect to strength is an aim which most researchers are looking for. It is expected that in the magnetic polarized fields are produced by the motion of charged particles

III. CONSTITUENT MATERIAL

The constituent materials for MFPW are the same as those used in traditional vibrated concrete conforming to *IS 456:2000*.

- Cement

Cement used is according to *IS 8112:2013*[30] is applicable for the preparation of concrete mix. Portland cement mainly used as construction material around whole world. Tricalcium silicate usually is the largest phase in Portland cement and it makes a major contribution to strength development and durability. The hydration process of a paste of alite is similar to Portland cements but the microstructure is simpler than OPC [30]. Normally ordinary Portland cement of 43 or 53 grade can be used.

- Fly ash

Fly ash is a residue of the burning of coal during the generation of electricity in thermal power plants and is collected from the flue gases using electrostatic precipitators (ESP). The partials of Fly ash are generally small similar to cement particles, Spherical in Shape. The residues of quartz, mullite, hematite, magnetite, char and other crystalline phases produced during cooling process. The majority of fly ash particles are glassy, solid, or hollow (cenospheres), and spherical in shape (Figure b). At times, broken hollow spherical particles with smaller particles of fly ash inside them, known as plerospheres, have been observed. The glassy phases are typically 60 to 90 percent of the total mass of fly ash [30].

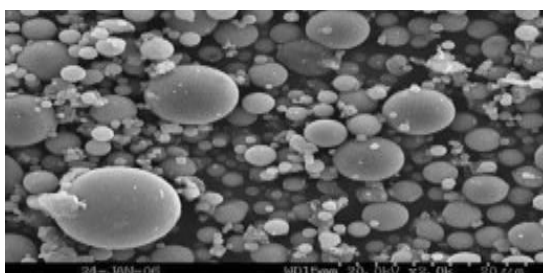


Fig b) Typical SEM images of fly ash (source: www.caer.uky.edu)

- Silica

The Silica induced fume (SF) is a by product of the smelting process. It is generally produced in the silicon and ferrosilicon industry. SiO_2 vapors are produced by decreasing high- purity quartz of silica at 2000°C temperatures. It oxidizes and condenses in tiny particles consisting of non-crystalline silica at low temperature zone. 85–95% non-crystalline silica are generally contained by silicon metal and the ferrosilicon alloys having silicon contents of 75% . Lower silica content are contain by the by-product of the production of ferrosilicon alloy having 50% silicon has and is less pozzolanic. Therefore, SiO_2 content of the silica induced fume is related to the type of alloy being. Silica induced fume is also known as micro silica, condensed silica induced fume, volatilized silica or silica dust. Silica induced fume is available in two conditions: dry and wet. Dry silica can be provided as produced or dandified with or without dry admixtures and can be stored in silos and hoppers. Silica induced fume slurry with low or high dosages of chemical admixtures are available. Slurred products are stored in tanks. . Silica induced fume is composed primarily of pure

silica in non-crystalline form. X-ray diffraction analysis of different silica induced fumes reveals that material is essentially vitreous silica, mainly of cristobalite form. Silica induced fume has a very high content of Amorphous silicon dioxide and consists of very fine spherical particles. Silica induced fume generally contains more than 90% SiO₂. Small amounts of iron, magnesium, and alkali oxides are also found.

IV. EXPERIMENTAL SETUP

The production of magnetic water can be explained with the help of figure 3. Four magnets are attached to the pipe and the water is passed through the pipe, water will get magnetized by this.

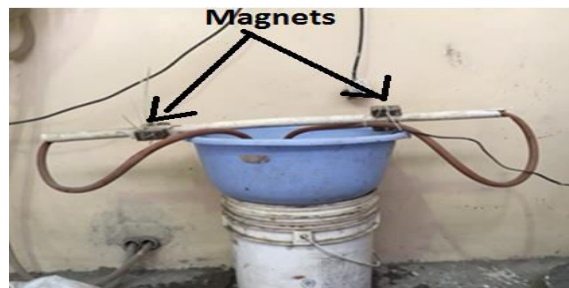


Fig (c): Setup for production of magnetic water.

V. METHODOLOGY

Cube specimens of size 100mm x 100mm x 100mm were casted for strength in compression as per Indian specifications are 516: 1959 [24] for normal concrete. After casting, all test specimens were finished with steel trowel & were covered with sheets to minimize the moisture loss from them. Specimens were demoulded after 1-day and then cured as shown in figure 9 in water at appropriate room temperature till 7, 28, 60 & 90-days for strength tests for cubes. All the specimens were tested in an automated compression testing machine (AIMIL Make) of 2000kN capacity with least count of 10kN. The load P acted on each of the samples with the rate loading as 5.25kN/sec on 150mm cube as shown in Figure 4. The strength in compression was then calculated according to the formula:

$$f_{ck} = P/A$$

Where f_{ck} Strength in compression (MPa)
 P Maximum load (N)
 A Cross sectional area of specimen (mm²)



Fig (d): Testing of specimen in compression testing machine

VI. RESULTS

Concrete specimens of size 100mm (cube) were casted for investigation of strength in compression according to per Indian specifications. For normal concrete results are explained below. Specimens are casted for 7days, 28 days, 60 days and 90 days. After recording all value of compressive strength average value is considered. Whole of the test is done in number of sets and final result is compiled.

Table 1: Strength in compression of normal concrete mixes

Mix	Compressive strength (Mpa)			
	7 Days	28 Days	60 Days	90 Days
NCNW	23.96	30.63	31.37	32.11
NCMW	24.33	32	34.16	34.88
S5NW	23.1	27.03	30	32.19
S5MW	27.63	32	36.49	38.53
S10NW	21.55	26.32	28.82	29.91
S10MW	26.52	31.12	32.08	34.82

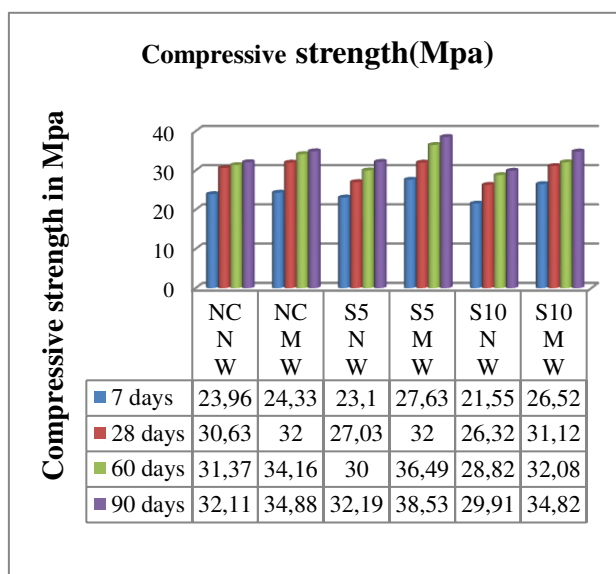


Figure e: Variation of Strength in compression

VII. CONCLUSION

- Normal Tap water concrete mix and magnetic water mix were prepared with varying percentages of Silica as 5% and 10% and all the mixes were tested for various properties like workability with strength properties by strength in compression,
- The strength in compression in early ages didn't show any gain in strength when the S5NW mix was observed for early age strength i.e. 7 days, 28 days & 60 days. The values got reduced by 3-10% respectively which shows that silica is not good for early age strength achievement but when mix was prepared by using MFPW we observed an increase of 15.31%, 4.5%, 16.32% and 20% with respect to NCNW mix for 7 days, 28 days, 60 days & 90 days respectively.



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