Influence of Magnetised Water on Strength Parameters of Concrete

Mrs R.Sumathi[1], K.Sindhuja[2]
[1]*Asst. Professor, Malla Reddy Engineering College, Dundigal*
[2]*M.Tech, Structural engineering, Malla Reddy Engineering College, Dundigal*

***Abstract*- Increasing the compressive strength of concrete is an aim which most concrete technologists are looking for, using various methods like fibre reinforcement in concrete mixture and usage of certain admixtures including super plasticizers to produce high strength concrete. The cost of these methods are not comparable with their advantages, thus most researchers concentrate their attention on producing economical concrete with higher strength using new philosophies in design methods and through modern techniques. One such technique is using magnetic water for manufacturing of concrete. In this technology, by passing water through a magnetic field, some of its physical properties change, which improves and enhances properties of concrete. In this project we studied the strength parameters such as compressive strength, flexural strength, and split tensile strength which are quite enhanced through the application of magnetized water.**

I. INTRODUCTION

As we all know that Concrete is the most widely used construction material. Despite its versatility in construction, it is known to have several limitations. (It is weak in tension, which is why steel reinforcement bars are embedded in the material to be able to build structures. The steel bars take over the load when the concrete cracks in tension). The ongoing research in the field of concrete technologyhas led to the development of special concrete considering the speed of construction, the strength and durability of concrete and the environmental friendliness with industrial material like fly ash, blast furnace slag, silica fume…etc. Recently, it is found that water being exposed to magnetic field altersthe physical propertieslike bond angle, pH, Surface tension, Electrical conductivity etc… which in turn affects the strength parameters like workability, hydration of cement etc

One such thought has led to the development of a very special concrete known as MAGNETIZED WATER CONCRETE where the waterexposed to magnetic field for a specified duration is induced in the place of normal water in the mortars and concrete. Worldwide more than 1 billion tons of water is used for the production of concrete annually. In addition to this, water is further needed for curing of concrete up to the specified period of time. The availability of drinking water across the globe is very limited and its importance needs not to be over emphasized. Therefore, optimum use of water in the production of concrete may be one of the ways to contribute towards the sustainable construction of infrastructure. Magnetized water (MW) seems to have some potential for saving in amount of water needed for concrete production in comparison with commonly used potable water.

II - LITERATURE REVIEW

B.SIVA KONDA REDDY ET AL., (2004) :The workability results of slump for three different (kinds of) water: N, S, N+S are presented in Table 4 and the results show that in case of the concrete made with mixed pole (N+S) magnetic water, the slump was slightly higher. Both mixes had good flow ability and there was no sign of bleeding as well as segregation. Te concrete made with MWC was very greenish compared with Normal Water Concrete (NWC). The compressive strength of concrete increases with the usage of magnetized water, and this increase in the strength is due to cluster concept of water and also memory of water concept

Usually, a water cluster consists of many water molecules of size 11–50 depending on the dominating force in the water molecule. But when water is exposed to magnetized field, it is observed

that the number of water molecules decreases to a smaller amount and is, usually, of about the size 5–6.Tus, water when exposed to magnetic field has better dispersion (or in simpler terms increased specific area). As the more water is available for hydration,

the more number of cement particles are hydrated, and this result in better quality and density of hydration products of cement. This increase in hydration may lead to increase in the compressive strength of the concrete. This effects increase in efficiency of cement used in concrete.

WANG & ZHAO'S (2008) :Study showed that when mixed with magnetic water, the properties of the cement paste and mortar improved. The magnetic treatment had a positive influence on the compressive strength, the pore size distribution and the durability of concrete

YASSER R.TAWFIC AND WAEL ABDELMOEZ ET AL.,(2013) :The cement consistency, the initial setting time, the final setting time, and the compressive strength tests were carried out and recorded for three different types of cement.Compared with tap water, test results show that slightly lower quantity of magnetized water is required to reach the cement consistency which may be attributed to high efficient dispersion effect of magnetized water on cement clusters in mortars. The use of magnetized water resulted in slightly lower initial setting time for all the cement types. However, no clear trend was observed for the effect of the magnetized water on the final setting time of the cement.

III –METHODOLOGY

TEST PROGRAMME: Cubes size of 150mmX150mmX150mm, Cylinders of size 150mmX300mm and Beams of size 100mmX100mmX500mm were casted and tested. The proportion of cement, fine aggregate and coarse aggregate is 1:1:2.6. In addition, plain concrete specimens were casted and tested as controlled specimens. The water cement ratio is taken as 0.42.

OBJECTIVE OF THE PRESENT INVESTIGATION: The main objective of the present experimental investigation is to study the strength parameters on standard grade concrete (M40). The present work is divided into two phases, they are

PHASE – I: Preparation of Magnetized water

PHASE – II: To study the strength behavior of concrete

PHASE – I

PREPARATION OF MAGNETIZED WATER: The water samples each i.e. one liter beakers with flat bottoms are placed over the strong magnets of 1200gauss strength with respective to the magnetic field exposure required i.e. North pole or South pole which result in obtaining North pole or South pole water with specific orientation and reduced bond angle.

PHASE – II

STUDY ON COMPRESSIVE STRENGTH OF CONCRETE: The investigation is carried out to study the compressive strength of a standard grade concrete (M40). A total of 30 cubes were casted and tests are conducted.

STUDY ON SPLIT TENSILE STRENGTH OF CONCRETE: The investigation is carried out to study the tensile strength of a standard grade concrete (M40). A total of 12 cylinders were casted and tests are conducted.

STUDY ON FLEXURAL STRENGTH OF CONCRETE: The investigation is carried out to study the flexural strength of a standard grade concrete (M40).A total of 12 beams were casted and tests are conducted.

IV- EXPERIMENTALINVESTIGATION

The main objective of the present experimental investigations is to obtain specific experimental data, which helps to understand the Bacterial concrete and its strength characteristics. In the present experimental investigation, studies have been carried out on the behavior of fresh and hardened properties of standard grade concrete with and without addition of Bacteria. The hardened properties like compressive strength of cement mortar, compressive strength and split tensile strength of concrete are determined by conducting suitable laboratory tests on concrete in hardened state.

MATERIALS USED:

CEMENT**:** Ordinary Portland cement of 53 grade, available in local market is used in the investigation. The cement used for all tests is from the same batch. The cement used has been tested for various properties as per IS: 4031-1988

Grade: OPC 53
Brand: BHARATHI
Date of Mfd: JAN 2017
FINE AGGREGATE: Locally available RIVER SAND is used as fine aggregate and is tested for various properties required.
COARSE AGGREGATE: The coarse aggregate used is locally available crushed granite stone of 20mm size. Tests are conducted to determine its physical properties. Size of aggregate: 20mm
WATER: Water used for mixing and curing is fresh potable water, conforming to IS: 3025 – 1964 part 22, part 23 and IS: 456 – 2000.

V - MIX DESIGN

STANDARD GRADE CONCRETE (M40):Mix design can be defined as the process of selecting suitable ingredients of concrete such as cement, aggregates, water and determining their relative proportions with the object of producing concrete of required minimum strength, workability and durability as economically as possible. The purpose of designing can be seen from the above definitions, as two-fold. The first objective is to achieve the stipulated minimum strength and durability. The second objective is to make the concrete in the most economical manner. The grade of concrete used in the present concrete and investigation is standard grade concrete. The mix proportions for standard grade concrete are designed using IS: 10262-2009. The proportions of the mixes are
The mix proportion is obtained by the following steps:
Step 1: Target strength for proportioning from 3.2 of the code book

$f_{ck}^1 = f_{ck} + 1.65 \times S$ (S stands for standard deviation)

$= 40 + 1.65 \times S$

Where f_{ck}^1 = target average compressive strength at 28 days
f_{ck}= characteristic compressive strength at 28 days, andS = standard deviation.= 40 +1.65 x 5 (standard deviation is taken as 5 from table1 of IS 456)
$f_{ck}^1 = 48.25$ N/mm^2
Step 2: Selection of W/c ratio from table 5 of IS 456

W/c = 0.42

From IS 456maximum W/c =0.5
0.42<0.5(ok)
Step 3: Selection of water content

From table 2 IS 10262-2009

For 20mm aggregate water content =186 litres
Step 4: Selection of cement content

W/c = 0.42

186/0.42 =c

Cement = 443Kg/m^3
Step 5: Proportioning of fine and coarse aggregates
The percentage of fine aggregate for W/c ratio 0.35 for Zone III sand is 25%
But present W/c ratio is 0.42, thus the fine aggregate is increased at rate 0.01 for every 0.05 change in W/c ratio

For 0.05 increase – 0.1% increase

For 0.7 increase – 1.4% increase

For Zone III sand there must be 1.5% increase of fine aggregate
Therefore a total of 2.9% is increased
Thus, the final fine aggregate proportion is 27.9%
Thus, the coarse aggregate proportion is 100-32.9 =72.1%

$$V = w + \frac{c}{s_c} + \frac{f_a}{p * s_{fa}}$$

$$0.98 * 1000 = 186 + \frac{443}{2.52} + \frac{f_a}{0.279 * 2.55}$$

f_a= 441 Kg/m^3

$$V = w + \frac{c}{s_c} + \frac{c_a}{(1-p) * s_{ca}}$$

$$0.98 * 1000 = 186 + \frac{443}{2.52} + \frac{c_a}{0.721 * 2.62}$$

C_a =1168 Kg/m^3
MIX PROPORTION:
1: 1: 2.6: 0.42
Materials required for 1 cubic meter of concrete are:
Cement: 443 Kgs
Fine aggregate: 441 Kgs
Coarse aggregate: 1168 Kgs
Water: 186 Ltrs

VI .TESTING

Cube specimens are been tested for compressive strength and cylindrical specimens for split tensile strength in COMPRESSION TESTING MACHINE (CTM) whereas the beam specimens are tested on flexural strength testing machine.
TEST FOR COMPRESSIVE STRENGTH: Cube specimens are tested for compressive strength as per IS 515:1959.The compressive strength of cubes after a curing period of 7 &28 days are determined. The

specimen is placed in compression testing machine and load is applied till its failure.

TEST FOR SPLIT TENSILE STRENGTH: Cylindrical specimens are been tested for split tensile strength according to IS 5816:1999.This test is carried out by placing the cylindrical specimen horizontally in CTM specimen metal plates are used to support cylinder. Specimens are tested after 7 & 28 days curing.

TEST FOR FLEXURAL SRENGTH: Beam specimens are been tested for flexural strength according to IS 515:1959.The flexural strength of beams after a curing period of 7 & 28 days are determined. The beams are placed in testing machine on steel rollers as specified in the code and the load at which the beam fails is to be noted as flexural strength.

The test results obtained are as follows

1. PHYSICAL PROPERTIES OF CEMENT

PHYSICAL PROPERTY TESTED	IS SPECIFICATIONS	RESULTS OBTAINNED
FINENESS OF CEMENT	% Residue :- <10% % Fineness :- >90%	3% 97%
SPECIFIC GRAVITY	3.15	3.1
STANDARD CONSISTENCY	30-32%	30%
INITIAL SETTING TIME	>30 minutes	60 minutes
FINAL SETTINGTIME	<600 minutes	340 minutes
COMPRESSIVE STRENGTH TEST	53 MPa for 28 days	26 MPa for 3 days

2. PHYSICALPROPERTIESOFFINEAGGREGATE

PHYSICAL PROPERTY TESTED	IS SPECIFICATIONS	RESULTS OBTAINED
SPECIFIC GRAVITY TEST	2.5 – 2.6	2.55
FINENESS MODODULUS	2 – 4	2.7

3.PHYSICALPROPERTIESOFCOARSEGREGATE

PHYSICAL PROPERTY TESTED	IS SPECIFICATIONS	RESULTS OBTAINED
SPECIFIC GRAVITY TEST	2.6 – 2.7	2.62
FINENESS MODODULUS	5.5 – 8	7.63

VII. RESULTS & GRAPHS

1. pH TEST:

Type of water	pH value
South pole water	8.96
North pole water	8.89
South + North pole water	8.45
Normal water	7.9

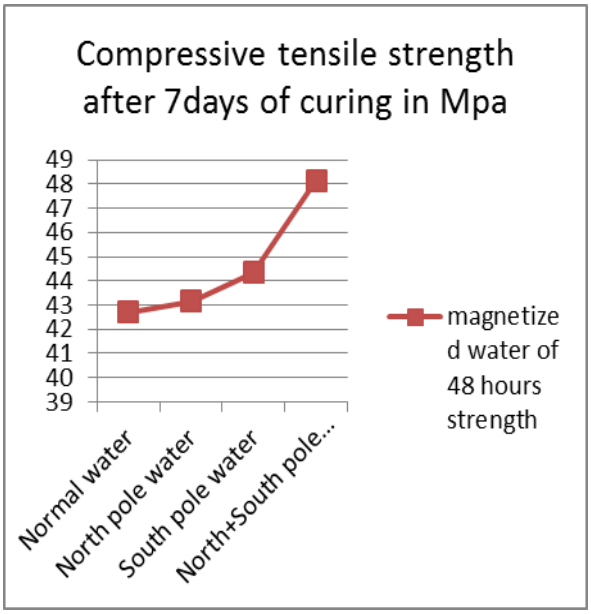
2. ELECTRICAL CONDUCTIVITY TEST:

Type of water	Electrical Conductivity
South pole water	1.27
North pole water	1.28
South + North pole water	1.25
Normal water	1.15

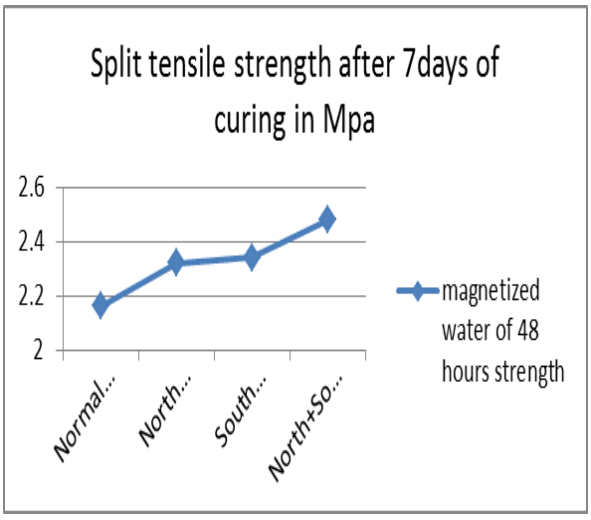
3. MORTAR CUBE STRENGTH TEST:

Specimen	Compressive strength @3days
Normal water specimen	18.69 N/mm^2
North Pole water specimen	20.18 N/mm^2
South pole water specimen	20.67 N/mm^2

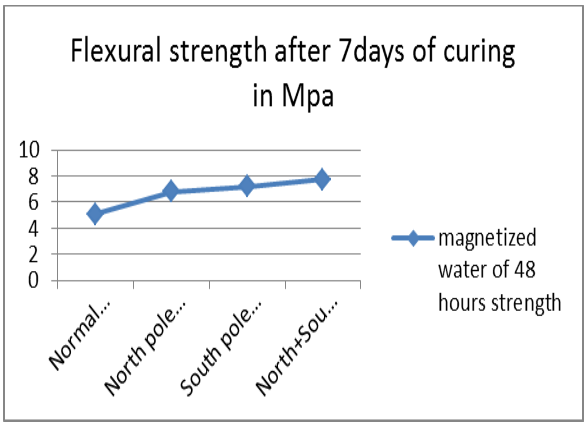
4. COMPRESSIVE STRENGTH TEST



5. SPLIT TENSILE STRENGTH TEST:



6. FLEXURAL STRENGTH TEST:



VIII-CONCLUSIONS

STUDIES ON MAGNETIZED WATER:
Magnetized water can be produced in the laboratory which is proved to be safe and cost effective.

1. After a certain conditions of magnetization process, physical and chemical properties of water were improved in the following areas: conductivity, viscosity and surface tension were decreased; PH value was increased
2. The magnetized water has lower surface tension, which can increase the activity of the cement. Therefore, magnetized water can make the cement hydration more completely and the structure more compactly.
3. Magnetized water molecules can easily enter into the cement grains. Therefore, magnetized water can increase the workability of concrete mixture, which can reduce the non-homogeneity degree of mixture.

STUDIES ON COMPRESSIVE STRENGTH, FLEXURAL STRENGTH AND SPLIT TENSILE STRENGTH OF CONCRETE:
Apart from normal water, magnetized water do not consist of large clusters which in turn helps in increased workability and also helps in complete hydration of cement.

- It is observed that the magnetized water concrete showed significant increase as follows @28days compared to conventional concrete of M40 grade.
- An increase in Compressive strength of 19.72% is observed with the influence of magnetized water
- An increase in split tensile strength of 12.7% is observed with the application of magnetized water
- Similarly there's a great improvement in flexural strength of 31.5% when the concrete is treated with magnetized water
- From the above it can be concluded that magnetized water has enhanced the strength parameters of concrete.

SCOPE FOR FUTURE STUDIES:
The present work is concentrated on standard grade (M40) conventional and Magnetized water concrete. The same work can be extended to the higher grade concrete. Further the long term effects need to be studied.
Also it is recommended to develop the Magnetized water concrete by using different mineral admixtures like silica fume, metakaoline and their combinations and study the compatibility.
From the research data it depicts that the Magnetized water concrete shows no sign of corrosion when compared to a 1.25mm corrosion rate per year in conventional concrete. So the need for study of this magnetized water concrete in OFF-Shore structures is vital.

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