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EXPERIMENTAL STUDY ON STRENGTH CHARACTERISTICS OF GLASS FIBRE REINFORCED CONCRETE COLUMN IN SALT WATER ENVIRONMENT

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Abstract - *Glass fibre consists of finer fibres of glass which is manufactured with a bonding agent for strengthening of concrete. The concrete column of size 600 mm length x 150 mm wide and 300 mm deep was cast. The concrete columns were cast by 10 % of metakaolin replacement to cement. Totally 2 columns were cast. Among this one of the column was cured in potable water and another one column cured in salt water. This study comparatively analyzes to study the strength of glass fiber reinforced concrete columns using the non-destructive testing. Non-destructive testing such as rebound hammer and ultrasonic pulse velocity tests were conducted. The non destructive testing measurements were taken at the end of 7, 14, 28, 56 and 90 days of curing. Based on these observations, it was found that the strength is maximum at the 90 days curing. Finally, it was concluded that the strength obtained in salt water curing is similar to potable water curing.*

***Key Words*: Non destructive testing, Rebound hammer, Ultrasonic pulse velocity, Metakaolin, Glass fibre**

1. INTRODUCTION

Concrete is a composite and most durable construction material. Concrete is strong in compression, hence strength plays a major role in concrete. However concrete is weak in tension, so that crack may happen in concrete construction. Proper mix proportioning to be done to avoid cracking. One of the structural member such as columns are composed of ordinary Portland cement with GFRP (Glass Fiber Reinforced Polymer) and steel rebars. The GFRP rebars are used because it is a cost effective material which extend the life of structures where corrosion plays a vital role, installation process is convenient to cut and machined, increases the life span of the concrete structures and manufactured in custom lengths, bends and shapes. Mainly non-destructive testing used to determine the strength characteristics of construction.

Shahad Abdul Adheem Jabbar [1] had described that the GFRP rebars are good alternative material of steel in the applications of foundation and have achieved 13 % higher yield strength than to that of steel rebars. Ahmed B. Kizilkanat [2] discussed about the higher fibre content leads to greater compressive strength and BF (Basalt Fibre) addition is better than GF (Glass Fibre) for better workability and fracture behaviour. Filip Grzymski [3] shown the recycled fibres is six times lower efficiency in energy absorption after cracking of concrete matrix. Tassew [4] reports that concrete flow gets reduced when glass fibre added to a ceramic concrete matrix. Najia Saleh [6] observed that the shearing off between the steel ribs was responsible for a pull out failure. Xiaojian Gao [8] concluded that the plastic viscosity plays a major role in controlling the vibration. Yan Lv [9] reports that the fatigue performance of GFRC is much better than the plain cement concrete.

2. OBJECTIVE

To study the properties of metakaolin and salt water.

To determine the compressive strength of the concrete column.

To determine the quality of the concrete.

3. MATERIALS USED

3.1 Cement

Ordinary Portland cement of 53 grade (Ultra Tech) available in local market is used for this study. The properties of cement are given in the table 1.

Table -1: Properties of Cement

Properties	Values
Specific Gravity	3.13
Fineness Modulus	4 %
Initial setting time	35 min
Consistency	33 %

3.2 Coarse Aggregate

Crushed angular granite metal was used as coarse aggregate for this study. The 20 mm grade of coarse aggregate retained on 4.75 mm sieve are used. The properties of coarse aggregate are given in the table 2.

Table -2: Properties of Coarse Aggregate

Properties	Values
Specific Gravity	2.75
Bulk Density	1666.67 kg/m^3
Fineness Modulus	7.32
Water absorption	2

3.3 Fine Aggregate

M-Sand was used as a fine aggregate. The fine aggregate passing 4.75 mm sieve was used as fine aggregate. The Properties of fine aggregate are given in the table 3.

Table -3: Properties of Fine Aggregate

Properties	Values
Specific Gravity	2.66
Bulk Density	1520 kg/m^3
Fineness Modulus	3.82
Water absorption	0.7

3.4 Metakaolin

Metakaolin is widely used as mineral admixtures for high strength concrete mixes. The 10 % replacement of metakaolin to cement was used for this study. The metakaolin is off white, odourless, insoluble in water and non – explosive. The Specific gravity of metakaolin is found to be 2.6.

Fig -1: Metakaolin

3.5 Potable Water

Fresh potable water used for drinking purposes were used for mixing and curing the concrete column specimen. Water is more important to gain the strength properties of concrete specimens.

3.6 Salt Water

The 3.5 kg of crystal salt were dissolved in 100 litres of water for preparing the salt water. The properties of salt water are given in the table 4.

Table -4: Properties of Salt Water

Properties	Values
pH	8.3
Chloride	15243 ppm
Sulphate	212 ppm
Total Hardness	750 ppm
Total Dissolved Solids	18514 ppm
Calcium	124 ppm
Magnesium	83 ppm
Alkalinity	612 ppm

3.7 GFRP (Glass Fibre Reinforced Polymer) rebar

GFRP (Glass Fibre Reinforced Polymer) rebars of 10 mm diameter were used as an alternative material to steel mainly for the purpose of light weight, non corrosive and high mechanical performance.

Fig -2: GFRP Rebar

3.8 Steel Rods

Steel rods of size 8 mm diameter are provided as vertical ties for casting of concrete column specimen.

4. EXPERIMENTAL METHODOLOGY AND ANALYSIS OF RESULTS

4.1 Rebound Hammer Test

Rebound Hammer Test is one of the non-destructive testing methods. It gives convenient and rapid compressive strength of the concrete. This test is also called as Schmidt hammer test. The plunger of the rebound hammer is pressed against

the concrete surface. The surface hardness is measured with the help of graduated scale and the obtained value referred as rebound number (rebound index). As the days of curing gets increased, C-S-H gel plays a vital role in increasing the strength of the concrete. The compressive strength of the concrete column at 90 days of curing in salt water was found to be 58 N/mm$^{2.}$. It is slightly better than potable water curing. The compressive strength of the concrete is determined and the values are shown in the chart 1.

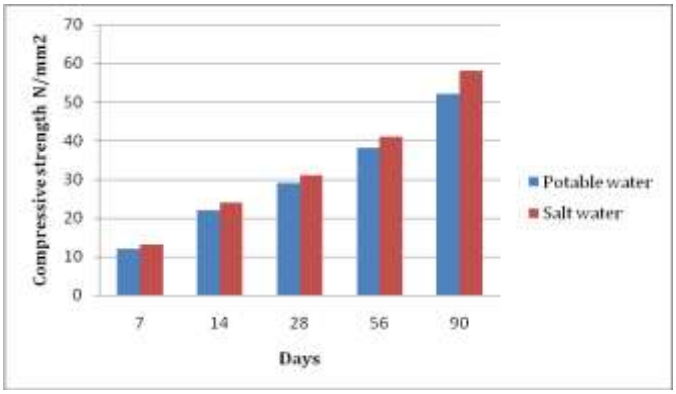

Chart -1 : Test results of rebound hammer

4.2 UPV (Ultrasonic Pulse Velocity) Test

Ultrasonic Pulse Velocity test is one of the non-destructive testing method. The quality of the concrete is determined by obtaining the value of pulse velocity. This test will not be influenced by the specimen shape. It provides the least lateral dimension not less than the pulse vibrations wavelength. The quality of the concrete is given in table 3.

Table -5: Quality of concrete

Days	Pulse Velocity km/s		Concrete Quality
	Potable Water	Salt Water	
7	2.1	2.1	Poor
14	3.1	3.2	Satisfactory
28	3.8	3.9	Good
56	5	5.3	Excellent
90	7	7.1	Excellent

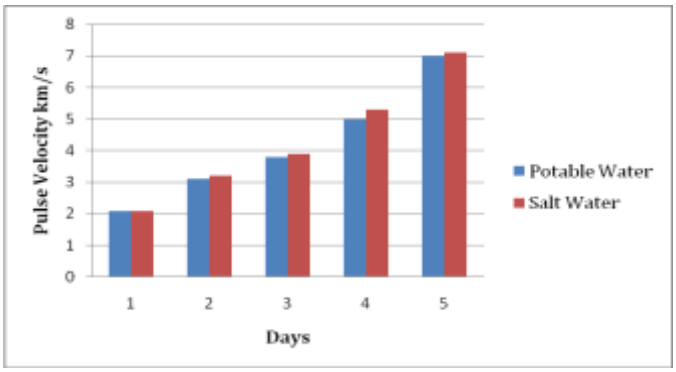

Chart -2 : Test results of UPV

5. CONCLUSION

From the above results, it has been observed that the compressive strength of the concrete column at 90 days curing in salt water is 58 N/mm^2 and potable water is 52 N/mm^2. The salt water curing gets increased 11.5% than the potable water curing. Hence salt water can be used as a replacement for potable water for curing and it will reduce the usage of potable water. The quality of the concrete is excellent both in potable and salt water curing of the specimen.

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