Journal of Advances in Science and Technology

Vol. 11, Issue No. 22, May-2016, ISSN 2230-9659

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AN INTERNATIONALLY INDEXED PEER REVIEWED & REFEREED JOURNAL

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Journal of Advances in Science and Technology
Vol. 11, Issue No. 22, May-2016, ISSN 2230-9659

Experimental Study on Salinity Effect on Properties of M20 Grade Concrete in Different Normality Condition

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Abstract – In the present experimental study, the effect of saline water on the properties of concrete was investigated. This paper presents the results of an experimental research on the effect of different Normality of saline water on properties of concrete. Total 24no of concrete cubes and cylinder were casted using fresh water and 0.2N, 0.4N and 0.6N saline water for a design mix of M-20 (1:1.5:3) concrete, and 0.55 W/C ratio. Concrete specimen were casted and cured with fresh water and remaining specimen were casted and cured with saline water. The concrete cubes were tested for 7,14 and 28 days respectively. The result of the compressive strength and Split Tensile strength of concrete obtained using fresh water at 28th day is 21.22 N/mm^2 & 3.225 N/mm^2 and using salt water at 0.2N, 0.4N and 0.6N results at 28th day is 21.41 N/mm^2,22.21 N/mm^2 & 22.91 N/mm^2.split tensile strength is 3.239 N/mm^2, 3.299 N/mm^2 &3.351 N/mm^2.

Keywords: - Concrete Specimen, Fresh Water, Salt Water, Compressive Strength. Split Tensile

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1. INTRODUCTION

Concrete is a mixture of cement, aggregates and water in a given proportions. Aggregates represent about 60-80% of the concrete volume. They are inert grains bound together by means of a binder which is cement. Although inert, they introduce an important contribution to these major characteristics which make concrete the most favoured building material. Cement generally represent 12-14% of concrete weight. It plays an active part in the mixture by ensuring cohesion between aggregate grains Water occupies 6-8% of the composition of fresh concrete. It provides for cement hydration and for the workability of the fresh concrete mixture.

The Quality and quantity of the water plays an important role in the preparation of concrete .Impurities in water may interfere the setting of the cement and may adversely affect the strength properties. The chemical constituents present in water may participate in the chemical reactions and thus affect the setting, hardening and strength development of mixture. The IS: 456(2000) code stipulates the water quality standards for mixing and curing. In some arid areas, local drinking water is impure and may contain an excessive amount of salts due to contamination by industrial wastes and it has excessive salt content near sea shores. Water is said to be salty if it contains chlorides and sulphates. Therefore an Experimental investigation carried out to test the effect of different percentage of salt on standard grade of concrete.

2. MATERIALS USED

a) Cement

b) Fine aggregate and Coarse aggregate

c) Water

d) Salt water

a) Cement

The most important use of cement is the production of mortar and concrete, which is a combination of cement and an aggregate to form a strong building material that is durable in the face of normal environmental effects. In the present investigation OPC 53 grade cement is used

Table 2.1: Results of Tests on Cement

S. no	Properties	Values obtained
1	Specific gravity	3.15
2	Standard consistency	35%
3	Initial setting time	65 min
4	Final setting time	300 min

b) Aggregate

Sand is naturally occurring granular material composed of finely divided rock and mineral particles. The most common constituent of sand is silicon dioxide, usually in the form of Quartz. Normally fine aggregate is used as fine aggregate for preparing concrete. The aggregate which passed through 4.75mm is called fine aggregate. The aggregate which retained above 4.75mmseive is called coarse aggregate .20mm size aggregate is used

Table 2.2: Results of Tests on Fine Aggregate

S. no	Properties	Values
1	Specific gravity	2.65
2	Fineness modulus	2.2
3	Water absorption	0.19%

Table 2.3: Results of Tests on Coarse Aggregate

S. no	Properties	Values
1	Specific gravity	2.6
2	Water absorption	0.82%
3	Zone	II

c) **Water -** Ordinary clean portable water free from suspended particles and chemical substances was used for both mixing and curing of concrete cubes cast with fresh water.

d) **Salt water:-** Seawater is water from a sea or ocean. On average, seawater in the world's oceans has a salinity of about 3.5% (35 g/L). This means that every kilogram (roughly one litre by volume) of seawater has approximately 35 grams of dissolved salts (predominantly sodium (Na+) and chloride (Cl−) ions).But in this Experiment the cubes were prepared using 0.2N (8gm) ,0.4N(16 gm) and0.6N (24 gm) of salts in one litre of water.

3. EXPERIMENTAL PROGRAM

In the present study we are casting and curing M20 Grade concrete using fresh water and Salt water. The saline water is prepared by adding salt in different proportions by volume of water I,e (grams/litre) 0.2N (8gm) ,0.4N(16 gm) and0.6N (24 gm) Total 24 no of Specimen were casted .12 No cubes of 150mm x 150mm x150mm size and 12 No of cylinder of 150mm x 300mm size. The prepared specimens were cured for 7 days,14 days and 28 days in Fresh water and Saline water and were tested for compressive strength and split tensile strength of the specimen, the details of the experimental program for specimen are mentioned below.

Saline water Preparation for 0.2N, 0.4N and 0.6N

$$\text{Normality} = \frac{\text{Equivalent Wt(EW)}}{\text{vol of Solution(1000ml)}}$$

Total Molecular Wt of Nacl =40gm

a) $0.2N = \frac{2}{10} \times 40 = 8\ gm/l$ i,e 8gm per 1000ml(1Litre)

b) $0.4N = \frac{4}{10} \times 40 = 16\ gm/l$ i,e 16gm per 1000ml(1Litre)

c) $0.6N = \frac{6}{10} \times 40 = 24\ gm/l$ i,e 24gm per 1000ml(1Litre)

Table 3.1: Mix of salt added in water

M20 Grade Concrete (1:1.5:3)	Fresh water	Saline water Salt added(gm/l)
	Normal Water	8gm/l
		16gm/l
		24 gm/l

Fig 3.1: Salt

4. TEST RESULTS

4.1 Workability: The ability of concrete by which it can be mixed, transported, placing and compacting is known as workability

4.1.1 Slump test

Ingredients of mixes are properly mixed so as to produce homogeneous and uniform fresh concrete in macro-scale in order to know its workability using slump test. The results of same test for the conventional concrete (fresh water) and saline water concrete. The slump is in between 40mm-80mm.

Fig 4.1: Slump Cone Test

4.2 Compressive Strength of Concrete Cubes:

This test is done to determine the cube strength of concrete mix prepared. The test is conducted on the 7th, 14th and 28th day and their observations are listed below in the form of a graph. Compressive strength values for Fresh water and saline water with salt 0.2N, 0.4N and 0.6N.in casting and curing condition.

4.3 Tensile strength of cylinder: This test is done to determine the tensile strength of the cylinders. The test is conducted on the 7th ,14th and 28th day and its observation are listed below in the form of a graph. The cylinder is placed in a horizontal position and the load is applied gradually and value is recorded if the cylinder splits into two half or if the cylinder fails while applying the load on it. Tensile strength values for Fresh water and saline water with salt 0.2N, 0.4N and 0.6N.in casting and curing condition.

Fig 4.2: Curing Tank

Fig 4.3: compressive strength Test

Compressive Strength of Concrete Cubes:

Table 4.1: Results of compressive strength

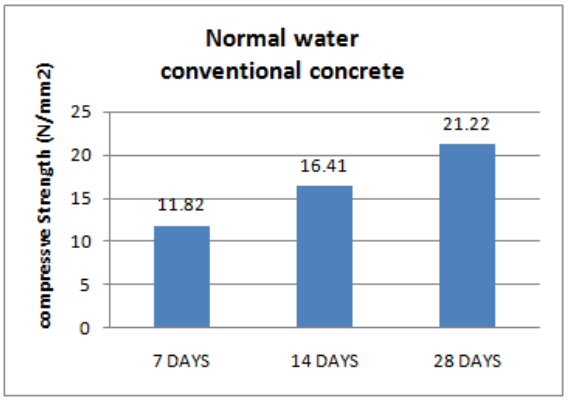
S.No	Saline water Salt added (gm/l)	Compressive Strength (N/mm2)		
		7th Day	14th Day	28th Day
1	Normal water	11.82	16.41	21.22
2	0.2N (8gm/l)	11.61	16.72	21.41
3	0.4N (16gm/l)	12.14	17.10	22.21
4	0.6N (24gm/l)	12.46	17.61	22.91

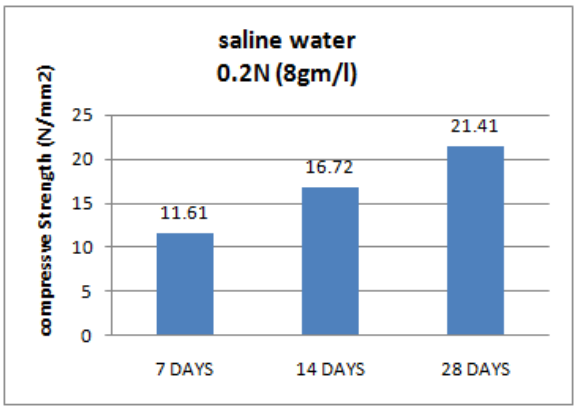
Split Tensile Strength of Concrete:

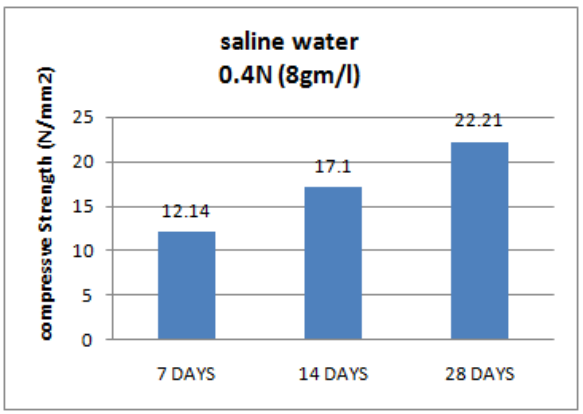
Table 4.1: Results of split tensile strength

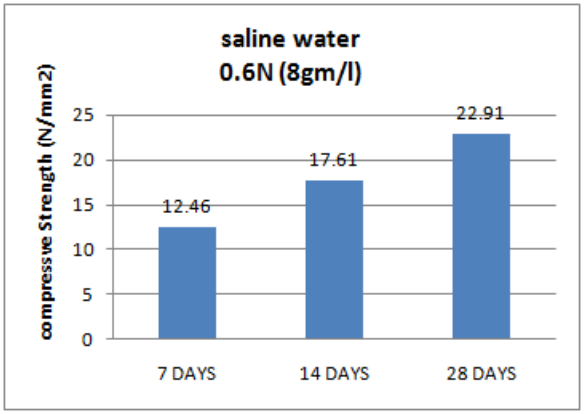
S.No	Saline water Salt added (gm/l)	Tensile Strength (N/mm2)		
		7th Day	14th Day	28th Day
1	Normal water	2.407	2.836	3.225
2	0.2N (8gm/l)	2.385	2.862	3.239
3	0.4N (16gm/l)	2.439	2.895	3.299
4	0.6N (24gm/l)	2.471	2.937	3.351

Compressive strength Graphs

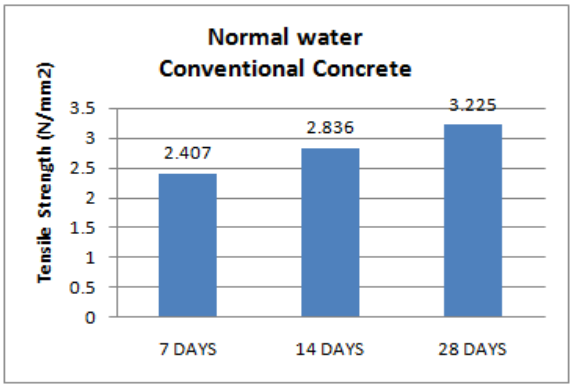


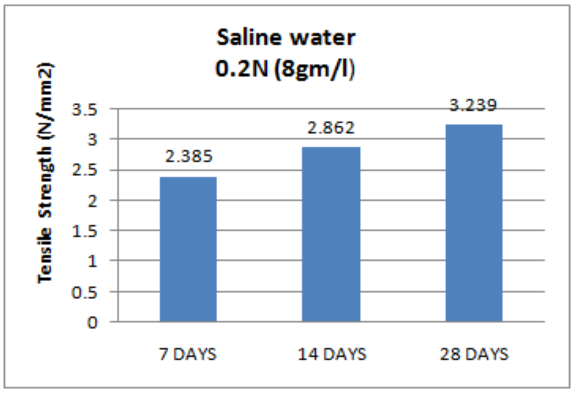


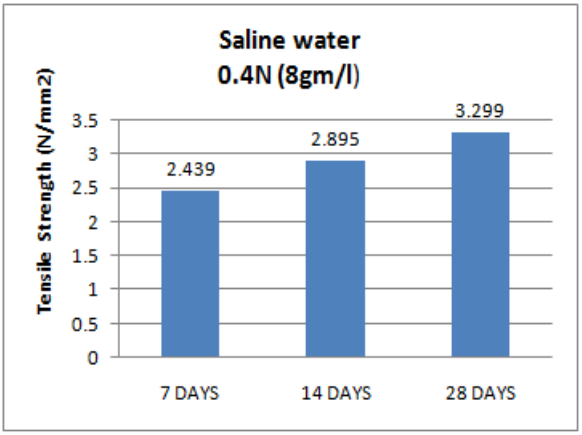


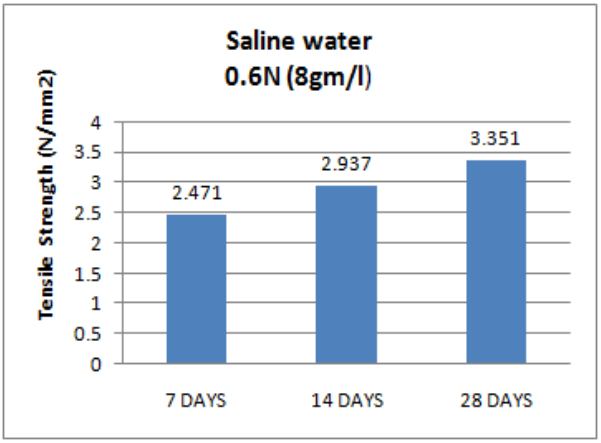


Split Tensile strength Graphs









CONCLUSION:

- The strength of concrete cubes and cylinder cast and cured in fresh. The 28th day strength was found as 21.22 N/mm^2 and 3.225 N/mm^2 respectively.
- The strength of concrete cubes and cylinders cast and cured in salt water at 0.2N, 0.4N and 0.6N. The 28 days strength was found as 21.41 N/mm^2, 22.21 N/mm^2 & 22.91 N/mm^2.split tensile strength is 3.239 N/mm^2, 3.299 N/mm^2 &3.351 N/mm^2 respectively
- There is marginal increase in the strength of cubes and cylinder cast and cured in salt water as compared to those of cast and cured in fresh water at all ages of curing.
- From the above finding we can conclude that there is no reduction in the strength if we use salt water casting and curing the concrete. There is some increase in the strength if salt water is used for casting and curing. This concrete can be used for mass concreting without any decrease in strength properties.

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