EFFECT OF SEA WATER IN MIXING AND CURING ON STRENGTH OF CONCRETE

Paramesu Chintagada[1], Anusuri Uma Maheswari[2]

[1] *PG Student, Civil Department, Chaitanya Engineering College, Kommadi, Andhra Pradesh, India*
[2] *Assistant Professor & HOD, Civil Department, Chaitanya Engineering College, Kommadi, Andhra Pradesh, India*

ABSTRACT

In construction field billion tons of water is used for mixing, curing and cleaning around the world, annually. Due to this there is a large scarcity of fresh drinkable water around the world; so there is a need to save fresh water. So a study is being carried out on sea water whether to use it for mixing and curing concrete. Additionally, if use of seawater as concrete material is permitted, it will be very convenient and economical in the construction; especially in the coastal works. The effect of seawater on concrete deserves special attention as the coastal and offshore structures are exposed to simultaneous action of a number of physical and chemical deterioration processes. Moreover, 80 percent of the earth is covered by seawater either directly or indirectly (e.g. winds can carry sea water spray up to a few miles in land from the coast). In this research work, the effect of sea water and fresh water on the concrete is going to be investigated. For the preparation of concrete specimens M40 mix was adopted. The concrete specimens were cured in fresh water and salt water and tested for compressive strength at 3, 7 and 28 days, for split tensile and flexural strength at 7 and 28 days. The test result showed that the compressive strength of cubes, split tensile strength and flexural strength of concrete specimens which were cast and cured with salt water is slightly higher than the concrete specimens casted and cured with fresh water. This trend is observed for testing of cubes at different ages of curing.

Keyword : - *Sea water, Conpressive Strength, Flexural Strength, Split Tensile Strength..*

1. INTRODUCTION

In concrete industry, many billion plenty of H_2O is annually used, as mixing, hardening and cleansing water, round the world. From the view point of saving water, it's believed that the chances of victimization water as mix water in concrete got to be investigated seriously. Moreover, if the utilization of saltwater as a solid material is allowed, it'll be very advantageous and conservative within the development, significantly within the seacoast. According to IS 456:2000, mixing or curing of concrete with sea water is not recommended because of presence of harmful salts. Under inevitable situation sea water may be used for mixing and curing in plain concrete with no embedded steel after having given due consideration.to possible disadvantages and precautions including use of appropriate cement system. The need to use sea water for construction arises in such situations where no other source of fresh water is available or costly to transport. Such conditions have occurred along the sea coast construction. In the present investigation the effects of salt water on compressive strength, split tensile strength and flexural strength of concrete are determined, M-40 grade of concrete is used to determining the effect of salt water. Four mix categories were prepared.

1.1 Objectives

a) To study about the salinity of salt water
b) Collection of various materials required for project from different outsources.
c) To design a concrete mix for M40 grade as per Indian standard recommended method.
d) To cast cubes, beams & cylinder by using a various ingredients as per mix design.
e) To test the casted cubes, beams & cylinders for strength after 3, 7 and 28 days of curing respectively
f) To perform various test like compressive test, Flexural test, split tensile test.
g) To compare the variation of M30 grade of concrete by plotting a graph

1.2 Materials

(a) Coarse Aggregate: Crushed granite stone aggregate of maximum size 20mm confirming to IS 383-1970 was used. The coarse aggregate used in this investigation was aggregate retained on 4.75 mm sieve with specific gravity of 2.75.

(b) Fine Aggregate (sand): The fine aggregate used in this investigation was sand passing through 4.75 mm sieve with specific gravity of 2.71. The grading zone of fine aggregate was zone III as per Indian standard specification.

(c) Cement: Cement is a main element of concrete as it acts as a binding material, binds aggregates together. Cement is almost used in all construction works that involve use of concrete. OPC 53 grade Cement was used.

(d) Fresh 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.

(e) 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, or 599 mm).

2. LITERATURE REVIEW

[A] Dr. Amit Vishwakarma, Anubhav Rai, Abhishek Patel, (2020), "Effect of Salt Water on Compressive Strength, Flexural Strength and Durability of a Concrete":

In this thesis the study of compressive strength, flexural strength and durability of concrete and cement mortar cast and cured with Potable water, cast and cured with salt water is carried out. The present study is carried out in 2 phases .In first phase concrete cubes, concrete beam and mortar cubes cast and cured with Potable water for M30 grade and 1:3 cement mortar . In second phase concrete cubes, concrete beam and mortar cubes cast and cured with salt water M30 grade and 1:3 cement mortar. The result obtained from this research has shown that compressive strength, flexural strength increases with the use of salt water and durability of concrete decreases.

[B] Abhishek Patel, Anubhav Rai, Vedant Shrivastava, (2019), "Effect Of Salt Water On Compressive Strength Of Cement Mortar":

This study is aimed to investigate the effect of salt water on strength of cement mortar cubes cast using fresh and salt water separately, in which half of cubes were cast with fresh water and remaining half were cast with salt water. For the preparation of mortar cubes a mix ratio 1:3 (cement: sand) was adopted. The mortar cubes were prepared as per

relevant IS code of practice. The mortar cubes were cured in fresh water and salt water and tested for compressive strength at 3, 7 and 28 days. The test result showed that the compressive strength of cubes which were cast and cured with salt water is slightly higher than the cubes casted and cured with fresh water.

[3] B.Sathish kumar, P.Samuthirapandiyan, K.Sabari rajan, A.Subalakshmi, (2018), "Effect of Sea Water and Strength Of Concrete":

In this research work, the effect of sea water and fresh water on the concrete is going to be investigated. Totally 27 specimen (9 cubes, 9 cylinders, 9 beams) were casted and cured with fresh water and other 27 specimens (9 cubes, 9 cylinders, 9 beams) were casted and cured using sea water. The concrete cubes were cured for 7, 14 and 28 days. This paper presents the results of an experimental research on the effect of salt water and fresh water on compressive strength, split tensile strength and flexural strength of concrete.

3. EXPERIMENTAL WORK

To investigate the effect of salt water and fresh water on the compressive strength of concrete, concrete cubes were made, in which some of concrete cubes were casted and cured with fresh water and remaining concrete cubes were casted and cured with sea water.Due to controversy over the usage of sea water for mixing and curing of concrete, a research is carried out to find out the influence of sea water on the strength of concrete. The following four approaches are made:

(a) Casting and Curing the concrete using Fresh Water (FF)
(b) Casting concrete using Fresh Water and Curing with Salt Water (FS)
(c) Casting concrete using Salt Water and Curing with Fresh Water (SF)
(d) Casting and Curing the concrete using Salt Water (SS)

3.1 Material Properties

Table 1: Physical Properties of Cement

S.NO.	Property of Cement	Values Obtained
1.	Standard Consistency	29%
2.	Initial Setting Time	42 minutes
3.	Final Setting Time	480 minutes
4.	Fineness	8%
5.	Specific Gravity	3.15

Table 2: Physical Properties of Fine Aggregate

S.NO.	Property of Fine Aggregate	Values Obtained
1.	Specific Gravity	2.71
2.	Fineness Modulus	2.89
3.	Grading Zone	III
4.	Water Absorption (%)	1.5

Table 3: Physical Properties of Coarse Aggregate

S.NO.	Property of Coarse Aggregate	Values Obtained
1.	Specific Gravity	2.75
2.	Fineness Modulus	8.79
3.	Water Absorption (%)	0.5

3.2 Mix Design

The various quantities of mix design for M30 grade of concrete are carried out by mix design as per IS 10262: 2009

- Volume of concrete = 1cum.
- Water Cement ratio =0.40
- Quantity of Cement = 492.5kg/m^3.
- Quantity of Water = 197 litres
- Quantity of fine aggregate =754.97 kg/m^3.
- Quantity of coarse aggregate=1025.31 kg/m^3.
- Quantity of admixture =1.84Kg.

C: FA: CA= 1:1.532:2.200

3.3 Test Results

Table 4: Compressive Strength results of Concrete Cubes

Mix designation	Compressive strength (N/mm^2)		
	3 days	7 days	28 days
FF	**16.45**	**28.34**	**42.56**
FS	**16.89**	**28.74**	**42.91**
SF	**17.56**	**29.01**	**43.05**
SS	**18.12**	**29.87**	**44.21**

Chart 1: Compressive Strength results of Concrete Cubes

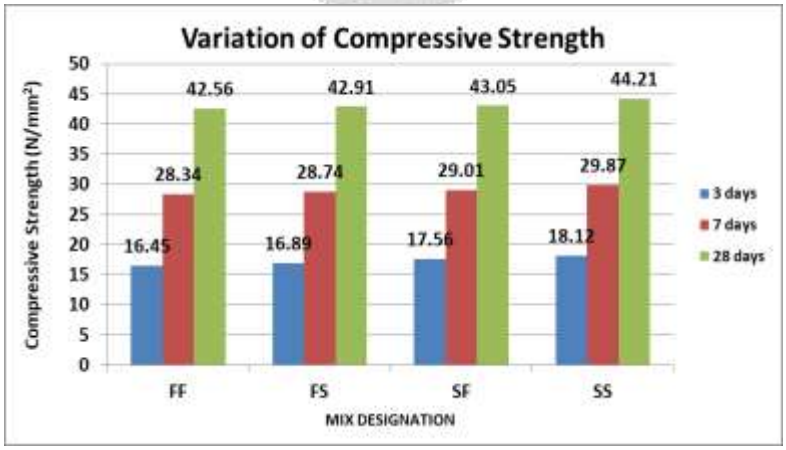


Table 5: Split Tensile Strength results of Concrete Cylinders

Mix Designation	Split Tensile Strength (N/mm^2)	
	7 days	28 days
FF	3.96	4.70
FS	4.03	4.78
SF	4.67	5.04
SS	5.01	5.56

Chart 2: Split Tensile Strength results of Concrete Cylinders

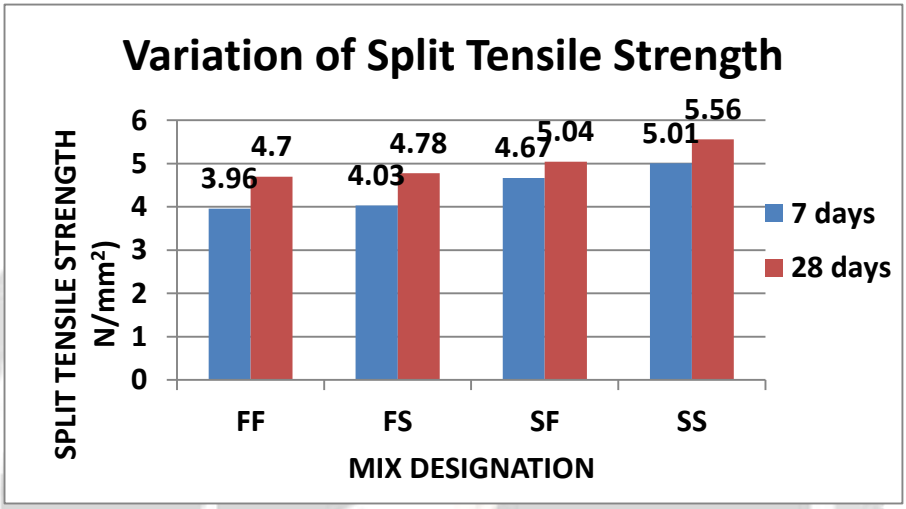
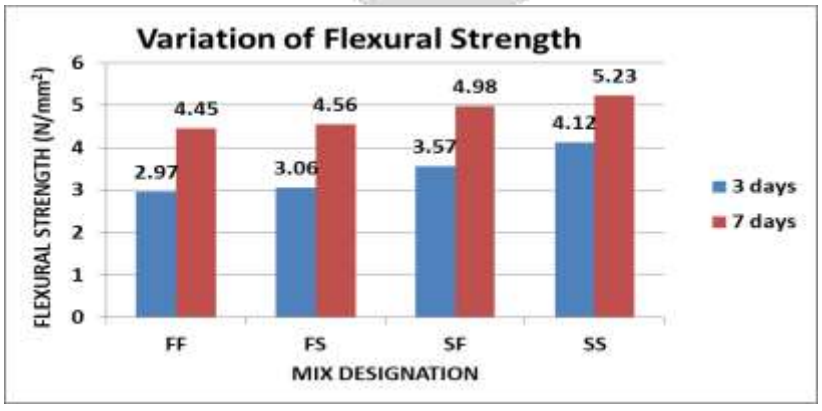


Table 6: Flexural Strength results of Concrete Prisms

Mix Designation	Flexural Tensile Strength (N/mm^2)	
	7 days	28 days
FF	2.97	4.45
FS	3.06	4.56
SF	3.57	4.98
SS	4.12	5.23

Chart 3: Flexural Strength results of Concrete Cylinders



4. CONCLUSIONS

Four alternative design conditions are developed on water for mixing & curing of concrete. There is higher in the strength of concrete specimen cast & cured with salt water as compared to those of cast & cured in fresh water. The rate of the strength gain in fresh water cubes is slow as compared with salt water. here is marginal increase in the compressive strength, split tensile strength and flexural strength of concrete cube, cylinder and beam 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 & curing the concrete. This concept can be used for region having more salty water, rural area having salty bore water.

5. REFERENCES

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BIOGRAPHIES

	Anusuri Uma Maheswari, working as an HOD & Assistant Professor in Dept. of Civil Engineering, Chaitanya Engineering College,Kommadi.
	Paramesu Chintagada, pursuing M.Tech Degree in ChaitanyaEngineering College, Kommadi.