

# Comparative Study of Effect of Salt Water and Fresh Water on Concrete

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**Abstract** - In this research work, the comparative study of effect of salt water and fresh water on concrete was investigated. This paper presents the result and findings of an experimental research on the effect of salt water and fresh water on compressive strength, flexural strength, split tensile strength of concrete. For this concrete cubes, beams, cylinders were cast using fresh water and salt water for a mix of M-30 1: 2.093: 4.038 by weight of concrete and 0.45 water cement ratio. This concrete cubes, beams, cylinders were cure using fresh water and salt water. A total specimen of 24 cubes, 24 beams, and 24 cylinders including specimens for reference concrete were cast for both mixes and exposed to 7 days and 28 days period of curing. The reference concrete was prepared with PPC using only fresh water and salt water both for mixing and curing.

**Key Words:** Fresh Water, Salt Water, Compressive Strength, Flexural Strength, Split Tensile Strength

## 1. INTRODUCTION

Concrete is one of the major building materials use in modern day construction, because of its durability to cost ratio. Today's concrete is made using Portland cement, coarse and fine aggregates of stone and sand, and water. Admixtures are chemicals added to the concrete mix to control its setting properties and are used primarily when placing concrete during environmental extremes, such as high or low temperatures, windy conditions, etc.

It is difficult to find out alternate materials for construction which is as suitable as that of such material from durability and economic of view. Out of that water plays an important role as in preparation of concrete. Water is main ingredient of concrete as it actively participates in chemical reactions with cement. Today's construction sector drinking water use in lot of amount. Investigation on saving fresh water is seriously needed. As world consist more than 70% land covered by oceanic water oceanic water having salty test

The primary chemical constituents of seawater are the ions of chloride, sodium, magnesium, calcium and potassium. The concentrations of major salt constituents of

seawater we are given in weight % of salt as 78%NaCl, 10.5%MgCl, 5%MgSO<sub>4</sub>, 3.9%CaSO<sub>4</sub>, 2.3%K<sub>2</sub>SO<sub>4</sub>, and 0.3% KBr.(O.O. Akinkulere, 2007) On an average sea water having total salinity about 3.5% per litre of sea water. Water containing large quantities of chlorides (sea water) tends to cause persistent dampness and surface efflorescence.

In the present investigation the effects of salt water on Compressive strength, Flexural Strength, Split Tensile Strength of concrete are determined. M-30 grade of concrete is used to determining the effect on salt water and fresh water on concrete.

### 1.1 Materials

The following are details of concrete ingredients materials such that coarse aggregate, fine aggregate, cement and water used in the experimental investigation. Coarse aggregate, fine aggregate and cement purchased from nearest place.

#### 1. Coarse Aggregate -

Crushed granite stone aggregate of maximum size 20mm confirming to IS 383-1970 was used. The coarse aggregate used in this investigation from nearest construction site at Maharshi Nagar, aggregate retained on 4.75 mm sieve with specific gravity of 3.2.

#### 2. Fine Aggregate (sand) -

The fine aggregate used in this investigation From nearest construction site at Maharshi nagar sand passing through 4.75 mm sieve with specific gravity of 2.95. The grading zone of fine aggregate was zone II as per Indian standard specification.

**3. Cement-:** Portland Pozzolana Cement (Dalmia cement) was used. Portland pozzolana cement is kind of blended cement which is produced by either inter grinding of opc clinker along gypsum along with pozzolanic material in certain proportion of grinding the OPC clinker.

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

**5. 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<sup>+</sup>) and chloride (Cl<sup>-</sup>) ions). The cubes were prepared using 35g of salts in one litre of water

## 2. LITERATURE REVIEW

O. O. Akinkulere <sup>(1)</sup> et.al in 2007 suggested that The compressive strength of concrete is shown to be increased by the presence of salt or ocean salt in the mixing & curing water. the rate of strength gain is also affected when the concrete is cast & cured with salt water & vice versa. Mixing concrete with salt water increases the compressive strength rapidly & the strength was still increasing at 28 days.

Preeti Tiwari <sup>(6)</sup> et.al In 2014 suggested that there was an marginal increase in the of concrete cubes which were casted and cured with salt water as compared with the concrete cubes cast and cured with fresh water. The rate of the strength gain in fresh water cubes is slow as compared with the salt water cubes. At 28 days, the rate of strength gain is still increasing in all the concrete cubes. The fresh water cubes also recorded its maximum strength at 28 days. Although, the compressive strength of the salt water concrete cubes was slightly higher than that of the fresh water concrete cubes.

P. Krishnam Raju<sup>(8)</sup> et.al In 2014 suggested that there is no quantitative reduction in compressive strength compared to target strength when the concrete is exposed to both "potable water mixing and sea water curing" and "mixing and curing by sea water". There is an increase in 7 days Split tensile strength of concrete for "Potable water mixing and sea water curing" in M30 and M35

Olutoge, F. Adeyemi <sup>(11)</sup> et.al In 2014 suggested that It was observed that concrete cast and cured with seawater increases gradually for all curing days beyond the strength of control cast (FF). The compressive strength of concrete batches FF agrees with the value of the compressive strength of 1:2:4 mix at 28days, of about 20N/mm<sup>2</sup>.The strength of concrete batches cast with salt water and cured with fresh water (SF) was also observed to have increased even at 28 days and 90days respectively.

Swati Maniyal<sup>(12)</sup>et.al In 2015 suggested that during mixing and curing on compressive strength of concrete. The necessity of this research work is that, commonly water used for concreting is water from boreholes which contains

number of salts and hence we are testing it for extreme case i.e. sea water case

## 3. OBJECTIVE

1. To study the effect of Compressive strength, Flexural strength and Split Tensile strength on concrete.
2. To study the variation of M30 grade of concrete by plotting graph compressive strength, Flexural strength & split Tensile strength versus curing time (in days 7 and 28).
3. Comparing series of cubes, beams and cylinders cast with fresh water as well as salt water and cured with fresh water as well as salt water.
4. To suggest that possibility of salty water as a mixing water or curing.
5. By providing alternate method which result into saving a fresh water.
6. To give a better solution to the society.

## 4. METHODOLOGY

- To find out number of literature on effect of fresh water and salt water on concrete.
- To study about the salinity of salt water
- Collection of various materials required for project from different outsources.
- To design a concrete mix for M30 grade as per Indian standard recommended method.
- To cast cubes, beams & cylinder by using a various ingredients as per mix design.
- To test the casted cubes, beams & cylinders for strength after 7, 28 days of curing respectively
- To perform various test like compressive test, Flexural test, split tensile test.
- To compare the variation of M30 grade of concrete by plotting a graph

## EXPERIMENTAL WORK:-

### 4.1 CEMENT

IS mark cement (Brand -Dalmia cement) was used for all concrete mixes. The cement used was fresh and without any lumps. Testing of cement was done as per IS: 8112-1989. The various tests results conducted on the cement are reported Table 1

Table No.1: Properties of Cement

Sr. No	Characteristics	Standard Values	Obtained Values
1	Fineness (%)	<10	5.2
2	Standard Consistency (%)		28
3	Initial Setting Time(minutes)	Not less than 30 minutes	35
4	Final Setting Time(minutes)	Not more than 600 minutes	560

#### 4.2 COURSE AGGREGATE

Locally available coarse aggregates having the maximum size of 20 mm aggregate. Testing of coarse aggregate was done as per IS: 383-1970.

Table No.2: Properties of Coarse aggregate

Sr. No.	Characteristic	Values
1	Specific Gravity	3.2
2	Total Water Absorption (%)	1.2
3	Total Crushing Value Test (%)	35
4	Grading Zone	II

#### 4.3 FINE AGGREGATE

The sand used for the experimental programmed was locally procured and conformed to grading zone II as per IS: 383-1970.

Table No.3: Properties of fine aggregate

Sr. No.	Characteristic	Values
1	Types	Artificial crushed sand
2	Specific Gravity	2.95
3	Water Absorption (%)	0.8
4	Grading Zone	II

#### 4.4 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 = 369.675Kg.
- Quantity of Water = 147.87 Liter
- Quantity of fine aggregate =774 Kg.
- Quantity of coarse aggregate=1493 Kg.
- Quantity of admixture =1.84Kg.

C: FA: CA= 1:2.093:4.038

#### 4.5 EXPERIMENTAL PROCEDURE

To investigate the effect of salt water and fresh water on concrete specimen will determine, the concrete cubes, beams and cylinders were made, in which cubes, beams and cylinders were cast and cured with fresh water as well as also with salt water. The amount salt (NaCl) used in water was kept was 35g/liter. Same concept also used for curing of remaining specimen

The details of the concrete specimen preparation conditions are given below

- FF :- concrete cast and cured with fresh water
- SF :- concrete cast with salt water & cured with fresh water
- FS :- concrete cast with fresh water & cured with salt water
- SS :- concrete cast and cured with salt water

The concrete cube size measuring 150×150×150 mm, concrete beam size 100mm x 100mm x 500mm, cylindrical mould of size 150mm x 300mm in dimension will be used. The concrete cubes were cast and cured for 7 and 28 days and will be tested for compressive strength, flexural strength, split tensile strength.

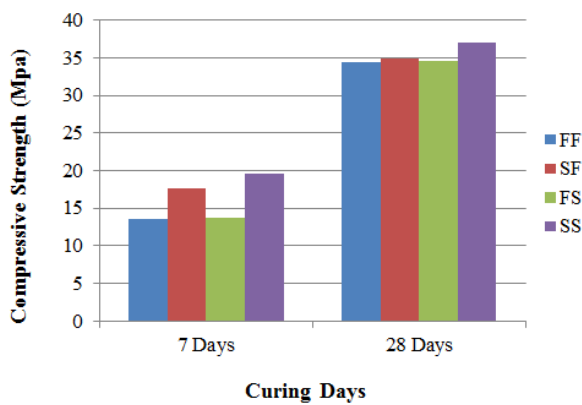
#### 5. TEST RESULT

The test was carried out confirming to IS 516-1959 to obtain compressive strength, Flexural strength, and Split tensile strength of concrete at the age of 7, 28 days. The cubes using Compressive Testing Machine, Beams and cylinder were tested using Universal Testing Machine. The result of compressive strength, split tensile strength and flexural strength are tabulated in Table-4, 5, 6

### 5.1 Compressive Test

Table-4: Compressive strength test result

Mix Designation	Compressive strength (N/mm <sup>2</sup> )	
	7 DAYS	28 DAYS
FF	13.60	34.46
SF	17.61	34.96
FS	13.81	34.52
SS	19.59	37.04

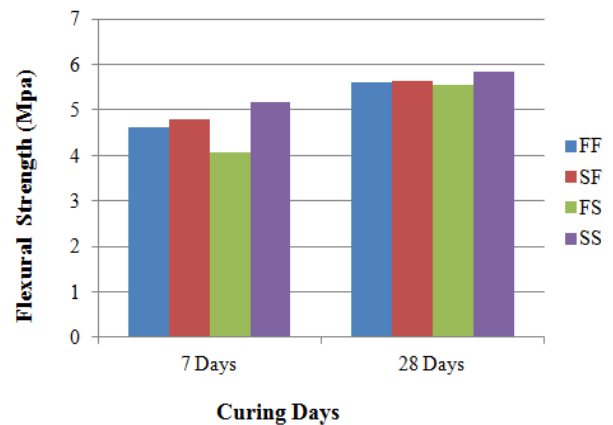


Variations of compressive strength

### 5.2 Flexural Test

Table-5: Flexural strength test result

Mix Designation	Flexural strength (N/mm <sup>2</sup> )	
	7 DAYS	28 DAYS
FF	4.61	5.61
SF	4.81	5.64
FS	4.07	5.56
SS	5.16	5.83

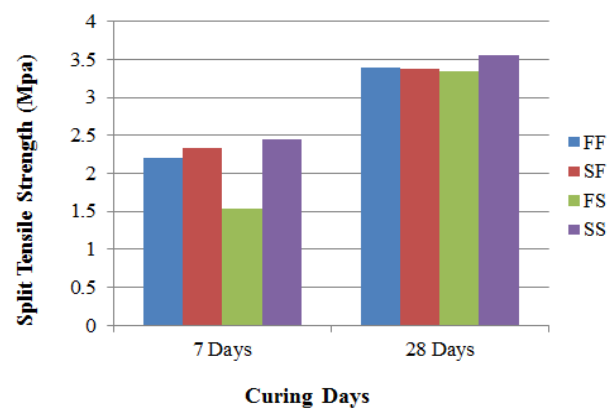


Variations of flexural strength

### 5.3 Split Tensile Test

Table-6: Split Tensile strength test result

Mix Designation	Split Tensile Strength (N/mm <sup>2</sup> )	
	7 DAYS	28 DAYS
FF	2.20	3.40
SF	2.33	3.37
FS	1.53	3.34
SS	2.45	3.55



Variations of Split tensile strength

## 6. CONCLUSIONS

- Series of experiment were conducted on M30 grade of concrete by this project work , the effect of salt water on compressive strength, flexural strength and split tensile strength of concrete was investigated
- 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.
- 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

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