EFFECT OF SEA WATER AND STRENGTH OF CONCRETE

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Abstract - *Construction engineering in coastal areas are facing the challenge of shortage of fresh water for mixing and curing. The quality of water places an important role in the setting and strength development of concrete structures. The investigation aimed to use sea water in thondi region both for mixing and curing of concrete as the potable water is a scarce commodity on the planet. At least sea water can be adopted in the construction industry as an alternative ingredient to potable water particularly in the coastal region. 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 going to be cured for 7, 14 and 28 days. This paper going to 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.*

Key Words **:**(sea water, Compressive Strength, Split durability, flexural 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. In any case, in the majority of the fortified solid principles, the utilization of seawater isn't allowed because of the danger of early consumption of support, actuated by Nacl in seawater mixes. The quality of the water plays an important role in the preparation of concrete.

In one in every of the facts in arid countries, desalinated water mixed with salt water used for concrete creating purpose and for creating concrete suspension additionally. Around 80 percent of the surface of the earth are secured by seas; in this manner, an expansive number of structures are presented to ocean water with high saltiness either straightforwardly, or in a roundabout way when winds conveys ocean water shower up to a couple of miles inland from the drift. Subsequently, a few seaside and seaward ocean structures are presented to the ceaseless activity of physical also, concoction crumbling forms. This test of building and keeping up strong solid structures in beach front environs have long turned into a difficult issue to the general population living here. The IS: 456(2000) code stipulates the water quality gauges for blending and curing. In some parched territories, neighbourhood drinking water is debased and may contain an unreasonable measure of salts because of tainting by modern squanders. At the point when chloride does not surpass 500 PPM or SO3 does not surpass 1000 PPM, the water is safe, but water with even higher salt contents has been used Satisfactorily (Building research station11956). Building Research Station reported the success recorded in the use of water with higher salts contents such as chloride (higher than 500ppm) and tri-oxo-sulphate V (higher than 1000ppm).

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, and 5%mgso4, and 3.9%caso4, and 2.3%k2so4, and 0.3% kbr. (o.o. akinkurolere, 2007) on average sea water having total salinity about 3.5% per liter of sea water. Water containing massive quantities of chlorides (sea water) tends to cause persistent moistness and surface efflorescence. Within the present project the consequences of salt water on compressive strength, flexural strength, split tensile strength of concrete are determined. M-40 grade of concrete is used to determining the effect on salt water and fresh water on concrete.

2. OBJECTIVES OF STUDY

- To study the effect of Compressive strength, Flexural strength and Split Tensile strength on concrete.
- To study the variation of M40 grade of concrete by plotting graph compressive strength, Flexural strength & split Tensile strength versus curing time (in days 7, 14 and 28).
- To suggest that possibility of salty water as a mixing water or curing.
- By providing alternate method which result into saving a fresh water.
- To give a better solution to the society

3. LITERATURE REVIEW

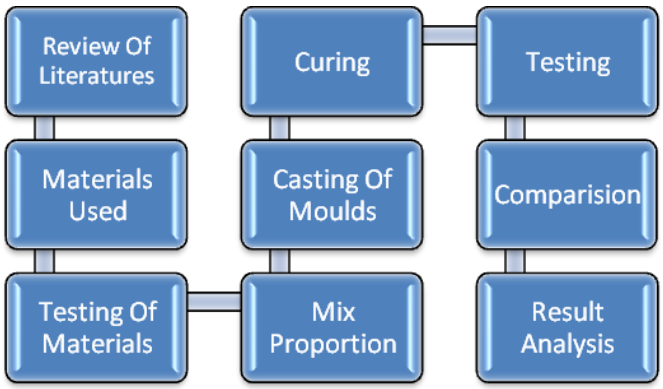
MORI et.al in 1981 revealed that the distinction of quality between concrete blended with seawater and new water is moderately little following 10 years of presentation test. Moreover, Yamamoto et.al in 1980 recommended that the

solid blended with ocean water may indicate higher quality contrasted and new water blending under nature beneath 15ºC.

AKINKUROLERE (1) et.al in 2007 proposed that the compressive quality of cement is appeared to be expanded by the nearness of salt or sea salt in the blending and curing water. The rate of quality pick up is additionally influenced when the solid is thrown and cured with salt water and the other way around. Blending concrete with salt water builds the compressive quality quickly and the quality was all the while expanding at 28 days.

MD. MOINUL ISLAM (3) et al in 2012 examined the suitability of sea water for mixing and curing of concrete. They studied the effect of sea water on compressive strength of concrete when used as mixing & curing water. Different mix ratios of concrete were prepared with different water cement ratios. Test specimens were cured under sea water of varying normality i.e.1N, 3N, and 5N, as well as plain water up to 180 days. (1N sea water means normal sea water made by mixing tap water with exact amount and proportion of principal salts found in natural sea water.) . They concluded that concrete specimen made & cured with sea water exhibits compressive strength loss of about 10% compared to plain water mixed and cured concrete. Also, their result showed that compressive strength is reduced with increase in seawater concentrations (i.e. increase in normality) and the nature of variation of strength is not proportional.

4. METHODOLOGY



i. CASTING

Casting is the process of mixing the required amount of materials (according to the mix design) together and placing them in a standard mould and allowing to dry for about 8-10 hours and bringing back the concrete for the process of curing.

ii. CURING

Curing is the support of an acceptable dampness substance and temperature in concrete for a timeframe promptly following putting and completing with the goal that the coveted properties may create. The requirement for satisfactory curing of cement can't be overemphasized. It impacts the properties of coagulated cement; legitimate curing can expand strength, quality, water-snugness, scraped area protection, volume solidness, and protection from natural action and defrosting and deicers.

5. MATERIAL TEST

A. CEMENT

Table -1: Properties of cement

S.NO	PROPERTIES	TEST RESULT	As per IS
1.	Specific gravity	3.17	
2.	Fineness	1.33	
3.	Consistency	30%	
4.	Initial setting time	50 min	Min 30 mins
5.	Final setting time	350 min	Max 600 mins

B. COARSE AGGREGATES

Table -2: Properties of coarse aggregate

S.NO	PROPERTIES	TEST RESULT
1.	Specific gravity	2.79
2.	Fineness modulus	7.17
3.	Bulk density	1741
4.	Water absorption	1.83

C. FINE AGGREGATES

Table -3: Properties of fine aggregate

S.NO	PROPERTIES	TEST RESULT
1.	Specific gravity	2.45
2.	Fineness modulus	3.6
3.	Bulk density	1753
4.	Water absorption	1.2

D. SEA WATER

Table -4: Properties of sea water

S.NO	PROPERTIES	TEST RESULTS
1.	PH	11.96
2.	Total Hardness	190ppm

6. MIX DESIGN

Indian standard recommended method of concrete mix design (IS 10262 1982) was first introduced during the year 1982. In the revision of IS 456-2000, a number of changes were introduced in IS 456 which necessitated the revision of IS 10262-1982. A committee was set up to review the method of mix design in conformity with IS 456-2000. The committee took long time and came up with new guidelines

for concrete mix proportioning. The information given below is based on the guidelines given in Indian standard IS 10262:2009 for concrete mix proportioning.

Cement = 400 kg/m3

Water = 160 kg/m3

Fine aggregates = 660 kg/m3

Coarse aggregate = 701 kg/m3 (for 20mm)

Coarse aggregate = 467 kg/m3 (for 10mm)

Total volume of coarse aggregate = (701+467)

= 1168 kg/m3

W/c = 0.4

Final Mix Proportions

C : FA : CA

400 : 660 : 1168

1 : 1.65 : 2.92

7. EXPERIMENTAL DETAILS

A. COMPRESSIVE STRENGTH TEST

Compressive strength test is the maximum stress a material can sustain under pushing, crushing forces. The compressive strength of a material is determined by shattering fracture of the material under those forces. The compression test on concrete cube at 28 days is used to ensure the grade of concrete used for construction.

Fig -1: Compressive strength test

Compressive strength was determined by using Compression Testing Machine.

Compressive strength = (load / area) in N/sq.mm

B. SPLIT TENSILE STRENGTH

Knowledge of tensile strength of concrete is of great importance. Tensile strength was determined using Universal Testing Machine (UTM).

Fig -2: Split tensile strength test

The split tensile strength of concrete was tested using 150 mm x 300 mm cylinder specimens and carried out by placing a specimen between the loading surfaces of a UTM and the load was applied until the failure of the specimen.

The Split Tensile Strength = $2P/\pi LD$

Where, P = applied load

D = diameter of the specimen= 150mm

L = length of the specimen= 300 mm

C. FLEXURAL STRENGTH

Flexural strength, also known as modulus of rupture, or bend strength. The flexural strength is measured in terms of stress, here given the symbol ϭ.

Fig -3: flexural strength test

The Flexural strength = 3pa/ (bd^2)

Where,

P=maximum load in N

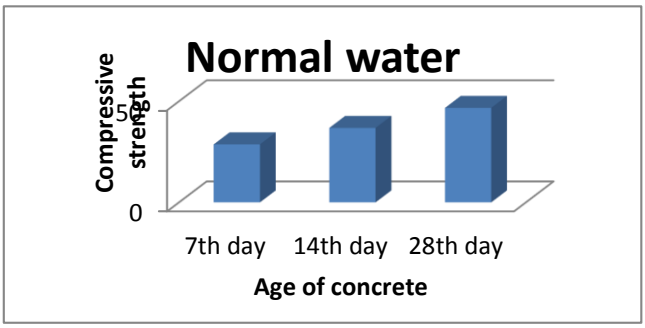
B, d, l are width, depth and span of the beam respectively, all in mm.

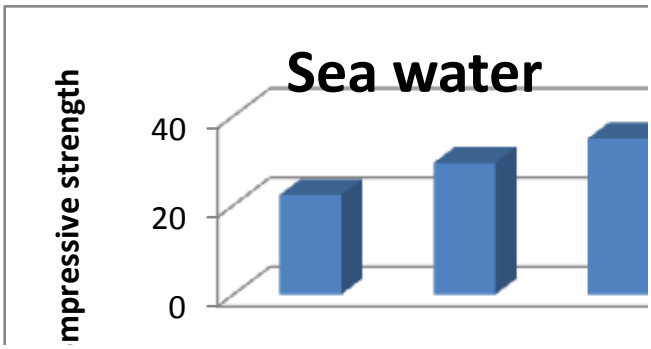
8. TEST RESULTS

1. Compressive strength test

Table 5: Compressive strength for M40 grade

S.N	PROPERTY	AREA (mm)	COMPRESSIVE STRENGTH in N/mm2		
			7TH DAY	14TH DAY	28TH DAY
1.	Normal water	150*150	28.67	36.83	46.71
2.	Sea water	150*150	22.35	29.55	35.02

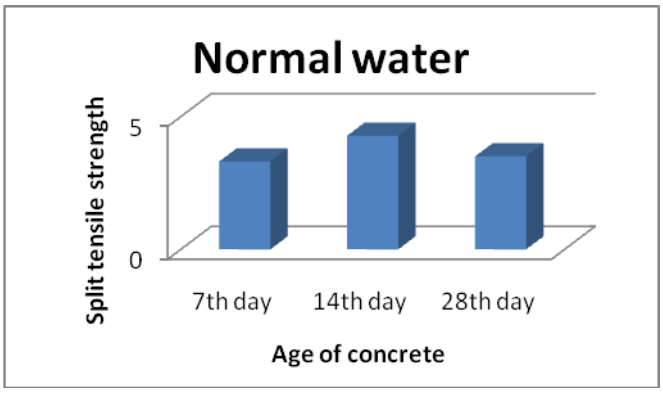


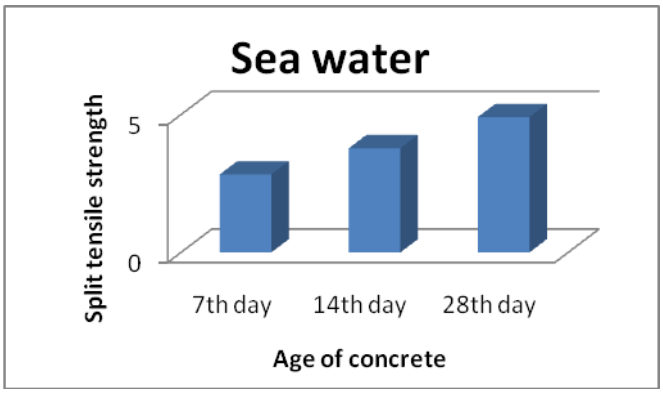


Split tensile strength test

Table 6: Split tensile strength for M40 grade concrete

S.N	PROPERTY	AREA in mm	SPLIT TENSILE		
			7th day	14th day	28th day
1.	Normal water	1.414×10^5	3.31	4.28	5.48
2.	Sea water	1.414×10^5	2.83	3.78	4.91

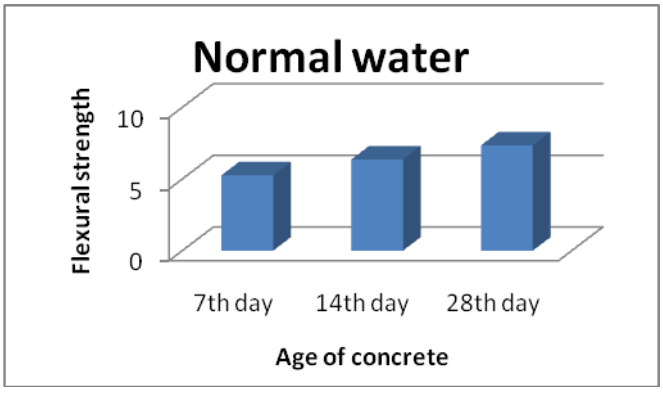




2. Flexural strength test

Table 7: Flexural strength for M40 grade concrete

S.N	PROPERTY	AREA in mm	Flexural strength		
			7th day	14th day	28th day
1.	Normal water	500×100×100	5.25	6.35	7.34
2.	Sea water	500×100×100	4.22	5.30	6.52



9. CONCLUSION

- Series of experiment were conducted on M40 grade of concrete by this project work, the effect of sea water on compressive strength, flexural strength and split tensile strength of concrete was investigated. There is lower in the

strength of concrete specimen cast & cured with salt water as compared to those of cast & cured in fresh water.

- The attained ph value is 11.96, hardness value is 190 ppm, minimum ph value in sea water must lie between 7.2 - 8.0 and hardness must lie between 90-180 ppm. When the sea water's ph and hardness value comes under minimum requirement then those sea water can be used in concrete construction.
- The rate of the strength gain in salt v water cubes is slow as compared with salt water. From the above finding we can conclude that there is reduction in the strength if we use salt water casting & curing the concrete.
- From the outcomes obviously, there was a minimal increment in the solid 3D shapes which were threw and cured with ocean water in seventh day test to 28th day test yet the quality pick up in 28th day trial of ocean water is low when contrasted with crisp water concrete.
- Although, the compressive strength of the concrete cubes which were casted using sea water shows slightly acceptable.
- The surface of cubes casted and cured using sea water has salts in it.
- From the above research, we can conclude that if the water contains fewer amounts of hardness, PH and salts then there is no reduction in strength. Hence, this water can be used for casting. If reinforcement is needed to be provided, then the structures should be provided with proper admixtures to protect it from corrosion.

FUTURE SCOPE OF WORK

- Anti-chloride admixtures can be used in concrete production to avoid the sea water effect on concrete.
- Investigation can be extended for higher strength concrete (M50 or more etc).
- Outer covering of un-plasticized poly vinyl chloride (UPVC) tube may also be used to safe guard concrete column against seawater.

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