

# EFFECT OF SALT WATER ON COMPRESSIVE STRENGTH OF CEMENT MORTAR

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**Abstract** — 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. This trend is observed for testing of cubes at different ages of curing.

**Keywords**- Salt water, Fresh water, compressive strength, mortar.

## 1. INTRODUCTION

Concrete is one of the most widely used construction material, because of its good durability to cost ratio. However, when subjected to severe environments, its durability can significantly decline due to degradation. Cement used in concrete is a mixture of complex compounds. The reaction of these with water leads to setting and hardening of cement when it is gauged with water. The C3A (tricalcium aluminate), C3S (tricalcium silicate) and C4AF (tetra calcium alumina ferrite) phases react very rapidly and the gauging water become saturated with  $\text{Ca}(\text{OH})_2$  formed in the hydrates rather slowly. The aqueous phase is essentially a solution of the hydroxide and sulphates of Ca, Na and K and it is likely that equilibrium sets in among them.

## 2. MATERIALS

Following are the materials used which are

- 1. 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. Some cement based structure works like building work, railway sleepers, road work, tunnels and other weighty structure.
- 2. Sand (fine aggregates):** Sand used in concrete was originally specified as roughly angular but rounded grains are now preferred. The fine aggregates use in this examination was Narmada river sand passing through 4.75 mm sieve with specific gravity of 2.64. The grading zone of fine aggregates was zone II as per Indian standard specification.
- 3. Water:** Ordinary water clean, portable free from suspended particles and chemical substances was used for both mixing and curing of concrete
- 4. 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). This means that every kilogram (roughly one litre by volume) of seawater has around 35 grams of dissolved salts (predominantly sodium ( $\text{Na}^+$ ) and chloride ( $\text{Cl}^-$ ) ions). Salt water produced by dissolving 35 gm/l of NaCl in plain water was also used for mixing and curing of concrete and mortar cubes

## 3. EXPERIMENTAL INVESTIGATIONS

To investigate the effect of salt water on compressive strength of mortar, mortar cubes were casted as per relevant IS code of practice. In which half of mortar cubes were cast and cured with fresh water. Remaining half of the cubes cast and cured with salt water which was prepared by adding salt in limited amount in water (35g/liter).

The batching of the mixture for mortar moulds was done by weight. Cement mortar cubes (1:3) having an area of 5000mm<sup>2</sup> are prepared and tested in compression testing machine. For ordinary Portland cement 43 grade, the compressive strength at 3 days, 7 days and 28 days curing shall not be less than 23 MPa, 33 MPa and 43 MPa respectively. The graded standard sand confirming to IS:-650-1991 was used for preparing the cubes.

**AMOUNT OF WATER FOR MORTAR PASTE:-** The average compressive strength of mortar cubes (area of 50cm<sup>2</sup>) composed of one part of cement three part of standard sand (conforming to IS: 650-1991) by mass and  $(p^*/4) + 3.0$  percent (of combined mass of cement and sand) water obtained in the manner described in IS: 4031 (part-6)-1988. Where  $p^*$  is the percentage of water to produce a paste of standard consistency. Hence to find out the amount of water, the consistency of cement is determine with the help of vicat apparatus. After test the consistency is found to be 29%.

#### **COMPRESSIVE STRENGTH**

The test specimens for the determination of compressive strength of mortar are prepared using the standard metallic cube moulds adopting is procedure for the rodding and hard compactions Fig 1. The concrete cubes moulds were lubricated with oil before the mixed concrete was placed inside it, in order to reduce friction between the concrete and the cubes. The cubes are demoulded after 24 hour of casting and cured in water, having similar quality as used in the preparation of mix. The concrete cubes were cured for 3, 7 and 28 days respectively. For each of the hydration period, cubes were tested and the average compressive strength recorded. The cubes were tested in 200T capacity compression testing machine Fig 1 and the result were reported.



Fig1 Testing of cube in UTM machine



Fig: 2 Testing of mortar cubes in compression machine

#### **4. RESULTS AND DISCUSSIONS**

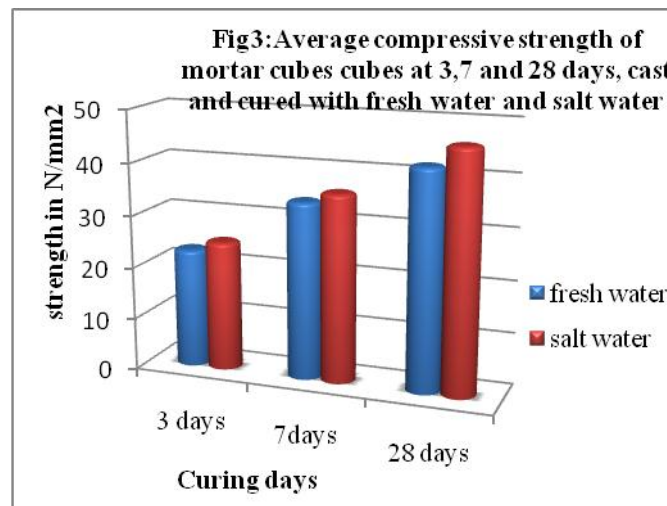
After casting and demoulding the salt water cubes has a darker surface than the reference mortar when cured in salt water a deposit of salt formed on specimens, with whitish appearance at Bottom edges. The salt water mortar cubes have the most pronounced salt deposits. Test results of the cubes prepared from fresh water and water containing salts. The results indicate that, there is significant increase in the compressive strength of all mortar cubes at 3, 7 and 28days.

Table 1 – Compressive strength of mortar cubes cast and cured with fresh water.

Cube Size (mm)	Cube Size (mm)	Average Test loads (tone)	Average compressive strength (N/mm <sup>2</sup> )
7.05X7.05 X7.05	3	11	23
7.05X7.05 X7.05	7	18	34
7.05X7.05 X7.05	28	21	42

Table 2 – Compressive strength of mortar cubes cast and cured with salt water.

Cube Size (mm)	Cube Size (mm)	Average Test loads (tone)	Average compressive strength (N/mm <sup>2</sup> )
7.05X7.05 X7.05	3	13	25
7.05X7.05 X7.05	7	19	36
7.05X7.05 X7.05	28	24	46



Average compressive strength of cubes prepared with fresh water and salt water respectively

**Discussion:** - From the results it is clear that, there was an marginal increase in the strength of mortar cubes which were casted and cured with salt water as compared with the mortar 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 mortar cubes. The fresh water cubes also recorded its maximum strength at 28 days. Although, the compressive strength of the salt water mortar cubes was slightly higher than that of the fresh water mortar cube.

## 5. CONCLUSION

Series of experiments were conducted on 1:3 cement mortar cubes were cast and cured in fresh water and in salt water as per the relevant IS code of practice. The cubes were tested at different ages i.e. 3, 7 and 28 days. Based on the result following conclusion can be drawn:-

1. The strength of mortar cubes cast and cured in fresh water at 3, 7 and 28 days was found as 23N/mm<sup>2</sup>, 34N/mm<sup>2</sup> and 42N /mm<sup>2</sup> respectively.
2. The strength of mortar cubes cast and cured in salt water at 3, 7 and 28 days was found as 25N/mm<sup>2</sup>, 36N/mm<sup>2</sup> and 46N /mm<sup>2</sup> respectively.
3. There is marginal increase in the strength of cubes cast and cured in salt water as compared to those of cast and cured in fresh water at all ages of curing.
4. The percentage increase in strength ranges from 8% to 8.69%.

From the above finding we can conclude that there is no reduction in the strength if we use salt water making and curing the mortar. There is some increase in the strength using salt water casting and curing mortar.

#### REFERENCES

- [1] Selin Bhaskar, Smitha M.S, Dr. Elson John “Relevance of Sea Water as Mixing Water in Concrete” ISSN(Online) : 2319-8753 ISSN (Print) : 2347-6710 Vol. 5, Issue 9, September 2016
- [2] Arunya A, Rajesh S” INVESTIGATIONAL STUDY ON EFFECT OF SEA WATER ON CONCRETE” ISSN: 1314-3395 Volume 119 No. 12 2018,
- [3] S. O. Osuji<sup>1</sup> and E. Nwankwo”MARINE WATER EFFECT ON COMPRESSIVE STRENGTH OF CONCRETE: A CASE STUDY OF ESCRAVOS AREA OF NIGERIAN DELTA” ISSN: 1115-8443 Vol. 34 No. 2, April 2015, pp. 240 – 244
- [4] E.M. Mbadikea, A.U. Elinwab “EFFECT OF SALT WATER IN THE PRODUCTION OF CONCRETE” Vol. 30, No. 2, June 2011.
- [5] Md. Moinul Islam, Md. Saiful Islam, Md. Al-Amin and Md. Mydul Islam” Suitability of sea water on curing and compressive strength of structural concrete” (IEB), 40 (1) (2012) 37-45
- [6] Olutoge, F. Adeyemi and Amusan, G. Modupeola “The Effect of Sea Water on Compressive Strength of Concrete “ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726 Volume 3 Issue 7 | July 2014 | PP.23-31
- [7] Preeti Tiwari, Rajiv Chandak , R.K. Yadav “Effect Of Salt Water On Compressive Strength Of Concrete” ISSN : 2248-9622 Vol. 4, Issue 4( Version 1), April 2014, pp.
- [8] Ir. Nurmaidah, MT, Kamaluddin Lubis “The Effect of Concrete Treatment with Sea Water and Fresh Water against Compressive Strength of Concrete e-ISSN: 2278-1684,p-ISSN: 2320-334X Volume 14, Issue 5 Ver. III (Sep. - Oct. 2017), PP 47-52
- [9] Sakthivel R Dr. V. Murugaiyan “STUDIES ON THE EFFECTS OF SEAWATER ON COMPRESSIVE STRENGTH OF CONCRETE CUBE” ISSN Print: 0976-6308 and ISSN Online: 0976-6316 Volume 9, Issue 12, December 2018,
- [10] Prof. Sagar Gawande, Prof. Yogesh Deshmukh, Mr. Milind Bhagwat, Mr. Suhas More, Mr. Namdev Nirwal, Mr. Akshay Phadatare “Comparative Study of Effect of Salt Water and Fresh Water on Concrete” e-ISSN: 2395 -0056 p-ISSN: 2395-0072 Volume: 04 Issue: 04 | Apr -2017
- [11] Dr. Nagabhushana, Dharmaraj Hebbal, Nitin Akash , S Deepak, Mukesh Kumar “EFFECT OF SALT WATER ON COMPRESSIVE STRENGTH OF CONCRETE” p-ISSN: 2395-0072 e-ISSN: 2395 -0056 Volume: 04 Issue: 05 | May -2017
- [12] B.Sathish kumar, P.Samuthirapandiyan, K.Sabari rajan, A.Subalakshmi “EFFECT OF SEA WATER AND STRENGTH OF CONCRETE” e-ISSN: 2395-0056 p-ISSN: 2395-0072 Volume: 05 Issue: 04 | Apr-2018