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"Effect Of Salt Water On Compressive Strength Of Concrete"

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ABSTRACT:-
In this research work, the effect of salt water on the compressive strength of concrete was investigated. This paper therefore presents the result and findings of an experimental research on the effect of salt water on compressive strength of concrete. For this concrete cubes were cast using fresh wi and salt water for a design mix of M-30 1:1.8:3.31 by weight of concrete, and 0.45 water- cement ratio. Half of concrete cubes were cast and cured with fresh water and remaining half cubes were cast and cured with salt water. The concrete cubes were cured for 7,14 and 28 days respectively. The result of the average compressive strength of concrete obtained using fresh water ranges from 27.12 - 39.12N/mm^2 and using salt water ranges from 28.45 – 41.34N/mm^2.
Keywords:- concrete cubes,fresh water, salt water, compressive strength.

I. INTRODUCTION:-

Concrete is the most widely used construction material all over the world. It is difficult to find out alternate material for construction which is as suitable as that of such material form durability and economic point of view.

The 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. When chloride does not exceed 500 ppm, or SO_3 does not exceed 1000 PPM, the water is harmless, but water with even higher salt contents has been used Satisfactorily (**Building research station[1]1956).**

According to **Osei [2](2000) and Water encyclopedia[3] (2012)**,great bodies of water covers about five seventh of the earths' surface about 71% reaching in some places to depth more than ten kilometers (10km). . **Adebakin[4] (2003)** described fresh water as that purified expanse of water, which is devoid of any form of impurities. Whereas seawater is considered as water containing high percentage of Sodium chloride. Only 2.5 Percent of the world's water bodies is said to be fresh water, the remaining constitute seawater. Sea water (SW) is a complex solution of many salts containing living matter, suspended silt, dissolved gases and decaying organic material. The average salt concentration of sea water is about 3.5% although it varies from sea to sea depending upon geological location. The primary chemical constituents of seawater are the ions of chloride, sodium, magnesium, calcium and potassium. The concentration of major salt constituents of seawater we are given in weight % of salt as 78%NaCl, 10.5% $MgCl_2$, 5% MgSO4, 3.9% CaSO4, 2.3% K2SO4, 0.3%KBr. It evident from above that sodium chloride is by far the predominant salt component of seawater **Akinkurolere O.O et.al[5] (2007)**.

Sea water has a total salinity of about 3.5% (78% of the dissolved solids being Nacl and 15% $MgCl_2$ and $MgSO_4$), and produces a slightly higher early strength but a lower long-term strength **Abrams Duff[6](1924).** Generally the effects on setting are Unimportant if water is acceptable from strength consideration. Water containing large quantities of chlorides (sea water) tends to cause persistent dampness and surface efflorescence. Such water should, therefore not be used where appearance is important, or where a plaster- finish is to be applied **Lea F M[7](1956).**

In the present investigation the effects of salt water on compressive strength of concrete are determined. M-30 grade of concrete is used to determining the effect of salt water.

II. MATERIALS AND METHODOLOGY :-

MATERIALS

The detail of various materials used in the experimental investigation are following:-

(a) Coarse Aggregate- Crushed granite stone aggregate of maximum size 20mm confirming to IS 383-1970 was used. The specific gravity were found to be 2.78 for 20mm size of particle and 2.76 for 10mm size of particle and fineness modoulus is found to be 7.25 for 20mm size of particle and 6.68 for 10mm size of particle.

(b) Sand (fine aggregate) -The fine aggregate used in this investigation was Narmada river sand passing through 4.75 mm sieve with specific gratuity of 2.645. The grading zone of fine aggregate was zone II as per Indian standard specification.

(c) Cement-: OPC 43 grade (JP cement) was used.

(d) 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). 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). The cubes were prepared using 35g of salts in one litre of water.

III. METHODOLOGY

Experimental system- To investigate the effect of salt water on compressive strength of concrete, concrete cubes were made, in which half of concrete cubes cast and cured with fresh water and remaining concrete cubes were cast and cured with salt water. The amount of salt (NaCl) used in water was kept as 35g/litre).

The concrete cube size measuring 150×150×150 mm in dimension was used. The batching of the concrete was carried out by weight. Mixture was proportioned for a target cube strength of 30N/mm2 and had a cementitious material content of 372kg/m3, a fine aggregate content of 669.68kg/m3, a coarse aggregate content of 1230.6kg/m3 and a water cement ratio of 0.45. When the concrete was properly mixed using the salt water and fresh water respectively, the concrete cubes mould were filled to one third of their height and compacted 25 times. The cube mould were later filled to two third of their height and finally filled completely. In each of the layer, the concrete cubes were compacted 25 times respectively. The concrete cubes were cast and cured for 7, 14 and 28 days respectively.

WORKABILITY:- Workability of concrete which were made with fresh water and salt water separately, checked in time of casting of concrete cubes. The slump was maintained from 25mm to 50mm i.e. for mass concrete.

COMPRESSIVE STRENGTH :- The test specimens for the determination of compressive strength of concrete were prepared using the standard metallic cube moulds adopting is procedure for the rodding and hard compactions. 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 7, 14 and 28 days respectively. For each of the hydration period, cubes were tested and the average compressive strength recorded. The concrete cubes were tested in compression testing machine and the result were reported.

IV. TEST RESULTS:-

After casting and demoulding, the salt water concrete cubes has a darker surface than the reference concrete cubes, when cured in salt water a deposit of salt formed on a specimens with whitish appearance at bottom edges. The salt water concrete 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 concrete cubes at 7,14 and 28days.

Table 1 and 2 shows the results of the average compressive strength of mortar cubes produced using fresh water and salt water.

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

Cube Size (mm)	Age of cube (days)	Average Test loads (tonnes)	Average compressive strength (N/mm^2)
150X150X150	7	61	27.12
150X150X150	14	72	32
150X150X150	*28*	*88*	*39.12*

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

Cube Size (mm)	Age of cube (days)	Average Test loads (tonnes)	Average compressive strength (N/mm^2)
150X150X150	7	64	28.45
150X150X150	14	78	34.67
150X150X150	28	93	41.34

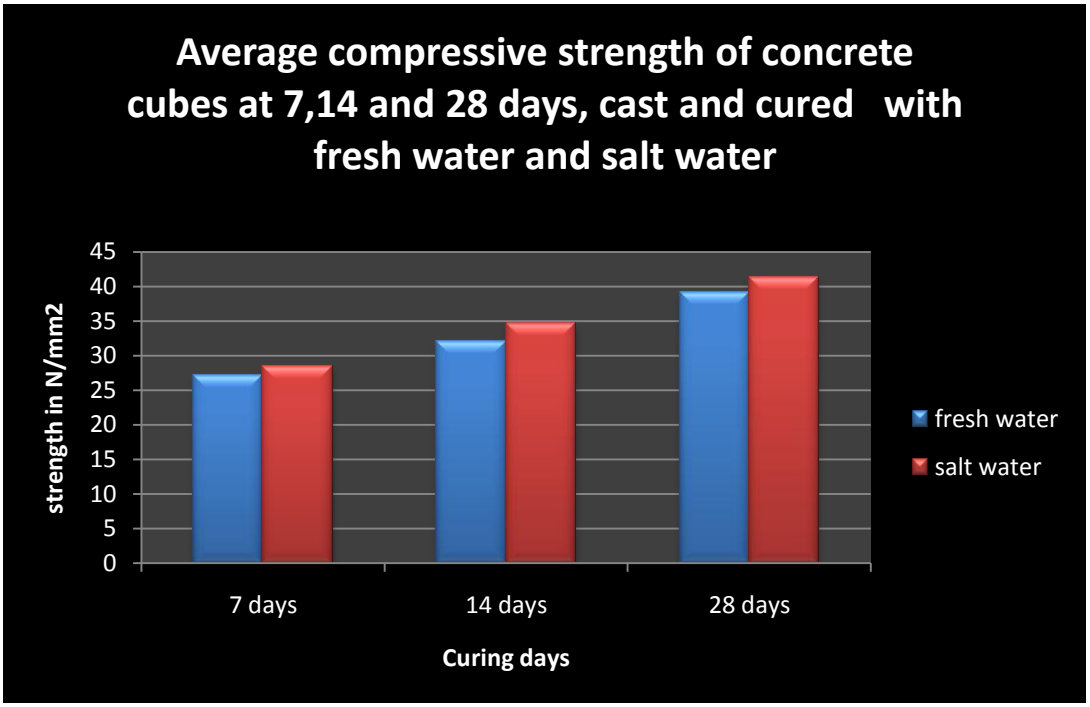

Fig.1- Average compressive strength of concrete cubes.

V. Discussion: -

From the results it is clear 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.

VI. Conclusion: -

Series of experiments were conducted on M-30 grade (*1:1.8:3.31)* concrete. 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. 7.14 and 28 days. Based on the result following conclusion can be drawn:-

1. The strength of concrete cubes cast and cured in fresh water at 7,14 and 28 days was found as 27.12N/mm^2, 32N/mm^2 and 39.12N /mm^2 respectively.
2. The strength of concrete cubes cast and cured in salt water at 7,14 and 28 days was found as 28.45N/mm^2, 34.67N/mm^2 and 41.34N /mm^2 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.

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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