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Effect of Saline water on Compressive strength of Concrete

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ABSTRACT

This paper investigated on how the compressive strength of concrete can be affected when it is produced with saline water. The water samples collected was of different qualities and sources and presented as underground saline water from Saline belt of Vidarbha region. The samples were collected from different parts of Akola, Amravati and Buldana district. The chemical compositions of these water samples were analyzed while 16 concrete cubes were produced at a ratio of 1:1.5:3 using each water sample. The cubes were cured and tested at 7, 14, 21 and 28 days with the resulting compressive strength. It was observed that the concrete produced with saline water have compressive strengths gradually increased in 7 days to 14 days but decreased drastically at 21 and 28days age. However, concrete cubes obtained from potable water gained acceptable strength with age. With the result of this research, it is recommended that potable water and water without obvious impurities should be used for concreting.

Keywords— Concrete, saline, water, saline belt Introduction

1. INTRODUCTION

As per Is 456-2000, Water approved for drinking is satisfactory for usage in concrete production, but there are exceptional cases, for instance, in some arid areas, where local drinking water is saline and may contain an excessive amount of chloride, undesirable amount of alkali carbonates and bicarbonates, which could contribute to the alkali silica reaction .

The Ground Water Survey and Development Agency (GSDA), Government of Maharashtra identified 547 salinity-affected villages (136 in Amravati District, 318 in Akola District and 93 in Buldana District) of Vidharbha region, covering Purna river valley of 4693 sq km. The ground water in these villages is severely affected by salinity and poor quality. The water quality in this region has very high hardness value. The surface water and ground water in this region is highly Contaminated. As there is no other water source, the people in this region use such water for drinking purpose. Saline water has very bad effect on human health.

The chemical analyses revealed that groundwater contained high concentrations of sodium Na, potassium K, chloride Cl-, and carbonate CO3- amongst others which led to concrete strength reduction. Consequently, proper water analysis should be encouraged before choosing water for concrete work.

The presence of sodium carbonate accelerates the setting time of concrete while bicarbonates may either accelerate or retard the setting time**.** Water serves the following purpose.

1. To wet the surface of aggregates to develop adhesion because the cement pastes adheres quickly and satisfactory to the wet surface of the aggregates than to a dry surface.
2. To prepare a plastic mixture of the various ingredients and to impact workability to concrete to facilitate placing in the desired position.
3. Water is also needed for the hydration of cementing materials to set and harden during the period of curing.

The quality of water in the mix plays a vital role on the strength of the concrete. Some water which has adverse effect on hardened concrete sometimes may not be harmless or even beneficial during mixing, so clear distinction should be made between the effect on hardened concrete and the quality of mixing water.

The compressive strength is an important property of concrete. The compressive strength of concrete is taken as the maximum compressive load it can carry per unit area. Compressive strength of concrete is used as a measure of overall quality of the concrete and therefore an indication of other properties relating to determination of strength and durability.

2. LITERATURE REVIEW

Lee [1] noticed that seawater with a total salinity of about 3.5 percent produces a slightly higher early strength but a lower long terms strength, the loss of strength is usually no more than 15% and can therefore often be tolerated. Bella M. & Fabuss, T [2] suggested that the sea water slightly accelerates the setting time of cement. Bryant. M [3] reported that water containing large quantities of chlorides e.g. sea water tends to cause persistent dampness and surface efflorescence.

H.Y.Ghorab et al [4] found that water with pH of 6.0 to 8.0, which does not taste saline or brackish, is suitable for use. Steinour [5] described that impurities in water may interfere with the setting of the cement, adversely affect the strength of the concrete or cause staining of its surface, and also lead to corrosion of the reinforcement. Addition of 2 per cent Sodium Benzoate reduces the compressive strength of concrete.
Gupta et al [5] opined that water with pH range of 6.0 to 8.0 is good for concreting. For hand mixing, a water cement ratio of 0.6 is recommended. When the concrete has to be pumped into position the water cement ratio may be increased to 0.7. Using water with high content of suspended solid needs to be done with caution and should be allowed to stand in a settling basin before use, a turbidity limit of 2000ppm has been suggested by U.S Bureau of reclamation (1975). Natural water that are slightly acid are harmless, but water containing humid or other organic acids may adversely affect the hardening of concrete.
Neville [6] utilized and recycled sludge water as mixing water for concrete production and found that concrete slump and strength reduced drastically. The carbonate sand bicarbonates of potassium and sodium affect setting time of concrete.

3. MATERIAL AND METHODS

Sample stations are named as follows.

Sample Designation	Location/water sample
A	Potable water
B	Jalgaon Jamod,Dist Buldana
C	Balapur,Dist Akola
D	Daryapur, Dist Amravati

A total 16 cubes of having standard size 150 mm x 150mm x150 mm were cast and tested at 28 days for compressive strength having grade M20.
The used material properties are as follow.
Cement: Portland Pozzolana Cement (PPC) 53 grade ACC concrete plus is used in this study. The cement has Specific Gravity as 3.09 and Fineness as 6%
Fine & Coarse Aggregate: Locally available course aggregates having size 12 mm and crushed/manufactured sand is used.
Water: Water samples from different sample station is collected and tested for Hardness. Underground bore well water from saline belt region is used for making concrete. The tests are performed as per IS 3025: 1964.
Design of Concrete Mix: The mix design is done as per Indian Standard code IS-10262 (2009)
Testing of Concrete: The testing of concrete is carried out as per IS 516-1959.

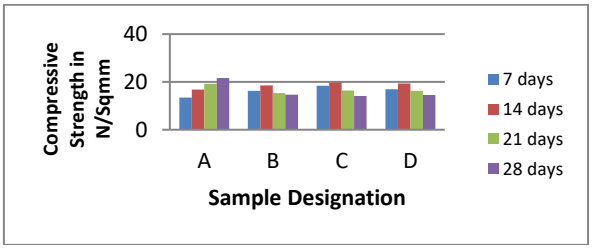
4. RESULTS AND DISCUSSION

Results of water sample analysis are as follows.

Sample Designation	Hardness (in mg/L)		
	Observed Value	DL	MPL
A	500	300	600
B	800		
C	900		
D	840		

*DL-Desirable Limit MPL – Maximum Permissible Limit
Results of Compressive testing are as follows.

Sample Designation	Average Compressive Strength (in N/mm^2)			
	7 days	14 days	21 days	28 days
A	13.50	16.80	19.20	21.60
B	16.30	18.50	15.30	14.60
C	18.40	19.80	16.40	14.10
D	16.90	19.30	16.20	14.50



The results obtained from the chemical analysis showed that the collected water samples have higher concentrations of hardness.From Table No.1 is can be seen that the hardness exceeds the permissible limits.Table No. 2 and Figure No.1 show that the compressive strength of concrete cubes produced with potable water increased with age and this goes a long way to depict the suitability of potable water for concrete. With potable water produced concrete, there was a progressive increment in compressive strength from 13.50 N/mm^2 to 21.60 N/mm^2.It was found from Table 2 that the compressive strength of concrete cubes produced with saline water at early age of 14 days tends to increase but later shows massive loss of compressive strength with its progression in age. The presence of elements such as Na, K, Ca, Cl helped to increase the rate of hydration which facilitated the early compressive strength increment but it later witnessed drastic reduction due to excessive hardness.

5. CONCLUSION AND RECOMMENDATIONS

Following the observations made in this study, it can be concluded that concrete produced with potable gained acceptable strength with age. Though, there was slight decrease in the strength but later on, the strength became steady. The concrete produced with saline water increases its compressive at the 7days but later decreased drastically at the 14days, 21days and 28days.

6. RECOMMENDATIONS

1. Portable or fresh water should always be used for making concrete to achieve maximum compressive strength over time.
2. Saline or hard water should not be used for concrete production.
3. All water intended to be used for production of concrete must be checked and tested to make sure it conforms to the laid down standards.

7. REFERENCES

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IS codes-
1. IS 456-2000 ―Plain and reinforced concrete code of practice (fourth revision).
2 IS 3025 ―Methods of sampling and test (physical and chemical) for water and wastewater.
3. IS-10262 (2009) - Concrete mix proportioning - guidelines (First Revision)
4. IS 516 (1959) -Methods of tests for strength of concrete.