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Impact of Water Quality on Strength Properties of Concrete

KEYWORDS: Effect of water quality, Compressive, Split tensile and Compressive Strength

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ABSTRACT *The hardening of cement gives strength and durability to concrete. The quality of mixing water may affect the setting, hardening and strength of the concrete. Great control on properties of cement and aggregates is exercised, but the control on the quality of water is neglected. The suitability of a particular source of water for making concrete can be checked by casting concrete cubes using water under question and comparing its 7 days, 14 days and 28 days strength. If the compressive strength is up to 90 percent, the source of water may be accepted. The aim of the present study was to know the effect of chemical impurities in mixing water on different properties of concrete. This work was carried out for a mix of M 20 Grade concrete with to study effect of use of Potable, Ground and Sewage water on the strength development of concrete at 7, 14 and 28 days. From the results it is observed that Potable water results in good strength properties in concrete and there is increase of 33.34% in compressive strength when compared to sewage water.*

1. Introduction:

Water is an important ingredient of concrete. Part of mixing water is utilized in the hydration of cement and the balanced water is required for imparting workability to concrete. Thus the quantity and quality of water is required to be looked into very carefully. The strength and durability of concrete is reduced due to the presence of chemical impurities in water. Most of the specifications recommended the use of potable water for making concrete. A practical solution would be tests for time of set and strength of concrete between the water under consideration and the water of proven quality.

1.1 Function of Water in Concrete:

The water serves the following purpose:

a. 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.
b. To prepare a plastic mixture of the various ingredients and to impart workability to concrete to facilitate placing in the desired position and
c. Water is also needed for the hydration of the cementing materials to set and harden during the period of curing.

The quantity of water in the mix plays a vital role on the strength of the concrete. Some water which have 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.

2. Literature Review:

Abrams [1] cast concrete cylinders using a large number of waters, many of which were unpotable and tested them in compression at ages up to twenty eight months and found that in spite of the wide variation in the quality of water used, most of the samples gave good results. Abrams [1] quoted 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. Thomas and Lisk [2] suggested that the sea water slightly accelerates the setting time of cement. Lea [3] reported that water containing large quantities of chlorides e.g. sea water tends to cause persistent dampness and surface efflorescence. Mc Coy [4] reported 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. P. Ghosh et.al [6] reported that presence of micro-organism in mixing water increases the compressive and tensile strength of concrete. G.Reddy Babu Et.Al [7] reported that samples prepared with treated wastewater of electroplating industry did not show loss of strength, though their setting time had increased. In high concentration of metal ions, the compressive and flexural strength marginally increased.

3. Present Investigation

The experimental work was carried out in two stages. In the first stage preliminary investigations such as consistency, specific gravity, initial and final setting time of cement and sieve analysis of fine aggregates and coarse aggregates and testing of quality of water were carried out on materials used. In the second stage concrete mix proportioning was done as per the draft code (IS: 10262-2009) for M-20 grade Concrete and cubes, beams and cylinders were cast with three different sources of water [Potable water (PW), Sewage water (SW) and Ground water (GW)] and tested. The cubes beams and cylinders were tested properly in uniaxial compressive testing machine, Rebound Hammer Value, flexural testing machine and split tensile testing machine at the age of 7, 14 and 28days

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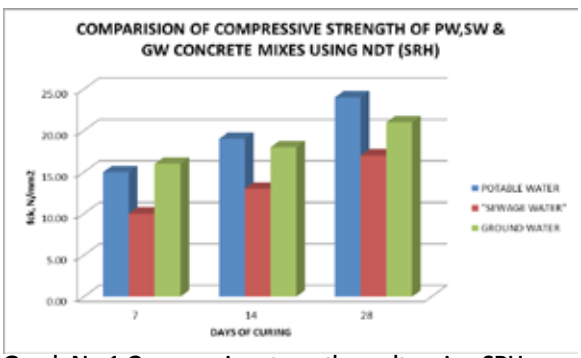
Table No.1 Compressive strength results using Schmidt Rebound Hammer

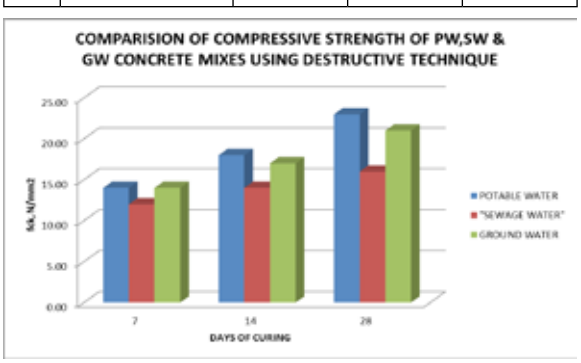
Sl No	Water type	Average Compressive Strength NDT Value (SRH)		
		7 days	14 days	28 days
1	Potable Water	14.90	18.00	23.00
2	Sewage Water	9.00	12.50	16.00
3	Ground Water	15.50	16.50	20.10



Graph No.1 Compressive strength results using SRH

Table No.2 Compressive strength Results using Compression Testing Machine

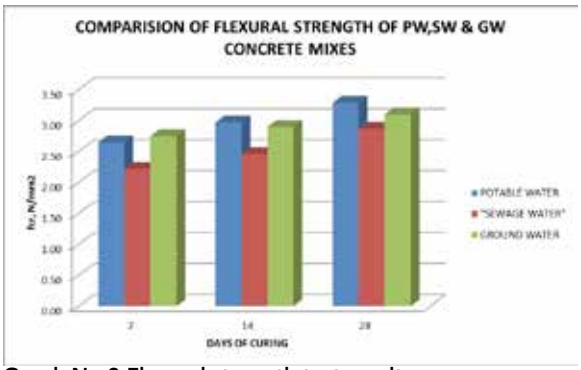
Sl No	Water type	Average Compressive Strength fck, Nmm^{-2}		
		7 days	14 days	28 days
1	Potable Water	14.50	17.50	22.50
2	Sewage Water	10.20	13.10	15.00
3	Ground Water	14.30	16.10	20.85



Graph No.2 Compressive strength results using CTM

Table No.3 Flexural strength Test Results

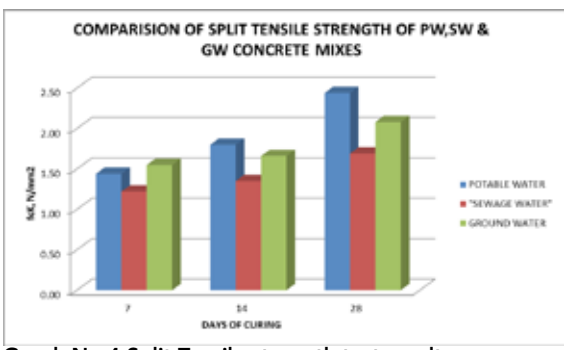
Sl No	Water type	Average Flexural Strength fcr, Nmm^{-2}		
		7 days	14 days	28 days
1	Potable Water	2.50	2.80	3.15
2	Sewage Water	2.00	2.35	2.80
3	Ground Water	2.55	2.70	3.00



Graph No.3 Flexural strength test results

Table No.3 Split Tensile strength Results

Sl No	Water type	Average Split Tensile Strength fck, Nmm^{-2}		
		7 days	14 days	28 days
1	Potable Water	1.40	1.70	2.35
2	Sewage Water	1.00	1.30	1.55
3	Ground Water	1.50	1.55	2.00



Graph No.4 Split Tensile strength test results

Table No.4 Tests on Water Samples for different Parameters

Characteristics	Portable water	Ground water	Sewage water
pH	8.2	6.6	10.2
Total dissolved solids	580mg/l	246mg/l	---
Total Hardness	328mg/l	690mg/l	----
nitrates	35mg/l	75 mg/l	0.5mgl/l
Chlorides	150mg/l	175mg/l	210mg/l
Total Suspended solids	----	----	270mg/l

4. Results and Discussions

From the present study the following observations are made:

I. Potable water suits the requirements of water to be used for construction activity results in increase of Compressive, Flexural and Split tensile strength of concrete compared to other sources of water
II. It is observed that there is an increase of 33.34% in compressive strength of potable water concrete when compared to concrete prepared with sewage water
III. It is observed that there is an increase of 11.12% in Flexural strength of potable water concrete when compared to concrete prepared with sewage water
IV. It is observed that there is an increase of 14.89% in Split tensile strength of potable water concrete when com-

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pared to concrete prepared with sewage water

5. Conclusions

From the present study, the following conclusions are drawn,

1. If the pH value of water increases the strength in concrete decreases substantially
2. Because of high suspended solids and pH present in sewage water, the calcium Silicate Hydrate (C-S-H) which is responsible for strength in concrete gets deteriorated and weakens the concrete

6. Acknowledgement

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