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Effect of Different Types of Water on Compressive Strength of Concrete

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ABSTRACT: The study centered on the effect of different qualities of water on concrete compressive strength. The concrete mix of M20 grade. with Water samples, such as tap water, waste water, well water, bore well water & mineral water (packed drinking water) were collected from various sources at college campus and were used to cast 150mm concrete cubes. The cured cubes were crushed on 7 & 28 days for compressive strength estimation. The results showed that the compressive strength of the concrete cubes made with mineral water, tap water, well water, waste water increased with days & not having much variation in their compressive strength

I. .INTRODUCTION

The cement concrete is a mixture of cement, sand, pebbles or crushed rock and water, which when placed in the skeleton of forms & allowed to cure, becomes hard like a stone. Aggregates are the important constituents in concrete. They give body to the concrete, reduce shrinkage and effect economy. Earlier, aggregates were considered as chemically inert materials but now it has been recognized that some of the aggregates are chemically active and also that certain aggregates exhibit chemical bond at the interface of aggregate and paste. The mere fact that the aggregate occupy 70 – 80% of the volume of concrete, their impact on various characteristics and properties of concrete is undoubtedly considerable. To know more about the aggregates which constitute major volume in concrete. Without the study of the aggregate in depth and range the study of the concrete is incomplete. Cement is the only factor made standard component in concrete. Other ingredients namely, water and aggregate are natural materials and can vary to any extent in many of their properties. The depth and range of studies that are required to be made in respect of aggregates to understand their widely varying effects and influence on the properties of concrete cannot be underrated. Cement is an extremely ground material having adhesive and cohesive properties which provide a binding medium for the discrete ingredients.

Cement generally represent 12-14% of concrete weight. It plays an active part in the mixture. During the hardening process, it generates shrinkage and heat dissipation phenomena which lead to material cracking.Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel, the quantity and quality of water is required to be looked into very carefully. It has been discussed enough about the quantity of mixing water but so far the quality of water has not been discussed. In practice, very often great control on properties of cement and aggregate is exercised but the control on the quality of water is often neglected. Since quality of water affects the strength, it is necessary for us to go into the purity and quality of water. In the present work, the mix proportion is designed as per IS 10262 for M20 grade of concrete. As there are so many types of quality of water are available namely tap water, well water, bore well water, waste water etc. all these types of water were used for making the concrete cubes, specimen of size 150mm × 150mm × 150mm as per Indian standard were tested at 7 days and 28 days to find out compressive strength.

OBJECTIVE

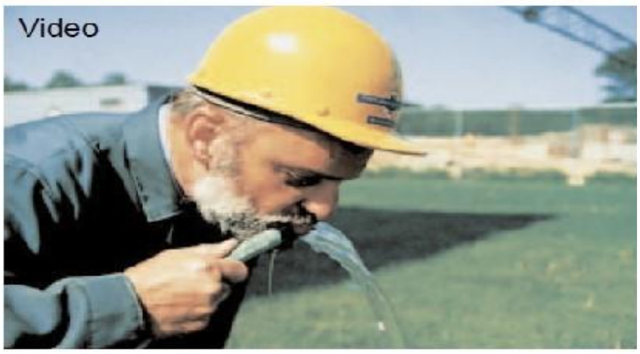
In our country various sources of water are available in different regions of the country for mixing the concrete. A popular yard-stick (criteria) to the suitability of water for mixing concrete is that, if water is fit for drinking it is fit for making concrete. This does not appear to be a true statement for all condition. Some water containing a small amount of sugar would be suitable for drinking but not for mixing concrete and conversely water suitable for making concrete may not necessarily be fit for drinking.

Generally water which is available easily on the site such as tap water, bore well water, well water, municipal waste water etc. are directly used for mixing the concrete. Hence in this project work an attempt is made to investigate the effects of different types of water on compressive strength of concrete and identification of civil work where these water can be used without compromising structural strength parameters.

A. Qualities of water for making concrete. (mixing water for concrete)

Almost any natural water that is drinkable and has no pronounced (strongly marked) taste or odor can be used as mixing water for making concrete (Fig.1). However some waters that are not fit for drinking may be suitable for use in concrete. Six typical analyses of city water supplies and seawater are shown in Table 1. These waters approximate the composition of domestic water supplies for most of the cities over 20,000 population in the United States and Canada. Water from any of these sources is suitable for making concrete. A water source comparable in analysis to any of the waters in the table is probably satisfactory for use in concrete

Fig. 1. Water that is safe to drink is safe to use in concrete.



Excessive impurities in mixing water not only may affect setting time and concrete strength, but also may cause efflorescence, staining, corrosion of reinforcement, volume instability, and reduced durability. Therefore, certain optional limits may be set on chlorides, sulfates, alkalies and solids in the mixing water or appropriate tests can be performed to determine the effect of the impurity has on various properties. Some impurities may have little effect on strength and setting time, yet they can adversely affect durability and other properties.

METHODOLOGY

A. The present study

The objective of the present work is to compare the compressive strength of concrete for M20 grade by using the different qualities of water such a tap water, bore well water, well water, waste water etc. which are available on different construction sites and are directly being used for making concrete, also identification of civil works where these water can be used without compromising structural strength parameters.

B. Water

Locally available potable water (drinking water) confirming IS: 3025 – 1986 (Bureau of Indian Standards 1986) having Ph. value 7.0 is used. The concrete mix for M20 grade with water cement ratio 0.5 were investigated, then using different quality of water such as waste water, well water, bore well water, Bisleri water (mineral water) (Photos showing various qualities of water) were used to cast 150mm concrete cube.

Fig. 2. Water sample – Bisleri Water (Mineral Water).

Fig. 3. Collection of waste water.

A. Mixing

Concrete shall be mixed in a mechanical mixer. The mixer should comply with IS 1791 and IS 12119. The mixers shall be fitted with water measuring (metering)

Fig. 4. Compressiontesting Machine

E. Compression Test

Compression test is the most common test conducted on hardened concrete, partly because it is an easy test to perform, and partly because most of the desirable characteristic properties of concrete are qualitatively related to its compressive strength.devices. The mixing shall be continued until there is a uniform distribution of the materials and the mass is uniform in color and consistency. If there is segregation after unloading from the mixer, the concrete should be remixed.

Fig. 5. Mineral water sample was being used to mixed the concrete.

***D** Experimental set up of concrete compression test*The compression test is carried out on specimens cubical or in cylindrical shapes. Prism is sometime used, but it is not common in our country. Sometimes the compression strength of concrete is determined using parts of beams is usually of square cross section, this part of beam could be used to find out compressive strength.

The cube specimen is of the size 15x15x15 cm. If the largest nominal size of the aggregate does not exceed 20 mm, 10 cm size cube may also be used as an alternative. Cylindrical test specimens have a length equal to twice the diameter. They are 15 cm in diameter and 30 cm long. Smaller test specimens may be used but ratio of diameter of the specimen to maximum size of aggregate, not less than 3 is maintained.The 7 days & 28 days cubes (150mm x 150mm x 150mm) were collected from their curing location. The cure location was the same for each of the specimen which were made from various quality of water. The specimen, which were removed from the water bath, were keep aside for drying until they were ready for testing. Two cubes from each set were taken for testing of 7 days concrete. After this then two cubes were take for testing 28 days concrete.

This Compression testing Machine (Fig.5) was used on the seven day, and twenty eight day cured concrete specimens. For each test day, the cubes were placed in the loading apparatus, and the load was actuated at a controlled loading rate. Once the specimen reached its critical load, one of the load indicators needle recorded the exact failure point

Fig. 6. Machine indicator needle (Point of failure).

RESULT AND DISCUSSION

A. Result of concrete mix design

Table 1: Trial Mix Results of Concrete Cube M-20.

Test Details	Unit	Compressive strength of concrete cubes.		
Sample No.	-	1	2	3
Specimen ID	-	A-1	A-2	A-3
Date of casting	-	05/05/2012	05/05/2012	05/05/2012
Age. of specimen	Days	7	7	7
Date of Test	-	12/05/2012	12/05/2012	12/05/2012
Maximum Failure load	Tonne	60	61	60
Compressive strength	N/mm2	26.16	26.596	26.16

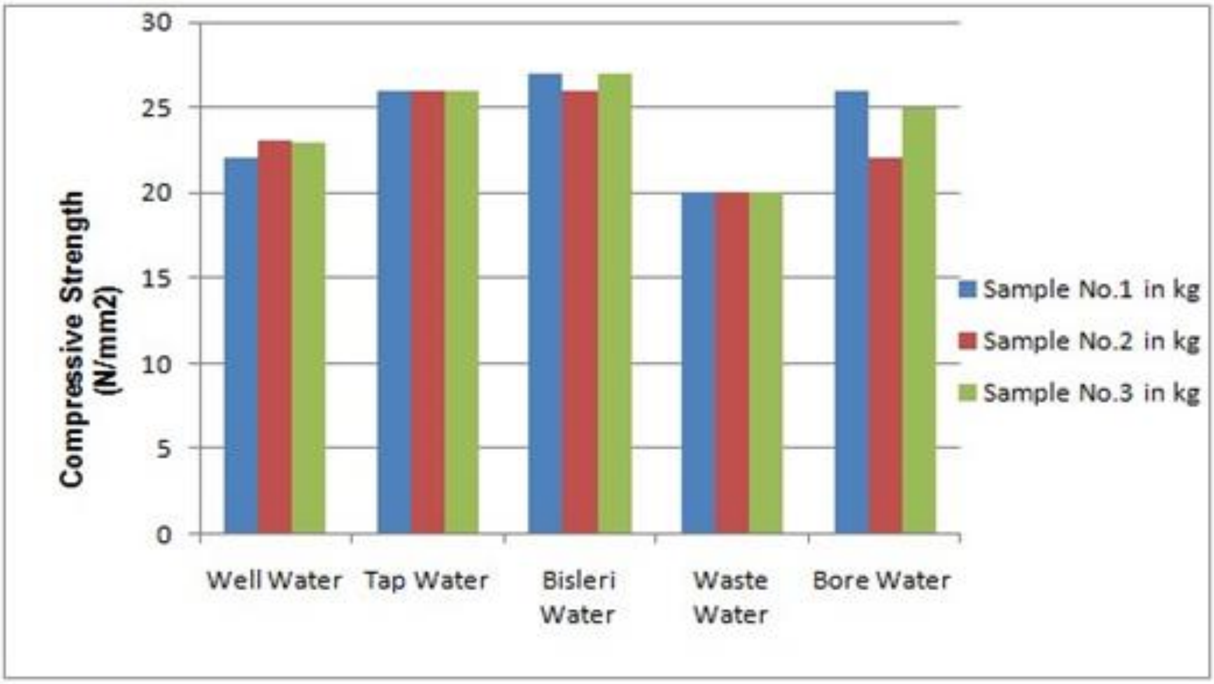
Table 2: Mix Proportion of Concrete.

Proportion	Water	Cement	Sand	Coarse Aggregate
By Weight (kg/m3)	191	382	705	1150
Weight(kg)	0.5	1	1.85	3.02
Volume(liters)	0.5	1	2.16	3.52
For 1 Bag of Cement, The quantities of material are				
By weight(kg/bag)	25kg	50kg	92.28kg	150.52kg

Table 3: "Weights of Cubes (Kg) For 7 Days of Different Water Samples."

Type of water sample	Cube Size(mm)	Age of cubes(days)	Weights of cube in kg	Avg. Weights (Kg)
Well Water	150x150x150	7	8.700	8.841
			8.985	
			8.840	
Tap Water	150x150x150	7	8.800	8.820
			8.850	
			8.810	
Mineral	150x150x150	7	9.158	9.113

Water(Bisleri)			9.062	
			9.120	
Waste Water	150x150x150	7	9.198	9.127
			9.068	
			9.115	
Bore well Water	150x150x150	7	8.832	8.908
			9.002	
			8.890	



Graph 1: 7 Days Compressive strengths of Cubes.

Table 4: 7 Days Compressive Strength

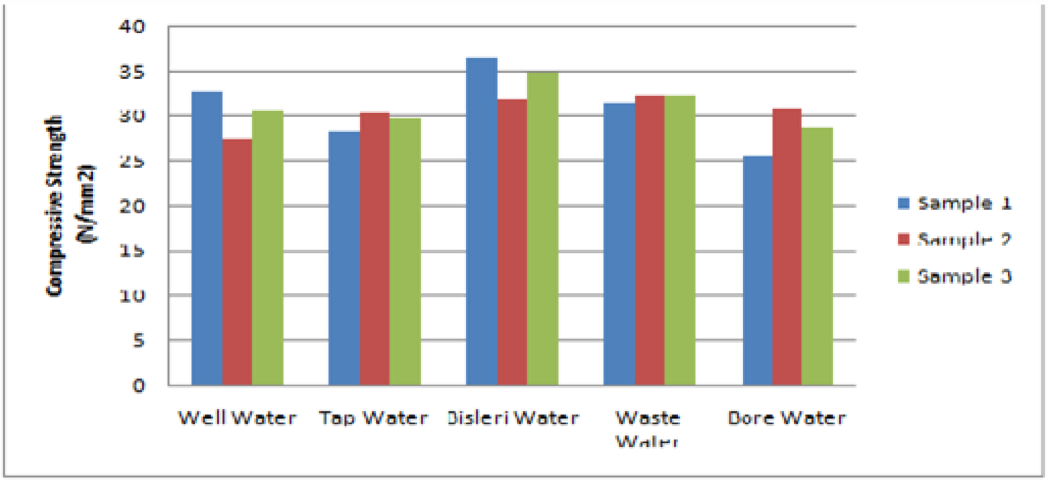
Type of water sample	**Cube Size(mm)**	**Age of cubes (days)**	**Compressive Strength (Tone)**	**Compressive Strength (N/mm2)**	**Avg. Strength (N/mm2)**
Well Water	150x150x150	7	51	22.236	22.963
			53	23.108	
			54	23.544	
Tap Water	150x150x150	7	60	26.160	26.305
			60	26.160	
			61	26.596	

Mineral Water (Bisleri)	150x150x150	7	63	27.468	27.168

Mineral Water (Bisleri)	150x150x150	7	63	27.468	27.168
			63	27.468	
			61	26.596	
Waste Water	150x150x150	7	47	20.490	20.633
			47	20.490	
			48	20.92	
Bore well Water	150x150x150	7	60	26.160	24.852
			59	25.724	
			52	22.672	

Table 5: "Weights of Cubes (Kg) For 28 Days of Different Water Samples".

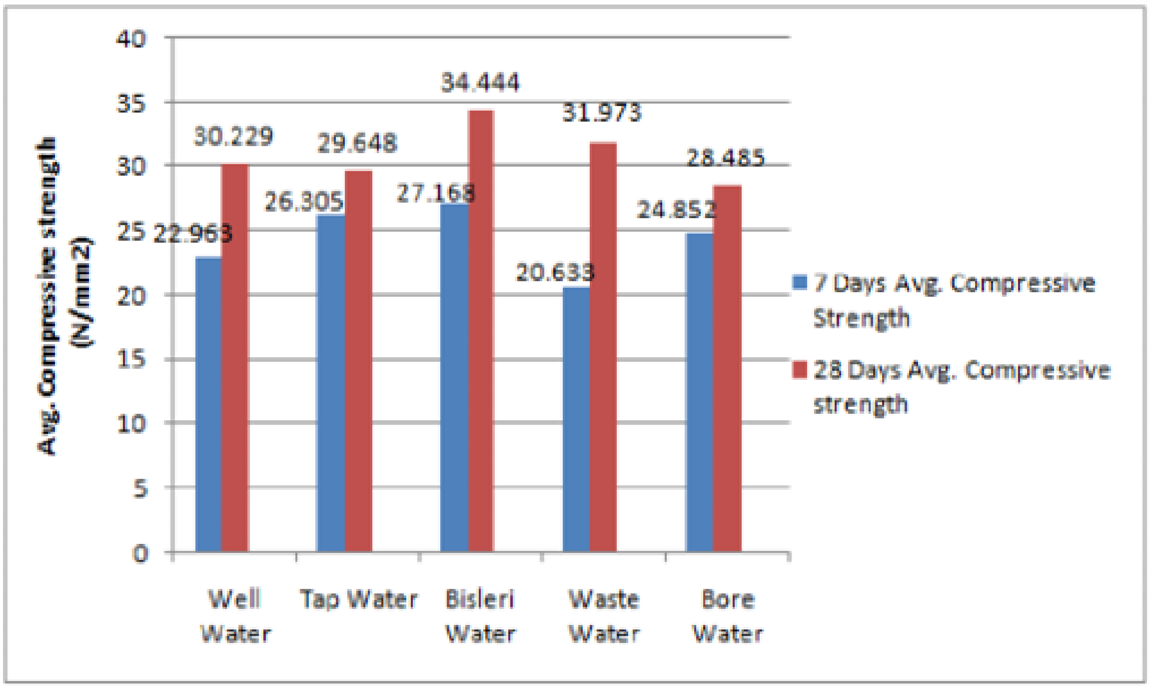
Type of water sample	Cube Size(cm)	Age of cubes (days)	Weights of cube in kg	Avg. Weights (Kg)
Well Water	15x15x15	28	8.642	8.875
			8.910	
			9.074	
Tap Water	15x15x15	28	8.904	8.908
			8.910	
			8.910	
Mineral Water(Bisleri)	15x15x15	28	8.838	8.828
			8.875	
			8.772	
Waste Water	15x15x15	28	9.112	8.828
			9.110	
			8.672	
Bore well Water	15x15x15	28	8.806	8.822
			8.810	
			8.850	

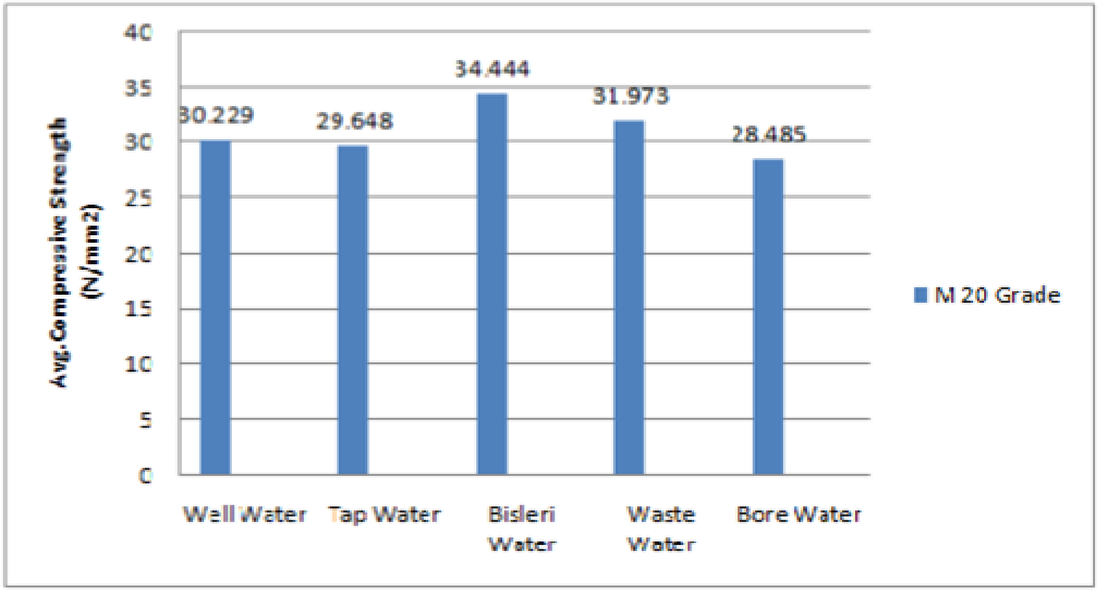


Graph 5: 28 Days Compressive strengths of Cubes.

Table 6: "28 Days Compressive Strength".

Type of water sample	**Cube Size(cm)**	**Age of cubes (days)**	**Compressive Strength (N/mm2)**	**Avg. Strength (N/mm2)**
Well Water	15x15x15	28	32.700	30.229
			30.520	
			27.468	
Tap Water	15x15x15	28	28.340	29.648
			29.648	
			30.956	
Mineral Water(Bisleri)	15x15x15	28	36.624	34.226
			34.880	
			31.828	
Waste Water	15x15x15	28	31.392	31.828
			32.264	
Bore well Water	15x15x15	28	25.724	28.485


Avg. Compressive strength (N/mm2)
40
35
30
25
20
15
10
5
0
30.229
29.648
34.444
31.973
28.485
22.963
26.305
27.168
20.633
24.852
Well Water
Tap Water
Bisleri Water
Waste Water
Bore Water
7 Days Avg. Compressive Strength
28 Days Avg. Compressive strength


Avg.Compressive Strength (N/mm2)
40
35
30
25
20
15
10
5
0
30.229
29.648
34.444
31.973
28.485
Well Water
Tap Water
Bisleri Water
Waste Water
Bore Water
M 20 Grade

CONCLUSION

The results shows that concrete made with different qualities of water samples such as ground water, packed drinking water, waste water etc. have 7-

(i) and 28 – day compressive strength equal to or at least 90 percent of the strength of reference specimens made with clean water for M20 grade of concrete. (Except Waste water specimen for 7-day).

(i) From the analysis of test carried out, it was revealed that, the concrete made with questionable water sample i.e. waste water sample with a constant water – cement ratio of 0.5, there was about 20% less 7- day compressive strength compared to reference specimen. (iii) The compressive strength obtained for concrete made with packed drinking water have 13.5% more strength than the cubes made with tap water. (iv) The concrete made with bore water (ground water) having slightly less 28 - day compressive strength, compared to other specimens. (5% less compared to reference specimen).

(v) The tensile strength to compressive strength ratio (from table 4.12) for packed drinking water & waste water are 7.5, for bore well & tap water specimen are 9.5 & well water specimen having 8.10. (vi) From present study, slightly acidic, alkaline, salty, brackish, colored or foul smelling water should not be rejected outright, as this is important because of the water shortage in many areas of the world.

(vii) Also, recycled waters from cities, mining and many industrial operations can be safely used as mixing waters for concrete.

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