

An Experimental Investigation on Suitability of Ground Water for Construction Practice

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Abstract— This study provides the suitability of ground water of a village named Bolor of Dakshina Kannada District, Mangalore for construction practice in the wet season and dry season. So, concrete cubes of M20 grade with water-cement ratio of 0.45 is been casted from the 15 water samples of different region of the locality to find compressive strength at 7 and 28 days for both wet season and dry season. For calculating the water quality of 15 ground water samples various parameters like pH, alkalinity, chloride, iron, hardness etc were compared with Indian Standard Drinking water specification IS: 10500-2012. It involves comparison of strength characteristics of ground water and potable water.

Keywords: Water Analysis, Permissible limit, well water, compressive strength

I. INTRODUCTION

The concrete is a mixture of cement, Fine Aggregate and Coarse Aggregates mixed with water, which when placed in the skeleton of forms then allowed to cure, becomes hardened concrete. Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. Quality and Quantity is the major aspects that we should look into for the strength enhancement of concrete. The contamination water has been a major concern over time. Increase in industrialization and population has led to pollution of the water to a great extent and the quality is depressed. Underground water may get polluted due to domestic wastes from residential area, institutions and industries which may cause harm to the underground water source. Therefore, analysis of water is very essential for knowing the changes in strength of concrete. These analysis has to be made for different seasons i.e, dry season and wet season. In dry season there will be no flow of groundwater and in the wet season there will be rise in the water table thus the groundwater flow is maximum. This seasonal change effect in the properties of ground water. Conducting certain tests that will determine the important properties and characteristics of water samples wherein most of the tests include testing of pH level, total dissolved solids, total alkalinity, total hardness, chloride and many more. In both the season after analyzing the properties of water, the mix proportion is designed for M20 grade of concrete. The samples of different well waters are collected and these samples of water are used for making the concrete cubes. Specimen of size 150mm × 150mm × 150mm as per Indian standard and are tested at 7 days and 28 days to find out compressive strength and its suitability for construction.

II. OBJECTIVES

Based on literature review, the objectives of the study are as follows,

- 1) To identify the properties of groundwater in different regions of Bolor Village.
- 2) To compare the seasonal change of quality of water
- 3) To find the suitability of different samples of well water with the RMC water.
- 4) To find out the compressive strength of M-20 concrete cubes casted with different samples of well water.

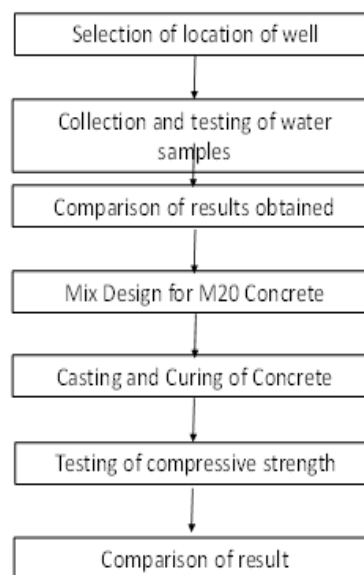
III. METHODOLOGY

Methodology has been divided into two phases.

The first phase of the experiment involves tests such as total alkalinity, hardness, chloride and pH. Dissolved oxygen, iron tests, sulphates and turbidity etc.

The second phase of the experiment covers casting of concrete cubes for all 15 well water samples and finding its compressive strength for 7 and 28 days and comparing it with RMC water.

IV. FLOW CHART OF THE PROJECT



V. MATERIALS USED

- Cement
- Fine Aggregate
- Coarse Aggregate
- Water

A. Cement

For the entire experimental work, a popular brand of Ordinary Portland Cement (OPC) 53 grade is used. The cement is tested accordance with IS codal provisions. A sample of cement to be used for the research was tested for compressive

strength as per the procedure mentioned in IS 4031(Part 2):1999.

B. Fine Aggregates (River Sand)

In the present study locally available river sand is used. The fine aggregate (River sand) conforming to zone III (I.S 383-2016 grading requirements) with specific gravity 2.7 is used. For the casting of concrete, the sand passing through 4.75 mm IS sieve is used.

C. Coarse Aggregates

The crushed coarse aggregate of 20mm-12.5 mm (downsize) is used and tested as per the IS 2386- 1963. The coarse aggregate is tested for its specific gravity is 2.64.

VI. CONCRETE MIX DESIGN

Mix Design is done to decide diverse amounts of materials which are expressed before, required to acquire a concrete mix having required strength, workability and functionality utilizing certain codes for direction. The mix design used for the present study is based on IS 10262: 2009.

Grade of concrete : M20
Cement content : 415 kg/m³
Water Cement ratio : 0.45
Water content : 196 litres
Fine Aggregate : 698 kg/m³
Coarse Aggregate : 1114kg/m³

Cement	FA	CA
1	1.68	2.7

Table 6.1: Mix proportions

VII. RESULTS AND DISCUSSION

The results of well water samples during the dry season of Bolor area are as follows:

Sample no.	pH	Alkalinity (mg/l)	Chloride (mg/l)	Hardness (mg/l)
Sample 1	6.8	672	1257	512
Sample 2	7.81	413	729	412
Sample 3	7.73	435	756	427
Sample 4	7.59	527	812	448
Sample 5	7.64	482	809	439
Sample 6	7.87	370	627	396
Sample 7	7.25	598	947	472
Sample 8	7.53	553	923	454
Sample 9	7.89	366	608	377
Sample 10	7	634	1110	493
Sample 11	7.92	325	575	335
Sample 12	7.98	527	527	264
Sample 13	7.95	534	534	289
Sample 14	7.92	573	573	324
Sample 15	8.01	232	518	252

Table 7.1: Characteristics of well water samples during dry season

The pH value of water samples varies from 6.8 to 8.01. The observed pH values of samples are within the permissible limit. Alkalinity content in the water samples varies from 232-672mg/l. The observed values shows that the alkalinity content for 15 samples is within the permissible limit and in can be used for drinking purpose. The hardness

of water samples varies from 252-512mg/l. The result shows that the water samples are within the permissible limit. The chloride content in the water samples varies from 527-1257 mg/L. From the observed result the chloride content in the water samples exceeds the permissible limit.

Sample no.	pH	Alkalinity (mg/l)	Chloride (mg/l)	Hardness (mg/l)
Sample 1	6.43	416	258	566
Sample 2	6.44	410	279	570
Sample 3	6.47	450	286	568
Sample 4	6.22	436	298	498
Sample 5	6.38	468	276	495
Sample 6	6.06	470	277	587
Sample 7	6.1	498	295	566
Sample 8	6.06	472	251	567
Sample 9	5.59	486	297	498
Sample 10	5.55	500	284	518
Sample 11	5.63	417	269	525
Sample 12	5.58	502	281	524
Sample 13	6.87	410	289	526
Sample 14	5.8	450	271	512
Sample 15	5.76	451	300	50

Table 7.2: Characteristics of well water samples during wet season

Sample no.	Total Dissolved Solids (mg/l)	Iron (mg/l)	Turbidity (NTU)
Sample 1	512	0.7	2
Sample 2	518	0.35	2.8
Sample 3	524	0.4	2.4
Sample 4	528	0.3	3.2
Sample 5	530	0.25	3.6
Sample 6	506	0.25	2.1
Sample 7	578	0.2	2.7
Sample 8	587	0.4	2.8
Sample 9	606	0.15	3.8
Sample 10	617	0.35	3.4
Sample 11	611	0.20	3.1
Sample 12	604	1.55	3.7
Sample 13	600	0.30	2.8
Sample 14	600	0.25	2.4
Sample 15	610	0.2	3.2

The pH value of water samples varies from 6.87 to 5.55. pH The it is observed that pH values of samples are not within the permissible limit. So it is considered as soft water thus it is acidic in nature. Therefore it can be corrosive and harmful to any metals it comes into contact with it. Total dissolved solids in 15 water samples are varies from 506-617. This is within the permissible limit. Alkalinity content in the water samples varies from 410-502mg/l. The observed values shows that the alkalinity content for 15 samples is within the permissible limit and in can be used for drinking purpose. The hardness of water samples varies from 495-587mg/l. The result shows that the water samples are within the permissible limit.

The chloride content in the water samples varies from 251-300 mg/L. From the observed result the chloride content in the water samples is less than the permissible limit. Iron content is little higher than the desirable limit. The iron content is ranges from 0.15 to 1.55 mg/L. The desirable limit

of iron value is 0.3mg/l. Iron content in water gives a metallic taste to water and it can affect food and it does not present a health problem. Turbidity of water content ranges from 2-3.8 NTU and this within the limit. The limit for turbidity is 10 and this shows that the water can be used for drinking purpose. The above result shows that the water can be used for drinking purpose. Only iron content and pH value is not within the limit. For that some treatment is required.

Sl.No	Mix Designation	Average Compressive Strength (N/mm ²)
1	RMC Water	24.238
2	Well Water Sample 1	22.056
3	Well Water Sample 2	23.101
4	Well Water Sample 3	22.996
5	Well Water Sample 4	22.86
6	Well Water Sample 5	22.958
7	Well Water Sample 6	23.22
8	Well Water Sample 7	22.323
9	Well Water Sample 8	22.639
10	Well Water Sample 9	23.235
11	Well Water Sample 10	22.151
12	Well Water Sample 11	23.25
13	Well Water Sample 12	23.564
14	Well Water Sample 13	23.552
15	Well Water Sample 14	23.482
16	Well Water Sample 15	23.712

Table 7.3: Compressive strength of cubes cured for 7 days for wet season

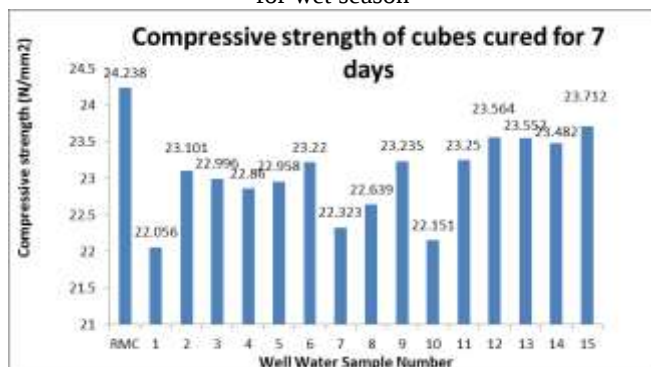


Fig 7.1: Test results of Compressive strength of cubes cured for 7 days

Sl.No	Mix Designation	Average Compressive Strength (N/mm ²)
1	RMC Water	33.786
2	Well Water Sample 1	27.458
3	Well Water Sample 2	30.645
4	Well Water Sample 3	30.52
5	Well Water Sample 4	29.57
6	Well Water Sample 5	29.854
7	Well Water Sample 6	31.236
8	Well Water Sample 7	28.66
9	Well Water Sample 8	29.452
10	Well Water Sample 9	31.675
11	Well Water Sample 10	27.891
12	Well Water Sample 11	32.552
13	Well Water Sample 12	32.856
14	Well Water Sample 13	32.794
15	Well Water Sample 14	32.635
16	Well Water Sample 15	32.935

Table 7.4: Compressive strength of cubes cured for 28 days for wet season

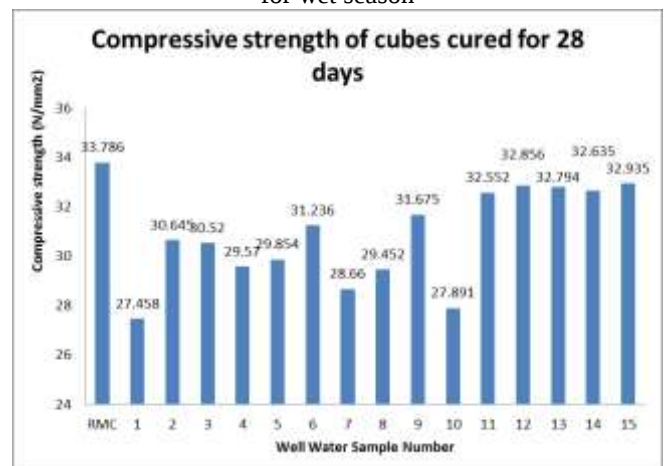


Fig 7.2: Test results of Compressive strength of cubes cured for 28 days

VIII. CONCLUSIONS

- 1) Properties of groundwater of bolloor village through 15 samples is found to be within limit as per IS 10500: 2012. Except chloride & iron chloride is increased because of the salt content from the nearby river basin.

- 2) The results shows that concrete made with different qualities of well water samples 1 to 15 have 7- and 28 – day compressive strength equal to or at least 90 percent of the strength of reference specimens made with clean water of RMC for M20 grade of concrete.
- 3) In dry season the contamination of the groundwater is more compared to wet season
- 4) Well water of different regions are suitable for construction practice except the well water 1 & 10.
- 5) The chloride content of ground water is increasing the limit. It indicates the amount of salt content. Presence of salt leads to corrosion when used for construction.
- 6) Iron content of one sample is high than the desirable value. Since presence of iron has no effect in construction practice, the water can be made used for construction.
- 7) The compressive strength of potable water has higher compressive strength than all other ground water samples.

IX. FUTURE WORK

- 1) Finding other characteristics like Electrical Conductivity, Dissolved Oxygen, Total Dissolved Solids, Sulphates, Iron, BOD, COD, and Turbidity for all the 15 well water samples during dry season.

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