Effect of High Concentrated Ground Water on Compressive Strength of Mortar

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Abstract- *The growth of population, technology, and industry leads to pollute the natural resources. This polluted natural resource not only affected the human health but also a durability of structure. The present dissertation works proves the effect of high concentration ground water on strength and leaching behavior of cement mortar". The quality of the curing water plays a vital role in hydration of cement and thus it effect on strength & durability of concrete. In this work mortar cubes were casted and cured in synthetic water with pH ranging from 4 to 10 at an increment of 1, Total hardness ranging from 600mg/L to 1600mg/L at an increment of 200mg/L, Sulphate water ranging from 200mg/L to 1000mg/L, Chloride water ranging from 250mg/L to 1000mg/L, Acidity water ranging from 50mg/L to 150mg/L ,Alkalinity water ranging from 250mg/L to 1000mg/L.This results the significant strength but has no durability in cement mortar.*

Keywords- Synthetic water, pH, Total Hardness, Chlorides, Sulphate, Cement mortar, Compressive strength.

I. INTRODUCTION

Natural resource is the gift of god to mankind. Water is one of the natural resource that is precious. WORLD HEALTH ORGANISATION describes about society their stage of development and their social, economic conditions. All animate or inanimate things depend on water. It is also used for construction purpose [11].

As Population increased, need for water also increased in random. The necessity of water has beyond the limit. There is no other option than using the available water, people start using partially or fully treated contaminated water according to their living standards.

The commodity called water on earth surface is uneven 3% of water is fresh water and 97% of water is ocean in 3% of fresh water 69% includes gracious 30% ground water and less than 1% of water is lake, river, swamps.it is so surprising that even though we have such large quantity of water only 1 % is used by man. Rest 99% is unusable underground [11].

A. Need of Water for Construction

Building cannot be constructed without water building of historical period was strong and durable only because of the purity of water in constructing building. The main ingredients for construction are water, cement and aggregate. The purity of water is considered in construction of a building. "The purer the water stronger the building" [12].

The water as a whole as chemical and biological character the ground water level differs from area to area the shallow ground water changes according to human activities the surface water is more fresh than ground water because it is polluted by bacteria's and also it is polluted by many dissolved mineral and organic constituents. Such water does not help in strengthening the building [12].

Water is made up of many dissolved minerals from rocks and it gives a tangy taste which we enjoy in drinking it. Water is combination of calcium, sodium, magnesium, potassium chloride, sulphate and bicarbonate. Too much of minerals dissolved in water make it impure that is not suitable for construction. Water that contains a lot of magnesium and calcium is said to be hard. Chloride, sulphate, and total hardness of water that affect to the life span of the building. Soft water reduces the strength of building because of corrosion [13].

The ground water contains acid which leads to the increase rate of iron content that effects the constructions. The hydrogen ion concentration ranges from 0 to 14.the pH of the neutral water is 7.The pH above the 7 water isalkaline in nature and pH bellow 7 is water is acidic in nature. Basic water can corrode. U. S. Environment Protection Agency reports on water for drinking and construction purpose should have pH 6.8 to 8.5 and more than 6.The Table 1 Shows the drinking and construction water quality parameters [13].

Table 1: Water quality parameters for Drinking and Construction Standards

Water Quality Parameters			
Sl No.	Parameter	Drinking	Construction
1	pH	6.8 - 8.5	>6
2	Total Hardness	300-600mg/L	Max 900mg/L for RCC
3	Chloride	250-1000 mg/L	Max 500mg/L for RCC
4	Sulphate	200-400mg/L	Max 400mg/L for RCC
5	Total Dissolved Solids	500-2000mg/L	500-2000mg/L
6	Alkalinity	200-600mg/L	Max 25ml
7	Acidity		Max 5ml

The effect of modernization has given life to industry, technology population that has affected the use of water both on land and water. The over use of water for industries chemical fertilizers pesticides domestic purpose has affected the quality of ground water. In recent years because of scarcity of water we use ground water comparatively to surface water as a result the long life of the building decreases. Today this is the living example with most of the construction we go through and read a lot of complaints about them [13].

B. Need of Cement for Construction

"As a knowledge and experience makes a perfect man" so "cement and pure water mortar and concrete makes a durable building. Cement and water plays a prominent role in construction of a building. Cement is a good binding material which is used in the production of mortar and concrete in construction work. Cement, fine aggregate and water mixed to form cement plaster. Concrete especially is use for building because it is strong element. It fixes the building and makes durable with chemical process called hydration. When water mix to the cement reaction is hardened the concrete.it is used for different constructive purpose such as bridges, overpass, motor ways and Roads etc [12].

II. MATERIALS AND METHODOLOGY

Materials

In this chapter materials used to carry out experiments, their description and methods adopted are discussed in detail.

1. Cement

Presently Ultra tech 43 grade ordinary Portland cement is used. The percent of composition of the major compounds present in cement are presented in Table No 2

Table 2: Composition of The Major Compounds Present In Cement.

Sl.No.	Name of the Compound	% Present in Cement
1	Lime (CaO)	60 - 68
2	Silica (SiO_2)	17 - 24
3	Alumina (Al_2O_3)	3 - 8
4	Iron Oxide (Fe_2O_3)	0.5 – 7
5	Magnesia (MgO)	0.1 - 4
6	Sulphur trioxide (SO_3)	1 – 3
7	Soda/Potas (Na_2O+K_2O)	0.5 – 1.3

Table 3: Properties of Cement.

SL.No.	Property	Unit	Result
1	Specific Gravity	--	3.14
2	Consistency	%	31
3	Initial setting time	Hour-min	0.45
4	Final setting time	Hour-min	7.45

2. Fine Aggregate

The fine aggregate (Sand) river sand is used. The standard sand is used for prepare the mortar blocks. Sand properties are presented in Table 4.

Table 4: Properties of Sand.

Sl.No.	Properties	Results
1	Specific Gravity	2.61
2	Bulking of Sand	5%
3	Fineness Modulus	3.37mm

3. Chemicals

The chemicals included sulfuric acid, Potassium chromate, Indicator, Silver nitrate, Ethylene diamine tetra acetic acid indicator, Ammonia buffer, Erichrome black T, Sodium hydroxide, Methyl Orange indicator, phenapthlene indicator, conditioning reagent, barium chloride potassium dichromate, etc. were used to carry out this project work.

4. Water

Potable or clean tap water is used to prepare Synthetic water of desirable and undesirable quality Parameter of Alkalinity, Acidity, Chloride, Sulphate, pH, Hardness of water.

B. Methodology

Analyzed the tap water before preparing the synthetic water. On the basis of tap water concentration synthetic water is prepared. Synthetic water is made with the mixture of chemical substances. Prepared the syntheticHardness and Chloride water calculate the amount by adding calcium chloride for required concentration. Prepared the synthetic sulphate water by calculate the amount by adding sodium sulfate for required concentration. Prepared the acidity and alkalinity of water by adding sulfuric acid and sodium hydroxide for required concentration. The Table 5 shows the concentration of water parameters.

Table 5: Concentration of Water Parameter.

Parameter	Concentrations
PH	4,5,6,7,8,9 and 10
Chloride	250,300,400,600,800 and 1000mg/L
Sulphate	200,300,400,800 and 1000mg/L
Total Hardness	600,800,1000,1300 and 1600mg/L
Acidity	50,100 and 150mg/L
Alkalinity	250,500 and 1000mg/L

1. Compressive Strength

The mortar cube size measuring 70.6mm X 70.6mm X 70.6mm in dimension was used. The batching of the mortar was carried out by weight. Mixture was proportioned for target cube strength and had a cementitious material content of 200g/cube and 600 g/cubes. The standard fine aggregate (sand)

The mortar was properly mixed using sulphate water, hardness water, chloride water, acidity water, alkalinity water and different pH water respectively.

The test specimen for the determination of compressive strength of mortar was prepared using the standard metallic cube moulds. The mortar cube moulds were lubricated with oil before the mixed mortar was placed inside it, in order to reduce friction between the mortar and the cubes. The procedure for the rodding and hard compactions filled to one third of their height and compacted 25 times respectively. The mortar cubes were demoulded after 24 hour of cured water having similar quality as used in the preparation of mix. The mortar cubes were cured for 3,7,14 and 28 days. The mortar cubes were cast and cured for 3,7,14 and 28 days in particular water sample. The compression test pieces are as shown in the table 5.

Table 5: Compressive Strength of Mortar Cube.

Age of Cubes in Days	Average Test Load, KN	Average Compressive Strength N/mm^2
pH 4		
3	93.30	1.86
7	126.67	2.53
14	188.33	2.63
28	196.67	2.70
pH 5		
3	90	1.80
7	130	2.60
14	161.67	2.60
28	168.33	2.86
pH 6		
3	115	2.30
7	113.33	2.26
14	138.33	2.77
28	166.67	2.97
pH 7		
3	121.67	2.43
7	135	2.70
14	150	2.74
28	136.67	3
pH 8		
3	118.33	2.37
7	173.33	3.47
14	171.67	3.43
28	146.67	2.93
pH 9		
3	108.33	2.16
7	165	3.31
14	161.67	3.24
28	145	2.90
pH 10		
3	121.67	2.43
7	148.33	2.97
14	180	3.61
28	110	2.20
Chloride 250mg/L		
3	81.67	1.63
7	106.67	2.13
14	121.67	2.43
28	118.33	2.36
Chloride 400mg/L		
3	90	1.80
7	143.33	2.86
14	136.67	2.73
28	195	3.91

Chloride 600mg/L		
3	116.67	2.33
7	141.67	2.83
14	150	3
28	88.35	3
Chloride 800mg/L		
3	126.67	2.53
7	140	2.80
14	150	2.82
28	151.67	2.89
Chloride 1000mg/L		
3	121.67	2.43
7	146.67	2.93
14	141.67	2.83
28	161.67	2.68
Acidity 50mg/L		
3	106.67	2.13
7	128.33	2.57
14	121.67	2.43
28	211.66	2.30
Acidity 100mg/L		
3	78.33	1.56
7	141.67	2.80
14	160	2.60
28	201.67	2.20
Acidity 150mg/L		
3	75	1.50
7	71.67	1.43
14	165	1.80
28	193.33	2.10
Alkalinity 250mg/L		
3	96.67	1.93
7	116.67	2.30
14	125	2.50
28	175	2.54
Alkalinity 500mg/L		
3	86.67	1.73
7	100	2
14	133.33	2.33
28	156.67	2.33
Alkalinity 1000mg/L		
3	78.33	1.56
7	106.67	2.13
14	148.33	2.97
28	195	2.21
Total Hardness 600mg/L		
3	73.33	1.46
7	155	2.30
14	165	3.31
28	183.33	3.67

Total Hardness 800mg/L		
3	110	2.20
7	115	2.30
14	188.33	3.77
28	225	4.51
Total Hardness 1000mg/L		
3	98.33	1.96
7	116.67	2.30
14	175	3.51
28	205	4.11
Sulphate 200mg/L		
3	96.67	1.93
7	126.67	2.53
14	148.33	2.97
28	170	3.40
Sulphate 300mg/L		
3	101.67	2.03
7	141.67	2.83
14	178.33	3.57
28	173.33	3.53
Sulphate 400mg/L		
3	90	1.80
7	126.67	2.53
14	135	2.76
28	203.33	4.07
Sulphate 800mg/L		
3	125	2.50
7	146.67	2.93
14	131.67	2.63
28	116.67	2.33
Sulphate 1000mg/L		
3	116.67	2.33
7	133.33	2.67
14	136.67	2.74
28	155	3.10

III. RESULTS AND DISCUSSIONS

To study the effect of pH, Total Hardness, Chloride Sulphate, Alkaline and Acidity contents on the properties of mortar, compressive strengths were tested on material when their material ages reached 3,7,14 and 28 days. After casting, remolding, and cured separately in particular parameter of sulphate, hardness, chloride, acidity alkalinity and different pH water mortar cubes, When cured in sulphate, hardness, chloride, acidity alkalinity and different pH water a deposit of white powdered with whitish appearance at the bottom and top of the cube. Test results using the compression testing machine of the different concentration water parameters. The results indicate that, there is changes strength in the intervals

of all parameter. The average compressive strength of mortar cubes cast and cured in same water. Test pieces were measured and are listed in Figures 1 to 6.

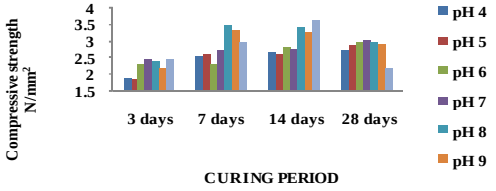


Figure 1: Compressive Strength of pH water changes accordance with age of curing.

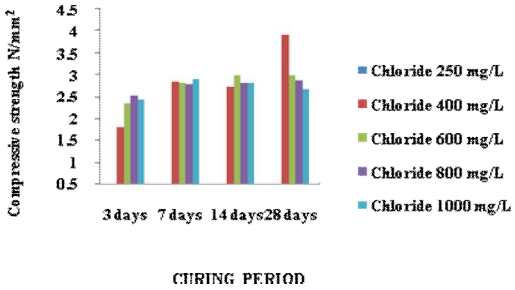


Figure 2: Compressive strength of chloride water changes in accordance with age of curing.

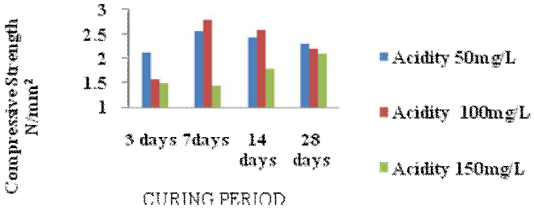


Figure 3: Compressive strength of Acidity water Changes in accordance with age of
Curing.

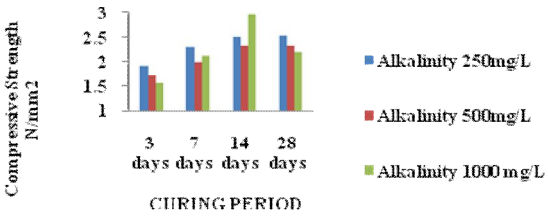


Figure 4: Compressive Strength of Alkalinity Water Changes Accordance with Age of Curing.

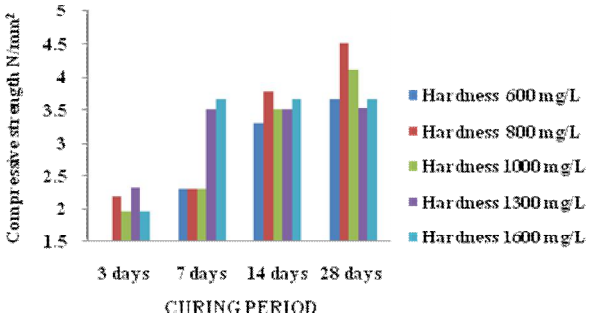
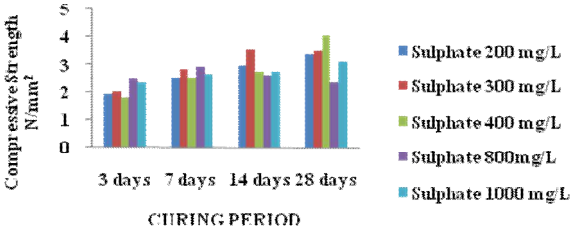


Figure 5:Compressive strength of Hard Water Changes accordance with age of curing.



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gure 6: Compressive Strength of Chloride Water Changes Accordance with Age ofCuring.

IV. CONCLUSIONS

The conclusion of this report is as follows.

- Compressive strength of mortar is maximum at neutral i.e at pH 7. If pH decreases or increases from neutral in mixing water the compression strength slightly reduces because of high suspended solids calcium silicate hydrate strength in concrete gets deteriorated and weakens.
- At 900mg/L of hardness water the compressive strength of mortar is N/mm^2. At higher concentration the compressive strength was decreased, but at lesser concentration there was no significant change in compressive strength.
- When higher concentration of chloride and sulphate is present in mixing, water retards the strength of concrete.
- Based on curing water analysis pH level in curing water increased compared to the maintained. pH level initially at 3,7,14 days and from 14th to 28th day pH level was decreased.
- There was linear increment in total dissolved solids that was found in curing water as the age of curing increases compared to synthetic water.
- The strength of mortar cubes. When casted and cured with acidity and alkalinity water there was decrement in strength as the concentration increased.

- Electrical conductivity gets retarded as the age of curing increases.
- The strength of concrete or mortar is dependent on hydration reaction mainly water plays critical role. When less water is used to make concrete its strength increases and it consumes specific amount of water. Concrete mixed with water results in hydration reaction.
- If water is not consumed.it loses the strength because hydration reaction takes place in the structure. Through structure hydration reaction takes place and pores are form, these pores make mortar weak because of hydrate the calcium silicate bonds. However the concrete has been compacted some pores will remain. 10. If strength gained at 28 days for the lower and higher concentration of water it is failed in durability.
- The excessive impurities like acidic, alkaline, sulphate, hardness and chloride in mixing water affect the setting time and also cause staining, corrosion of reinforcement, reduced durability, efflorescence (white salts deposits on the surface of the concrete or mortar), and change in volume.
- pH raised in cured water because the cement liberates the lime, alumina content to water it turned in to alkaline nature.
- Total dissolved solids are depend on pH it is less TDS is less pH is high TDS is high due suspended solids.
- Electrical conductivity is also increased when increasing number of impurities or ions present in the cured water. EC is measured in ms.

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