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### RESEARCH ARTICLE

#### TO STUDY THE PERFORMANCE M30 GRADE CONCRETE DUE TO CHANGE IN PH VALUE OF MIXING AND CURING WATER.

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#### Abstract

The quality of water used in mixing and curing the concrete is the major factor which influences the strength of the concrete, As per IS 456-2000, it specifies the quality of water to be within the limiting range. The effect of variation of water quality on strength of concrete is not known. In the present work, the effect of pH value of the water used in mixing and curing of concrete in strength of concrete is studied by considering pH values as pH4, pH7, pH9 and pH12.

This work was carried out for a mix of M30 grade concrete to study effect of the water of different pH values used in mixing and curing on the strength development of concrete at 7,28,56 and 90 days. From the results it is observed that concrete casted and cured using pH 9 shows the greater strength when compared with other pH values, pH 4 gives out the least of the strength. There was no homogeneity effect on concrete by changing in the pH values. Little change was seen on the concrete. when the compressive testing was done pH-4 was taking the load up to the crushing of concrete. There should be changing of water for the pH-4, pH-9 and pH-12.

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#### Introduction:-

Concrete is one of the most commonly used construction materials in the world. Concrete has relatively high compressive strength, but lower tensile strength. However, when exposed to severe environments its strength can significantly decline due to degradation of concrete. Cement used in concrete is a mixture of complex mineral compounds. The reaction of these with water leads to setting and hardening of cement. The Tricalcium Silicate and Dicalcium Silicate are the most important compounds responsible for strength. Together they constitute 70 to 80 percent of cement. The average C3S content in modern cement is about 45 percent and that C2S is about 25 percent. The sum of the contents of C3A and C4AF has decreased slightly in modern cement. the hydrates rather slowly. The initial setting is attributed to hydration reactions. The C2S (Dicalcium Silicate) phase the reactions of C3A, C3 S and C<sub>4</sub>AF (lea, 1956).

Impurities in water may interact with the of the cement and may adversely affect the strength of the concrete (Neville,1970). The chemical constituents present in water may participate in the chemical reactions and thus affect the setting, Hardening and strength development of concrete.

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**Material And Specifications:-**

The water cement ratio is selected based on the desired compressive strength or the expected exposure conditions. The amount of mixing water is based on the maximum aggregate size and the desired slump range. The aggregate proportions are selected to provide for an economical mixture with the desired workability and finish ability characteristics. A different type of Portland cement allows some tailoring of strength gain characteristics or for additional resistance to chemical attack.

In practice mix proportions vary depending on the properties of the individual ingredients and on the desired properties of the concrete in service details of some actual mixes used in the past.

**Cement:-**

Ordinary Portland cement of 53 grade was used.

The specific gravity	-	3.14
Normal consistency	-	32%
initial setting time	-	35 Minutes
and final setting time	-	580 Minutes

**Fine aggregate:-**

The fine aggregate were tested and are as per IS: 383-1970.

Specific gravity	-	2.60
Fineness modulus	-	2.34
Zone	-	III
Moisture content	-	0.20%
Water absorption	-	1.15%

**Coarse aggregate:-**

Coarse aggregate was procured from local market. The specific gravity, moisture content, water absorption, crushing value and impact value of coarse aggregate were 2.744, 0.10%, 0.55%, 23.76% and 15.875% respectively. All the physical and mechanical properties of coarse aggregate were as per the standard limit of IS: 383-1970.

**Chemicals used for maintaining desired pH:-**

1. Sodium hydroxide
2. Hydrogen chloride
3. Ammonia Solution

The chemicals procured were manufactured by E. Merck India Limited were used in this research work.

**Preparation of Alkaline water (for Ph-12):-**

1. Take 1 litre of deionised water.
2. Approximately 40 gm of sodium hydroxide (NaOH) was added in 1 litre of normal water and mixed thoroughly to obtain alkaline solution.
3. Finally, a digital pH meter was used to measure the pH value of the solution and which obtained the solution of pH 12.

**Preparation of Alkaline water (for Ph-9):-**

4. Take 1 litre of deionised water.
5. Approximately 22ml of Ammonia solution (NH<sub>3</sub>) was added in 1 litre of normal water and mixed thoroughly to obtain alkaline solution.
6. Finally, a digital pH meter was used to measure the pH value of the solution and which obtained the solution of pH 9.0.

**Preparation of Acidic water (for Ph-4):-**

7. Take 1 litre of deionised water.

8. Approximately 2ml of hydrogen chloride (HCl) was added in 1liter of normal water and mixed thoroughly to obtain acidic solution.
9. Finally, a digital pH meter was used to measure the pH value of the solution and which obtained the solution of pH 4.

### Methodology:-

The M30 grade of concrete is proportioned as per the mix design and the water to be used for mixing of water is made with different pH of waters. The four different mixes P-4, P-7, P-9 and P-12 were prepared for four different pH values (pH-4, pH-7, pH-9 and pH-12) in water.

The mix design is as shown in table I

**Table I:-mix design**

Mix	w/c ratio	Mix proportion
P-4	0.5	1:2.12:2.92
P-7	0.5	1:2.12:2.92
P-9	0.5	1:2.12:2.92
P-12	0.5	1:2.12:2.92

**Table II:-The quantity of material**

Water	Cement	Fine aggregate	Coarse Aggregate
187kg/m <sup>3</sup>	370kg/m <sup>3</sup>	787kg/m <sup>3</sup>	1082kg/m <sup>3</sup>
0.5	1	2.12	2.92

### Methods of curing:-

Curing is the process in which the rate and extent of loss of moisture from concrete to make hydration process of cement is done. Proper curing will maintain temperature of concrete in its early ages, as this directly affects the rate of hydration of cement and eventually the strength gain of concrete.

In the present work the effect of acids and bases mixing in water on the strength and durability of hardened concrete is studied. An experimental work is carried out in following curing conditions: -

1. Normal water curing
2. Alkaline curing
3. Acid curing

### Normal water Curing:-

Portable water is generally considered satisfactory for curing. The samples were tested for 7days, 28days, 56days and 90 days of proper curing.

### Alkaline and Acidic curing:-

The solution used for alkaline and acidic curing of concrete samples was prepared using NaOH, NH<sub>3</sub> and HCL which was dissolved in water to obtain solutions with pH of 12, 9, 4. The concrete samples were tested after 7 days, 28 days, 56 days and 90 days of proper alkaline and acidic curing. There curing was done in different tubs with different pH values in each tubs. There should be change in water for changing of pH values in tubs. Every day check the pH values in tubs.



Figure showing the curing process



Figure showing the monitoring of pH of curing water

### Results And Discussion:-

Compressive strength of concrete is measured in two different ways:

1. Cube compressive strength (Destructive) test and
2. Non Destructive test method.

Compressive strength test is done in compressive testing machine for M30 Grade concrete after 7, 28, 56 and 90days curing.

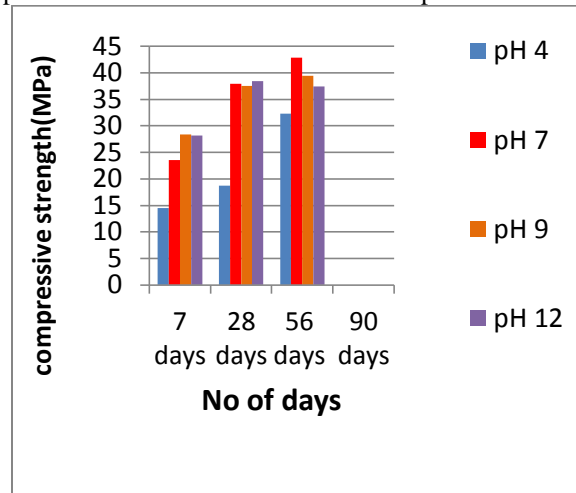
Schmidt Rebound Hammer test is done in the laboratory. Test is done by placing the concrete cube in compression testing machine and by applying 30% load required to that of the full strength of the specimen. The test was done for 28days only.

Ultrasonic Pulse velocity test was done to find the homogeneity of the concrete for every change pH values in the concrete. The test was done for 28days only.

**Table III:-**Compressive strengths of the Mixes

Mix	Compressive strength(MPa)			
	7 days	28 days	56 days	90 days
P-4	14.5	23.53	28.4	28.167
P-7	18.7	37.93	37.5	38.5
P-9	32.3	42.83	39.51	37.4
P-12	14.5	23.53	28.4	28.167

Graph for M30 Grade concrete in deferent pH values variation.

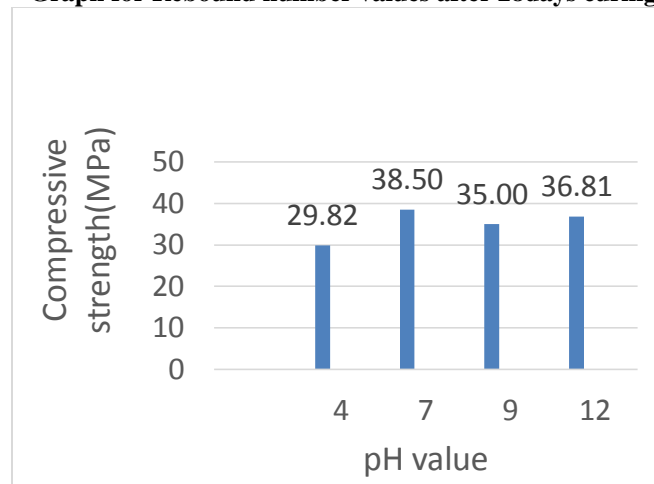


The cube compressive strength of M30 Grade concrete is observed that, for pH 4 and pH 12 are decreased. Further, the 90 days strength is observed to be reduced for all pH values except for pH 7 (which is normal water).

**Table IV:-**Rebound number compressive strength value for 28 days

pH values	Average rebound number compressive strength values (MPa)
pH-4	29.82
pH-7	31.66
pH-9	25.6
pH-12	25.46

The rebound hammer test for of M30 Grade concrete is observed that, the rebound compressive strength is reduced to all the pH of water except for pH 7, from which it can be concluded that the concrete has got surface disintegrated.

**Graph for Rebound number values after 28days curing****Table IV:-**Ultrasonic pulse velocity test after 28 days curing.

pH values	Ultrasonic pulse velocity test values for 28days(km/s)	Concrete Quality
pH-4	4.8	Very good to Excellent

pH-7	5.01	Very good to Excellent
pH-9	4.85	Very good to Excellent
pH-12	4.53	Very good to Excellent

The UPV test for of M30 Grade concrete is observed that, the pulse velocity is reduced to all the pH of water except for pH 7, from which it can be concluded that the concrete has lost its integrity.

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