Experimental Investigation on Properties of Concrete by using Different Types of Water

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Abstract - *The impact of several types of mixing water on the compressive, flexural, and tensile strength of concrete was explored in this study. The research focused on the impact of varied water quality on concrete compressive strength. The investigation focused on a concrete mix of M30 grade with a water cement ratio of 0.4. Water samples were obtained from several sources on campus, including bore well water, waste water, well water, sea water, and mineral water (packed drinking water), and utilised to cast 150mm×150mm×150mm concrete cubes and 150mm×150mm×750mm concrete beams.*

The cured cubes and beam were crushed after 7 and 28 days to determine compressive, flexural, and tensile strength. The results revealed that the compressive strength of concrete cubes formed using mineral water, tap water, well water, and waste water increased with time and had little fluctuation.The effects of other contaminants, such as silt and suspended particles, on concrete strength were also looked at. Chemical analysis was performed on water samples from five different sources to determine their chemical composition. These water samples were used to make 150mm cube samples.

The cubes were put through a compressive strength test, and the results were analysed statistically. The findings revealed that the kind of water used in concrete mixing had a considerable influence on the final concrete's compressive, flexural, and tensile strength. It ended by recommending that if tap water is inadequate, river water may be utilised for mixing. Other attributes like durability and shrinkage, on the other hand, should be addressed before usage.

Key Words : **Waste water, borewell water, compressive strength, flexural strength, workability, mineral water.**

1.INTRODUCTION

Cement is one of the most energy-intensive structural components in concrete, making it one of the most durable construction materials. The most important factors to consider when it comes to mixing water quality are its performance in both the fresh and hardened states. In the manufacture of concrete, the quality of the water is critical. Water impurities can impact the cement's setting time as well as the concrete's strength and durability. Water's chemical contents may play an active role in chemical processes, influencing the setting, hardening, and strength development of concrete. Furthermore, health concerns about the proper management of such water must be considered. Water's appropriateness can be determined based on previous service records or by testing it against performance standards such as setting times and compressive strength and durability tests.

For combining water with its constituents, such as total alkalis, chloride sulphate, and so on, limits are set. Reclaimed water, bore well water, well water, mineral water, waste water, and salt water all benefit from biological treatment and pathogen reduction. By removing the lime and alumina from cement, pure water decomposes the set cement compounds. This leaching activity continues and gradually slows down until the water is able to travel through the concrete mass constantly. There are a variety of current and new water sources that might be used to substitute potable water in concrete production completely or partially. It contains bore well water, well water, cleaned sewage water, and sea water, among other things. Water officials are working to locate new sources of water due to water shortages and scarcity in many parts of the world, including India, particularly in Maharashtra regions like Latur. Treated effluents are also utilised for irrigation in these nations, as well as concrete mixing, curing, and aggregate washing. If the water does not include brackish stuff, it can be used from a stream, river, or even the sea. One of the realities is that desalinated water is mixed with brackish ground water in dry places.

1.1 Objectives of the study are stated below;

- Examine the strength of concrete by substituting different types of water for the water used to make regular concrete.
- Examine the effects of substituting different types of water for standard water.
- Find a substitute for regular water and test the strength of concrete using various types of water as well as V.S.I. sand.
- Determine the suitability of various types of water as a concrete replacement for regular water.
- Find a replacement for fundamental materials that have been used in building for many years.

- Research the characteristics of fresh and hardened concrete when produced with various types of water.

1.2 Scope of the project:

- The use of various forms of water in concrete is a relatively recent invention in the field of concrete technology, and much study is required before this material can be employed in concrete construction.
- The use of various types of water in concrete to increase its strength.
- For various water samples, an experimental investigation must be done.

2. METHODLOGY

2.1 MATERIAL USED:

a) Cement:

- The Cement used for this experimentation is Ultratech Portland pozolona cement of 53 grade with specific gravity of 3.15.
- PPC 53Grade at ULTRATECH CEMENT is produced conformed to the Indian standards specification as per IS:1489-1991.
- PPC is employed here because it makes concrete more impermeable and denser than OPC. In comparison to OPC, PPC has stronger long-term strength.

b) Fine aggregate(VSI sand)

- Vertical Shaft Impactor (VSI) (V.S.I.) Sand is sometimes known as Crushed Sand or Artificial Sand. Only sand produced by V.S.I. Crusher has a cubical and angular form. Generally the size of the aggregate lesser than 4.75 mm is measured as fine aggregate.
- V.S.I sand has a specific gravity of 2.60.

c) Coarse aggregate:

- Locally available coarse aggregate from a quarry with a specific gravity of 2.68 and a water absorption of 0.705 percent was utilised, with a maximum aggregate size of 20mm.
- Testing is carried out in accordance with Indian Standard Specification IS: 383-1970.

d) Water:

- Acids, oils, alkalies, vegetable or other organic contaminants should be absent from the water.
- Water used for curing should be clean, portable, fresh, and free of germs, and desire matter that conforms to IS 3025-1964 should be used for mixing.

- **Chemical properties of different types of water**

Chemical properties of different types of water as obtained given in following table.

TABLE 1: chemical properties of bore well water:

Sr. No	Property	Test results
1	PH	8.6
2	Total dissolved solids	570mg/l
3	Total hardness	330mg/l
4	Nitrates	34mg/l
5	Chlorides	150mg/l
6	Total suspended solids	---------

TABLE 2: Chemical properties of well water:

Sr. No	Property	Test results
1	PH	6.8
2	Total dissolved solids	250mg/l
3	Total hardness	680mg/l
4	Nitrates	74mg/l
5	Chlorides	175mg/l
6	Total suspended solids	---------

Table 3: Chemical properties of waste water:

Sr. No	Property	Test results
1	PH	10.8
2	Total dissolved solids	---------
3	Total hardness	---------
4	Nitrates	0.5mg/l
5	Chlorides	220mg/l
6	Total suspended solids	270mg/l

Table 4: Chemical properties of mineral water:

Sr. No	Property	Test results
1	PH	7.5
2	Total dissolved solids	380mg/l
3	Total hardness	330mg/l
4	Nitrates	2.3mg/l
5	Chlorides	344mg/l
6	Total suspended solids	---------

Table 5: Chemical properties of sea water:

Sr. No	Property	Test results
1	PH	6.69
2	Total dissolved solids	3500mg/l
3	Total hardness	330mg/l
4	Nitrates	15.51mg/l
5	Chlorides	18379.18mg/l
6	Total suspended solids	530mg/l

2.2 Casting of specimen:

Using conventional moulds, test specimens of Cubes 150mm x 150mm x 150mm and beams 750mm x 150mm x 150mm will be manufactured. The samples are ready to be cast. After 24 hours of casting, the samples are remoulded and cured in a water tank for 7 to 28 days. A total of 45 specimens were cast in order to evaluate qualities like compressive and flexural strength.

For different kinds of water, 30 cube samples of 150mmx150mmx150mm were employed. All cubes will be cast in a single lift and consolidated with the help of a machine vibrator. The cube moulds will be removed after the final setting of the cubes, and the cubes will be maintained in the water tank for curing for 7 to 28 days. All specimen beams with dimensions of 750mm x 150mm x 150mm will be cast in a single lift and consolidated with tamping rods with the required compressive strength for the specified mix. Wet gunny bags will be used to cover the beams after they have been placed. The burlap will be held for a period of three days. The forms will be peeled at the conclusion of the third day, and the beams will be maintained for up to 28 days to cure.

2.3. Testing of specimen:

The specimens were removed from the mould after 24 hours and treated to 7 and 28 days of water cure. Following curing, the specimens were evaluated for compressive and flexural strength using a compressive testing equipment with a capacity of 200KN, as per Indian standard specification IS;516-1959. The cube's strength was evaluated after seven and twenty-eight days. The beam's strength was evaluated after 28 days.

3. WORKABILITY:

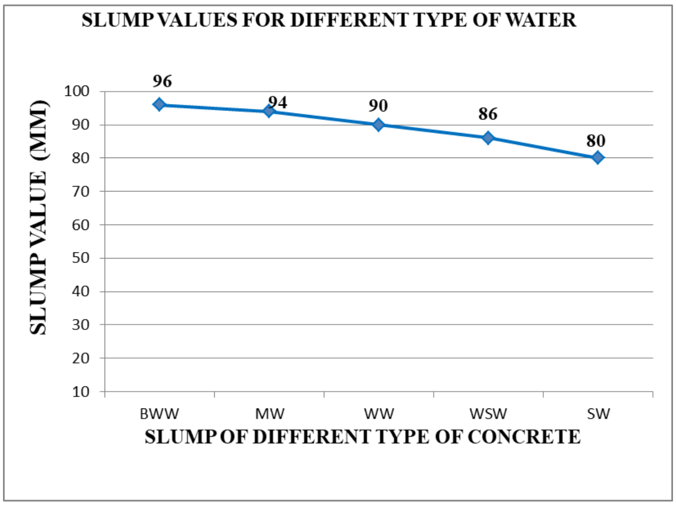
It is the amount of beneficial internal effort required to generate complete compaction of concrete on the job site. There are both field and laboratory methods for determining concrete workability.

Slump cone tests with a w/c ratio of 0.40 are used to determine the workability of concrete when various types of water used

The results for various mixes are listed below.

Table 6: Slump values for different types of water:

Different types of water	Slump value(mm)
Bore well water	96
Well water	94
Mineral water	90
Waste water	86
Sea water	80



4. EXPERIMENTAL METHODLOGY:

4.1 Compressive Strength Test:

At 7 and 28 days, compressive strength is assessed. The results show that the compressive strength of different forms of water varies as we utilise them. That implies we can make concrete with bore well water or well water,mineral water.

4.2 Flexural Strength Test:

All beam specimens are subjected to two-point loading to determine their flexural strength. A hydraulic jack and a load cell were used to apply the load. A loading beam was used to transfer the load from the jack to the main specimen. The responses were handled by two roller supports, hence the loading states were two incremental bending point loads. Dial gauge is used to measure the deflection at the web's centre.

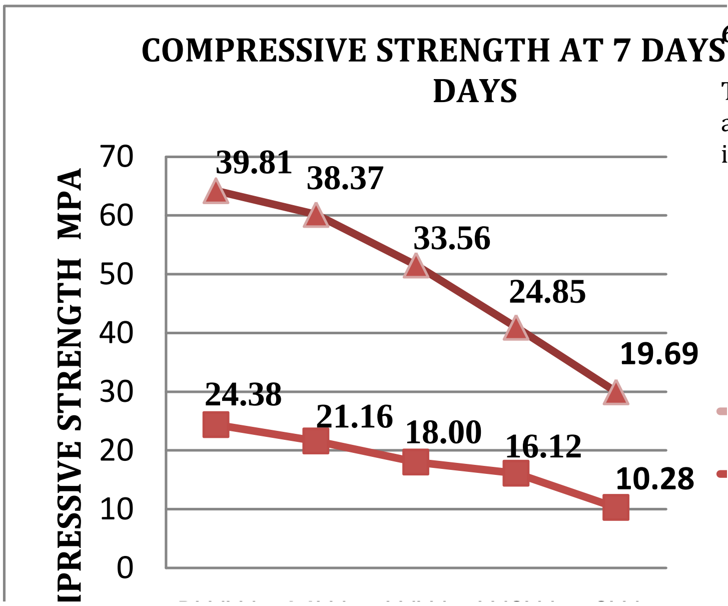
$$F_r = \frac{P \times L}{b \times d^2}$$

5. EXPERIMENTAL RESULTS:

5.1 Compressive strength test result:

Table 7: Compressive Strength at 7 days and 28 days

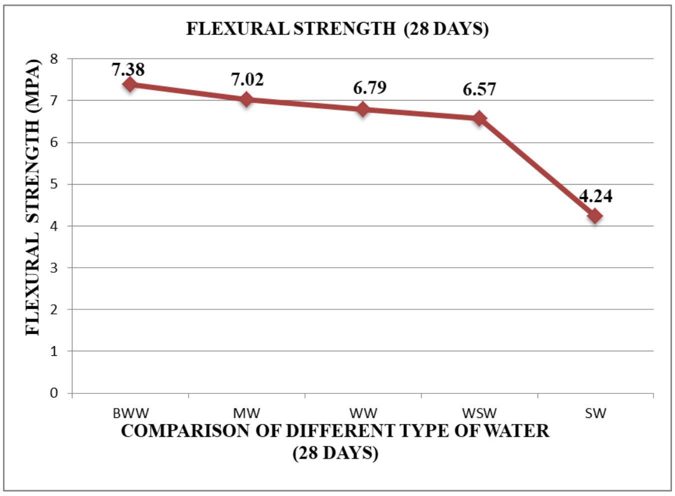
Type of water	Compressive strength at 7 days(N/mm²)	Compressive strength at 28 days(N/mm²)
Bore well water	24.38	39.81
Well water	18.00	33.56
Mineral water	21.61	38.37
Waste water	16.12	24.85
Sea water	10.28	19.69



5.2 flexural strength test results:

Table 5: Flexural Strength at 28 days:

Type of water	Flexural strength at 28 days
Bore well water	7.38
Well water	6.79
Mineral water	7.02
Waste water	6.57
Sea water	4.24



6. CONCLUSIONS

The following conclusions are formed based on the findings and observations gathered during the experimental research investigation.

1. It's worth noting that the workability levels for various types of water varies.
2. The results show that concrete made with various types of water samples, such as bore well water, well water mineral water, waste water, and sea water, has 7- and 28-day compressive strengths of well water and mineral water that are equal to or greater than 90% of the strength of reference specimens made with clean water (bore well water) for M30 grade of concrete. (With the exception of the waste water and sea water specimens for the 28-day period.)
3. The compressive strength of concrete cubes created using packed drinking water is 13.5 percent higher than that of waste water cubes.

4 According to the results of the tests, the concrete made with questionable water sample, i.e. waste water sample with a constant water – cement ratio of 0.4, had about 7% lower compressive strength for 7 days, 15% lower compressive strength for 28 days, and 1% lower flexural strength for 28 days than the reference specimen.

5 According to the results of the tests, a well water sample with a constant aggregate-cement ratio of 5.52 had roughly 7% lower compressive strength after 7 days, 6% lower compressive strength after 28 days, and 1% lower flexural strength than a reference specimen.

6 When compared to other specimens, the concrete prepared with sea water had somewhat lower 28-day compressive and flexural strength. Compressive and flexural strength are 20 percent lower than the reference specimen.

7 Additionally, recovered waters from cities, mining, and a variety of industrial processes can be properly utilised as concrete mixing fluids.

8 It is feasible to increase the compressive and flexural strength of concrete by using well water.

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