# A case study on properties of building material when using different waters in concrete production

**Madhu Gopal.B, MaheswaraRao.R[1*], B.Vijay Sekhar[1], Sarath kumar .D[2] Ayyappa.M[1]**

**And Narasimha Reddy.K[1]**

Asst. Prof, Department of Civil Engineering, QIS College of Engineering & Technology, AP, India
[2]Assst. Prof, Department of Mechanical Engineering, QIS College of Engineering& Technology, AP, India
* Corresponding Author: maheswararao.r@qiscet.edu.in (Maheswararao.R)

## Abstract

This study looked into how different types of blending water affected the compressive strength of cement. It investigated the effects of debasements on the compressive strength of cement, including sodium salts, manganese, tin, zinc, copper, and lead. Moreover, the results of the presence of different contaminants, such as sediment and suspended particles, on significant strength were investigated. Tests were conducted on water from six sources in the climate of life to identify its synthetic components. These water testing included 100mm solid shape tests. The solid shapes underwent a compressive strength test, and the results were quantifiably handled. The findings demonstrated that the compressive strength of the finished cement is generally influenced by the water sources utilized when mixing concrete. It suggested as a conclusion that if ordinary water is in short supply, stream water could be used for blending. In any event, prior to usage, many characteristics like as toughness and shrinking should be taken into account.

**Keywords:** Concrete, mixing water, Compressive strength, durability

## 1. Introduction

Concrete (typically Portland cement and other cementations materials like fly ash and slag concrete), aggregate (typically a coarse aggregate made of crushed rock or stone, such as limestone or stone, as well as a fine aggregate like sand), water, and compound admixtures are the main ingredients in concrete, which is a building material. due to hydration, a chemical process, substantial cements and solidifies after mixing with water and location. Concrete is produced in response to the water, which fuses various components together to create a substance that finally resembles stone. Cement can be created in a variety of ways by altering the dimensions of the basic components. The finished item can be modified to its use with modifying strength, thickness, or substance and warm resistance properties by adjusting the extents of materials or by substituting the cementitious and total stages. The blend configuration is determined by the design of the building, how the materials will be combined and delivered, and how this structure will be shaped. A crucial component of cement is water. A cementitious material is hydrated to form a concrete glue when water is added to it. The concrete glue holds the whole thing together, fills in any gaps, and allows it to flow with even greater abandon. A more firmly anchored, stronger cement will result from less water in the concrete adhesive, whereas a more. Polluted cement-making water may cause issues with setting or early design dissatisfaction. Additionally, it has been discovered (Abram, 1924) that contaminant in water samples used in cement blending might weaken cement's strength, notably its compressive strength. Similarly, water used for cement restoration might reduce the strength of the considerable (Smith, 1976). The course of hydration will likely be disrupted by contaminants and harmful compounds that are typically present in the water used to mix concrete. This will prevent strong linkages between the totals and network. Sometimes the contaminations make the overall structure less durable (Neville, 1995). Due to Nigeria's increasing water shortage, it is necessary to look for alternative water sources that can be used for significant creation. It's crucial to assess how much water is appropriate for blending concrete. The assumption that water suitable for drinking is also suitable for producing concrete is often incorrect (Ullman, 1973). Even while various regulations attempting to ensure the appropriateness of water for mixing new cement demand that Polluted cement-making water may cause issues with setting or early design dissatisfaction.. It has been discovered that a few glasses of water that don't conform to these models can nonetheless produce appetising cement kinds (Sandorolini and Franzoni, 2001).

### 1.1 Various factors affect the strength of concrete

Aside from close checks, there are currently no unique tests designed to determine whether mixing water is appropriate. Generally speaking, such tests call for comparing the strength of the substance formed with water in question to the strength of cement made with water of known reasonableness in the event that the nature of water is unknown. Concrete that is intended to be used in the development activities must be used to make the two cements. According to the American Standard ASTM C 94, mortar characteristics created with test water should be at least 90% as strong as those created with refined water after 28 days. Additionally, same method was applied in this work. In determining whether water used to mix concrete is fair, two rules should be taken into consideration (Borger, et al, 1994; Sandrolini and Franzoni, 2001). The first is the potential impact of debasements in waste water from dubious sources on the properties and composition of concrete, and the second is the maximum level of pollution that can be allowed. Both of these models have been somewhat examined in this essay. The nature of water from various sources was examined in this study. After that, experiments on cement and mortar were conducted. The grounds of the college in Ile-Ife as well as other adaptable surface waters used for significant blends in the region were given special consideration. Osun State. the quality of water used in the mixing of concrete; The fine and coarse totals used in cementing have an impact on the cement's compressive strength in terms of debasements, harmful materials, and natural matter. For instance, it has been discovered that contaminants like Mica in fine aggregate significantly reduce cement's compressive strength. The method for carrying out the restoration process is as follows: correctly released material results in increased strength and decreased porousness, and prevents breakage where the surface dries out hastily. Due to the exothermic setting of concrete, caution should also be taken to avoid freezing or overheating. Unwise relief can result in scaling, weakened resistance, regrettable scraped spot opposition, and breakage. The benefit of using water in a relieving and restorative system is that it produces both physical and compound characteristics. Mechanical strength, low wetness penetrability, material and volumetric dependability are just a few of the traits. The rate of hydration: Cement undergoes an exothermic reaction during hydration, which releases heat. This level of intensity is referred to as the hydration level. The environment in which this response occurs determines how quickly the substance hydrates, which in turn affects how strong it is. For instance, concrete needs a damp, to fully solidify and gain strength in a controlled setting.

The substantial is more stiff because of the support bars that are there in it. Concrete is typically supported with materials that are solid under strain due to its fairly high compressive strength but essentially lower flexibility (frequently steel). The method of blending the substance: For instance, separate glue blending has demonstrated that combining concrete and water to make a glue before condensing the compressive strength of the resultant cement can be improved by these materials with totals. When concrete, water, and sand are blended quickly with a minimal net energy consumption of 5 kilojoules per kilograms of the mixture, high-energy blended concrete (also known as Trim cement) is created. In a typical strong blender, it is put to a plasticizer mixture and blended with the remaining ingredients.

## 2. Experimental investigation

### 2.1 Materials

The preparation of the 100mm significant solid shape examples used ordinary Portland concrete (OPC) that complied with BS EN 197-1 (2001) requirements. As a fine total, clear stream sand with a specific gravity of 2.70 and a water retention of 0.8% was used. As a coarse total, crushed stone with an apparent maximum size of 12.5 mm was used. The coarse total's particular gravity was 2.65, water retention was 0.6%, and it complied with BS EN 932 (1999) requirements for evaluation. The sources sold the water tests that were used for the exploration effort. listed below, and instances 1-6 are listed in Table 1 sequentially as follows:

**Table 1.** Description treated water samples

| Number | Sample of water |
|---|---|
| 1 | River behind the O.A.U. Sample Building Laboratory |
| 2 | a sample of the river Opa's |
| 3 | River running in front of the Mountain of Fire and Miracles Church on Ile-Ede-Osogbo Ife's Road. |
| 4 | Along the Ede-Osogbo Road in Ile-Ife, the River flows in front of the C.A.C. Mount Bethel Church. |

| | |
|---|---|
| 5 | The River running alongside Ibadan Road, behind the Magistrate Court in Ile, is a sample. |
| 6 | The OAU waterworks' treated water sample, which is used as the experimental work's control sample. |

**2.2 Preparation of Specimens and test methodology**

According to BS EN 12390-2, 100mm solid forms were prepared. For this research, blend proportions of 1:2:4 and 1:3:6 were used. Since it was the most dependable, the bunching by weight method was accepted and applied to all test experiments. According to BS EN 12390-2, the instances were fixed. Given that it has been determined to be the optimal method for lateralized concrete, the restoration strategy used in this study was totally water-lowered (Falade, 1991). The cases were shielded from vibration, shock, and dehydration. When utilising a pressure testing machine that is modified to BS EN 12390-4 in line with BS EN 12390-3, the compressive strength for all samples is still unknown. The test case complied with BS EN 12350-1, EN 12390-3, and EN 12390-2 standards. It was a 100mm 3D square. At 7, 14, 28, and 56 days, examples were heaped to the point of disappointment. The example's compressive strength was calculated after recording the maximum load it could support.

**3. Results and discussion**

The pH range for all of the water tests is between 6.7 and 7.0. (Table 1). According to Neville's (1995) findings, cement's compressive strength is affected by pH levels between 6.0 and 8.0. Additionally, according to BS 3148: Strategies for Testing for Water for Making Concrete, the Maximum Allowed TDS Level is 2000 ppm (part per million). It is obvious that every water test made an effort to incorporate the TDS as much as feasibleThe other metallic particles used in the exploration function that are depicted as water constituents in the Table are without a doubt considered to be debasements since pure water is only supposed to contain hydrogen and oxygen.

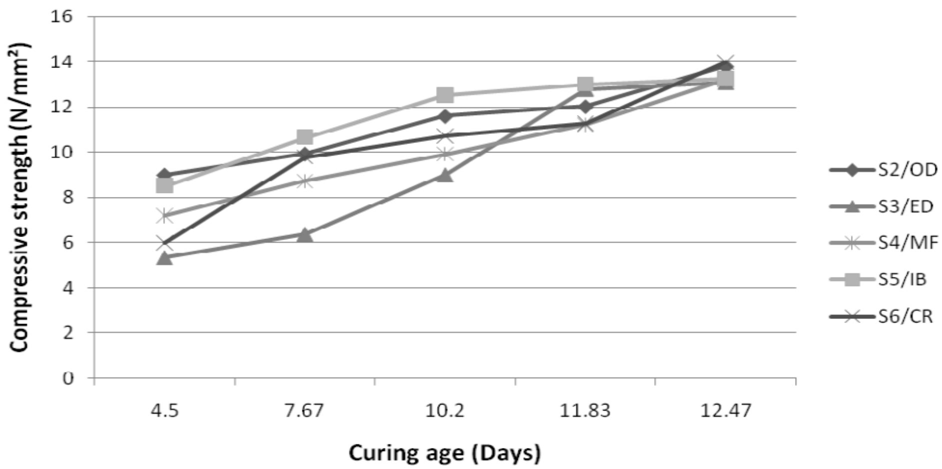


**Figure 1.** Variation of compressive strength with curing age

Figure 1 shows the compressive characteristics of the significant cast with water from various sources at various restorative ages (likewise in Table 2). In general, though at varying rates, all main 3D squares created with blended water from all of the investigated sources demonstrate a rise in compressive strength with an increase in relieving age. In general, when comparing the effects of the various water, example IB has the highest value of 11.6N/mm2, indicating that water from Ibadan Street is expected to generate concrete with the highest compressive strength when mixed with water from other sources in the Ile-Ife area. This indicates that the water from the Ibadan Street stream will be the best water to use for blending concrete in the event that we might elect to project with just one of these water tests. However, the lengthy process and durability of cement made using these water tests have not been identified. Compressive strength of cement may be affected over time by the presence of E. coli, turbidity, and organic materials. These are likely valid justifications for additional investigations in order to gather sufficient data regarding the quality of the stream water in Ile-Ife for cementing.

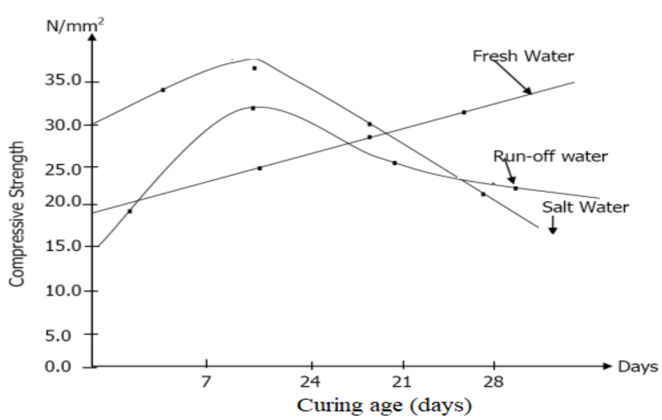


**Figure 2.** compressive strength vs curing age for three types of waters

To better understand the differences between the compressive strength of cement and its ages when made with salt water, run-off, and fresh water, a chart of compressive strength and their ages was displayed. The results of the compound investigation revealed that there are varying centralizations of synthetic piece in the three water tests. When compared to freshwater and runoff water, salt water has the most notable concentration of chlorides and carbonates. The results show that new water has the fewest compound focuses when compared to other new water, which makes it suitable for thorough mixing. In comparison to run-off water, salt water had higher levels of corrosiveness, pH, CO3, and HCO3. Due to the development of its streams inside the defined catchment area, there were significant amounts of debasements present in overflow water. Figure 1 illustrates how the compressive strength of large, 3D forms made using fresh water grew significantly with time and how this illustrates the suitability of fresh water for use in cement production. Compressive strength of freshwater-produced concrete increased dynamically from 21.74N/mm2 to 30.88N/mm2. Figure 1 shows that the compressive strength of large shapes made with salt water and runoff water will generally increase at the early stage of 14 days, but that there will be a tremendous loss of compressive strength thereafter. The presence of elements like Na, K, Ca, and Cl helped to improve the rate of hydration, which contributed to the early gain in compressive strength but later experienced an unusual fall due to their high levels.

### 3.1 pH value, turbidity and total solids

Results of water testing are shown, using three typical scenarios. The pH upsides of the tested tap and subterranean water ranged between 6 and 8, whereas wash water had a pH of above 11. This is most likely caused by the fact that residual concrete fragments are present in the wash water. Tap and underground water had turbidities of 0.08 and 1.7 NTU, respectively, which are significantly lower than the standard of CNS [8] for normal water (6NTU). Given the suspended materials, the base wash water's turbidity was as high as 493 NTU overall. But neither ASTM nor BS research has uncovered any turbidity standards for mixing water. The water from the faucet had a lot of particles. The level of solids in faucet water was quite similar to that of underground water, despite the fact that the level of solids in wash water rose with water depth from 1530 ppm for top wash water to 7130 ppm for base wash water.

### 3.2 Effect on properties of concrete

#### 3.2.1. Setting time

All mortars' underlying setting times, when combined with underground water and top, centre, and base wash waters, were between 10 and + 30 minutes longer than the control mortar's (blended in with faucet water). These examples' final setting times, when compared to the control, were within 15 and + 15 minutes, demonstrating that the use of these kinds of water complies with ASTM C94's setting time requirement, which establishes a resistance of 60 minutes for the initial setting time and 90 minutes for the final setting time.. While mortars blended with subsurface water or top wash water had similar underlying setting times to the control, mortars blended with base wash water had slightly slower underlying setting times. This is most likely the case since base wash water contains more alkalines ($Ca(OH)2$, $NaOH$) than top wash water, which would shorten the setting time. There may also be a problem since base wash water contains some hydrated concrete and fine particulates from multiple time-consuming processes, which could impair the setting time.

### 3.2.2. Fluidity

While mortars blended in with top and middle wash waters were easier to blend than those blended in with base wash water, the ease of mortars blended in with base wash water was essentially lower. This is most likely because base wash water contains more tin solids than other types of water does.

### 3.2.3. Compressive strength

The effects of compressive strength on mortars are described in Fig. 1. After seven days of relieving, the compressive strength of mortars mixed with underground water, top, centre, and base wash waters was 90%, 103%, 91%, and 90% of that of mortars mixed with regular water as displayed. This is higher than the maximum that can be achieved with 90% of what is predefined in ASTM C94 and BS 3184 be acknowledged as blending water for concrete. However, during a 28-day recovery period, the compressive strength of mortars combined with the aforementioned four types of water was 92–93% lower than that of mortars mixed with regular water.

## 4. Conclusions and Recommendations

Regular water, underground water, top, centre, and base wash water, as well as the other five types of water used in this study, all complied with ASTM C94's guidelines for mixing water for concrete. According to the findings of this specific investigation, it is assumed that materials given with fresh water gained apparent strength over time. Even if there was a little decline in strength, it later recovered and remained constant. The substance given with salt water grows its compressive after 7 days, but after that, at 14, 21, and 28 days, it obviously starts to lose its compressive effect. The significant amount of saltwater provided with support will have an unsettling effect on intake.

**Recommendations:**

1. Concrete that had been combined with wash water or subterranean water did not show a considerably unfavorable impact on the droop, even though the droop stream was only slightly harmed.

2. When compared to cement mixed with faucet water, cement mixed with wash water or groundwater showed a higher compressive strength. Even 10% more concrete combined with base wash water had a compressive strength than concrete mixed with regular water.

3. Due to the pozzolanic reaction of FA and impact heater slag being activated by the wash water's high alkalinity, the early strength improvement of cement blended with wash water was greater than that of cement blended with ordinary water.4. When making cement, compact or new water should always be used to achieve the greatest compressive strength after some time.

5. Saltwater shouldn't be used for significant creation unless appropriate precautions are taken, such as protecting the support from rusting and compound degradation.

6. All water that is anticipated to be used in the production of cement should be evaluated to make sure it complies with the established guidelines.

7. Decisions should be adhered to strictly, especially when it comes to supporting big development.

8. Taking everything into account, the variances in the first setting times of mortar and mortar mixed with faucet water.

**References**

[1] H.H. Steinour, Concrete mix water—how impure can it be? J. PCA Res. Dev. Lab. 3 (3) (1960) 32 – 50.

[2] A.M. Neville, Properties of Concrete, fourth ed., Longman Group, England, 1995, pp. 182 – 184.

[3] F.M. Lea, The Chemistry of Cement and Concrete, Arnold, London, 1956.

[4] K. Thomas, W.E.A. Lisk, Effect of sea water from tropical areas on setting times of cements, Mater. Struct. 3 (14) (1970) 101 – 105.

[5] ACI 318-89, Building code requirements for structural plain concrete, ACI Manual of Concrete Practice, Part 3: Use of Concrete in Build- ings, American Concrete Institute, Detroit, 1987, p. 14.

[6] ASTM C94, Standard specification for ready-mixed concrete, American Society for Testing and Materials, Philadelphia, 1992.

[7] AASHTO, Standard method of test for quality of water to be used in concrete, AASHTO Designation T 26-79, twelfth ed., American Association of State Highway and Transportation Officials, Washington, 2000.

[8] Standard Testing Bureau, Standard specification for mixing water of concrete, CNS 13961, Department of Economic Affairs, Taiwan, 1998.

[9] Al-Manaseer, A.A., Haug, M.D. and Nasser, K.W. (1988), Compressive Strength of Concrete containing Fly- ash, Brine and Admixture, American Concrete Institute, Material Journal, 85(2): 109-116.

[10] Bella M. &Fabuss, T. (1989), Properties of Seawater.1st Edition Academic PressBoston.

[11] Bryant. M. (1964), Effects of Seawater on Concrete, Miscellanous Paper no 6-690, U.S. Army Engineers, Waterways Experiment Station, Corps of Engineers Vicks Berg Mississipi.

[12] Chatveera. B., Lerwattanaruk, P. and Makul, N. (2006), Effect of Sludge Water from ReadyMixed Concrete Plant on Properties and Durability of Concrete, Elsevier, Cement and Concrete Composities, 28(5):441-450.

[13] Footes, P.G., &Mettan, J.D. (1998), Concreted Deterioration and Corrosion of Steel in Marine Environment, Element and Concrete association.

[14] Ghorab, H.Y., Hilal, M.S. and Kishar, E.A. (1989), effect of Mixing and Curing Waters on the Behaviour of Cement Castes and Concrete. Part I: Microstructure of Cement Pastes, American Concrete Institute of Cement and Concrete Research. 19(6): 868-878.

[15] Gupta B.L. and Gupta Amid (2012), Concrete Technology, Standard Publishers ltd, India.
[8] Neville, A.M. (1996), Properties of Concrete, 4th Edition, ELBS Longman London, 1-50.