A STUDY ON THE VARIATION OF CONCRETE STRENGTH DUE TO THE VARIATION OF MIXING AND CURING WATER.

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A thesis submitted to the Department of Civil Engineering in partial fulfillment for the degree of Bachelor of Science in Civil Engineering

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147/I, Green Road, Dhaka-1215, Bangladesh

Section: 16C

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Dedicated

to

"Our Parents"

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ABSTRACT

Concrete an artificial stone like mass, is the composite material that is created by mixing binding material (cement or lime) along with the aggregate (sand, gravel, stone, brick chips etc.) water admixtures etc. in specific proportion. The strength and quality are depended on the mixing proportion. Water is the most important & least expensive ingredient of concrete. It plays an important role in mixing, laying, and compaction, setting & hardening of concrete. This research investigated the effect of different types of mixing water on the compressive strength of concrete. Samples of water collected three sources. Such as Tap water, Dhanmondi lake water and Mineral water. 8-inch height and 4-inch diameter of cylinder samples were cast with these water samples. Compressive strength test was carried out on the cylinder and the findings were statically processed. The results indicated that sources of water used in mixing concrete have a significant impact on the compressive strength of the resulting concrete. It concluded by suggesting that tap water could be used for mixing where mineral water is scars.

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CHAPTER 1
INTRODUCTION

1.1 Background and Motivations

Concrete is a construction material composed of cement (commonly Portland cement and other cementations materials such as fly ash and slag cement, aggregate (generally a coarse aggregate made of gravels or crushed rocks such as limestone, or granite, plus a fine aggregate such as sand), water, and chemical admixtures. Concrete solidifies and hardens after mixing with water and placement due to a chemical process known as hydration. The water reacts with the cement, which bonds the other components together, eventually creating a stone-like material. Water is an essential component of concrete. A cement paste is created when water and a cementitious substance are combined during the process of hydration. The cement paste fills any gaps in the aggregate, binds it together, and promotes greater flow. A stronger, more resilient concrete will result from using less water in the cement paste, whereas a more fluid concrete with a larger slump will result from using more water. When making concrete, impure water might lead to issues with setting or early building failure. Additionally, it has been discovered (ABRAMS, 1924) that impurities in water samples used to mix concrete might reduce the material's strength (Davies, Goett Jr, Sinley, & Smith, 1975). The process of hydration is likely to be hampered by impurities and harmful elements, which are primarily introduced from water used in mixing concrete. This prevents an efficient binding between the aggregate and matrix. Sometimes the contaminants make the aggregate less durable.

In this experiment three different type of water was taken for mixing and curing of concrete. The three types are Mineral Water, Normal Tap Water and Impure Water. Mineral water bought from local shop, Normal tap water was collected from domestic water supply of Dhaka WASA, and impure water collected from Dhanmondi Lake.

Three criteria should be considered in evaluating the suitability of water used for mixing concrete. One is whether the impurities in the waste water from questionable sources will affect the properties and quality of concrete and the other is the degree of impurity which can be tolerated. Both of these criteria have been studied to some extend in this work.

1.2 Research Objectives

This study analyzed the quality of water from different process. Then, tests were conducted on mortar and concrete. Particular attention on focused on various portable surface water used for concrete regional parts of including the campus of Sonargaon University, Dhaka-1215.

1. To determine the compressive strength of concrete by using different type of water.
2. To know different types of water effect on concrete compressive strength test.
3. The comparison of compressive strength of concrete by using three types of water are mineral, normal and impure.

1.3 Outline of the Study

This study has been documented in the following manner.

Chapter 1 (Introduction): This chapter gives primary understanding of the problem statement and objective of the study.

Chapter 2 (Literature Review): This chapter has been devoted to review of the earlier studies to set the guidelines for present work.

Chapter 3 (Methodology): This chapter briefly describes the water collection, concrete mixing, curing and strength testing procedures.

Chapter 4 (Results & Discussions): Analysis and discussion of the obtained results are given in this chapter.

Chapter 5 (Conclusions and Recommendations): The specific conclusions drawn from this study and recommendations for further works are given in this chapter.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

For any type of building activity, compressive strength is crucial. In construction projects, many types of water are used for compressive strength. A material or structural element's capacity to endure loads that, when applied, cause them to shrink in size is referred to as their compressive strength. A test sample is subjected to a force at its top and bottom until it breaks or deforms. Even if there are many different types of water at work, many of us are unable to decide which water is the best. Another one of them is compressive strength. (DC Teychenné, 1975) In order to determine which form of water consumption in structures will be long-lasting, trials were crucial. The concrete cylinder test's compressive strength gives an understanding of all the properties of concrete. One can determine whether concrete pouring was done correctly or not by using this one test. One of the most crucial characteristics of concrete and mortar is its compressive strength. Therefore, the water's strength significantly influences the mixture's performance characteristics and ensures the overall quality of the final product. Tests on new concrete take into account characteristics including temperature, air content, unit weight, and strength. You can identify changes in concrete that may have an impact on its long-term performance by consistently carrying out these tests. The did a thesis using different types of water. Basically, the major objective of this research is to identify which water, among mineral, normal, and dirty water, has the strongest compressive strength. Concrete is a man-made composite construction material that is made by mixing pre-measured amounts of fine and coarse filler aggregates with cement, water, and air under specific conditions that make it simple to move and transport, place, cure, compact, and harden into a sturdy, long-lasting, and compression-resistant product. As an engineering material, concrete is technically assessed based on five primary deciding factors, including strength, Workability, setting state, and hardened state. Concrete essentially exists in any of these three states. The compressive strength of the concrete is typically the stipulated attribute while carrying out the design of any proposed concrete structure and taking into account its quality control (QC). This is due to the fact that evaluating concrete's compressive strength is simpler than other concrete parameters. (Hover, 2011) Additionally, some other characteristics of concrete, such as weathering resistance, impermeability, and modulus of elasticity have a direct relationship with the compressive strength of concrete and can therefore be deduced from the values of the three commonly tested strengths of hardened concrete, namely compressive strength, tensile strength, and flexural strength. Compressive strength is typically regarded as concrete's most significant engineering characteristic.

2.2 Aggregates

The uniformity and size of the particles used to classify aggregates. They can be separated into crushed aggregates and natural stone aggregates (sand and gravel) (stone chippings and crushed stones). The most common form of aggregate is a homogeneous bulk product. Standardized product attributes ensure the required levels of process capability and dependability. For many different uses, aggregates are employed in a wide range of industries. They are a key ingredient in the creation of concrete and asphalt, but they can also be used as a filler, filter, or fundamental building block for roads and railroads. Our product line varies from nation to nation. A material or structure's capacity to defeat (resist) loads that frequently result in. (L Evangelista, 2007).

2.3 Coarse Aggregate

Concrete is made from aggregates, which are granular and uneven materials like sand, gravel, or crushed stone. The majority of the time, coarse is produced naturally and can be obtained by blasting quarries or by manually crushing them in crushers. Before using them to make concrete, they must be thoroughly cleaned. Their strength and angularity have a variety of effects on the concrete. It goes without saying that choosing these aggregates is a crucial step. The amount of water required for the concrete mix, as well as the strength and workability of the concrete, are all influenced by the size of the coarse particles. It also aids in calculating the quantity of fine aggregate required to make a batch of concrete. The smaller the bondable size, the larger the size. For grades M15 and M20, the cement to water ratio is 0.50 depending on the size of the coarse aggregate. A stronger mixture is produced with less water, but it also becomes less workable. The distance between TMT bars is one crucial element. To allow the aggregate to travel between the rebar and settle equally throughout the building, the aggregate must be smaller than the distance between internal reinforcements. (R. Jones, 1957)The perfect CA should have a minimum amount of flat and elongated particles and be clean, cubical, angular, and 100% crushed (MA Rashid, 2009). Trap rock tends to generate the strongest concrete among the various crushed aggregates that have been tested, including quartzite, lime stone, greywacke, granite, and crushed gravel. But limestone generates However, limestone yields almost as strong of concrete as those made from trap rock. The strength of HSC varies very little depending on the CA gradation within ASTM standards. A ratio of CA to FA over what is often advised for NSC results in the strongest and most workable HSC possible. For this experiment, use black stone.

Figure 2.1: Brick Chips.

2.4 Fine Aggregate

When the granular material's particles are small enough to pass through a 4.75 mm sieve, it is referred to as fine aggregate. Aggregate is the granular material needed to make concrete or mortar. It is frequently used in the construction sector to increase the volume of concrete; as a result, it is a material that saves money. However, to select the best material, you need be completely knowledgeable about the fine aggregate size, its density, and the grading zone. Concrete made of natural sand or crushed stone needs fine aggregate as a key component. The quality and fine aggregate density have a significant impact on the concrete's hardened qualities. If you chose the fine aggregate based on the grading zone, particle form, surface texture, abrasion and skid resistance, absorption, and surface wetness, the concrete or mortar mixture will be more resilient, stronger, and less expensive. Sand from Sylhet was chosen in this experiment because it has a higher compressive strength than regular sand. (HDonza, 2002).

Figure 2.2: Fine Aggregates.

2.5 Effect of Water Impurities on Concrete Strength and Durability

On the 28th day of curing, a difference in compressive strength is determined. To determine the caliber of the mixing water, up to 10% of the controlled test is sufficient. Given that the initial setting time is not less than 30 minutes, ISO: 456-2000 allows for a variance in the initial setting time of a value +/-30 minutes. The effluents that are discharged from the sewerage works, sugar and fertilizer industries, paint, gas works, and textile industries have an impact on concrete. According to numerous studies, using water or building near a body of water with an excessive number of salts (dissolved salts) tends to reduce the concrete's compressive strength by 10 to 30 percent. When compared to concrete made using purified water, concrete's strength has decreased. The high chloride content of water causes surface efflorescence, chronic dampness, and makes the reinforcement steel susceptible to corrosion. The lean mix problem, which affects concrete constructions because of poor water quality, is more severe in tropical areas. (Skominas, 2019).

2.6 Maximum Limit of Water Impurities for Concrete Construction

The maximum allowed level of several solid contaminants in water used to make concrete is shown in table 2.6.1 The pH range that is best for making concrete is typically between 6 and 8. It is stated that the finest water for construction is one that is comparable to drinking water. The methods outlined in IS: 3025 are used to determine the solid contents of water. (Skominas, 2019).

Table 2.1: Limits of Permissible Impurities in Water for Concrete Construction.

Types of Impurities in Water	Limit of Permissible Salt (Percentage weight of water)
Organic Solids	0.02
Inorganic Solids	0.03
Sulfates (SO3)	0.04
Alkali Chlorides (as Cl2)	0.05
1. Plain Concrete	0.2
2. Reinforced Concrete	0.05

2.7 Effect of Impurities in Curing Water on Concrete Construction

The basic goal of curing is to allow water to seep into the concrete. If sufficient measures were taken to stop the concrete from losing water, no water is required for curing. Evaporation causes some water to unavoidably evaporate from the surface of structural members. The hydration process takes place inside the building, but at the surface, things are different since there is less moisture or water because of evaporation. There must therefore be curing. If seawater is being used, the chloride ions will enter the surface zone and then diffuse their way deeper. It should be emphasized that the majority of durability problems originate from the surface or are caused by an attack that moves inward from the surface. The dissolved salts in the sea pose a serious risk to marine constructions that are meant to be submerged in the water. But if appropriate curing is carried out using fresh water, these issues are resolved. The stains or deposits on the concrete surface are caused by the iron content or organic matter in the water used for curing. According to IS: 456-2000, the presence of iron or compounds containing tannic acid is prohibited in curing water. (Skominas, 2019).

2.8 Water and Water Cement Ratio

The water cement ratio is the ratio of the weight of water to the weight of cement used in a concrete mix. A lower ratio leads to higher strength and durability, but may make the mix difficult to work with and form. Workability can be resolved with the use of plasticizers or super plasticizers. Water cement ratio produced by conventional mixing technologies are usually prepared with water cement ratio in the range of 0.50 for grade M15 and to 0.50 for grade M20, and their 28 days compressive strength is about 60 to 10 MPa when normal density aggregate is used to. The requirements for water quality stringent than those for conventional concrete. Usually, water for concrete is specified to be a portable quality. (S.B.Singh, 2015).

CHAPTER 3
METHODOLOGY

3.1 Sieve Analysis of Fine and Coarse Aggregates

The term “sieve analysis” is the sample operation of dividing a sample of aggregates into fractions each consisting of particles between specific limits. The analysis is conducted to determine the grading of material proposed for use as aggregates. The term Fineness Modulus (F.M) is a ready index of coarseness or fineness of material. It is an empirical factor obtained by adding the cumulative percentages of aggregates retained on each of the standard sieves and dividing this sum arbitrarily by 100. No. 100, No. 50, No. 30, No. 16, No. 8, No. 4, and 3/8 in. are the ASTM standard sieves. This test method conforms to the ASTM standard requirements of specification C136.

Figure 3.1: Sieve Analysis (Fine Aggregates).

Figure 3.2: Sieve Analysis (Coarse Aggregates).

3.2 Procedure of Coarse Aggregate and Fine Aggregate

1. Dry the sample to constant weight at a temperature of 110 ± 50C.

2. Nest the sieve in order of decreasing size of opening from top to bottom and place the sample on the top sieve.

3. Agitate the sieves by hand or by mechanical apparatus for a sufficient period, say 1.5 minutes.

4. Limit the quantity of material on a given sieve so that all particles have the opportunity to reach sieve openings a number of times during the sieving operation. For sieves with openings smaller than 4.75mm (No. 4), the weight retained on any sieve at the completion of the sieving operation shall not exceed 6 kg/m2 (4 lb./in2) of sieving surface. For sieves with openings 4.75mm (No. 4) and larger, the weight in kg/m of sieving surface shall not exceed the product of 2.5 *(sieve opening in mm). In no case shall the weight be so great as to cause permanent deformation of the sieve cloth.

5. Continue sieving for a sufficient period and in such manner that after completion, not more than 1% weight of the residue on any individual sieve will pass that sieve during 1 minute of continuous hand sieving.

6. Determine the weight of each size increment by weighing on a scale or balance to the nearest 0.1gm of the total original dry sample weight. The total weight of the material after sieving should check closely with original weight of sample placed on the sieves

Figure 3.3: Procedure of Sieve Analysis.

3.3 Preparation of Concrete Cylinders

The cylinder specimens are cast in steel, cast iron or any mold made of nonabsorbent material. Cylindrical specimens for testing should be (4 x 8) inch (100 x 200) mm. The mold must hold the concrete without any leakage. Before placing the concrete mix within the mold, the interior of the mold must be properly greased to facilitate easy removal of the hardened cylinder. The mixed concrete is placed into the molds in layers not less than 5 cm deep. The strokes per layer during the compaction must not be less than 30 in number. Compaction must reach the underlying layers allowing the majority of the air voids to escape. The specimens are stored undisturbed in a place with at least 90% relative humidity at a temperature of 27° ± 2°C for 24 hours. After this period, the samples are taken and submerged in clean and fresh water until the testing age is reached.

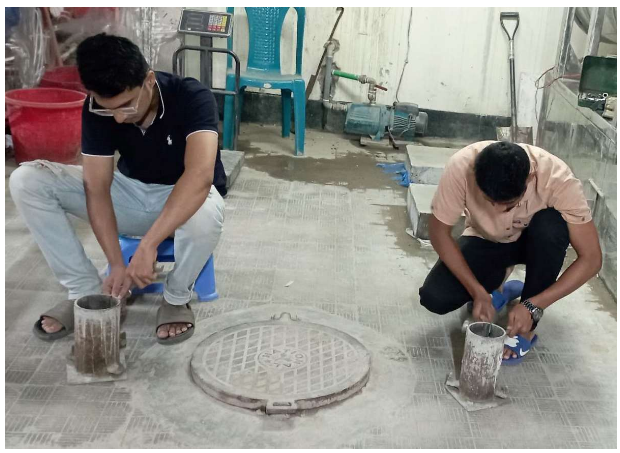


Figure 3.4: Preparing Cylinder Formwork.

3.4 Collecting water

We are collecting water in three type sources for mixing concrete. Mineral water was collecting from market, Normal water was collecting our WASA line and impure (dirty) water was collecting from DHANMODI LAKE.

Figure 3.5 Collecting Water.

3.5 Concrete Mixing

Concrete of mixing is a process of mixing the ingredient of concrete such as cement, sand, aggregate, water and admixture together to make concrete of suitable grade. To make the different grades of concrete mixing of concrete materials should be done properly as per the mix design of concrete to achieve the design strength of concrete. A concrete mixture ratio of 1 part cement, 1.5 parts sands and 3 parts aggregates will produce a concrete mix of approximately 3000 psi. Mixing water with the cement, sand and stone will from a paste that will bind the materials together until the mix hardness. Mixing of concrete is a very complex process. For making good quality concrete, we just have to follow some standard process of mixing its ingredients. It just does not up to making concrete, but making good quality concrete is important. Production of good quality and bad quality of concrete includes the same material, but the proportion and mixing method can be a differentiating factor. It requires proper care and knowledge for making good quality concrete.

Figure 3.6: Concrete Mixing.

3.6 Casting of Cylinder

The casting method for the cylinder head should be determined early on. It is recommended to take the expertise on casting and pattern making into consideration when creating the basic design of the cylinder head. The desired geometries cannot be implemented with all casting method. The shape and position of the intake and exhaust ducts as well as the shape of the combustion chamber in particular determine the overall geometry of the cylinder head. Furthermore, the cylinder bore and the distance between the cylinders have great as the combustion of fuel causes high temperatures also in the cylinder head an appropriate cooling concept is of great significance.

The coolant is generally feed into the underside of the cylinder head via the cylinder head gasket of the crank case and via multiple openings. From all the possible cooling systems (e.g., cross flow cooling, longitudinal flow cooling or a combination), the optimum cooling system is determined using appropriate simulation models, and possible critical. The ducts for the water-cooling system and the oil supply are often very fine and pose the greatest challenge to the caster in cylinder head manufacturing nowadays, since even minor changes in the process can lead to rework or rejections of the component. Typically set of M15 & M20 test for 7 days & 28 days curing cylinder required 24 nos.

Figure 3.7: Casting of Cylinder.

3.7 Curing

Curing is a process during which a chemical reaction (such as polymerization) or physical action (such as evaporation) takes place, resulting in a harder, tougher or more stable linkage (such as an adhesive bond) or substance (such as concrete). Some curing processes require maintenance of a certain temperature and/or humidity level, others require a certain pressure. Initial curing during the first 24 to 48 hours after molding, all test specimens shall be stored under conditions representative of the concrete in the structure or pavement. Following the period of initial cure, the specimens may be transported to the laboratory subsequent curing and testing.

Figure 3.8: Curing of Cylinder.

3.8 Preparation of Cylinder to Crush

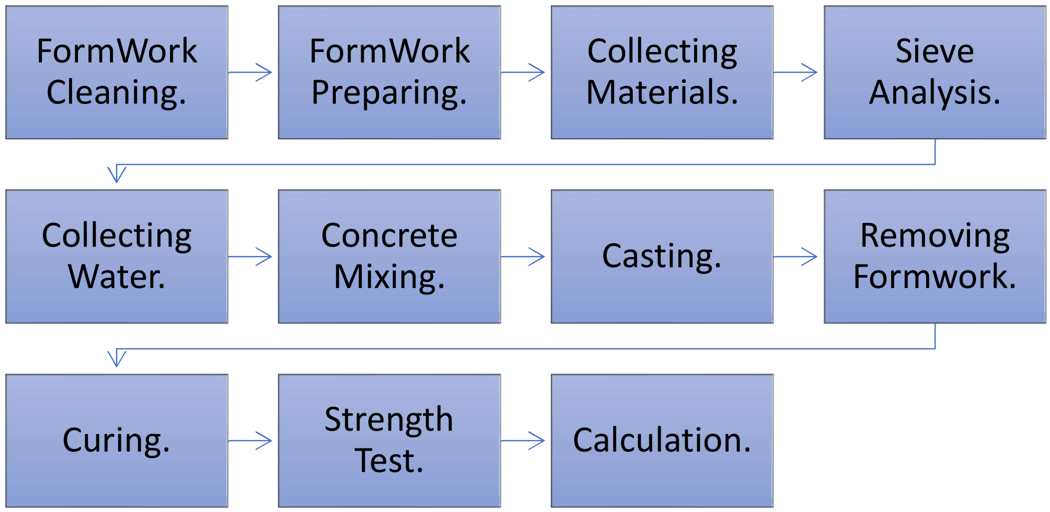
Kept submerged the cylinder as long as for 7 days. After that were withdraw 09 cylinders of Mineral, Normal and Dirty Water variation from the dram. In Sonargaon University (SU)Lab, after that the cylinders has placed in the center of Universal Testing Machine (UTM) one by one (take help from the manual) to find out the crushing of each cylinder. Then were kept submerged as long as for 28 days. Then we kept another test for 28 days. After that withdrew from the dram and crushing the cylinders and note down the value.

Figure 3.9: Preparation of Cylinder to Crush.

3.9 Compressive Strength Formula

Compressive strength is the maximum compressive stress that, under a gradually applied load, a given solid material can sustain without fracture. Compressive strength is calculated by dividing the maximum load by the original cross-sectional area of a specimen in a compressive test. The compressive strength is one of the most important and useful properties of concrete. The design strength of the concrete normally represents its 28th day. Compressive strength can be defined as the capacity of concrete to withstand loads before failure. Of the many tests applied to the concrete, the compressive strength test is the most important, as it gives an idea about the characteristics of the concrete. The compressive strength was calculated by using the equation: $F = P/A$ Where, F is compressive strength of specimen in Pound per square inch (Psi). P is the maximum applied load by Pound. A is the cross-sectional area (inch square). Compressive strength test, mechanical test measuring the maximum amount of compressive load a material can bear before fracturing. The test piece, usually in the form of a cube, prism, or cylinder, is compressed between the platens of a compressive-testing machine by a gradually applied load.

3.10 Working Process.



CHAPTER 4
RESULTS AND DISCUSSION

4.1 Result of Fine Aggregate

The test sample of the aggregate (F.M) shall weigh, after drying, approximately the following requirement: Aggregate with at least 85% passing No. 4 Sieve 500gm and more than 5% retained on a No. 8 Sieve. Aggregates with at least 95% passing No. 8 Sieve 100gm.

Table 4.1 Sieve Analysis of Fine Aggregate.

Sieve no.	Retain (gm)	%Retain	%Cumulative Retain	%Finer	FM
#4	0	0	0	100	2.66
#8	0.049	9.8	9.8	90.2	
#16	0.189	37.8	47.6	52.4	
#30	0.164	32.8	80.4	19.6	
#50	0.083	16.6	97	3	
#100	0.012	2.4	99	1	
PAN	0.003	0.6	100	0	

4.2 Results of 7 Day Compressive Strength Test of M20 Ratio

Table 4.2: 7 Day Compressive Strength Test of M20 Ratio.

Type	No. of Sample	Strength (psi)	Average Strength (psi)
Mineral Water	1	1576	1419
	2	1401	
	3	1280	
Normal Water	1	1337	1292
	2	1328	
	3	1212	
Dirty Water	1	985	947
	2	875	
	3	983	

4.3 Results of 14 Day Compressive Strength Test of M20 Ratio

Table 4.3: 14 Day Compressive Strength Test of M20 Ratio

Type	No. of Sample	Strength (psi)	Average Strength (psi)
Mineral Water	1	1667	1706
	2	1757	
	3	1693	
Normal Water	1	1488	1490
	2	1569	
	3	1414	
Dirty Water	1	1359	1192
	2	1182	
	3	1035	

4.4 Results of 28 Day Compressive Strength Test of M20 Ratio

Table 4.4: 28 Day Compressive Strength Test of M20 Ratio.

Type	No. of Sample	Strength (psi)	Average Strength (psi)
Mineral Water	1	2509	2558
	2	2475	
	3	2691	
Normal Water	1	1984	2023
	2	2157	
	3	1927	
Dirty Water	1	1553	1560
	2	1450	
	3	1677	

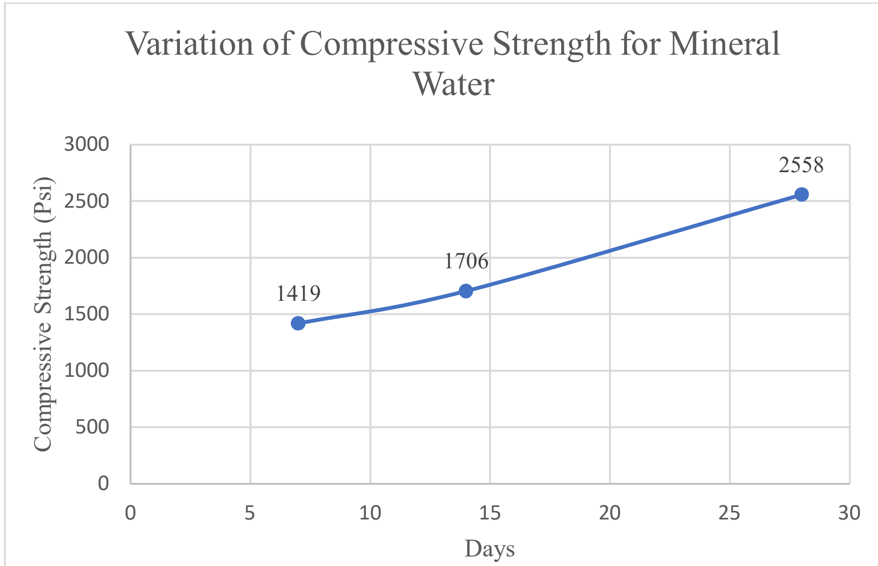


Figure 4.1: Variation of Compressive Strength for Mineral Water.

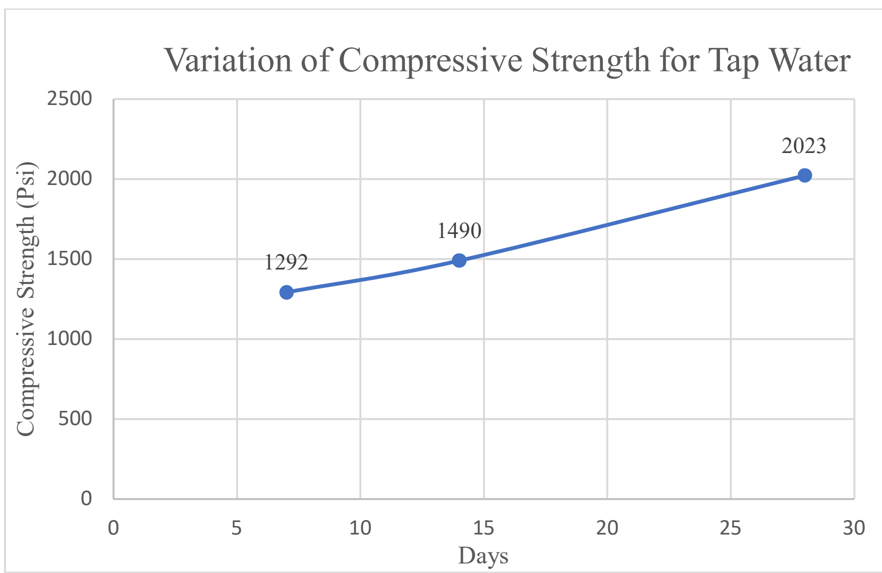


Figure 4.2: Variation of Compressive Strength for Tap Water.

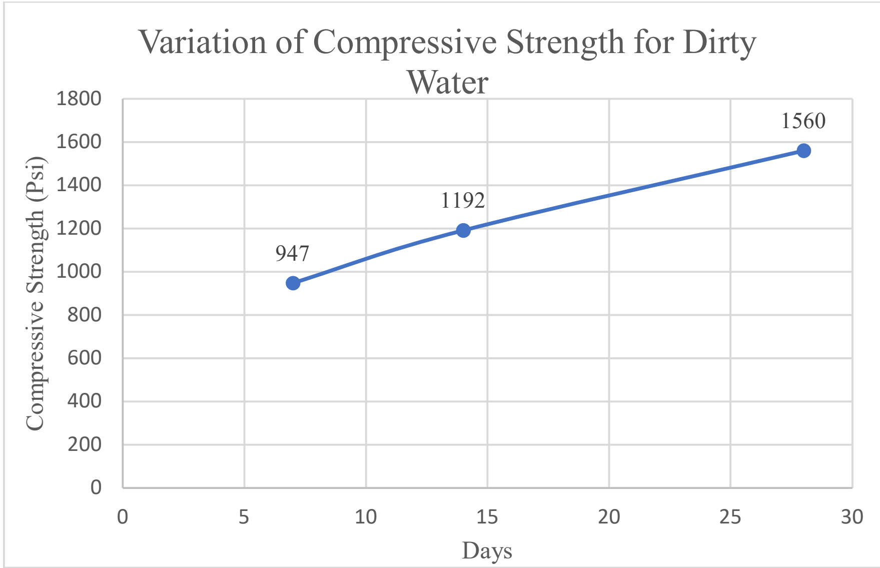


Figure 4.3: Variation of Compressive Strength for Dirty Water.

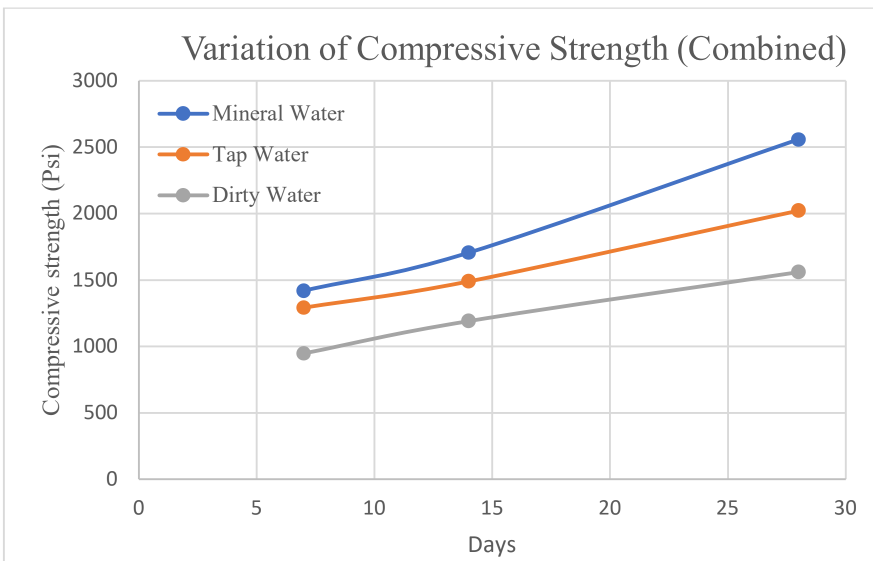


Figure 4.4: Variation of Compressive strength (combined).

4.5 Summary

The findings of the study, which looked at three different types of water mineral water, regular water, and unclean water included. The compressive strength for 7 days, 14 days, and 28 days has been examined. The higher strength mineral water and the lower strength impure water are two of the three varieties of water

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

After the experiment we get the below decision:

In 7 days:

Mineral water = 1419 psi

Normal water = 1292 psi

Impure water = 947 psi

In 14 days:

Mineral water = 1706 psi

Normal water = 1490 psi

Impure water = 1192 psi

In 28 days:

Mineral water = 2558 psi

Normal water = 2023 psi

Impure water = 1560 psi

When comparing clean (pure) water to dirty (impure) water, we find that mineral water has the maximum compressive strength. In conclusion, all tests show that mineral water is superior to other types of water.

5.2 Limitations and Recommendations for Future Works

The following are some recommendations provided considering the previous discussion:

1. The other grades like M10, M15, M25, M30, M35, M40, M50, M60 may be used in future works.
2. BOD, COD, DO and other water quality parameters should be checked.
3. More contaminated water, like sewage water, should be used in future experiments.
4. Use of either sea-water or salt water can be done.

REFERENCES

ABRAMS. (1924). *Design of Concrete Mixtures.* Kimberley Holland.

Davies, P., Goett Jr, J., Sinley, J., & Smith, N. (1975). *Acute and chronic toxicity of lead to rainbow trout salmo gairdneri, in hard and soft water.* 2003.

DC Teychenné, R. F. (1975). *Design of normal concrete mixes.* brebookshop.com.

HDonza, O. F. (2002). *High-strength concrete with different fine aggregate.* Science Direct.

Hover, K. (2011). The influence of water on the performance of concrete. *Construction and Building Materials*, Elsevier.

L Evangelista, J. D. (2007). Cement and concrete composites. *Elsevier*.

MA Rashid, M. M. (2009). ACI 363R,. *Journal of civil engineering (IEB),*.

R. Jones, B. P. (1957). *No AccessThe effect of coarse aggregate on the mode of failure of concrete in compression and flexure.* ICE Virtual Library.

S.B.Singh, P. M. (2015). *Role of water/cement ratio on strength development of cement mortar.* Science Direct.

Skominas, R. (2019). *EFFECT OF AGGREGATES IMPURITY ON CONCRETE PROPERTIES.* Rural Development 2021.