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Use of Sewage Treated Water in Concrete

Umesh Gaikwad[1], Charudatt Ahire[2], Vedant Bhad[3], Ajinkya Pawar[4], Rushikesh Pawar[5], Mr. Wagh M.N[6]

[1,2,3,4,5]Student, Matoshri Institute of Technology, Yeola, India
[6]H.O.D. of Civil Engineering Department, Matoshri Institute of Technology, Yeola, India

Abstract
The hardening properties of concrete are crucial for its strength and durability. The use of treated water in the production of concrete has been shown to have a positive impact on its hardening properties. Specifically, the use of STP (Sewage Treatment Plant) treated water in concrete production has been studied extensively. STP treated water is a form of recycled water that is produced from municipal wastewater treatment plants. It is treated to remove contaminants and impurities, making it suitable for use in a variety of applications, including concrete production. The use of STP treated water in concrete production has several benefits, including reducing the environmental. Impact of concrete production and conserving water resources. Studies have shown that the use of STP treated water in concrete production can Improve the hardening properties of the concrete. The treated water contains dissolved minerals and organic matter, which can react with the cement in the concrete and improve its strength. And durability. Additionally, the use of STP treated water can improve the workability of the concrete, making it easier to pour and shape.
Overall, the use of STP treated water in concrete production is a promising approach for improving the hardening properties of concrete. Further research is needed to optimize the use of this. Water source and to evaluate its long-term effects on the strength and durability of concrete.

Keywords: Sewage Treated Water, Fresh Water, Wastewater, Treated Wastewater, Treated Sewage, Concrete, Compressive Strength.

1. Introduction

Due to growing agriculture, urban and industrial needs, water tables in every continent are falling, by this the drinking water resources are becoming scare. It is suggested that with water, practical large scale solution is to use the resources which are not currently efficient. The most widely used construction material is concrete, commonly made by mixing Portland cement with sand, crushed rock (aggregates) and water. Normal concrete contains about 70 % aggregate, 20% cement and 10% mixing water by mass approximately. Concrete industry is consuming annually 1 billion tons of mixing water in the world. Moreover, large quantity of fresh water id used for curing of concrete. The concrete industry has therefore serious impact on the environment with regard to consumption of water.
Therefore, there is a need to study alternative to fresh water for mixing and curing of the concrete. Water is used for domestic and industrial purpose from surface water body and underground water sources all over the world. In last few decades, there has been a tremendous increase in both domestic wastewater and industrial wastewater generation due to rapid growth of population and accelerated pace of

industrialization. Almost 80% of the water used for domestic purpose comes out as wastewater. Impurities in water used for mixing concrete, when excessive, may affect not only the concrete strength but also setting time. Therefore, certain optional limits may be set on chlorides, sulphates, alkalis and solids in mixing water or appropriate tests can be performed to determine the effects the impurity can have on various properties.

1.1 Objectives:

1. Water conservation: Reduce the consumption of freshwater by utilizing treated wastewater.
2. Environmental sustainability: Minimize the impact of concrete production on water resources and the environment.
3. Cost savings: Lower the production costs associated with using freshwater for concrete mixing.
4. Performance evaluation: Assess the mechanical properties and long-term durability of concrete made with sewage treated water.

1.2 Scope of the study:

1. Feasibility study: Investigate the technical feasibility of using sewage treated water in concrete.
2. Material compatibility: Determine the impact of sewage treated water on the properties of concrete mixtures.
3. Performance testing: Conduct laboratory tests to evaluate the strength, workability, and durability of concrete specimens containing sewage treated water.
4. Field application: Explore the practical implementation of using sewage treated water In real construction projects.
5. Regulatory compliance: Ensure that the use of sewage treated water in concrete Production meets local regulations and standards.

2. Literature Reviewed

Aastha Gupta et al [1]: The study investigated the strength of concrete made with treated sewage water through experimental testing. Cement paste tests were conducted before filling the moulds, with curing times of 3, 7, and 28 days for the test cubes. Compressive and tensile strengths were measured after curing, showing higher strengths in cubes made with treated sewage water compared to regular water. Concrete paste was then tested in moulds after 7, 14, and 28 days of curing, with compressive strength tests conducted on the concrete cubes. Results indicated that concrete using treated sewage water exhibited greater strength than that made with regular water. The findings suggest that treated sewage water can be effectively used in preparing cement mortar and concrete, highlighting its potential for sustainable construction practices.

Asif Rashid Shaikh and Dr. V. M. Inamdar [2]: Stated the efficient use of water is crucial for cleaner production, and utilizing wastewater in concrete production is a key strategy. However, there is a lack of studies on the quality of concrete plant wastewater and its potential uses. This paper aims to assess the quality of concrete plant wastewater and provide guidelines for treating it for non-potable applications. Research shows that the type of water used for mixing does not impact concrete slump and density, but setting time increases with deteriorating water quality. Given the scarcity of potable water, using treated wastewater in concrete production is essential for the industry.

Bhavesh Kank and Snehansu Nath [3] : Worked on the underdeveloped nations, the construction industry heavily relies on drinkable water to produce concrete, with around 150 liters of potable water needed for every cubic meter of concrete. As water demand increases due to climate change and population growth, access to clean water is becoming limited. Municipalities treat wastewater at sewage treatment plants, releasing a significant amount into nearby water bodies. This study aims to explore the potential reuse of treated wastewater, primarily from households, in construction activities like concrete casting and curing. By investigating whether treated wastewater can be utilized in the construction industry, this research seeks to reduce environmental strain and water scarcity issues.

Dineshkumar Govindarajan et al [4]: Worked on the majority of construction projects require a significant amount of fresh water, with approximately 150 liters needed for every 1m3 of concrete. However, only 3% of available water is fresh, while the remaining 97% is high-salinity seawater. Urbanization has led to increased sewage production from residential areas, with around 80% of water used domestically ending up as municipal effluent. Treated wastewater, obtained from treatment plants, is primarily used for agriculture due to its high sulfate and chloride content. By utilizing treated sewage water effectively in construction, millions of liters of wastewater can be conserved and potentially reused.

E. Saranya et al [5]: This study investigates the potential of reusing treated wastewater in concrete production to address environmental concerns associated with traditional methods. Concrete production, a major contributor to greenhouse gas emissions, consumes large amounts of water. The research explores the use of bio-adsorbents to remove color from textile industry wastewater. Experiments were conducted to optimize parameters such as adsorbent dosage, temperature, and contact time. The study also examines the reuse of treated wastewater and potable water in producing and curing M-40 grade concrete. Compressive strength, durability, and microscopic characteristics of the concrete mixes are analyzed for both water sources.

3. Materials & Methodology

3.1 Materials:

1. **Cement:** A crucial binding agent in concrete mix design, cement is a fine powder that, when mixed with water, forms a paste that hardens and binds the other materials together to create a solid structure.
2. **Sand:** Used as a fine aggregate in concrete mixtures, sand provides bulk, strength, and workability to the mix. It helps fill the voids between the larger aggregate particles and contributes to the overall durability of the concrete.
3. **Aggregate:** Comprising coarse and fine particles, aggregate is a key component in concrete mix design. Coarse aggregate provides strength and stability, while fine aggregate improves workability and helps achieve a smooth surface finish.
4. **Normal Water:** Typically sourced from clean water supplies, normal water is essential for mixing concrete ingredients to form a workable mixture. It plays a crucial role in hydration reactions and the setting of concrete.
5. **Sewage Treated Water:** Treated wastewater from sewage treatment plants that has undergone purification processes to remove contaminants and impurities. Sewage treated water can be used as an alternative water source in concrete production, contributing to sustainable practices by conserving fresh water resources and reducing environmental impact.

3.2 Methodology:

Flowchart of the methodology: -

Collection of Sewage Treated Water from STP

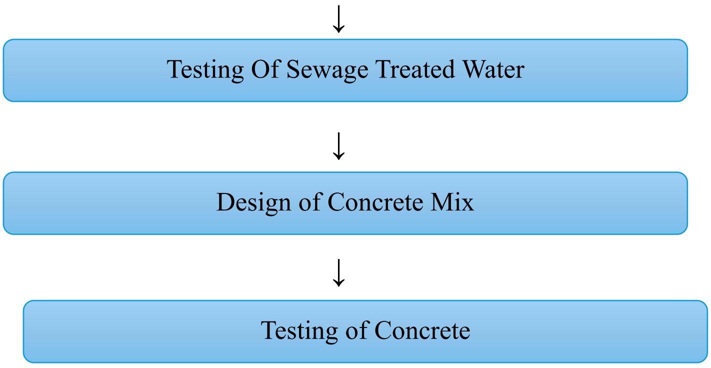

Fig. 1. Flowchart of the methodology

4. Results and discussion

Based on the chemical analysis of treated sewage water and the testing of cubes made with that water, following results were observed:

Table 1 Results of chemical Analysis of Treated Sewage Water

S. No.	Name of Test	Results	Permissible Limits, Max.
1.	pH Value	7.5	Should Not Be Less Than 6 (As Per IS 456:2000)
2.	Chloride	136.32 Mg/L	2000 Mg/L (As Per IS 456:2000)
3.	Total Suspended Solids	6 Mg/L	2000 Mg/L (As Per IS 456:2000)
4.	Alkalinity	218 Mg/Lit As Caco$_3$	3000 Mg/L (As Per IS 456:2000)
5.	Sulphates	32 Mg/L	400 Mg/L (As Per IS 456:2000)
6.	Total Solids	1986 Mg/L	5000 Mg/L (As Per IS 456:2000)
7.	Turbidity	2.6 NTU	5 NTU (As Per IS 10500:2012)
8.	Mixed Liquor Suspended Solids	1840 Mg/L	2000-5000 Mg/L (As Per IS 12933:1990)

A. Discussion

From the studies and tests performed earlier, it is clear that the treated sewage water is an interesting candidate for use in concreting for the application in construction works. The treated sewage water is found to be fit in the chemical analysis conducted on it, all the impurities or say suspended matter are under the permissible limit. This treated sewage water can also be used the curing water, as it is satisfy the chemical standards to be fit for the same. The treated sewage water when used in concreting or making concrete specimen cube, the compressive strength of cubes were satisfactory, in fact the cubes made with the treated sewage water attained more compressive strength.

Table 2 Compressive Strength of Concrete Cubes

Day’s	Specimen 1	Specimen 2	Specimen 3	Average
7 Days (Normal Water)	14.22 N/mm²	13.77 N/mm²	15.55 N/mm²	14.51 N/mm²
14 Days (Normal Water)	18.88 N/mm²	19.77 N/mm²	20.44 N/mm²	19.69 N/mm²
28 Days (Normal Water)	25.11 N/mm²	26.44 N/mm²	26.00 N/mm²	25.85 N/mm²
7 Days (Sewage Treated Water)	17.55 N/mm²	14.44 N/mm²	16.88 N/mm²	16.29 N/mm²
14 Days (Sewage Treated Water)	21.11 N/mm²	22.00 N/mm²	21.33 N/mm²	21.48 N/mm²
28 Days (Sewage Treated Water)	26.66 N/mm²	28.88 N/mm²	27.55 N/mm²	27.69 N/mm²

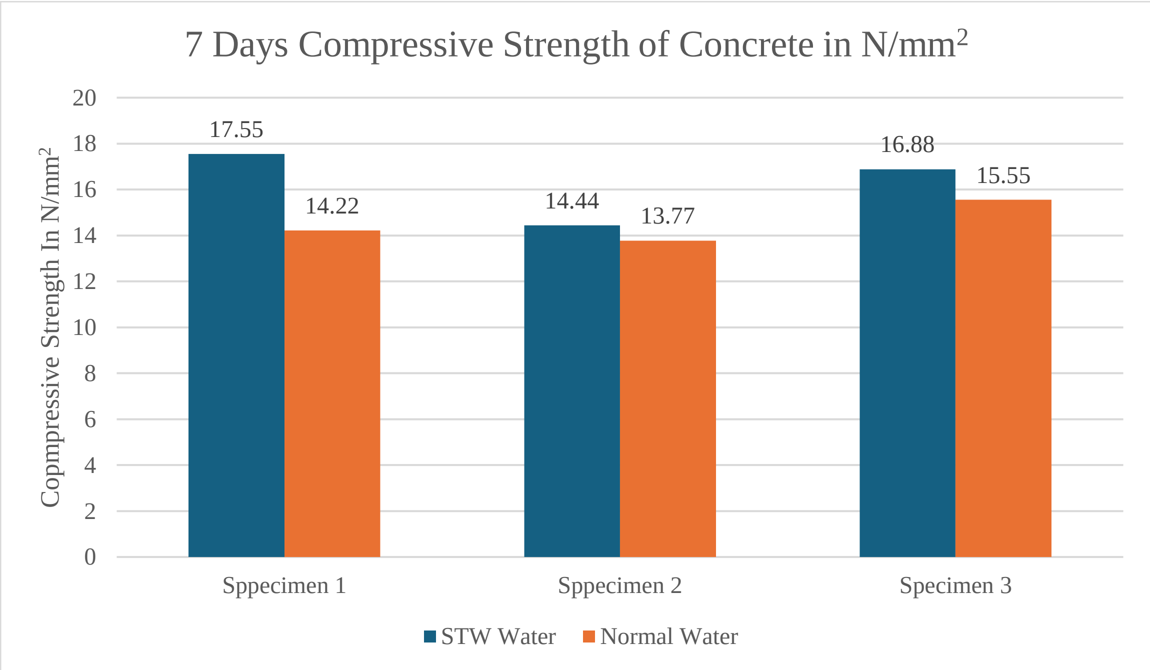

Chart No.1: Graphical Representation of 7 days Compressive Strength of Concrete in N/mm²

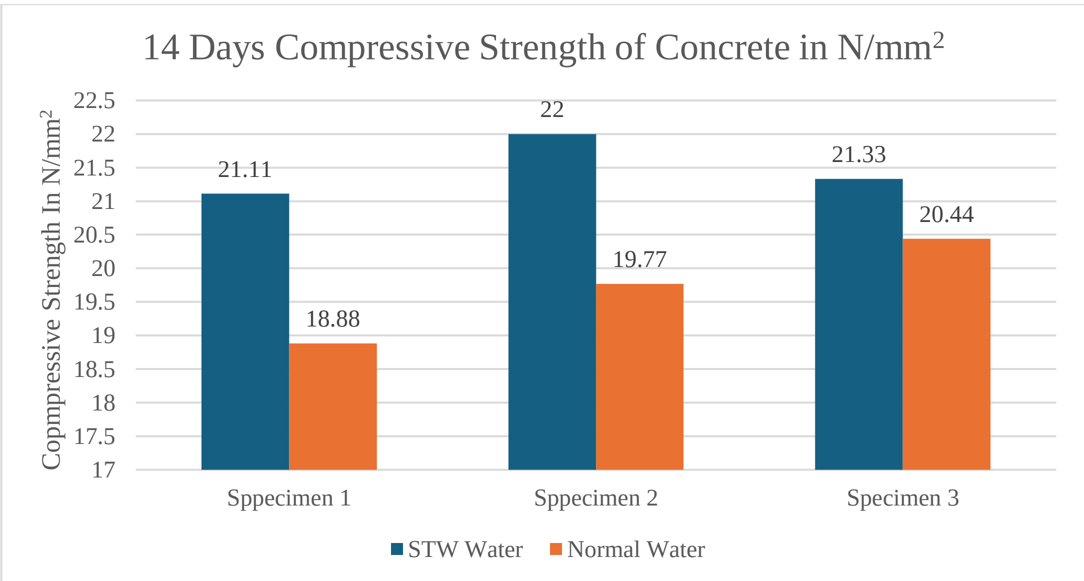

Chart No.2: Graphical Representation of 14 days Compressive Strength of Concrete in N/mm²

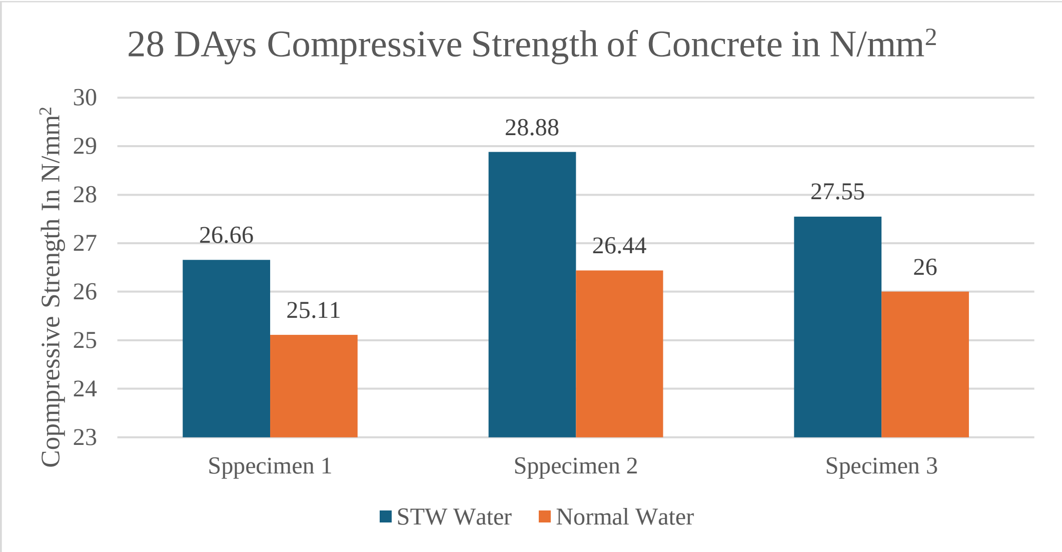

Chart No.3: Graphical Representation of 28 days Compressive Strength of Concrete in N/mm^2

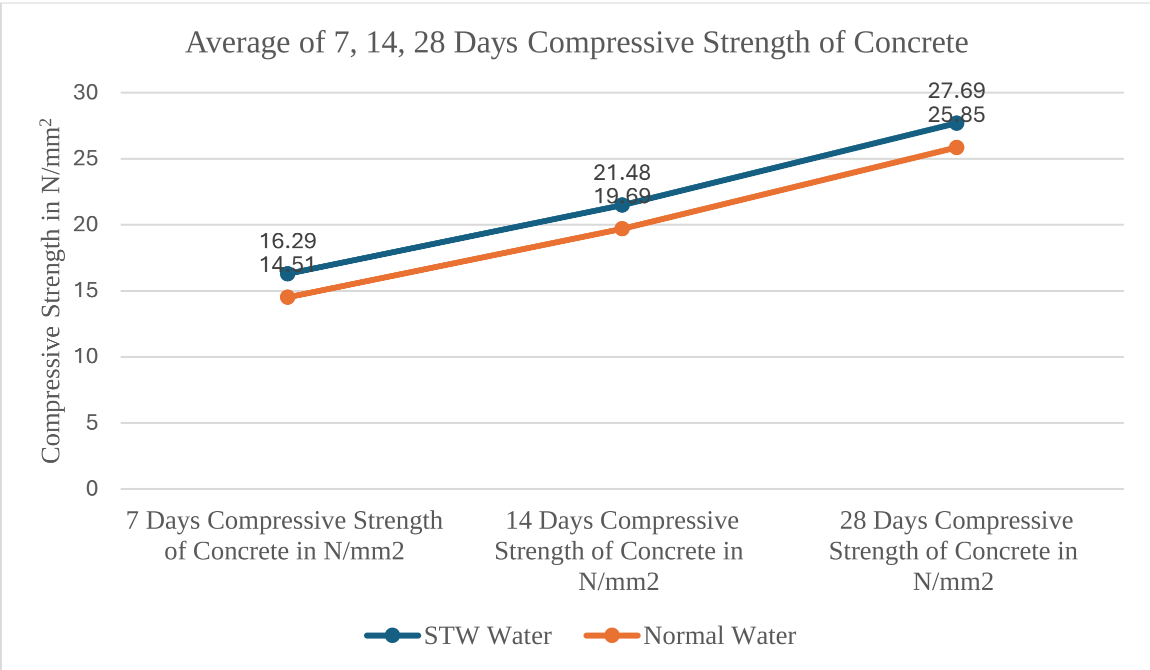

Chart No.4: Graphical Representation of 7, 14 & 28 days of Average Compressive Strength of Concrete in N/mm^2

5. Conclusion

We have studies and performed various test on the sewage water and as a whole the studied concluded that, the treated sewage water can be used concreting as a chemical test give positive results and the impurities / suspended matter are under permissible limits. Also when this water is used to prepare concrete cubes under normal condition, then those cubes gives satisfactory result of compressive strength. It is observed that the compressive strength of the cubes made with the treated sewage water is more than the cubes made with normal tap water. This implies that the treated sewage water used in concreting works under normal condition. The use of treated sewage water is economical than the use of convectional water and help in conserving the portable fresh water for other life giving purpose rather than construction.

Commercial use of treated sewage water also encourages the authorities to set up more sewage treatment plants to achieve the capacity of water recycling. The objective of sustainable development can be achieved through the use of sewage treated water. Regarding the durability of concrete made with the treated sewage water, it can be concluded that, if the treated sewage water satisfies the required limits and purify the standards as mentioned in the IS 456:2000, then it can definitely satisfy the durability demands. For getting a more clean and commercial view, we can work out on this project on real ground and use of treated sewage water in construction practices, and we think that the water recycled from STP deserves a chance to be used in concreting works so that the valuable portable water can be saved for other purposes.

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