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Review Paper on Feasibility of use of Treated Waste Water in Concrete.

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ABSTRACT

This review paper examines how various types of water samples affect key strength-related properties of concrete, including compressive strength, tensile strength, and workability. The study involves testing water collected from a wastewater treatment facility. The water types under investigation include potable water, influent water, and effluent water. These samples will be analyzed for their chemical characteristics, such as pH, alkalinity, concentrations of chlorides and sulphates, and levels of inorganic solids. A concrete mix will be prepared using each type of water, and the resulting concrete specimens will be evaluated for their mechanical performance. The outcomes will provide a comparative analysis, identifying the most suitable water type for use in concrete mix designs.

Keywords: Compressive strength, workability, potable water, effluent water, concrete mix.

1. INTRODUCTION:

Concrete is one of the most widely utilized construction materials, composed primarily of cement, water, aggregates, and occasionally chemical or mineral admixtures. It plays a critical role in civil engineering due to its versatility and structural integrity. Among its components, water is essential—not only as a medium to initiate the chemical reaction known as hydration between cement and other materials but also to help form a cohesive paste that fills voids and binds aggregates. This study explores how different water sources, including potable water and treated effluent from wastewater treatment facilities, influence concrete's mechanical properties, specifically compressive strength, tensile strength, and workability. These water samples will undergo chemical characterization for parameters such as pH, alkalinity, chloride and sulphate content, and the concentration of inorganic solids.

The concrete industry is a significant consumer of freshwater, both for the hydration process and for cleaning aggregates and equipment. This high demand poses challenges in regions facing water scarcity. As a result, using treated wastewater as an alternative water source in concrete production is gaining attention as a sustainable solution. Research has examined the feasibility of incorporating various forms of treated wastewater—including primary, biological (secondary), and tertiary-treated water (TWW)—into concrete mixtures. Despite this, the use of domestic wastewater in concrete applications remains underexplored in current literature. Some studies suggest that using a blend of 20% treated effluent with 80% freshwater can yield acceptable results, although there may be minor reductions in strength relative to standard benchmarks.

According to existing concrete codes, treated wastewater can be used for mixing and curing if it meets specific quality standards. In Tehran, Iran, for instance, concrete made using effluent from both primary and secondary treatment processes achieved compressive strength values at 28 days that exceeded 90% of those obtained with potable water. Al-Jabri et al. (2011) also reported comparable strength values between concrete mixed with treated wastewater and that mixed with fresh water.

Countries like Egypt, where freshwater resources are strained due to rapid population growth, could benefit significantly from integrating treated wastewater into concrete production. On average, producing one cubic meter of concrete requires approximately 150 liters of water. Despite this demand, fresh water continues to be the primary source used in the industry. Given that untreated wastewater poses significant health and environmental risks, proper treatment is essential. The treatment process typically involves three stages: primary treatment (removal of suspended solids), secondary treatment (elimination of settleable and organic matter), and tertiary treatment (advanced purification). Greywater—wastewater from sources such as sinks and showers— also holds potential for reuse in non-potable applications.

With increasing pressure from agriculture, urbanization, and industrialization, water tables across all continents are declining, leading to more pronounced water scarcity issues. A viable large-scale response is the reuse of underutilized water resources in sectors like construction. Conventional concrete consists of roughly 70% aggregates, 20% cement, and 10% water by mass. The global concrete industry is estimated to consume about 1 billion tons of water annually, not only for mixing but also for curing. This level of water use contributes significantly to environmental stress, underscoring the need for sustainable alternatives.

Objectives of the Study:

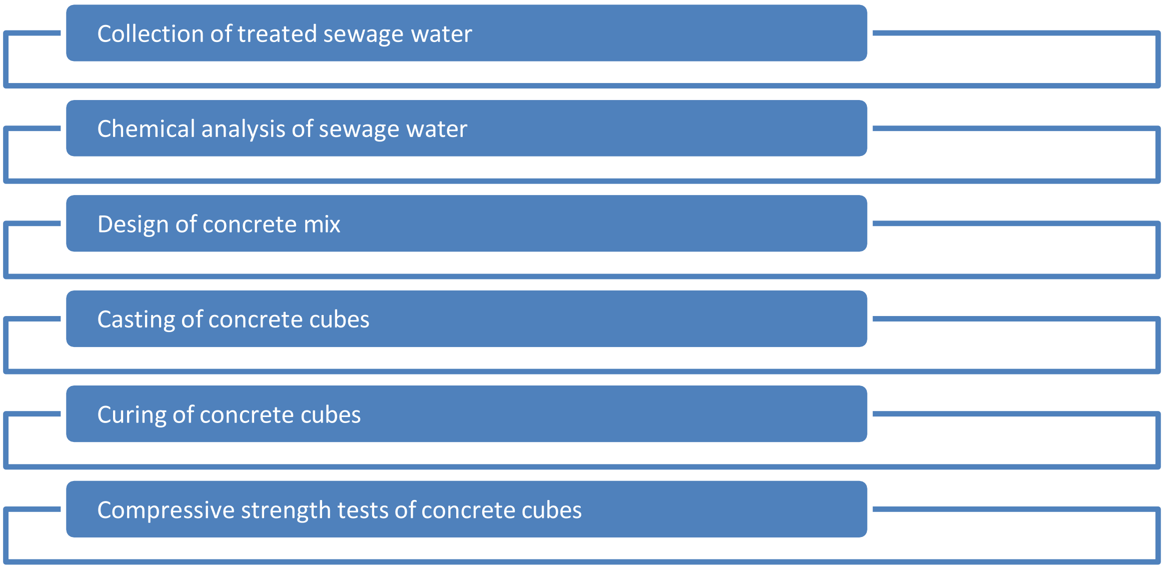
1. To investigate the potential of using treated wastewater in concrete production.

2. To perform chemical analysis of effluent water samples.

3. To evaluate the performance of various water samples in concrete mix design.

4. To assess the effects on compressive strength, tensile strength, and workability of concrete.

2. METHODOLOGY:



1. Collection of Treated Sewage Wastewater: Water is collected from Ajeenkya D Y Patil School of engineering and Pride World City of charholi.
2. Chemical analysis of sewage water: Chemical analysis of sewage water involves evaluating the water's physical, chemical and biological characteristic to assess its quality and identify Potential pollutants for treatment.
3. Design of concrete mix: Designing a concrete mix involves selecting the optimal proportions of cement, water, aggregates (coarse and fine), and admixtures to achieve desired properties like strength, workability, and durability.
4. Casting of Concrete Cubes: Casting concrete cubes involves preparing a mold, mixing concrete, filling the mold, compacting the concrete, and then curing the cubes in a controlled environment before testing.
5. Curing of concrete cubes: Curing concrete cubes involves maintaining a consistent, moist environment to allow the concrete to properly hydrate and develop strength over time.
6. Compressive Strength Tests on concrete cubes: The Concrete Cube Test is a standard procedure to determine the compressive strength of concrete.

3. Literature Review

1. "Review on investigation on utilizing wastewater for production of concrete." by Mr. Ayush Jagtap and Pratik Chavan published in the year 2023. This study investigates the impact of various water samples on concrete properties, including compressive strength, tensile strength, and workability. Samples—potable, influent, and effluent water—will be collected from a wastewater treatment plant and analyzed for chemical characteristics such as acidity, alkalinity, chlorides, sulphates, and inorganic solids. Concrete mixes of grade M30 or higher will be prepared using these samples. The resulting concrete will be tested and compared to determine which water type is most suitable for use in concrete mix design.

2. "Reuse of treated wastewater in manufacturing of concrete: major challenge of environmental preservation." by Fatima Zahra Bouaich and Walid Maherzi published in the year 2021. This study explores the reuse of treated wastewater from the Er- Rachidia wastewater treatment plant (WWTP) in mixing B25 concrete, aiming to reduce groundwater overuse, limit environmental pollution, and prevent wastewater discharge into natural water bodies. Three types of water were tested: Drinking Water (DW), Groundwater (GW), and Treated Wastewater (TW). The performance of concrete in both fresh and hardened states was evaluated and compared to standard requirements.

3. "Analysis of the strength and efficiency of concrete made with domestic waste water from W.T.P salitre." by Edson Amaya Silva, Diana Gizeth Amaya Daza and Saieth Baudilio Chaves Pabón published in the year 2021. This study evaluates the compressive strength of concrete mixes designed for 21 MPa and 28 MPa using the ACI method, with aggregates meeting CTN 174 standards and HER-type cement per CTN 121. Mixing water was sourced from Bogotá's aqueduct and the Saltire Wastewater Treatment Plant. Six water dosages were tested, ranging from 100% treated wastewater to a 75/25 treated-to-potable water mix. For each dosage, nine specimens were prepared and tested at 7, 14, and 28 days. Results showed differences in strength compared to the standard mix, with variations decreasing as the proportion of potable water increased.

4. "Performance of concrete casted with treated wastewater: A sustainable solution in construction industry" by Milind V Mohod in published in the year 2022. This research aims to assess the effectiveness of sustainable construction techniques, particularly for medium to large-scale projects. As sustainability becomes increasingly vital, the construction industry is adopting practices to reduce waste and enhance long-term efficiency. This study evaluates the impact of using treated effluent in concrete as a sustainable approach. Experimental and analytical results show that treated effluent in concrete offers both cost-effective and environmentally friendly benefits, supporting sustainable construction goals.

5. "Use of Industrial Waste Water in Concrete" by Megha Bhujbal and Ankita Deshmukh published in the year 2021. .The construction industry heavily relies on concrete, which requires potable water—about 150 liters per cubic meter. As the second-largest consumer of water, this poses a challenge amid growing global water scarcity. Reusing treated wastewater from industries, such as the oil sector, could help conserve freshwater. This research explores the potential of using treated oil industry wastewater in construction to ease environmental impact.

6. "An Experimental Study on Reuse of Treated Waste Water in Concrete- A Sustaianable Approach" By Manjunath M and Mr. Dhanraj M R published in the year 2017. This project explores the sustainable reuse of treated wastewater in concrete, the world's most widely used construction material. Concrete production not only emits 2.5 billion tonnes of CO_2 annually but also consumes large amounts of water— about

150 liters per cubic meter. With rising construction activity in India, the demand for freshwater is increasing, making water scarcity and quality growing environmental concerns.

7. "Use of Sewage Treated Water in Concrete" by Sachin Mane, Shaikh Faizal and Gyan Prakash published in the year 2019. Efficient resource use is key to maximizing productivity, with modern practices emphasizing sustainability and recycling. This study tested concrete made with treated wastewater, combining coarse aggregates with fresh water (FW) and treated sewage water (TSW). Workability was assessed before casting, and compressive strength was measured after curing for 7, 14, 21, and 28 days. Results showed workability between 25–50 mm for all mixes. While concrete with untreated wastewater had reduced strength, mixes with TSW showed no significant strength loss at 28 days. This approach supports sustainable construction by reducing costs and conserving natural resources.

4. TESTS AND OBSERVATIONS:

Test reports on Water samples

Microbial Analysis of Sample-1

a) **Type of sample: Waste water**
b) **Sample Identification: STP Water (Sample-1)**
c) **Quantity: 1000ml**
d) **Duration of Analysis: 24/02/2025-04/03/2025**
e) **Sample Location/Source: --**
f) **Condition of Sample when received: Good**

Sr.no	Test parameters	Results	Units	Method of Analysis
1.	Coliforms	Present	/100ml	IS 15185 : 2016
2.	E.coli	Present	/100ml	IS 15185 : 2016

Chemical Analysis of Sample-1

Sr.no	Test parameters	Results	Units	Method of Analysis
1.	Colour	1	Hazen unit	IS 3025 (P-4)
2.	Odour	Agreeabl e	-	IS 3025 (P-5
3.	pH	7.67	-	IS 3025 (P-11)
4.	Turbidity	0.95	NTU	APHA 24th Edition 2130B
5.	Total Hardness (as Calcium Carbonate)	394.81	mg/lit	IS 3025 (P-21)
6.	Total Alkalinity	258.56	mg/lit	APHA 24th Edition 2320-B Titrimetric

7.	Chlorides	145.43	mg/lit	IS 3025 (P-32)

Results of Analysis of Sample-1

a) **Type of sample: Waste water**
b) **Sample Identification: STP Water (Sample-1)**
c) **Quantity: 2 Litre**
d) **Duration of Analysis: 24/02/2025-04/03/2025**
e) **Sample Location/Source: --**
f) **Condition of Sample when received: --**

Sr.no	Test parameters	Results	Limits as per CPCB	Units	Method of Analysis
1.	pH	7.67	6.5-8.5	-	IS 3025 (P-11)
2.	Total Suspended solids	4.0	10	mg/lit	IS 3025 (P-17)
3.	Oil and Grease	<1.0	10	mg/lit	IS 3025 (P-39)
4.	Total Dissolved Solids	725.0	-	mg/lit	IS 3025 (P-16)
5.	Chemical Oxygen Demand (COD)	34.38	50	mg/lit	APHA 24th Edition 2017 5220 C
6.	Biochemical Oxygen Demand (BOD)(for 3 days at 27 C)	7.08	10	mg/lit	IS 3025 (P-44)

Sr.no	Test parameters	Results	Units	Method of Analysis
1.	Dissolved Oxygen	**5.68**	mg/lit	IS 3025 (P-38) RA 2019 : 1989
2.	Sulphates	**0.022**	mg/lit	IS 3025 (P-24) RA 2019

Microbial Analysis of Sample-2

a) **Type of sample: Waste water**
b) **Sample Identification: STP Water**
c) **Quantity: 1000ml**
d) **Duration of Analysis: 24/02/2025-04/03/2025**
e) **Sample Location/Source: D.Y. Patil – Pride world city**
f) **Condition of Sample when received: Good**

Sr.no	Test parameters	Results	Units	Method of Analysis
1.	Coliforms	Absent	/100ml	IS 15185 : 2016
2.	E.coli	Absent	/100ml	IS 15185 : 2016

Chemical Analysis of Sample-2

Sr.no	Test parameters	Results	Units	Method of Analysis
1.	Colour	1	Hazen unit	IS 3025 (P-4)
2.	Odour	Agreeable	-	IS 3025 (P-5
3.	pH	7.94	-	IS 3025 (P-11)
4.	Turbidity	.95	NTU	APHA 24th Edition 2130B
5.	Total Hardness (as Calcium Carbonate)	412.24	mg/lit	IS 3025 (P-21)
6.	Total Alkalinity	247.20	mg/lit	APHA 24th Edition 2320-B Titrimetric
7.	Chlorides	194.76	mg/lit	IS 3025 (P-32)

Result of Analysis of Sample-2

a) **Type of sample: Waste water**
b) **Sample Identification: STP Water (Sample-2)**
c) **Quantity: 2 Litre**
d) **Duration of Analysis: 24/02/2025-04/03/2025**
e) **Sample Location/Source: D.Y. Patil – Pride world city**
f) **Condition of Sample when received: -- g)**

Sr.no	Test parameters	Results	Limits as per CPCB	Units	Method of Analysis
1.	pH	7.94	6.5-8.5	-	IS 3025 (P-11)
2.	Total Suspended solids	3.0	10	mg/lit	IS 3025 (P-17)
3.	Oil and Grease	<1.0	10	mg/lit	IS 3025 (P-39)

4.	Total Dissolved Solids	833.0	-	mg/lit	IS 3025 (P-16)
5.	Chemical Oxygen Demand (COD)	25.91	50	mg/lit	APHA 24th Edition 2017 5220 C
6.	Biochemical Oxygen Demand (BOD)(for 3 days at 27 C)	4.01	10	mg/lit	IS 3025 (P-44)

Sr.no	Test parameters	Results	Units	Method of Analysis
1.	Dissolved Oxygen	**3.88**	mg/lit	IS 3025 (P-38) RA 2019 : 1989
2.	Sulphates	**0.018**	mg/lit	IS 3025 (P-24) RA 2019

5. CONCLUSION:

Based on the test report provided for the treated wastewater (STP Water – Sample 1 and sample2) and comparing it with the potable water standards (IS 10500:2012). The presence of coliforms and E. coli indicates microbial contamination, making the water unfit for human consumption. Disinfection is required. But is suitable for construction purpose

All chemical and physical parameters fall within permissible limits of IS 10500:2012, making the water chemically safe for use. Slightly high hardness and alkalinity are within acceptable tolerance.

The treated wastewater meets the physical and chemical requirements for potable water as per IS 10500:2012.

However, it fails microbial standards due to the presence of coliforms and E. coli. Therefore, the treated wastewater is not suitable for drinking but suitable for construction purpose.

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