International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

Feasibility Study of using Treated Textile Wastewater in Concrete

Ms. Babitha Peter
Assistant professor
Civil engineering
ICET, Muvattupuzha

Alrifa A. S
Civil engineering
ICET, Muvattupuzha

Aysha Beevi K. N
Civil engineering
ICET, Muvattupuzha

Fathima Nesrin
Civil engineering
ICET, Muvattupuzha

Melvin Johnson
Civil engineering
ICET, Muvattupuzha

ABSTRACT

The increasing demand for sustainable construction materials has led to the exploration of alternative water sources in concrete production. This study evaluates the feasibility of using treated textile wastewater as a partial or full replacement for potable water in concrete. Textile effluent, characterized by high levels of colour, turbidity, biochemical oxygen demand, and chemical oxygen demand, is treated using natural adsorbents to achieve acceptable quality for reuse. Key physicochemical parameters such as pH, total dissolved solids, alkalinity, and hardness are analysed before and after treatment.

Concrete mixes are prepared using treated wastewater at varying replacement levels, and their fresh and hardened properties are examined. Workability is assessed through slump and compaction factor tests, while compressive strength is evaluated at different curing periods. Experimental results indicate that properly treated textile wastewater can be used in concrete without significant adverse effects on workability or strength characteristics.

The findings demonstrate that the reuse of treated wastewater in concrete contributes to water conservation, reduces environmental pollution, and promotes sustainable waste management practices. This approach provides a viable and eco-friendly solution for the construction industry, especially in water-scarce regions.

Keywords—Textile wastewater, sustainable concrete, water reuse, compressive strength, workability, eco-friendly construction.

1. INTRODUCTION

The construction industry consumes large amounts of freshwater for activities such as concrete production and curing. With increasing population and urbanization, freshwater demand has risen, causing scarcity in many regions. Hence, identifying alternative water sources is essential for sustainable development.

At the same time, the textile industry generates significant wastewater containing dyes, chemicals, heavy metals, and organic pollutants, which harm the environment if untreated. Proper treatment and reuse of this wastewater are therefore necessary. This study explores the use of treated textile wastewater in concrete production as a substitute for potable water. Eco-friendly and cost-effective natural coagulants and adsorbents are used to treat the wastewater, reducing turbidity, colour, BOD,

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

COD, and other contaminants. Compared to conventional methods, these natural treatments are biodegradable, produce less sludge, and are more sustainable.

The treated water is then used in concrete, and its effects on workability, setting time, compressive strength, and durability are evaluated to determine its suitability. This approach promotes sustainable engineering by conserving water, minimizing waste, and supporting a circular economy. It also reduces wastewater disposal issues and construction costs.

However, challenges such as variations in wastewater composition, treatment efficiency, and long-term durability must be addressed. Proper monitoring and adherence to standards are essential for safe implementation. Overall, the study presents an eco-friendly and practical solution for using treated textile wastewater in concrete, contributing to sustainable infrastructure and efficient water management.

2. LITERATURE REVIEW

Numerous studies have examined the use of industrial wastewater, especially textile effluents, in concrete production for sustainable construction. Untreated textile wastewater contains dyes, heavy metals, suspended solids, and high BOD and COD levels, which negatively affect cement hydration, strength, and durability.

Various treatment methods such as coagulation–flocculation, filtration, and chemical oxidation are effective in removing contaminants. Recently, natural coagulants like Moringa seeds, neem, and other plant-based materials have gained attention due to their low cost, biodegradability, and environmental benefits. These methods improve water quality by reducing turbidity, colour, and organic load. The pH of treated wastewater is critical, as near-neutral conditions are required for proper cement hydration. Improper pH can affect setting time and strength. In fresh concrete, treated wastewater may slightly influence workability, though proper treatment and admixtures can minimize this effect.

Studies show that the strength properties of concrete made with treated wastewater are generally comparable to conventional concrete, and sometimes improved due to dissolved minerals. However, untreated wastewater significantly reduces strength. Durability concerns mainly involve chlorides and sulfates, which must be kept within permissible limits to prevent corrosion and deterioration.

Microstructural studies (SEM and XRD) indicate that treated wastewater does not hinder the formation of essential hydration products like C-S-H gel. Additionally, reuse of treated wastewater reduces construction costs and environmental impact, supporting sustainable resource management. Standards such as IS 456:2000 and ASTM guidelines emphasize maintaining acceptable impurity limits. Despite promising results, challenges remain in large-scale application, long-term performance, and variability in wastewater composition.

Overall, literature supports the use of treated textile wastewater in concrete, provided proper treatment, monitoring, and quality control are ensured.

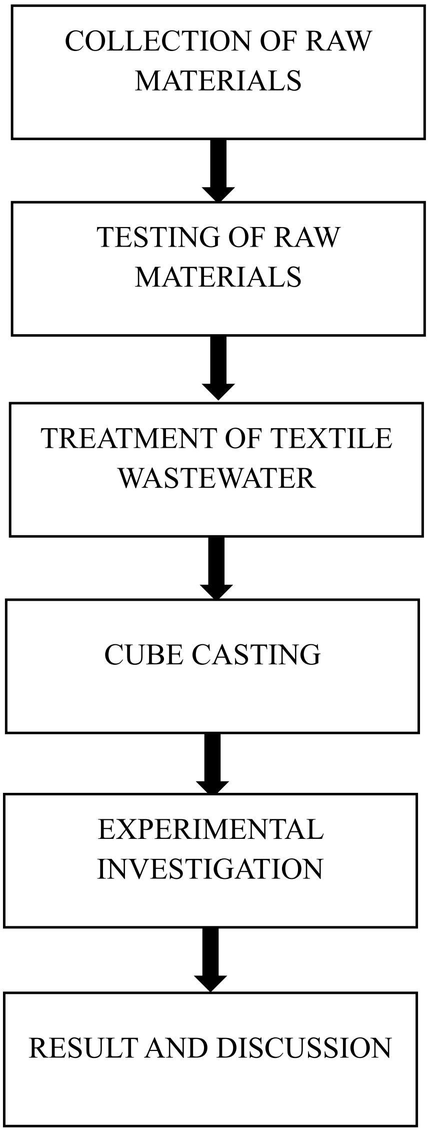
3. OBJECTIVES

The main objective of this study is to examine the potential of using treated textile wastewater as a substitute for potable water in concrete production. The study intends to evaluate the physical and chemical properties of textile wastewater and to improve its quality through eco-friendly, economical treatment techniques. It also aims to determine the suitability of the treated wastewater for use in construction in compliance with standard specifications. Furthermore, the study focuses on analysing the

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

influence of treated wastewater on the fresh properties of concrete, including workability and setting time, along with its impact on hardened properties, especially compressive strength. A comparison between conventional concrete and concrete made with treated wastewater is conducted to assess performance differences. Additionally, the study seeks to emphasize the environmental and economic advantages of wastewater reuse, thereby encouraging sustainable construction practices and efficient utilization of water resources.

4. METHODOLOGY



Preparation Of Banana Peel

The outer peels of banana were removed and washed thoroughly with distilled water to remove impurities and oven dried (Fig 4.1) at a temperature 105^{0}C for 24 hours to achieve a constant weight. The dried peels were crushed to obtain fine powder (fig 4.2). The powder was then carbonised and activated. Carbonisation was carried out in a muffle furnace at 450^{0}C for 1 hour (fig 4.3). The activation was done by adding 1M sulphuric acid in carbonized banana peel powder for 24 hours (fig 4.5). After 24 hours it is washed three times with distilled water to remove excess acid. The washed adsorbent is dried in oven at 110^{0}C for 4 hours.

Fig 4.1 oven drying

Fig 4.2 powdering

Fig 4.3 Carbonisation

Fig 4.4 Carbonised adsorbent

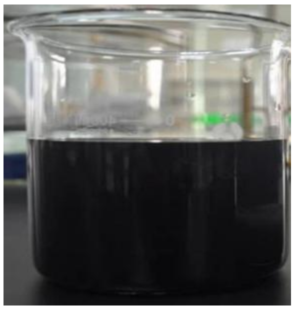


Fig 4.5 Chemical activation

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

Treatment Procedure

The adsorbent was added to the textile wastewater at a dosage of 5 g/L. The mixture was continuously stirred for 30 minutes to ensure uniform mixing and effective contact between the adsorbent and the contaminants present in the water. After stirring, the solution was allowed to remain undisturbed for 30 minutes to facilitate the adsorption process and settling of suspended particles. Finally, the mixture was filtered to separate the adsorbent along with the adsorbed impurities, resulting in clearer and improved quality water.

Fig 4.6 Adding adsorbent

Fig 4.7. Stirring

Fig 4.8. Filtration

Treatment Of Textile Water

The treated banana peel powder showed effective adsorption performance in wastewater treatment. After the treatment process, the water quality parameters were analysed and found to be within the permissible limits. This indicates that the prepared banana peel adsorbent successfully removed contaminants from the wastewater. The improvement in water characteristics confirms the efficiency of the carbonization and chemical activation processes in enhancing the adsorption capacity of the material. Therefore, banana peel powder can be considered a low-cost and eco-friendly adsorbent for water treatment applications.

Table 4.1. The characteristics of treated textile water

Properties	Obtained value	Permissible value	Remarks
Ph	6.8	6.5-8.5	Nearly neutral with slight alkaline features
Turbidity	4 NTU	5 NTU	Water contains impurities
Alkalinity	110.5 mg/l	200 mg/l	Within safe limit
BOD	10.7 mg/l	20 mg/l	Presence of organic pollutants

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

COD	9.07 mg/l	10 mg/l	The level of COD reduces
Hardness	246.80 mg/l	600 mg/l	Within the permissible limit
Colour	Colourless	15 Hazen units	The treated water became clear

The test results show that all the important parameters, including pH, turbidity, alkalinity, BOD, COD, and hardness, are within the permissible limits, indicating that the treatment process has worked effectively. The water appears clearer with a nearly neutral pH, and the lower BOD and COD values suggest that the level of organic pollution has been significantly reduced. The colorless appearance of the treated water further supports this improvement in quality. Overall, the treated water can be considered suitable for non-potable uses, particularly in construction activities.

CASTING OF CUBE

Concrete mixes prepared using both fresh water and treated textile wastewater to compare the performance between both. The aim of the comparison was to evaluate the effect of treated wastewater on the strength and overall properties of concrete. By casting and testing concrete cubes with both water sources, the suitability of treated textile wastewater as an alternative to fresh water was evaluated, ensuring concrete quality is not compromised.

CASTING OF CUBE USING NORMAL WATER

Table 4.2. Test analysis and result of cube using normal water

Test		Obtained Value	Range
Slump test		65 mm	25-50 mm → Low workability 50-100 mm → Medium workability 100-175 mm → High workability
Compaction factor		0.86	0.8-0.85 → Low workability 0.85-0.92 → Medium workability 0.92-0.95 → High workability
Compressive strength	7 days	9.1	65% to 70% of its characteristic compressive strength.
	28 days	20.12	For M20 → 20 MPa

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

The results show that the concrete made with normal water has medium workability, indicated by a slump of 65 mm and a compaction factor of 0.86, allowing proper mixing and placement. The compressive strength increases steadily, reaching 9.1 MPa at 7 days and 20.12 MPa at 28 days. The 28-day strength satisfies the requirement for M20 grade concrete, indicating that the concrete has achieved the desired strength and overall performance.

CASTING OF CUBE USING TREATED TEXTILE WASTEWATER

Table 4.3. Test analysis and result of cube using treated textile water

Test		Obtained Value	Range
Slump test		74mm	25-50 mm → Low workability 50-100 mm → Medium workability 100-175 mm → High workability
Compaction factor		0.88	0.8-0.85 → Low workability 0.85-0.92 → Medium workability 0.92-0.95 → High workability
Compressive strength	7 days	12.44	65% to 70% of its characteristic compressive strength
	28 days	20.38	For M20 → 20 MPa

The results show that the concrete made with treated textile wastewater has medium workability, with a slump value of 74 mm and a compaction factor of 0.88, ensuring good handling and compaction. The compressive strength is also satisfactory, reaching 12.44 MPa at 7 days and 20.38 MPa at 28 days, which meets the requirement for M20 grade concrete and indicates slightly improved early strength compared to normal water.

5. RESULT AND DISCUSSION

The results of the study indicate that banana peel powder is an effective and sustainable adsorbent for the treatment of textile wastewater. The treatment process significantly improved water quality by reducing impurities, colour, and organic pollutants, while maintaining important parameters such as pH, alkalinity, and hardness within acceptable limits. This demonstrates the efficiency of the adsorption process and confirms that banana peel powder can serve as a low-cost and eco-friendly material for wastewater treatment, making the treated water suitable for non-potable applications.

Furthermore, the performance of concrete prepared using treated textile wastewater was found to be comparable to that made with normal water. The concrete exhibited good workability and achieved satisfactory compressive strength, meeting the requirements for standard construction use. A slightly higher

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

early strength was also observed, indicating that the treated wastewater does not adversely affect the properties of concrete. Overall, the findings highlight the potential of reusing treated textile wastewater in construction, promoting water conservation and environmentally sustainable practices.

6. CONCLUSION

This study highlights that untreated textile wastewater contains excessive levels of contaminants, making it unsuitable for direct use. The high turbidity, BOD, COD, and colour indicate the presence of suspended solids, dyes, and organic pollutants, emphasizing the need for proper treatment before reuse.

The use of banana peel powder as a natural adsorbent proved effective in improving wastewater quality. After treatment, there was a significant reduction in key parameters, while pH, alkalinity, and hardness were maintained within acceptable limits. These results show that banana peel powder is a cost-effective, eco-friendly, and sustainable option for pollutant removal.

The findings also confirm that treated textile wastewater can be used in concrete production without affecting performance. The compressive strength of concrete made with treated wastewater was comparable to that made with normal water. This demonstrates that reusing treated wastewater is a reliable and sustainable solution for conserving freshwater and promoting eco-friendly construction practices.

REFERENCES

[1] Bhupendra Koul et al. (2022), "Application of Natural Coagulants in Water Treatment: A Sustainable Alternative to Chemicals", *volume 14*

[2] C. Thamaraiselvi et al. (2024), "Mitigating pollutants in textile dye wastewater with Aloe vera (L.) Burm. f. and Abelmoschus esculentus (L.) Moench: A study on treatment efficacy", *volume 16*

[3] E. Saranya et al. (2020), "Experimental investigation of textile waste water reusing in concrete" *volume 7*

[4] Fahmida Akter Jolly et al. (2022), "Wastewater treatment using coconut fibre ash as an adsorbent for removal of heavy metals"

[5] Gholamreza Asadollahfardi (2018), "The feasibility of using treated industrial waste water to produce concrete"

[6] Hussein M. Hamada et al. (2023), "Effect of wastewater as sustainable concrete material on concrete performance: A critical review"

[7] Jimoh Abdulfatai et al. (2012), "Development of Adsorbent from Banana Peel for Wastewater Treatment" volume 248

[8] Manjunath Maddikeari et al. (2024), "Manufacturing of Concrete: Fostering Sustainability through Recycling"

[9] Muhammad Atif Irshad et al. (2022), "Green and Eco-Friendly Treatment of Textile Wastewater by Using Azadirachta indica Leaf Extract Combined with a Silver Nitrate Solution"

[10] V. Naveenraj et al. (2020), "Treatment of contaminated wastewater from Textile industry: A review"