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Original Article

Resilient Water Supply System Using Alternative Filtration Method

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Abstract: *Water scarcity and contamination have become significant challenges in urban water supply systems. Many towns depend on infiltration wells and groundwater sources, which often fail during seasonal droughts and excessive extraction. This study proposes a resilient water supply system using an alternative filtration method to improve water quality and reliability. The system incorporates a dual media filtration unit consisting of activated carbon and sand layers to remove suspended solids, turbidity, odor, and organic impurities. Experimental analysis was conducted by passing raw water samples through the filtration unit and comparing the water quality before and after treatment. Results show a considerable reduction in turbidity and improvement in clarity of the treated water. The proposed system offers a cost-effective and sustainable solution for improving drinking water quality in small and medium-scale water supply systems. The approach enhances system resilience by providing an alternative filtration strategy during infiltration source failure.*

Keywords: *Alternative filtration, dual media filter, water treatment, water supply system, resilient infrastructure*

I. INTRODUCTION

Water supply systems play a crucial role in maintaining public health and supporting urban development. Many towns depend on infiltration wells and groundwater sources for drinking water supply. However, rapid urbanization, climate change, and excessive groundwater extraction have significantly affected the reliability of these sources.

Infiltration wells are constructed near riverbeds where water enters through sand layers by natural filtration. While this method provides relatively clean water, seasonal droughts and sand mining activities reduce their efficiency. When infiltration sources fail, water supply systems struggle to meet increasing demand.

To address this problem, alternative water treatment strategies must be developed to ensure continuous supply of safe drinking water. Filtration is an essential process used in water treatment plants to remove suspended particles, turbidity, and contaminants from raw water.

Dual media filtration, which uses two different filtration materials such as activated carbon and sand, has proven effective in improving water quality. Activated carbon removes organic compounds, odor, and color, while sand removes suspended solids and turbidity.

This study focuses on developing a resilient water supply system using an alternative dual media filtration method to enhance water quality and ensure reliable supply during infiltration source failure.

II. STUDY AREA

The study was carried out to evaluate an alternative filtration method for improving the resilience of urban water supply systems. Many towns depend on infiltration wells located near riverbeds as their primary source of water supply. These wells collect water through natural filtration occurring in sand layers beneath the riverbed.

However, seasonal drought, excessive groundwater extraction, and sand mining activities often reduce the efficiency of infiltration wells. When these sources fail, water supply systems face difficulties in meeting domestic water demand.

The selected study area represents a typical urban water supply system that relies on groundwater and infiltration sources. Increasing population and urban expansion have increased the demand for safe drinking water. Therefore, it is necessary to develop alternative treatment methods that can maintain water quality and ensure continuous supply.

The proposed filtration system aims to improve water quality using locally available materials such as activated carbon and sand.

III. MATERIALS AND METHODS

A. Filter Media Materials

The filtration unit used in this study consists of three layers of filter media arranged vertically.

- Activated Carbon Layer – removes odor, organic impurities, and dissolved contaminants.
- Sand Layer – removes suspended particles and turbidity.
- Gravel Layer – supports the upper filter layers and prevents media loss.

These materials were selected because they are economical, easily available, and effective in water purification.

B. Experimental Setup

The experimental setup consists of a cylindrical filtration column made of transparent material. The column is filled with filtration media arranged in layers.

Layer arrangement in the filtration column:

- Top Layer – Activated Carbon (30 cm)
- Middle Layer – Sand (60 cm)
- Bottom Layer – Gravel (30 cm)

Raw water samples were poured into the top of the column. Water passed through the filtration media under gravity and was collected at the outlet.

Filtered water samples were then tested for water quality parameters.

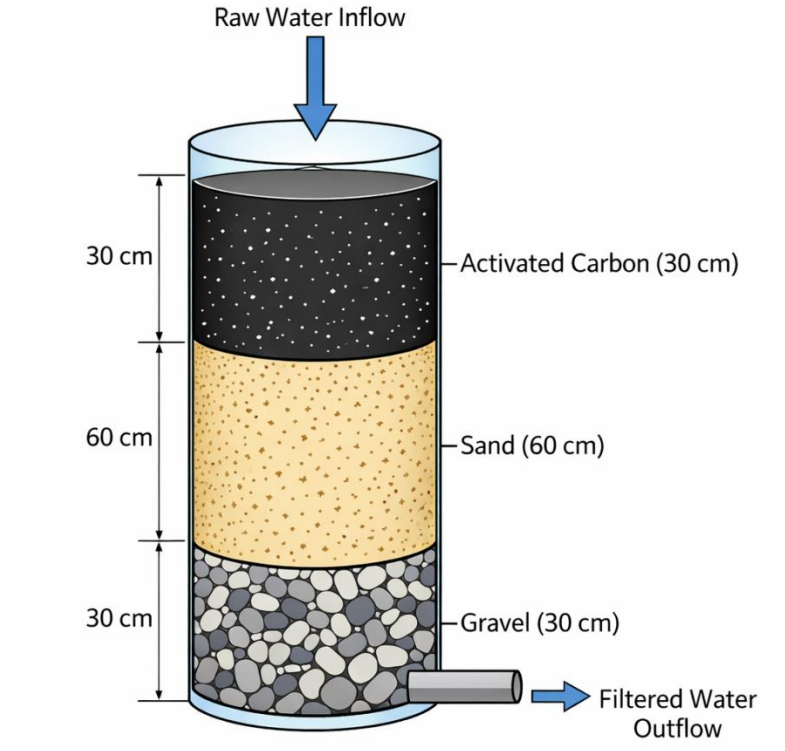

Figure 1: Dual Media Filtration System

C. Water Quality Testing

Water samples were tested before and after filtration to evaluate the performance of the filtration system.

The following parameters were analyzed:

- pH
- Turbidity
- Total Dissolved Solids (TDS)

These parameters are important indicators of drinking water quality.

IV. RESULTS AND DISCUSSION

The experimental results demonstrate that the filtration unit significantly improved water quality.

Table 1: Water Quality Before and After Filtration

Parameter	Raw Water	Filtered Water
pH	7.8	7.2
Turbidity	12 NTU	2 NTU
TDS	650 mg/L	480 mg/L

The results indicate a considerable reduction in turbidity and suspended particles after filtration.

The activated carbon layer helps remove odor and organic contaminants, while the sand layer effectively traps suspended solids.

Table 2: Filtration Efficiency

Parameter	Removal Efficiency
Turbidity	83%
TDS	26%
Suspended Solids	70%

The turbidity removal efficiency shows that the dual media filter performs effectively in improving water clarity.

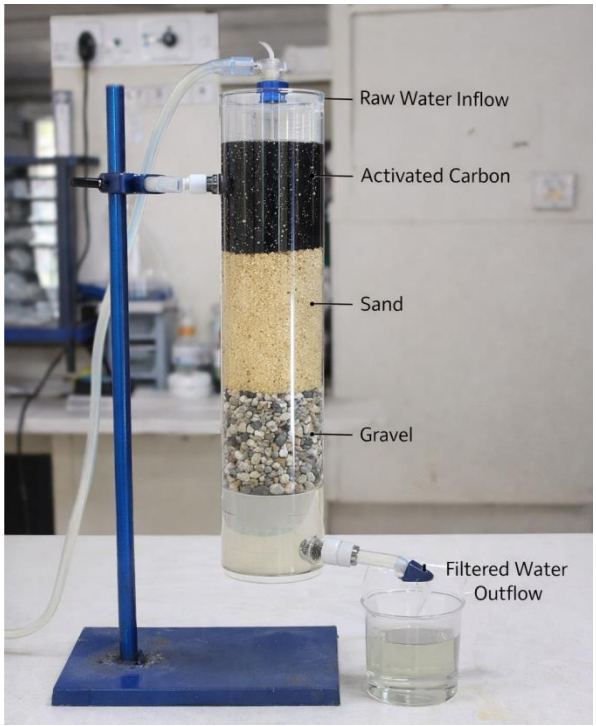

Figure 2: Experimental Filtration Setup

V. CONCLUSION

The present study evaluated an alternative filtration method for improving the resilience of water supply systems. The dual media filtration system using activated carbon and sand demonstrated significant improvement in water quality.

Experimental results indicate a considerable reduction in turbidity and suspended particles. The filtration system is simple, cost-effective, and easy to operate, making it suitable for small and medium-scale water treatment systems.

The proposed method can serve as an alternative water treatment strategy during infiltration source failure and contribute to sustainable urban water supply management.

Interest Conflicts

The author declares that there is no conflict of interest regarding the publication of this paper.

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VI. REFERENCES

[1] Logsdon, G.; Kohne, R.; Abel, S.; LaBonde, S. Slow sand filtration for small water systems. *Journal of Environmental Engineering* 2002, 128, 66–74.
[2] Crittenden, J.; Trussell, R.; Hand, D.; Howe, K.; Tchobanoglous, G. Water treatment: principles and design for drinking water systems. *John Wiley & Sons*, 2012, **3**, 421–450.
[3] Huisman, L.; Wood, W. Slow sand filtration. *World Health Organization*, Geneva, 1974, 1, 120–135.
[4] AWWA. Water quality and treatment: a handbook on drinking water. *American Water Works Association*, McGraw-Hill Education, 2011, 6, 320–340.
[5] Binnie, C.; Kimber, M.; Smethurst, G. Basic water treatment. *Thomas Telford Publishing*, London, 2002, 4, 95–110.
[6] WHO. Guidelines for drinking-water quality. *World Health Organization*, Geneva, Switzerland, 2017, 4, 150–170.
[7] Metcalf, L.; Eddy, H. Wastewater engineering: treatment and resource recovery. *McGraw-Hill Education*, New York, 2014, 5, 410–430.
[8] Montgomery, J. Water treatment principles and design. *John Wiley & Sons*, New York, 2005, **2**, 245–260.