IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 4, June 2025
Impact Factor: 7.67

Treatment of Flowing and Standing Rainwater Using Nanotechology

Manohar P[1], Ganesh H[2], Mohammed Asif [3], Balakrishna S[4], Abdul Wahab A[5], Raghunath M[6]
Assistant Professor, Department of Civil Engineering[1,2]
Student, Department of Civil Engineering[3,4,5,6]
Rao Bahadur Y Mahabaleswarappa Engineering College, Bellary, Karnataka, India

Abstract: *This project report investigates the application of nanotechnology in the treatment of water sourced from roof runoff and lakes, focusing on water bed filtration techniques. The primary objective is to develop efficient and sustainable methods for purifying and storing water, ensuring its safety for agricultural and household use.*

The report highlights the unique properties of nanomaterials, such as Titanium Dioxide (TiO_2) and Aluminium Oxide (Al_2O_3), which enhance the effectiveness of filtration systems by removing contaminants like heavy metals, bacteria, and organic compounds. The study emphasizes the advantages of nanotechnology, including reduced energy consumption, self-cleaning properties, and the ability to tailor filtration systems to specific regional challenges.

Experimental results demonstrate significant improvements in water quality post-treatment, showcasing the potential of nanotechnology to address global water quality issues. The findings advocate for the integration of advanced filtration systems in both urban and rural settings to promote sustainable water management practices.

Keywords: Titanium Dioxide (TiO_2) and Aluminium Oxide (Al_2O_3)

I. INTRODUCTION

This project investigates the treatment of water from various sources, including roof runoff and lake water, with a focus on water bed filtration techniques. The goal is to develop efficient methods for purifying and storing water, ensuring it is safe for use in agriculture, households, and other applications, while promoting sustainable water management practices.

Water filtration is a process that involves removing impurities, contaminants, and particles from water to make it safe, clean, and suitable for various applications. It is an essential step in ensuring access to clean and potable water for drinking, industrial processes, agriculture, and many other purposes.

Water from natural sources like rivers, lakes, and underground aquifers often contains various substances that can be harmful to human health or detrimental to the intended use of the water. These contaminants can include suspended particles, sediment, microorganisms, dissolved chemicals, heavy metals, and other pollutants.

Nanotechnology in water treatment is a rapidly growing field that leverages the unique properties of nanomaterials to address global water quality challenges. Nanotechnology involves manipulating matter at the nanoscale (typically 1 to 100 nanometers), where materials often exhibit enhanced characteristics such as increased surface area, reactivity, and specificity. These properties can be harnessed to develop more efficient, cost-effective, and sustainable solutions for water purification, desalination, and wastewater treatment.

One of the most promising applications of nanotechnology in water treatment is the development of advanced filtration systems. Nanomaterials, such as Titanium dioxide (TiO_2), Aluminium Oxide (Al_2O_3) and nanoparticles, are being used to create membranes and filters that can remove contaminants more effectively than traditional methods. These materials are capable of filtering out harmful substances like bacteria, viruses, heavy metals, and even dissolved salts, improving water quality and making it safer for consumption.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 4, June 2025
Impact Factor: 7.67

One of the most significant advantages of nanotechnology is its ability to operate with minimal energy consumption while delivering faster and more effective results. Nanomaterials also exhibit self-cleaning and antimicrobial properties, reducing maintenance needs and extending the lifespan of treatment systems. Additionally, nano- enabled filtration systems can be compact and tailored to meet specific regional water quality challenges, making them ideal for both urban and rural applications. Nanotechnology also plays a crucial role in desalination, improving the efficiency of converting seawater into fresh water by enhancing membrane performance. Furthermore, it contributes to wastewater treatment, enabling safe water reuse by removing industrial and domestic pollutants. With its potential to reduce costs, energy usage, and chemical requirements, nanotechnology is paving the way for a more sustainable and accessible future in global water treatment.

Titanium dioxide (TiO_2) has gained significant attention in water treatment due to its remarkable photocatalytic properties, which allow it to efficiently degrade organic pollutants and pathogens when exposed to ultraviolet (UV) light. As a widely available, non-toxic, and stable material, TiO_2 offers a sustainable and cost-effective solution for purifying water. Its ability to break down harmful chemicals like pesticides, dyes, and pharmaceuticals makes it particularly valuable in addressing emerging contaminants that are difficult to remove with traditional methods.

In addition to organic pollutant degradation, TiO_2 is highly effective at disinfecting water by inactivating bacteria, viruses, and other microorganisms, making it an important tool for ensuring safe drinking water. It also plays a role in the treatment of wastewater, helping to eliminate industrial pollutants and improve water quality for reuse. The photocatalytic process of TiO_2 is environmentally friendly, as it generates no harmful by-products and requires only UV light to activate its cleaning abilities, making it a green alternative to chemical-based treatments.

TiO_2 can be incorporated into various water treatment systems, including filters, membranes, and coatings, enhancing their performance while remaining efficient and long-lasting. Its versatility and effectiveness in both traditional and advanced water treatment applications have positioned titanium dioxide as a promising material in the global effort to provide clean and safe water.

Aluminium oxide (Al_2O_3), also known as alumina, is a versatile material widely used in water treatment due to its excellent adsorption and filtration properties. As a highly stable, non-toxic, and cost-effective material, aluminium oxide plays a crucial role in removing a range of contaminants from water, including heavy metals, organic compounds, and suspended solids. Its high surface area and porous structure make it an ideal adsorbent, allowing it to effectively capture pollutants from both drinking water and wastewater.

In water purification, alumina is commonly used as a filter media, where it helps to remove impurities such as arsenic, fluoride, and other toxic metals. It is also employed in the production of advanced filtration systems, including membranes, which can be used for desalination and wastewater treatment. Aluminium oxide's ability to selectively adsorb harmful substances while allowing clean water to pass through makes it a valuable component in ensuring safe drinking water.

Additionally, aluminium oxide can be used in the regeneration of spent adsorbents, contributing to more sustainable water treatment practices. Its resistance to chemical corrosion and high-temperature stability further enhances its durability, making it suitable for long-term use in harsh water conditions. With its efficiency, sustainability, and wide range of applications, aluminium oxide continues to be an important material in the advancement of water treatment technologies worldwide.

Water filtration systems are designed to eliminate or significantly reduce these impurities through physical, chemical, or biological processes. The choice of filtration method depends on the specific contaminants present and the desired level of purification. Some common types of water Rainwater harvesting is a sustainable practice that involves collecting and storing rainwater for various uses. Two common sources of water in this context are roof runoff and lake water.

Roof Runoff Rainwater: Roof runoff refers to the rainwater that collects on rooftops and drains into gutters or downpipes. This water can be captured and stored in tanks or cisterns for household, agricultural, or irrigation purposes. Roof runoff is generally clean, but it may require filtration to remove debris and contaminants, especially if the roofing materials are prone to shedding chemicals or particles. Harvesting roof runoff is an efficient way to reduce reliance on municipal water supplies, mitigate flood risks, and promote sustainability.

Lake Water: Lake water refers to water collected from natural or man-made lakes, which can be used for irrigation, livestock, or even drinking water (with proper treatment). Unlike rainwater, lake water is generally more stable in terms of availability but may contain higher levels of impurities such as algae, bacteria, or sediments. This makes it necessary to treat the water before use. Lakes also play a crucial role in maintaining the water cycle and can serve as a vital resource for communities, particularly in areas where rainfall is scarce or unpredictable.

Both roof runoff and lake water are valuable resources that can be sustainably utilized with proper management, filtration, and treatment methods, helping to address water scarcity and promote environmental conservation.

II. PRESENT STUDY

Nanotechnology offers innovative solutions for improving the quality and efficiency of water treatment in roof runoff rainwater and lake water, which are often contaminated by pollutants like heavy metals, chemicals, sediments and microorganisms.

Nanoparticles are materials with dimensions typically in the range of (typically 1 to 100 nanometers). Due to their small size, large surface area, and unique chemical properties, nanoparticles have shown significant potential in water treatment applications, offering efficient and sustainable solutions for water purification, contamination removal, and monitoring. These nano-sized chemicals have unique properties that enable them to interact with water contaminants at a molecular level, offering more effective and sustainable solutions compared to traditional methods.

Nanotechnology can improve water purification, enhance desalination, and provide safer, more efficient access to clean water.

By integrating nanotechnology into water treatment systems for roof runoff, rainwater, and lake water, these approaches can enhance the efficiency, sustainability, and cost- effectiveness of water purification, making them more accessible for both urban and rural communities.

Roof runoff rainwater Adsorption: Nanomaterials like titanium dioxide (TiO_2) and Aluminium Oxide (Al_2O_3) can be used in filtration systems to remove suspended solids, bacteria, and organic contaminants from roof runoff and rainwater.

Lake water Adsorption: Nanoparticles like titanium dioxide (TiO_2) and Aluminium Oxide (Al_2O_3) or activated carbon can be used to remove heavy metals, phosphates, and toxic chemicals from lake water. These nanoparticles can be tailored for specific contaminants and are easily removed after adsorption.

Filtration bed: This project explores the use of a filtration system consisting of layers of sand, aggregate, and gravel to purify water. The concept involves creating a multi- layered filter bed, where each layer serves a specific function gravel removes larger particles, aggregate filters out finer debris, and sand traps smaller impurities, ensuring clean water. This natural filtration method is simple, cost-effective, and environment- ally sustainable, making it ideal for treating roof runoff rain water, lake water, and other sources.

III. SCOPE OF PROJECT

A project focused on using nanotechnology for rainwater and lake water purification or management could have significant impacts on water quality, sustainability, and efficiency. Here’s a detailed scope for such a project

Project Goal: To develop advanced nanomaterial-based filtration systems that improve the efficiency of filtering pollutants, such as bacteria, viruses, heavy metals, and organic compounds, from rainwater and lake water.

Utilize nanomaterials (e.g., Titanium dioxide & Aluminium oxide) to create filters with high permeability and selective separation capabilities. The goal is to create filters that can remove contaminants more effectively while maintaining high flow rates. Self-cleaning filters Develop nanomaterial-based filters with self-cleaning or anti-fouling properties to increase the durability and effectiveness of water filtration systems.

Pollutant removal: Focus on removing specific pollutants like algae, organic waste, or heavy metals that may commonly be found in lake water or collected rainwater.

Real-time monitoring: Implement a system that provides real-time data on the quality of rainwater or lake water, using Nano sensors to monitor parameters like pH, turbidity, and chemical pollutants.

IV. LITERATURE SURVEY

1. PRANAY GAUTAM (JULY- SEPT 2013). NANOTECHNOLOGY IN ROOF RUNOFF RAIN WATER TREATMENT: The paper discusses how nanotechnology can help clean wastewater more effectively. It focuses on tiny materials called nanoparticles, which are very small and have special properties that make them good at removing harmful substances from water. The authors explain that these nanoparticles can be used in different ways, such as in filters or as part of chemical reactions, to get rid of toxic metals, bacteria, and other pollutants. They highlight the advantages of using nanoparticles, like their ability to work in hard-to-reach places and their efficiency in cleaning water. Overall, the paper emphasizes that using nanotechnology is a promising approach to tackle the serious problem of water contamination, making it a valuable tool for improving water quality.

2. ANKIT NAGAR (MAY 20, 2020). CLEAN WATER THROUGH NANOTECHNOLOGY: Ankit Nagar (may 20, 2020). The paper talks about the serious need for clean water and how nanotechnology can help solve this problem. As cities grow, especially in places like India, there is more demand for fresh water, but pollution and waste are making it harder to find clean sources. The authors explain different ways nanotechnology can improve water quality, like using smart water purifiers and special filters that can remove harmful substances such as pesticides and arsenic. They believe these technologies can make clean water more available and affordable, especially in developing countries. The paper also suggests that local governments should use these technologies to create jobs and boost the economy while ensuring that the solutions are environmentally friendly. Overall, it highlights the importance of using advanced technology to tackle the global water crisis.

3. M NAWAZ (MAY 2012). NANOTECHNOLOGY FOR ROOFTOP HARVESTED RAINWATER FOR POTABLE USE: Importance of Rainwater Harvesting. The document highlights the increasing practice of rainwater harvesting as an alternative water source in water-scarce areas. However, it notes that the quality of harvested rainwater can deteriorate due to contact with catchment surfaces, making it unsuitable for potable use. The study specifically targets P. aeruginosa and E. coli, which are common indicators of water quality and potential pathogens. The presence of these microorganisms in harvested rainwater raises concerns about its safety for drinking purposes Titanium dioxide to be use for the rain water and lake water. The study assesses the effectiveness of nanomaterial at concentrations ranging from 0.01 to 0.1 mg/l, which is within the safe limits set by the World Health Organization (WHO). The review references various studies that have explored the antimicrobial action of nanomaterial, including its interaction with microbial cells and its effectiveness in different water treatment scenarios. These studies provide a broader context for understanding the role nanomaterial of in water disinfection.

4. PRATHAMESH A. DHAKRAS (JUNE 2020). NANOTECHNOLOGY APPLICATIONS IN WATER PURIFICATION AND WASTE WATER TREATMENT: The paper discusses how new technologies, especially nanotechnology, can improve water purification and treatment methods. It highlights that traditional water treatment methods are often inefficient, costly and can produce harmful waste products. Nanotechnology involves using very small materials, like nanoparticles, which can effectively clean water without creating dangerous by-products. The paper reviews different types of nanomaterials, such as Titanium dioxide (TiO_2) and Aluminium Oxide (Al_2O_3) nanoparticles, and their potential benefits in making water cleaner and safer. Overall, the research emphasizes the importance of finding effective and safe ways to use nanotechnology for water treatment to ensure access to clean water for everyone.

5. SUVARDHAN KANCHI (JANUARY 2014). NANOTECHNOLOGY FOR WATER TREATMENT:

- Nanotechnology: It involves working with very tiny materials (at the scale of nanometers) to create new solutions for various problems, including cleaning water.
- Importance for water treatment: Nanotechnology can effectively remove harmful substances from water, such as bacteria, viruses, and toxic metals. This is especially important in developing countries where clean drinking water is scarce.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 4, June 2025 Impact Factor: 7.67

• Types of Nanomaterials: The paper mentions different types of nanomaterials, like carbon nanotubes and metal nanoparticles (Titanium dioxide (TiO_2), which can be used to filter and purify water.

• Advantages: Using nanotechnology for water treatment is often cheaper, faster, and more efficient than traditional methods. It can help recycle water and reduce pollution.

• Challenges: While promising, there are still challenges to overcome, such as the cost of developing these technologies and ensuring they are safe for the environment.

Overall, the paper highlights the potential of nanotechnology to provide better solutions for water purification, which is crucial for health and sustainability.

6. KONDA REDDY KUNDURU (JANUARY 2017). NANOTECHNOLOGY FOR WATER PURIFICATION, APPLICATION OF NANOTECHNOLOGY METHODS IN WASTE WATER TREATMENT:

The paper discusses the use of nanotechnology for water purification, particularly in treating wastewater. It highlights the growing global demand for clean water due to population growth and environmental issues, noting that many existing water treatment methods are not effective enough to remove all contaminants.

• Water Contaminants: Water can be polluted by various harmful substances, including heavy metals, organic pollutants, and emerging contaminants like pharmaceuticals. Traditional treatment methods often struggle to remove these effectively.

• Nanotechnology Solutions: Nanotechnology offers innovative materials and methods for water treatment. Nanomaterials have unique properties, such as a large surface area and high reactivity, making them effective for adsorbing pollutants and disinfecting water.

• Applications: The paper outlines several applications of nanotechnology in water treatment, including.

• Nano adsorption: Using nanomaterials to capture and remove contaminants from water. Using light-activated nanomaterials to break down organic pollutants. Overall, the paper emphasizes the importance of developing advanced technologies to ensure access to clean water in the future.

7. QILIN LI (MARCH 2013). APPLICATION OF NANOTECHNOLOGY OF LAKE WATER PURIFICATION: Nanomaterials in Water Treatment The review emphasizes the role of nanomaterials, such as carbon nanotubes and silver nanoparticles, in enhancing the efficiency of water purification processes. For instance, studies have shown that carbon nanotubes can effectively adsorb contaminants like heavy metals and pharmaceuticals from water.

An important finding is that re-growth of both P. aeruginosa and E. coli was observed at lower concentrations of silver, suggesting that these concentrations may only temporarily halt bacterial replication without causing permanent damage. This emphasizes the need for careful consideration of silver concentrations used in disinfection processes.

The review also covers the use of photocatalytic materials, such as titanium dioxide and platinized tungsten oxide, which can generate reactive species under light irradiation to degrade organic pollutants in water.

Overall, the research emphasizes the importance of finding effective and safe ways to use nanotechnology for water treatment to ensure access to clean water for everyone.

V. SELECTION OF NANOMATERIALS

FIG 1: ALUMINIUM OXIDE (Al_2O_3) & TITANIUM DIOXIDE (TiO_2)

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 4, June 2025 Impact Factor: 7.67

ALUMINIUM OXIDE (AL_2O_3) Aluminium oxide (Al_2O_3) is used in water treatment for its high surface area and chemical stability. It helps remove contaminants like heavy metals, fluoride, and arsenic, particularly in activated alumina form. Its porous structure makes it effective for adsorption, improving water quality by reducing turbidity and organic impurities. Aluminium oxide is durable, non-toxic, and can be reused in filtration systems. It is employed in both industrial and residential water purification. Additionally, it plays a role in wastewater treatment, ensuring cleaner effluent. Its efficiency and sustainability make it a valuable material in water treatment. Additionally, aluminium oxide can be used in desiccant applications to remove moisture from water sources. Its efficiency and durability make it a reliable material in water treatment technologies.

TITANIUM DIOXIDE (TiO_2) Titanium dioxide (TiO_2) is used in water treatment primarily for its photocatalytic properties, which help break down organic contaminants when exposed to UV light. It is effective in purifying water by degrading pollutants like pesticides, dyes, and bacteria. TiO_2 is also employed in self-cleaning filtration systems due to its ability to remove microorganisms and organic substances. It is non-toxic, stable, and can be reused in treatment processes. Titanium dioxide can be incorporated into water filtration membranes for enhanced performance. Its photocatalytic action aids in reducing harmful substances, making water safer for consumption. Additionally, TiO_2 can help in wastewater treatment by decomposing toxic compounds. Its versatility makes it a valuable material in environmental applications.

VI. COLLECTED WATER SAMPLE OF (ROOF RUNOFF RAIN- WATER & DAROJI LAKE WATER)

RAINWATER RUNOFF from roofs and lake water are important sources of water that can be utilized for various purposes, but they come with distinct characteristics and challenges. Roof runoff refers to rainwater that flows off the surface of roofs and into gutters or downspouts. It can be collected for uses such as irrigation, cleaning, or even as potable water after proper filtration and treatment. However, it may contain contaminants like dust, debris, and pollutants from the roof surface.

LAKE WATER, on the other hand, is water collected from natural or artificial lakes, often used for agricultural, industrial, and recreational purposes. While it is generally more stable than roof runoff, lake water can contain impurities such as algae, bacteria, or sediments that require treatment before use. Both sources offer potential benefits but require appropriate filtration, treatment, and management to ensure the water is safe and usable.

FILTRATION SYSTEM DESIGN

Instruments Required for Experimental Setup.
Water Cans
Steel Mesh
Coarse Aggregate (10mm)
Coarse Aggregate (20mm)
Gravel
Fine Aggregate

FIG 2: PROCESS OF FILTRATION BED SET UP

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 4, June 2025 Impact Factor: 7.67

TESTING FOR CONTAMINANTS

To treat rainwater and lake water with a filter bed, the water is first collected in a container. It then flows through layers of sand, gravel, and coarse aggregate to remove dirt, debris, and harmful particles. The filter bed traps larger impurities, improving the water's clarity. After filtration, the water is cleaner and safer for use.

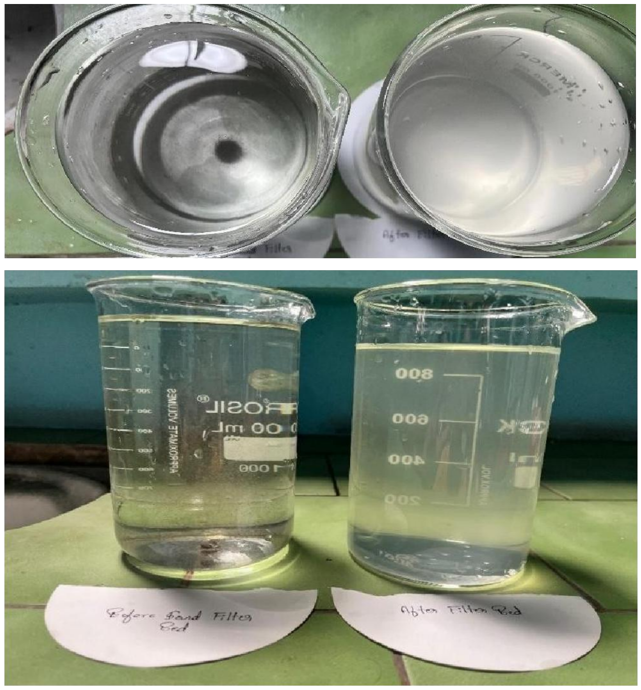

FIG 3: WATER SAMPLE BEFORE FILTER BED & AFTER FILTER BED

SELECTION OF DOSAGE

The selection of dosage for aluminum dioxide (Al_2O_3) and titanium dioxide (TIO_2) in water treatment depends on several factors, including the type of contaminants, water quality, and the treatment method.

Aluminum dioxide (Al_2O_3) For aluminum dioxide the dosage typical range from 0.1 to 1 mg/l, as it is commonly used for adsorbing metals and particles in water. This dosage can be adjusted based on the concentration of pollutants.

After studying the journal, we have selected the dosage amount to treat the water. After adding a dosage, we have looked for 0.1mg/l. It is the proper dosage to treatment the water in aluminum dioxide (Al_2O_3)

Titanium dioxide (TIO_2) This amount can be adjusted based on how much pollution is present. For titanium dioxide, when used with UV light to break down harmful substances, you need about 0.1 to 1 gram per liter (g/L). Tio_2 works well for breaking down chemicals and killing bacteria.

After studying the journal, we have selected the dosage amount to treat the water. After adding a dosage, we have looked for 0.1mg/l. It is the proper dosage to treatment the water in titanium dioxide (TIO_2)

The efficiency of both materials can vary with factors such as ph, temperature, bacteria, viruses and water turbidity.

It's important to do tests first to find the right amount needed for your specific water. Other factors, like temperature and water clarity, can affect how well these materials work. Always test and adjust to get the best results without wasting materials.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 4, June 2025
Impact Factor: 7.67

STATISTICAL ANALYSIS NANOMATERIALS

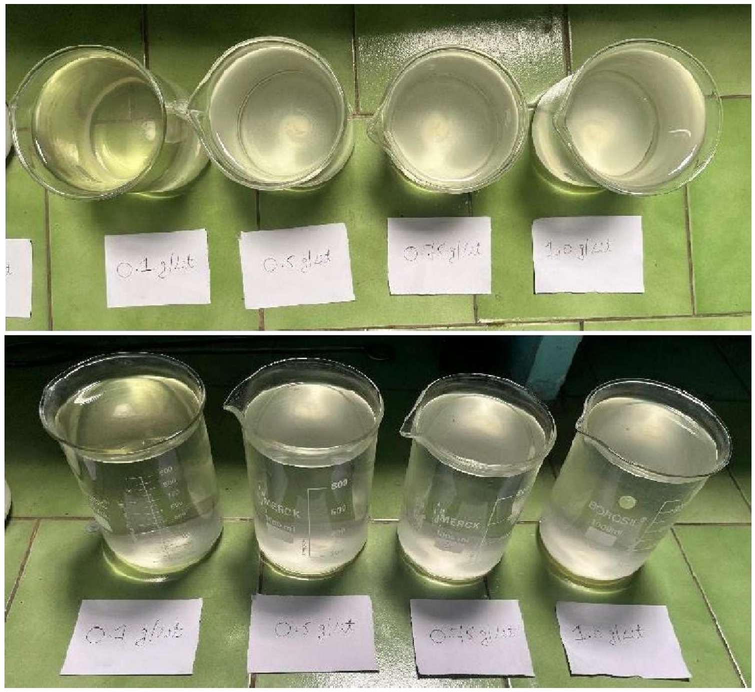

FIG 4: ADDING A NANOMATERIAL OF ALUMINIUM OXIDE (AL_2O_3)

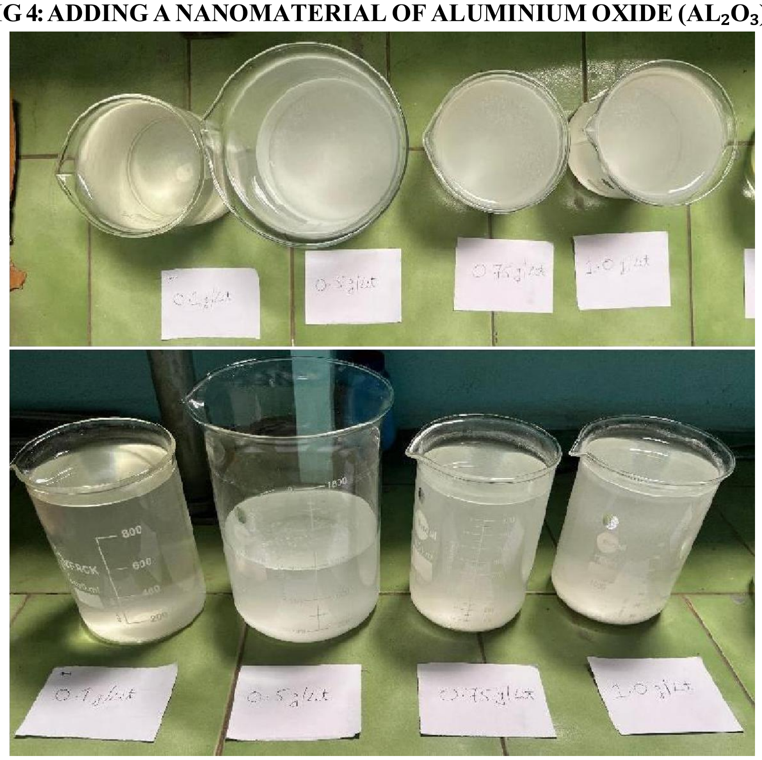

FIG 5: ADDING A NANOMATERIAL OF TITANIUM DIOXIDE (TIO_2)

DOI: 10.48175/IJARSCT-27630

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 4, June 2025 Impact Factor: 7.67

VII. RESULT AND DISCUSSION

TABLE 1: ANALYSIS FOR ROOF RUN OF RAIN WATER SAMPLE

SL NO	PARAMETERS	UNITS	UNTREATED SAMPLE		TREATED SAMPLE	
			BEFORE FILTER BED	AFTER FILTER BED	(TIO_2) 0.1 MG/L	(AL_2O_3) 0.1 MG/L
1	Acidity	Mg/l	0	0	0	0
2	Alkalinity	Mg/l	243	205.3	190	176
3	Hardness	Mg/l	439.5	327.2	206	185
4	PH	Mg/l	7.9	7	7	6.7
5	TDS	Mg/l	5.8	1.6	0	0
6	Total solids	Mg/l	3.5	1	0	0
7	Suspended solids	Mg/l	2	0.6	0	0
8	Fixed solids	Mg/l	0.9	0	0	0
9	Turbidity	NTU	NE	1.8	1.5	1
10	Iron (Fe)	Mg/l	NE	0.1	0.1	0.1
11	Zinc (Zn)	Mg/l	NE	0.1	0.1	0.1
12	E-coli	100/ML	NE	Absent	Absent	Absent

NOTE: NE-NEGLIGIBLE

TABLE 2: ANALYSIS FOR DAROJI LAKE WATER SAMPLE

SL NO	PARAMETERS	UNITS	UNTREATED SAMPLE		TREATED SAMPLE	
			BEFORE FILTER BED	AFTER FILTER BED	(TIO_2) 0.1 MG/L	(AL_2O_3) 0.1 MG/L
1	Acidity	Mg/l	0	0	0	0
2	Alkalinity	Mg/l	289	213.2	193	180
3	Hardness	Mg/l	648	396	289.2	198
4	PH	Mg/l	8.35	7.97	7	7
5	TDS	Mg/l	6.1	1.2	0	0
6	Total solids	Mg/l	2.8	0.8	0	0
7	Suspended solids	Mg/l	2	0.4	0	0
8	Fixed solids	Mg/l	0.8	0	0	0
9	Turbidity	NTU	NE	1.4	1.25	1
10	Iron (Fe)	Mg/l	NE	0.1	0.15	0.1
11	Zinc (Zn)	Mg/l	NE	0.9	0.7	0.5
12	E-coli	100/ML	NE	20	16	10

NOTE:NE-NEGLIGIBLE

IX. CONCLUSION

The research underscores the transformative potential of nanotechnology in water treatment, particularly for roof runoff and lake water. The use of nanomaterials has proven effective in enhancing filtration processes, leading to significant reductions in contaminants and improved water quality.

IJARSCT

International Journal of Advanced Research in Science, Communication and Technology

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

ISSN: 2581-9429

Volume 5, Issue 4, June 2025

Impact Factor: 7.67

The project successfully demonstrates that advanced filtration systems utilizing Tio_2 and Al_2O_3 can provide sustainable solutions for water purification, addressing critical challenges in water scarcity and pollution. Furthermore, the findings highlight the importance of real-time monitoring and data integration to ensure safe water usage. As urbanization and environmental challenges continue to escalate, the adoption of nanotechnology in water treatment presents a viable pathway towards achieving clean and accessible water for all. Future research should focus on optimizing these technologies for broader applications and ensuring their safety and efficacy in diverse environmental conditions.

Based on the findings of this study, more research is needed to fully understand how aluminum dioxide nanoparticles can be used to improve water treatment. Future studies should focus on making the nanoparticles more effective at removing contaminants, testing their long-term stability, and ensuring they are safe for the environment. It is also important to explore how they interact with different types of pollution in water. Continued research will help make this technology more reliable and useful for cleaning water on a larger scale.

REFERENCES

[1]. Kanchi, s. "nanotechnology for water treatment." j. Environ. Anal. Chem 1.2 (2014): 1-3

[2]. Nagar, Ankit, and thalappil Pradeep. "Clean water through nanotechnology: needs, gaps, and fulfilment." aces nano 14.6 (2020): 6420-6435.

[3]. Kunduru, Konda Reddy, et al. "nanotechnology for water purification: applications of nanotechnology methods in wastewater treatment." water purification (2017): 33-74.

[4]. Dhakras, Prathamesh a. "nanotechnology applications in water purification and waste water treatment: a review." international conference on nanoscience, engineering and technology (icon set 2011). Imee, 2011

[5]. Jangid, Priyanka, and Michel prabhu inbaraj. "Applications of nanomaterials in wastewater treatment." materials today: proceedings 43 (2021): 2877-2881.

[6]. Debnath, Biswajit, et al. "nanotechnology in waste water treatment: a review." E- coli urban areas 563 (2014).

[7]. Arora, Jayesh, and Akshat Mathur. "Role of nano-technology in water and waste- water management." internation journal of advance research in science and engineering 6.10 (2017): 161-168.

[8]. Usmani, Mohd amil, et al. "impact of nanotechnology on water treatment: carbon nanotube and graphene." handbook of composites from renewable materials. Wiley, 2017. 171-206.