



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 9.935

Volume 15, Issue 8, August 2026

Effectiveness of Natural Extract and Polymer in Treatment of Greywater

Gayatri A. Bahire, Rajshri D. Ukey

Assistant Professor, Department of Civil Engineering, PRMCEAM, Badnera, India

U. G. Student, Department of Civil Engineering, PRMCEAM, Badnera, India

ABSTRACT: Water is a universal need, to support our human life. However, rising population, pollution, and urbanization have contributed to the growing problem of water scarcity. The increasing amount of greywater highlights there is need for sustainably and eco-friendly methods for greywater treatment. Considering this need, natural extract and polymer can be effective in greywater treatment. Greywater results from domestic activities such as bathing, washing, dishwashing, and significant portion of domestic wastewater. Their initial parameter BOD, COD, DO, Turbidity, and pH were carried out. The natural extract were prepared by oven dried method, with each material dried separately under its respective temperature and drying period, to remove moisture, then grinded in mixer grinder, and sieved with mesh size of 212 μm to obtained uniform size powder. The prepared powders were mixed together in 1:1 ratio, and then after, jar test were conducted with selected dosages of 5, 10, 15, 20, and 25 g/L. Parameters such as turbidity, pH, COD, BOD, and DO were measured after using coagulants. The composite extract was effective in treating greywater, achieving reduction of 73.33% in turbidity, 31% in COD, 25% in BOD, along with an improvement in DO levels. Among the two polymers tested, Aluminium sulphate showed higher removal efficiencies of 82.67%, 49.75%, and 41.67% for turbidity, COD, and BOD, respectively. The study concludes that natural coagulants are a low-cost, and ecofriendly solution for wastewater treatment, especially in rural and resource-limited areas, and they have strong potential for use in small-scale water purification systems.

KEYWORDS: Greywater, Natural Extract, Polymer Extract, Coagulation, Flocculation.

I. INTRODUCTION

Water is an essential for the life of every living being. Life without it is unimaginable. Water is not only necessary for drinking but is also vital for maintaining the ecosystem, agricultural production, industrial operation, and global health and sustainability. It plays a crucial role in keeping nature in balance. Water is required for almost every daily activity such as drinking, cooking, bathing, cleaning, washing, and agricultural work. In India, the Bureau of Indian Standards (BIS – IS 1172:1993) gives guidelines for the daily water requirement per person for different activities. On an average, the recommended water use is 135 LPCD. Around 40% of this wastewater is grey water. The composition of greywater include soap, detergent, grease, and small amounts of organic matter. Physically, greywater appears light grey or cloudy and may have mild odor that can become unpleasant if the water is stored for more than 24-48 hours without treatment, due to bacterial growth. It often contains suspended solids like hair, lint, and dirt, leading to high turbidity. Chemically, greywater can have a pH range between 6 and 9 and contains substances such as soaps, detergents, surfactants, and small amount of nutrients like nitrogen and phosphorus. The level of biochemical oxygen demand (BOD) and chemical oxygen demand (COD) are moderate, reflecting the presence of organic matter. Biologically, greywater may contain low levels of pathogens, especially from source like showers or laundry that may carry traces of body fluids. The water quality degrades quickly without treatment due to microbial activity.

Greywater can be treated by using coagulants, which are substance that help in removing suspended particles and impurities from water. In this process, natural or chemical coagulants such as aluminium sulphate and ferric chloride and eco-friendly options like tulsi leaves, tamarind seed, moringa seed, and other plant-based materials are added to the grey water. These coagulants neutralize the charges of fine particles, causing them to clump together and form larger particles called flocs. The flocs then settle down at the bottom during sedimentation, making it easier to separate the clean water. This method significantly reduces turbidity, colour, soap residues, and organic matter present in grey water. After coagulation and sedimentation, the water can be passed through sand or charcoal filters for further purification and, if required, disinfected before reuse. Treating grey water with coagulants is considered simple, cost-

effective, and suitable for small-scale application likes households, communities, and rural areas where advanced treatment systems may not be affordable. The treatment of grey water using both natural and chemical coagulants has proven to be an effective and economical method for improving water quality. Overall, the combined study of Natural and chemical coagulants highlights that both method significantly enhance the clarity and safety of grey water, making it suitable for non-potable application such as irrigation, toilet, flushing and ground water discharge. The choice of coagulant ultimately depends on cost, availability, and the required quality of threatened water.

II. MATERIAL AND METHODS

2.1 Working Principle of Coagulation and Flocculation

Coagulation and flocculation work together to clean water by helping tiny suspended particles come together so they can be removed more easily. The first step is coagulation and second step is flocculation where the mechanism of coagulation and flocculation in greywater treatment starts with the fact that greywater contains a large number of fine suspended particles, soap residues, oils, food particles, and organic matter that usually carry a negative surface charge. Because of this charge, these particles repel each other and remain dispersed, making the water cloudy and difficult to clean. When a coagulant such as alum, ferric chloride, or natural materials like tulsi leaves or tamarind seed extract is added, it's releases positive ions that neutralizes the negative charges on the greywater particles. This reduces the repulsive forces and destabilizes the suspended matter, allowing them to come closer and form small clusters known as micro-flocs. Since these micro-flocs are still very light, the next step, flocculation, is applied. In this stage, gentle stirring is used to encourage the micro-flocs to bump into each other and stick together. If polymers or natural extracts are used, they act as bridging agents, helping to bind the particles into larger and stronger flocs. These bigger flocs are heavier and can easily settle down at the bottom of a tank or be filtered out, leaving the treated greywater much clearer and more suitable for reuse in activities such as gardening, flushing, or other non-potable purposes.

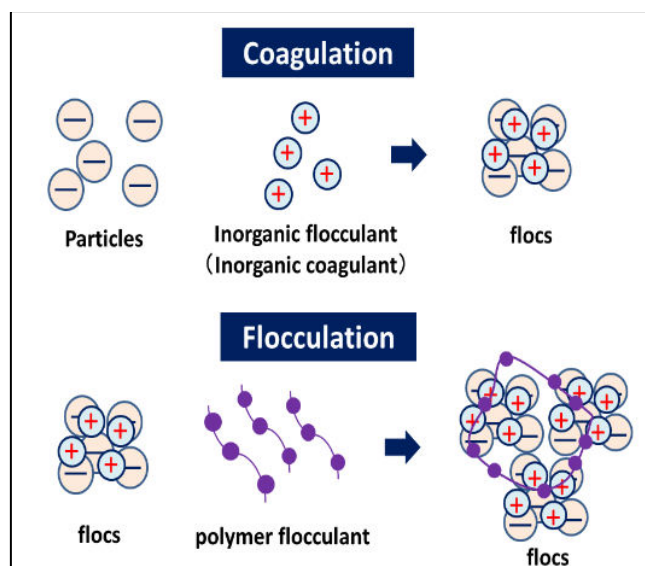


Figure 2.1.Coagulation and Flocculation Process

2.2 Types of Extract

i Artificial Extract : These are chemically manufactured substances used in water and greywater treatment to enhance the removal efficiency of suspended particles and contaminants. They play an important role in improving the overall efficiency of the treatment process.

ii Natural Extract : Natural Extract are derived from sources. This are ecofriendly alternative to synthetic chemical are biodegradable, less toxic and enhance the removal of suspended particles and contaminants. They are useful in such a regions where access of chemical extract is limited.

2.2.1 Types of Natural Extract

i. Plant Based Natural Extract: Plant based natural extracts are derived from various plants which are used in a process of coagulation to purify water by removing TSS, organic matter and other impurities. These coagulants are extracted from different parts of plants, including seeds, leaves and contain bioactive compounds, proteins, polysaccharides, polyphenolic, polyelectrolytes, tannins that aid the coagulation and flocculation.

ii. Animal-Based Natural Extract: Animal-based natural extracts are obtained from different animal-derived materials and can be used as natural coagulants in water and wastewater treatment. These materials may contain proteins, amino acids, polysaccharides, and other bioactive compounds that help in the coagulation and flocculation process.

2.3 Preparation of Pomegranate & Banana coagulant:

Before converting the raw material into powder form, the collected leaves and seeds were washed several times with tap water and followed by distilled water to remove the dust, dirt, impurities. This process is crucial because impurities present on the surface may interfere with the natural properties of coagulant and reduce its effectiveness. The washed material was subjected to a two-stage drying process. In the first stage, they were shade dried for 4 to 5 days at a room temperature to gradually reduce the moisture content and make sure that the existing bioactive compounds present in the material should not be affected and reduced. Direct exposure to sunlight can degrade the active compound in the coagulant, reducing its effectiveness, sundry involves high temperature and UV rays, which can affect the chemical properties of the coagulant. In the second stage, the tulsi leaves were kept in the oven at around 50 °C. Spread the leaves in a thin layer on a tray and dry for about 2 hr. check every 30 min. The leaves are fully dry when they become crisp and crumble easily by hand. Higher temperature can reduce the smell and useful properties of tulsi. For tamarind seed, washed then first and remove any dirt. Then dry them in the oven at around 60 °C for 8 hr. since seeds are thick and hold more moisture, they take longer than leaves. Turn them every 1 to 2 hr. even drying. They should become hard and fully dry before grinding.

Once the drying process was complete and the leaves and seeds became crisp and brittle, they were grounded into a fine powder using a mixer grinder. The ground material was passed through a sieve with mesh size of 212 µm to obtain a uniform powder with consistent size. This sieving step helps eliminate any larger unprocessed particles. After sieving the powder of tamarind seeds and tulsi leaves were mixed together in 1:1 ratio. This uniform particle size is crucial because it enhances the interaction between coagulant particles and the impurities present in the grey water. Smaller and consistent particles provide a greater number of active sites for adsorption and chemical reaction, thereby improving the overall efficiency of the coagulation process. Additionally, controlled particle size ensures better dispersion of the coagulant in the solution, leading to more effective floc formation and fast settling of suspended solids.

III. RESULT AND DISCUSSION

3.1 The effects of Tulsi leaves and Tamarind seed powder mixture, Aluminium sulphate & Ferric chloride on greywater sample are shown below.

Table 3.1 Effect of Coagulant Dosage on Turbidity

Initial reading of grey water (JTU)	Coagulant Dosage in (g/L)	Final reading (Tulsi leaves and tamarind seed powder mixture) (JTU)	Final reading of (aluminium sulphate) (JTU)	Final reading of (Ferric chloride) (JTU)
7.5	5	5	5.0	5.5
7.5	10	3.5	3.2	4
7.5	15	2.0	1.8	2.5
7.5	20	2.8	1.3	1.5
7.5	25	4.2	1.4	1.2

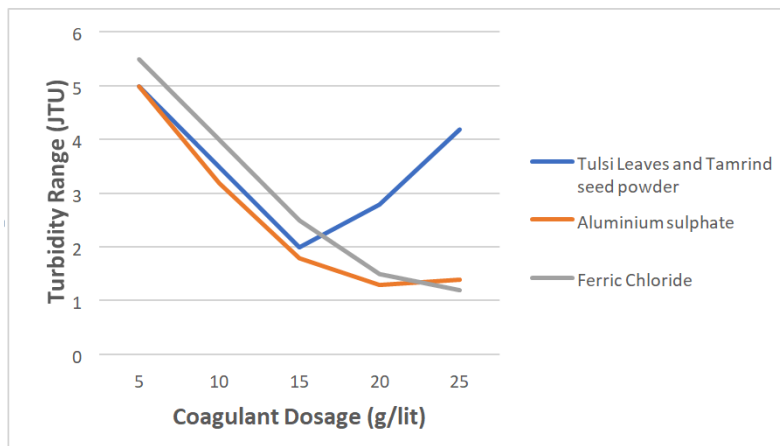


Figure 3.1 Effect of Coagulant Dosage on Turbidity

The initial turbidity of the greywater was recorded as 7.5 JTU before treatment. As the dosage of the coagulants increased, the final turbidity values changed accordingly, showing varying effectiveness of each coagulant. For the tamarind seeds and tulsi leaves powder, the turbidity decreased gradually with increase in dosage and reached an optimum value at 15 g, where turbidity was reduced to 2 JTU, indicating a removal efficiency of 73.33%. However, further increase in dosage beyond 15 g resulted in an increase in turbidity (2.8 JTU at 20g and 4.2 JTU a 25g), indicating overdosing and possible re-stabilization of particles. In case of aluminium sulphate, turbidity reduction improved significantly with increasing dosage, reaching the lowest value of 1.3 JTU at 20g, which corresponds to a removal efficiency of 82.67%. However, at higher dosage (25g), turbidity increased slightly to 1.4 JTU, indicating that overdosing affects the treatment efficiency. For ferric chloride, turbidity reduction was gradual and reached the minimum value of 1.2 JTU at 25g, showing the highest removal efficiency of 84%. Among all coagulants tested. Unlike the other coagulants, ferric chloride continued to show improved performance even at higher dosage levels. From the results, it can be concluded that ferric chloride showed the highest turbidity removal efficiency followed by aluminium sulphate and tamarind-tulsi powder. It was also observed the increasing the dosage beyond the optimum level may lead to overdosing, which results in reduced efficiency due to re-stabilization of suspended particles and deterioration of water clarity.

Table 3.2 Effect of Coagulant Dosage on PH

Initial reading of grey water	Coagulant Dosage in (g/L)	Final reading (Tulsi leaves and tamarind seed powder mixture)	Final reading of (aluminium sulphate)	Final reading of (Ferric chloride)
10	5	8	6	3
10	10	7	6	3
10	15	7	6	3
10	20	6	6	3
10	25	6	6	3

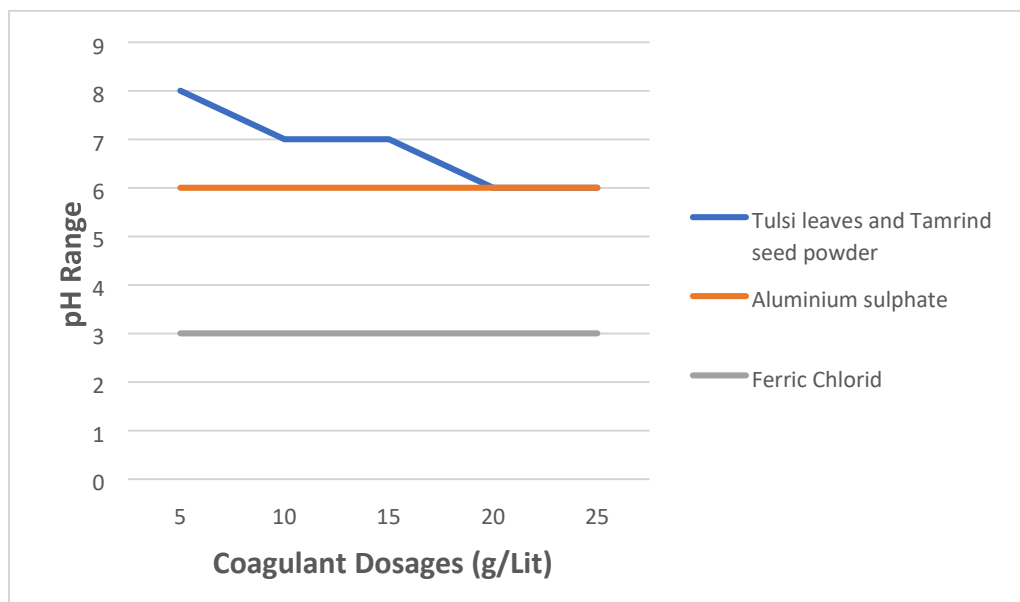


Figure 3.2 Effect of Coagulant Dosage on PH

The initial pH of the grey water was recorded as 10, indicating the alkaline nature of the sample. As the dosage of different coagulants increased, noticeable changes in pH were observed, showing the effect of each coagulant on the chemical characteristics of water. In the case of tamarind seeds and tulsi leaves powder, the pH decreased gradually with increase in dosage. The pH reduced from 8 at 5 g to 7 at 10 g and 15 g, and further to 6 at 20 g and 25 g. This indicates that the natural coagulant was effective in bringing the pH of wastewater closer to neutral range, making it suitable for safe discharge or reuse. For aluminium sulphate, the pH dropped sharply from the initial value to 6 at 5 g dosage and remained constant at 6 for all higher dosages. This shows that aluminium sulphate has a strong and immediate effect on reducing alkalinity and stabilizing the pH of wastewater. In the case of ferric chloride, a significant reduction in pH was observed even at the lowest dosage. The pH decreased to 3 at 5 g and remained constant at 3 for all higher dosages. This indicates that ferric chloride makes the water highly acidic, which may not be suitable without further pH correction. From the results, it was concluded that among all the coagulants, further pH correction. From the results, it was concluded that among all the coagulants, tamarind seeds and Tulsi leaves powder showed the better pH control by reducing it from 10 to a range of 6-8, bringing it closer to neutral conditions, while aluminium sulphate maintained a constant pH of around 6. On the other hand, ferric chloride caused a significant reduction in pH to a range of about 3, making the water highly acidic. Hence, tamarind and tulsi powder proved to be more suitable in terms of maintaining acceptable pH conditions.

Table 3.3 Effect of Coagulant Dosage on COD

Initial reading of grey water (mg/lit)	Coagulant Dosage in (g/L)	Final reading (Tulsi leaves and tamarind seed powder mixture) (mg/lit)	Final reading of (aluminium sulphate) (mg/lit)	Final reading of (Ferric chloride) (mg/lit)
200	5	182	160	192
200	10	168	184	188.4
200	15	149	100.5	190
200	20	138	136	195
200	25	172	152	199.2

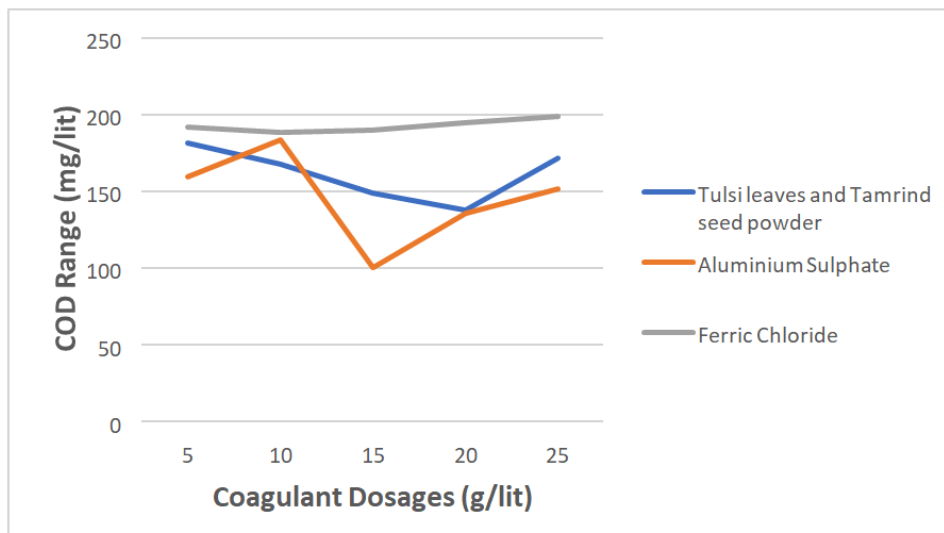


Figure 3.3 Effect of Coagulant Dosage on COD

The initial COD reading of the grey water sample was recorded as 200 mg/L, which indicates the presence of a considerable amount of organic pollutants in the wastewater. In this observation, it was found that the optimum dosage using tulsi leaves and tamarind seed powder was 20 g/L, achieving a COD reduction up to 138 mg/L. Aluminium sulphate showed the best result at a dosage of 15 g/L, where the COD value was reduced to 100.5 mg/L. Ferric chloride showed comparatively lower efficiency, with the optimum dosage at 10 g/L, achieving a COD value of 188.4 mg/L. The removal efficiency of tulsi leaves and tamarind seed powder, aluminium sulphate, and ferric chloride was found to be 31%, 49.75%, and 5.8% respectively at their optimum dosages of 20 g/L, 15 g/L, and 10 g/L. This clearly indicates that aluminium sulphate had the highest COD removal efficiency among all the coagulants used. The better performance of aluminium sulphate can be attributed to its strong coagulation properties, which help in effective removal of suspended and dissolved organic matter from grey water. Therefore, from the above data, it can be concluded that aluminium sulphate is the most effective Coagulant for COD removal compared to tulsi leaves and tamarind seed powder and ferric chloride.

Table 3.4 Effect of Coagulant Dosage on BOD

Initial reading of grey water (mg/lit)	Coagulant Dosage in (g/L)	Final reading (Tulsi leaves and tamarind seed powder mixture) (mg/lit)	Final reading of (aluminium sulphate) (mg/lit)	Final reading of (Ferric chloride) (mg/lit)
180	5	172.5	161.5	172.7
180	10	157.5	142.5	180
180	15	135	127.5	165
180	20	142.5	105	157.5
180	25	165	150	160

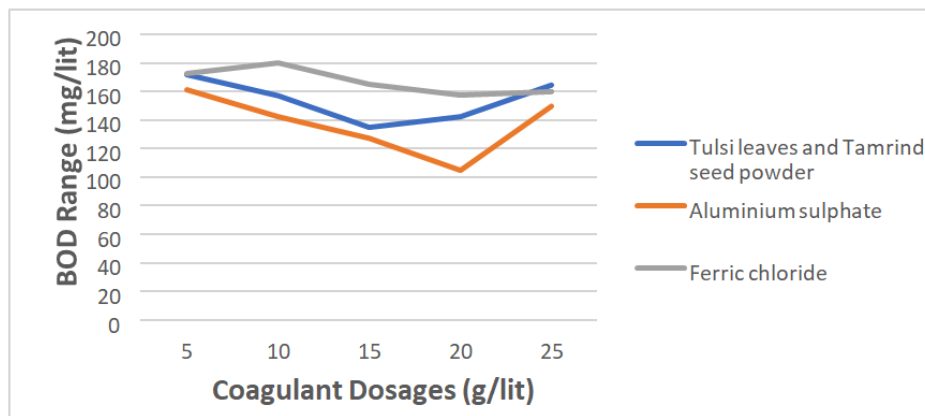


Figure 3.4 Effect of Coagulant Dosage on BOD

The initial BOD value of the grey water sample was recorded at 180 mg/L, indicating the presence of a considerable amount of biodegradable organic matter. For the tulsi leaves and tamarind seed powder coagulant, the lowest BOD value recorded was 135 mg/L at a dosage of 15 g/L, indicating a removal efficiency of approximately 25%. However, at higher dosages of 20 g/L and 25 g/L, the BOD value increased to 142.5 mg/L and 165 mg/L respectively, suggesting that 15 g/L was the optimum dosage for maximum BOD reduction. Aluminium sulphate showed better performance compared to the natural coagulant. The lowest BOD value obtained was 105 mg/L at a dosage of 20 g/L, achieving a removal efficiency of about 41.67%. At lower dosages, the reduction was comparatively less, while at 25 g/L the BOD increased again to 150 mg/L. This indicates that 20 g/L is the optimum dosage of aluminium sulphate for effective BOD removal. Ferric chloride showed moderate performance in reducing BOD. The lowest BOD value obtained was 157.5 mg/L at a dosage of 20 g/L, giving a removal efficiency of approximately 12.5%.

Table 3.5 Effect of Coagulant Dosage on DO

Initial reading of grey water (mg/lit)	Coagulant Dosage in (g/L)	Final reading (Tulsi leaves and tamarind seed powder mixture) (mg/lit)	Final reading of (aluminium sulphate) (mg/lit)	Final reading of (Ferric chloride) (mg/lit)
0.8	5	0.9	2.1	1.1
0.8	10	1.8	2.6	1.2
0.8	15	2	3.2	1.6
0.8	20	2.2	1.9	1.3
0.8	25	2.4	3.6	1

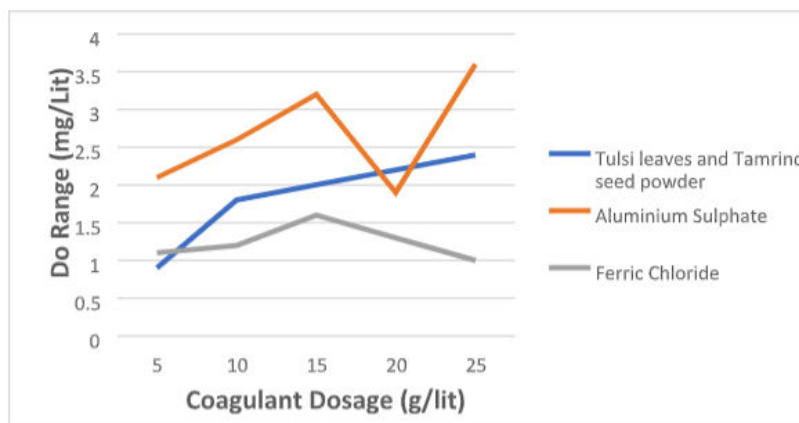


Figure 3.5 Effect of Coagulant Dosage on DO

The initial DO value of the grey water sample was 0.8 mg/L. After treatment with tulsi leaves and tamarind seed coagulant, the DO value gradually increased with dosage. At 5 mg/L, the DO increased to 0.9 mg/L, while at 10 mg/L and 15 mg/L it further improved to 1.8 mg/L and 2.0 mg/L respectively. The highest DO value of 2.4 mg/L was observed at 25 mg/L dosage, showing an overall increase of 200% from the initial value. This indicates that tulsi leaves and tamarind seed powder were effective in improving the dissolved oxygen level, although the values remained below the desirable range. For aluminium sulphate, the DO value showed a better overall performance compared to tulsi leaves and tamarind seed. At 5 mg/L dosage, the DO increased to 2.1 mg/L and continued to improve up to 3.2 mg/L at 15 mg/L. Although the value dropped slightly to 1.9 mg/L at 20 mg/L, the highest DO value of 3.6 mg/L was obtained at 25 mg/L dosage. This represents an increase of 350% over the initial value, indicating that aluminium sulphate was the most effective coagulant among the tested samples for improving dissolved oxygen. In the case of ferric chloride, the DO value increased slightly from 0.8 mg/L to 1.1 mg/L at 5 mg/L dosage and reached a maximum value of 1.6 mg/L at 15 mg/L dosage. However, after this point, the DO value declined to 1.3 mg/L at 20 mg/L and 1.0 mg/L at 25 mg/L. This suggests that ferric chloride was less effective in improving dissolved oxygen compared to tulsi leaves and aluminium sulphate, and its optimum dosage was around 15 mg/L.

3.2 Removal Efficiencies on optimum dosages

Removal efficiency of tulsi leaves and tamarind seed powder, aluminium sulphate, and ferric chloride is shown on given table

Table 3.5 Removal Efficiency

Test parameter	Initial value	Coagulant	Optimum dosages (g/lit)	Final value	Removal efficiency
Turbidity (JTU)	7.5	Tulsi leaves and tamarind seed power mixture	15	2	73.33%
		Aluminium sulphate	20	1.3	82.67%
		Ferric Chloride	25	1.2	84%
pH correction	10	Tulsi leaves and tamarind seed power mixture	10	7	Neutral
		Aluminium sulphate	5	6	Acidic side

Test parameter	Initial value	Coagulant	Optimum dosages (g/lit)	Final value	Removal efficiency
Turbidity (JTU)	7.5	Tulsi leaves and tamarind seed power mixture	15	2	73.33%
		Aluminium sulphate	20	1.3	82.67%
		Ferric Chloride	25	1.2	84%
pH correction	10	Tulsi leaves and tamarind seed power mixture	10	7	Neutral
		Aluminium sulphate	5	6	Acidic side

IV.CONCLUSION

The conclusion are drawn from the above experimental study conducted on grey water treatment are as follows: The experimental analysis, test result and all graphical comparison shows aluminium sulphate gave the best result compared to tulsi leaves, tamarind seed powder and ferric chloride. It performed best in removing turbidity (82.67%), COD (49.75%), BOD (41.67%) and increasing DO (350%). It means that the water can be used for non-potable use. The Tulsi leaves and tamarind seed powder was best at adjusting the pH near to natural. The slightly acidic effect of aluminium sulphate can be easily corrected, making it more useful overall.

At higher dosages like 25g, the coagulants did not show better performance. The results become less effective because of problem of overdosing. When too much coagulant is added, instead of helping particles in the water to floc together and settle, it can actually destabilize the floc particles. In the turbidity test, it was observed that after adding 15g and 20g dosages, the turbidity increased to some extents, it means that adding more coagulant can make the water cloudy again. Similarly, at 25g dosage, DO levels also indicating a decline in water quality. On the basic of the experimental observations, the most effective dosages for best results were within 10g to 20g, depending on the coagulant. This range provided optimum performance without overdosing and helped in achieving better water quality.

A low-cost, eco-friendly, and sustainable method is especially beneficial for people in rural areas, where there is scarcity of water, and communities with limited access to advanced wastewater treatment facilities. So, for personal level treatment purpose, domestic grey water which can lead to pollution can be treated again using these natural coagulants. The filtered or treated grey water can be reuse for non-potable purposes such as gardening, irrigation, cleaning, toilet flushing, vehicle washing, small scale firefighting, & construction works, etc. The use of this plant-based waste materials as coagulants not only treating wastewater effectively but also reducing organic waste that would otherwise be discarded. This helps turn waste into something useful, turning kitchen and agricultural waste into a valuable input for water purification.

REFERENCES

- 1) Katbarye N., Jasutkar D., Hiradas L. (2022). "Greywater Treatment by Using Coconut Shell". International Journal for Modern Trends in Science and Technology, Vol 8(04), 407-415.
- 2) Albalawneh. A., Tsun-Kuo Chang. (2015). "Review of the Greywater and Proposed Greywater Recycling Scheme for Agricultural Irrigation Reuse", International Journal of Research-Granthaalayah, Vol 3, Issue 12, 16-35.
- 3) Walle A., Minseok Kim., Md kawser., Alam. Xiaofei Wang., Di. Wu., Smruti Ranjan Dash., Korneel Rabaey., Jeonghwan Kim. (2023) "Greywater Reuse as a Key Enabler for Improving Urban Wastewater Management", Elsevier Environment Science and Technology, Vol 16.
- 4) Muruganantham I., D Thayalnayaki., Jayaprakash S. (2024). "A Review on Greywater Treatment ".Emerging Technologies and Innovvative Research, Vol 11, Issue 11.
- 5) Ikumapayi O. M., Laseinde .O. T., Akinlabi .E T. (2024). "An Overview of Sustainable Greywater Treatment Processes",Published by EDP Science, Vol 552.
- 6) Abujazar M., Karaagas S., Abu Amr S., Alazaiz M., Fatihah S., Bashir M. (2022). "Recent Advancements in Plant Based Natural Coagulant Application in the Water and Wastewater Coagulation - Flocculation Process Challenges and Future Perspectives", Global NEST Journal, Vol 24, 687-705.
- 7) Chitra D., Muruganandam L. (2019). "Performance of Natural Coagulants on Greywater Treatment", Recent Innovation in Chemical Engineering, Vol 13, 81-92.
- 8) Judith Emilian Christy SS., Anantharaj R., Ambedkar B., Dhanalakshmi J. (2017). "Treatment of Synthetic Turbid Water Using Natural Tamarind Seeds at Atmospheric Condition", Research Journal of Pharmaceutical Biological and Chemical Science, Vol 8 (35), 352.
- 9) Dhruva R., Suresh B. (2016). "An Investigation of Effect of Natural Coagulants
 - a. (Tulsi) for Reduction of pH, Turbidity and COD from Sewage Water",
 - b. International Research Journal of Engineering and Technology, Vol 03, Issue 07 .
- 10) Hanam H., Sherif A., Esraa M., Hager R., Yasser M., Gehad G. (2023). "Synthesis of Polyaluminum Chloride Coagulant from Waste Aluminium Foil and Utilization in Petroleum Wastewater Treatment ", Article Sepreation (MDPI),Vol 10 , 570.
- 11) Ghaitidak D., Yadav K., (2014). "Reused of Greywater Effect of Coagulant", Desalination and watertreatment,Vol 54.
- 12) Shahzeb., Khan Z., Rana Muhammad Asif Kanwar., Arshad Ameen., Adnan Khalid., Sajjad Rasool., Hassan Raza. (2022). "Greywater Characterization and Treatment Using Chemical Coagulation",Journal of Quality,Vol (1) , 46 - 52.
- 13) T.C Prathana., Srivastav A. (2020). "Ferric Chloride for Odour Control Studies from Wastewater Treatment Plants in India",Water Practice and Technologies .
- 14) Owusu S., Bumrah R., Atebiya K. (2021). "Polyaluminum Chloride Dosing Effects on Coagulation Performance; Case Study Barekese, Ghana", Water Practice and Technologies.
- 15) Taylor TS Appiah-Effah E., Akodwaa-Boadi K., Obeng E., Ofei-Quartey MNL., (2020). "Engineering Column Treatment of Greywater Using Raw and Pyrolyzed Coconut Husk Powder", Frontiers in Environmental Science.
- 16) Kurniawan H., Fadillah N. (2025). "The Effect of pH Variation and Aluminium Sulfate Coagulant Dosage on Reducing Turbidity in Salupangkag Tua River water", Journal of Green Chemical and Environmental Engineering, Vol (1) Issue 1, 20-27.
- 17) Siti Nurulhuda Mohd Imram., Aznam F. (2023). "The Effectiveness of Greywater Treatment Using Coconut Husk and Sugarcane Bagasse with Limestone as Filter-media for Non-potable Uses",Reseach Square,1-20.
- 18) Hoonka V., Tiwari M., Khare A. K., Tiwari P., Lodhi A. (2019). "Application of Tamarind Seed Powder as a Natural Coagulant in Drinking Water Purification", International Journal of Advance Research in Education and Technology, Vol-6 , Issue 5 , 832-836.



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details