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Diary Waste Water Treatment Using Natural Coagulants

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Abstract: *This study explores the use of natural coagulants in the treatment of dairy wastewater, aiming to provide a sustainable, cost-effective alternative to traditional chemical treatments. Dairy wastewater, characterized by high levels of organic matter, nutrients, pathogens, and suspended solids, poses environmental challenges due to its impact on water quality. The experimental approach focused on testing various natural coagulants—watermelon seed, chickpea, moringa oleifera, tamarind seed, and neem powder—to assess their efficacy in reducing turbidity, a key pollutant in dairy effluents. The results indicate significant turbidity reduction across all natural coagulants, with neem powder achieving the highest efficiency at a relatively low dosage. Compared to conventional coagulants like ferric chloride and alum, the natural options demonstrated promising potential, reducing turbidity effectively while ensuring the treated water remains suitable for irrigation and other non-potable uses. This research highlights the viability of natural coagulants as environmentally friendly solutions for dairy wastewater treatment, contributing to sustainable water management practices.*

Key Word: *Natural coagulants; Dairy wastewater treatment ; Turbidity reduction ; Coagulant efficiency.*

I.INTRODUCTION

Water is an essential resource for life yet its availability and quality are increasingly threatened by the industrial activities in particular the dairy industry generates a significant amount of wastewater which contains high levels of organic matter, nutrients, pathogens and suspended solids. This effluent if left untreated can lead to oxygen depletion, foul odors and increased turbidity in natural water bodies impacting aquatic ecosystems and human health. Traditional methods for treating dairy wastewater such as chemical coagulation with alum and ferric chloride are effective but costly and often result in chemical residues that may further affect the environment in response there is a growing interest in use of natural coagulants derived from plant based sources such as watermelon and seeds moringa oleifera tamarind seed cities nameless. These natural alternatives are widely available and have shown potential in reducing turbidity and other pollutants in wastewater. This study investigates the effectiveness of the natural coagulants in dairy waste water treatment with the goal of identifying efficient low cost solutions that align with environmental sustainability. By exploring their impact on parameters like turbidity PH and suitability for reuse this research contributes to a broader efforts to developing green technology in industrial wastewater management

II.MATERIAL AND METHODS

Natural coagulants

The study tested natural coagulants -watermelon seeds, chickpeas, moringa oleifera seeds, and neem leaves to see how well they clean the wastewater. This coagulants are collected locally, then washed and sun-dried for 7 days to keep their useful properties watermelon seeds are finally ground to improve their ability to help particles come together, as they contain proteins that can aid in coagulation chickpeas which have special proteins like lectin that help to bind the particle were also ground to make the more effective. Moringa oleifera seeds have high ability to purify water it those were dried and powdered to help to remove suspended particles or contaminants. Neem leaves which contain natural compounds like tannins and lectins that help particles stick together where dried crushed improve the effectiveness each of these natural materials are prepared in a way that maximizes is their ability to clean waste water offering an eco-friendly and biodegradable alternative chemical treatment

Dairy waste water characteristics

For this study dairy waste water was collected from Anjarakandy diary in Kannur to analyze properties and see how well natural coagulants can clean waste water. In the dairy, waste comes from different stages like milk collection transportation processing bottling and packaging these activities produce liquid waste that contain milk residues and organic matter from the milk The main sources of wastewater include receiving stations, manufacturing units and can washing facilities. The composition of dairy wastewater depends on what type of dairy products are processed, how much is produced, and the size of the operation. pH level the wastewater had pH of 5.8 meaning it was slightly non-neutral. Water is

more alkaline with the pH between 6.6 and what 12.2. Turbidity sample had a turbidity of 680 which is why about the same limit for drinking water (less than 1 NTU) this means water is very cloudy and needs treatment biological oxygen demand (BOD). The BOD was 100 mg per liter much higher than 30 mg per liter limit set by the central pollution control board (CPCB). This shows that water has a lot of organic pollution that need to be removed. The COD was 1904 mg per liter far above the 250 mg per liter limit for safe discharge. This means water contains many oxidizable pollutants that must be treated before disposal. These results clearly shows that diary waste water need proper treatment before being released into natural water sources .the next step in the study to use natural coagulants to reduce turbidity and organic pollution while improving pH stability, making dairy waste water management most sustainable and eco-friendly.

Methodology

Methodology The study helps to analyze coagulation flocculation process to evaluate waste water treatment and its efficiency. The experiment starts with collection and analysis of dairy waste water by using parameter such as pH, turbidity, biological oxygen demand (BOD) and chemical oxygen demand (COD). A jar test apparatus equipped with the six beakers and steel pedals used to determine optimal dosage for effective coagulation in the experiment. The waste water sample is first mixed thoroughly to make it uniform then different coagulants are added while stirring at different speed to see how particles clump together and settle. To measure how much the water clears up, a nephelometer is used. It checks how light scatters at 90°angle provide the accurate data on suspended particle removal. A pH meter tracks acidity or alkalinity. COD test are conducted to assess how well organic pollutant breakdown. In the BOD test, the wastewater sample are sealed and kept at 20°C for 5 days. After the process the resolved oxygen level in the sample is measured:

$$BOD = (initial\ DO - final\ DO) \times Dilution\ Factor$$

In the COD test at the sample is heated with chemicals like mercuric sulphate, sulphuric acid, and potassium dichromate for 2 hours. After the sample is treated with the ferrous ammonium sulphate using following indicator at the end the color change indicates the end point of the experiment.

$$COD = \frac{(V1 - V2) \times N \times 8000}{V}$$

V1=Titrant volume for blank
V2=for the sample
N=normality of ferrous ammonium sulphate
V=sample volume.

This study compares natural coagulants with the chemical coagulants to analyze the effectiveness of each in removal of pollution from daily wastewater. Its focus is on reducing COD, BOD, turbidity and achieving pH stability. By carefully preparing materials, conducting controlled coagulation tests, and using precise measurement the study will help you determine whether natural coagulants can be a reliable alternative to chemical coagulants for diary wastewater treatment

III. RESULT

The effectiveness of natural coagulants in dairy wastewater treatment was evaluated based on key parameters, including optimum dosage, pH variation, turbidity reduction, biochemical oxygen demand (BOD), and chemical oxygen demand (COD). The results are presented in Table 1, comparing the coagulation performance of watermelon seed, chickpea, neem leaves, Moringa oleifera, and ferric chloride.

Table no 1: Comparative Analysis of Coagulant Efficiency in Dairy Wastewater Treatment

Coagulant	Optimum Dosage (Mg/L)	Ph	Turbidity (NTU)	Bod (Mg/L)	Cod (Mg/L)
Watermelon Seed	24	6.58	435	22	160
Chickpea	28	6.67	345	13	146
Neem Leaves	16	6.96	210	10	140
Moringa Oleifera	32	6.81	250	14	143
Ferric Chloride	24	7.15	70.5	7	103

The results showed that Neem leaves exhibited the highest turbidity reduction among natural coagulants with a final value of 210 NTU. Chickpea and moringa showed notable reduction in BOD and COD suggesting a strong organic pollutant removal capacity. In case of synthetic coagulant, ferric chloride showed the most significant turbidity reduction and overall pollution removal.

The initial pH of diary wastewater before treatment was 5.8 indicating acidic condition.

After treatment the pH level varied. In Neem leaves and chickpeas, the pH value was closer to pH 7 indicating their ability to stabilize the water. It also improves treatment efficiency.

The initial turbidity of dairy wastewater was recorded at 600 NTU which indicates the need to reduce suspended solids. The removal efficiency of each coagulant is measured with results:

Neem leaves and Moringa Oleifera seed powder showed 65% and a 58.4% efficiency in turbidity reduction respectively. Ferric chloride shown highest turbidity reduction which was 88.25%, reinforcing its rapid coagulation properties in comparison to natural alternatives.

Biological oxygen demand of dairy wastewater before treatment was measured 100 mg/L, indicating high organic matter. After treatment BOD reduction is varied for different coagulants:

Neem leaves show the highest removal efficiency in natural coagulants 90% followed by chickpea 87% and moringa oliefera 86%. Synthetic ferric chloride demonstrated the highest bod removal efficiency which is 93%.

Chemical oxygen demand COD of dairy wastewater before treatment was 1904 mg/l, indicating a high level concentration of oxidation organic pollutants. After coagulation COD removal efficiency was observed across different coagulants: Neem leaves shown highest COD removal efficiency 92.64% followed by moringa oliefera 92.5 %. Ferric chloride showwd the highest removal in coagulants 94.6 %

The results suggest that natural columns provide comparable pollutant reduction reinforcing their potential as sustainable alternatives.

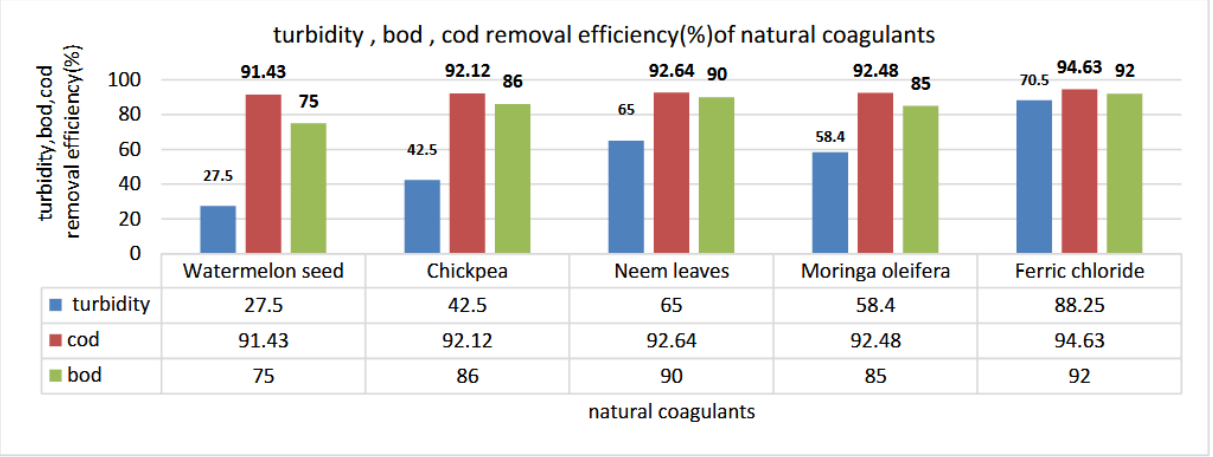

Fig 1.0 turbidity, bod, cod removal efficiency (%) of natural coagulants

IV.DISCUSSION

The study demonstrates the effectiveness of natural coagulants Watermelon seeds, Chickpea, Neem leaves and Moringa oleifera in improving dairy wastewater quality by significantly reducing turbidity, BOD and COD levels. Initial wastewater characteristics included 600 NTU turbidity, pH 5.8, BOD 100mg/L and COD 1904mg/L, all exceeding the discharge limits. The Jar test analysis revealed that neem leaves (210 NTU at 16 mg/L), chickpea (345 NTU at 24mg/L) and moringa oleifera (250 NTU at 32mg/L) exhibited high pollutant removal efficiency, indicating their potential as sustainable treatment alternatives.

Conclusion

The jar test results indicate that neem leaves (210 NTU at 16mg/ L), moringa oleifera (250 NTU at 32mg/L), and chickpea (345 NTU at 24 mg/L) effectively reduce turbidity in dairy wastewater, demonstrating potential as eco-friendly alternatives to synthetic coagulants.

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