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INVESTIGATIVE STUDIES ON TREATMENT OF DAIRY WASTEWATER BY USING NATURAL COAGULANTS.

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Abstract - *The dairy industry is generally considered to be largest source of food processing. These industries wastewater is characterized by high COD, Turbidity, nutrients etc. In the present study, dairy waste water was treated by Aloevera gel and Neem gel. The initial pH, TDS, EC, Turbidity, COD were 8.7, 527ppm, 810ms/cm, 52.5NTU, 728.5mg/l respectively. The maximum removal efficiency of TDS, EC, turbidity, and COD by Aloevera gel is 55.80% (at pH 8, at optimum dose 50 mg/l, 100RPM, contact time 60 min), 96.83% (at pH 6, optimum dose 40mg/l, 100RPM, 30 min), and 95.74% (at pH 6, at optimum dose 60mg/l, 100RPM, 30 min) respectively. The maximum removal efficiency of TDS, EC, turbidity, and COD by Neem gel is 55.64% (at pH 8, at optimum dose 30 mg/l, 100 RPM, contact time 60 min), 90.78% (at pH 6, at optimum dose 40mg/l, 80 RPM, 60 min), and 96.43% (at pH 8, at optimum dose 40mg/l, 100 RPM, 60 min) respectively. Compared to Neem, Aloevera exhibits greater removal efficiency in TDS, turbidity, EC, and COD from dairy waste water under ideal circumstances.*

Key Words: Natural coagulants, Turbidity, COD, EC, TDS, Dairy waste water treatment, Aloevera, Neem.

1.INTRODUCTION

The dairy business is among the most polluting in the food industry. A significant amount of effluent waste is produced daily by the dairy industry. These businesses release wastewater, which contains large amounts of nutrients, organic and inorganic substances, chemical and biological oxygen demands, and other characteristics [1]. A number of pretreatments are necessary in order to offset the effects. Different coagulation techniques, such as chemical and natural coagulation, as well as biological treatment processes, such as aerobic and anaerobic treatment, are used to treat dairy effluent. The cleaning and washing processes in the milk processing facilities are the main source of wastewater in the dairy sector. Approximately 2% of all milk is thought to be poured down sewers. High levels of COD, BOD and lactose, together with other nutrients and sanitizing agents, are characteristics of dairy effluent. The organic materials in the water are either present in milk in their original form or have been processed into a form that has deteriorated [2]. A range of acidic and alkaline detergents, as well as sterilizing chemicals, may be present in dairy cleaning fluids. Thus, depending on the cleaning technique used, the wastewater's pH can vary greatly. Global dairy market volume: USD 489.74 billion. Milk production worldwide each year is 600 million metric tons. Asia makes only 22% of the world's milk production, but it accounts for 60% of the world's population. Total global output exceeds 530 million tons for a population of approximately 400 billion tons, with an average yearly per capita accessibility of 100 kg. India is the world's leading country in milk manufacturing, contributing 23 percent of all milk manufacturing globally. Milk manufacturing in the United States has developed at a composite annual growth rate of approximately 6.2 percent, reaching 209 million tons in 2020–21 from 146.31 million tons in 2014–15. Three percent of the five million liters of milk produced were wasted due to an unreliable power supply. Karnataka produces an estimated 1.6crore liters of milk per day, of which 1.2crore liters are sold as a marketable commodity. Approximately 80 million liters, or nearly 70% of the milk produced, are procured by KMF[2]. Prior to the implementation of the incentive plan, KMF acquired over half of the milk products in the state, including ice cream, butter, peda, ghee, and other items. With the lockdown in place, other than honey and butter, the remaining goods in the bouquet are not sold, which leads to the stockpiling of raw milk. Currently, there are 13484 dairy cooperatives operating within the boundaries of 14 district milk federations, with 23.78 lakh farmers enrolled as members, of which 8.37 lakh farmers are active members. The first dairy cooperative that became the Kodagu district's KMF was established in Kudige in 1955[2]. The Karnataka dairy development cooperative, or KDDC, was established in 1974 with the goal of implementing a project overseen by the World Bank for dairy development. Dairy waste water can have many negative effects on the environment, including: Water pollution, Breeding ground for disease-carrying insects, Toxic to fish and algae, Nutrient runoff, Pathogens, Antibiotics and hormones, Sewage pipe clogging Gaseous emissions, Dust and odors [1]. Dairy waste water can be treated using a variety of methods, including: chemical coagulation, biological treatment, electrochemical treatment, natural coagulation [1]. The aloevera plants require very little water for growth because 98% of it is

found in its leaves. It has about 75 nutrients and 200 active molecules, including vitamins, enzymes, amino acids, and minerals. Thepurpose of this study was to examine the qualities of Aloevera gel and determine the spectrum of natural clarifying agents that can be utilized. Using a gel made of aloevera asa coagulant for the treatment of low- and high-turbid water is another topic of this study. Neem leaf juice is added to wastewater as a naturally occurring coagulant. By applying the various dosages of the coagulant Azadirachta indica, An experiment was carried out to ascertain its efficacy as an absorbent in the treatment of dairy effluent. One of the world's most significant food processing industries is the dairy sector [2]. In this study optimum dosage of coagulants are considered.

2 Materials and Methodology

2.1 Sample collection

Dairy waste water was collected from Bhati dairy industry in Davanagere. The physio – chemical characteristics of samples were analyzed. Samples of dairy effluent were collected in clean containers and precautions were taken for collection of wastewater.

2.2 Adsorbent preparation

2.2.1 Preparation of Aloevera Gel

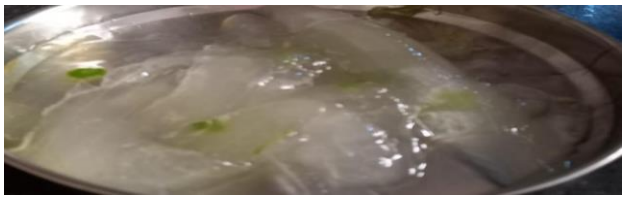


Fig 1: Preparation of Aloevera Gel.

The entire aloevera was thoroughly washed to eliminate any dirt or contaminants. The edges of the leaf were trimed and it was cut into pieces. Then the gel was removed with a spoon, and 50ml of aloevera gel was stirred with 500ml of distilled water. The extract was obtained by filtering the sample using whatsman filter paper. The collected filtrate was kept in a refrigerator until it was used, which was no longer than a week [8].

2.2.2 Preparation of Neem Leaves Powder into Gel.

Fig 2: Neem leaves to powder

The neem leaves were dried under the sun to remove moisture. They were processed into a fine powder. Once more, the powder was stored under direct sunlight and remove any remaining moisture. All the leaves were pulled out and dried. The preparation of coagulant extract were done by mixing 500g of neem powder with 500ml of distilled water. The extract was obtained by filtering the sample using whatsman fiter paper. The collected filtrate was kept in a refrigerator until it was used, which was no longer than a week [1].

Table -1: The Operational Parameters Considered in this Study are.

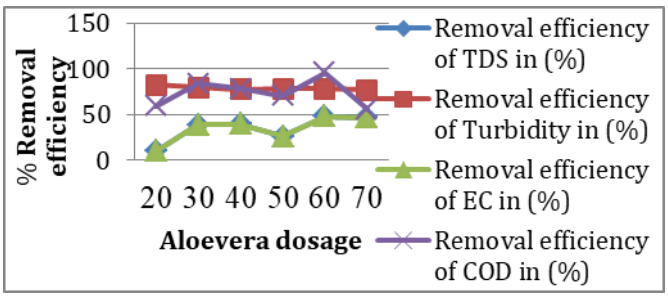
VALUES	RANGE
RPM	80rpm,100rpm
Contact time	30min,60min
Dosage	20mg/l,30mg/l,40mg/l,50mg/l,60mg/l 70mg/l.

3. RESULTS AND DISCUSSIONS.

The dairy waste water was collected from the Bhati dairy industry Davanagere. The table 2 shows the initial characteristics of dairy waste water.

Table 2: Initial Characteristics of Dairy Waste Water

PARAMETERS	VALUES
pH	8.7
TDS	527ppm
EC	810ms/cm
Turbidity	52.5NTU
COD	728.5mg/l



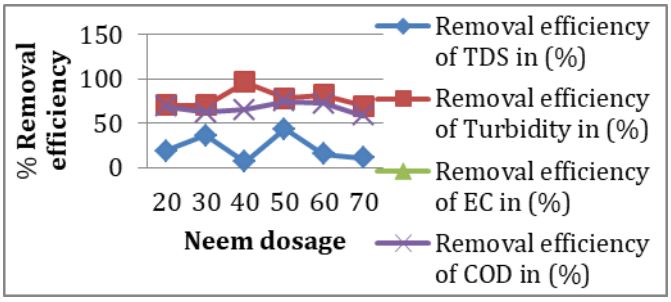
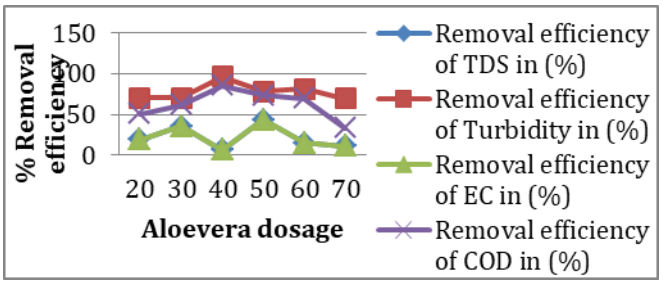


Chart 1: Graphs showing the variation of TDS, Turbidity, EC, COD for different dosage of Aloevera and Neem (pH6, 100rpm, Contact time 30 min).

The chart 1 shows the variation of TDS, Turbidity, EC, COD for different dosage of Aloevera and Neem at pH6, at 100rpm and Contact time 30 min. Aloe vera is a natural coagulant that works well when compared to neem for treating dairy wastewater at pH 6. It often exhibits a greater removal efficiency for turbidity, especially at lower dosages. On the other hand, Neem exhibits superior TDS and EC removal at specific doses, especially at 20 mg/l, indicating its potential as a robust adsorbent. While Neem's effectiveness varies greatly across dosages, aloevera performs best at higher dosages (60 mg/l), with a nearly total reduction in COD elimination. Aloevera is generally better at reducing turbidity and COD, while neem is better at removing TDS and EC.



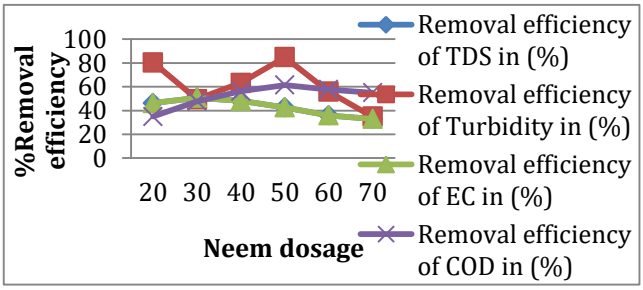
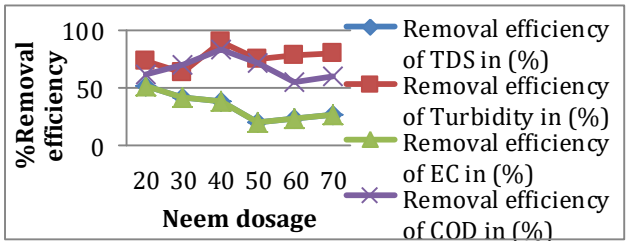


Chart 2: Graphs showing the variation of TDS, Turbidity, EC, COD for different dosage of Aloevera and Neem (pH6, 100rpm, Contact time 60 min).

The chart 2 shows the variation of TDS, Turbidity, EC, COD for different dosage of Aloevera and Neem, at pH6, at 100rpm, Contact time 60 min. With notable removal efficiency for TDS, turbidity, EC, and COD, aloevera and neem are useful natural wastewater treatment agents. At 40 mg/L, aloe vera removes turbidity to the greatest extent possible (96.83%) and reduces COD to the lowest possible level (85.17%). At 30 mg/L, neem demonstrates significant TDS removal (50.66%), while at 50 mg/L, it excels in turbidity reduction (84.76%). The differing efficacies between dosages highlight how crucial dosage optimization is to the efficient removal of pollutants. All things considered, these plants present viable options for enhancing water quality in an environmentally friendly way.



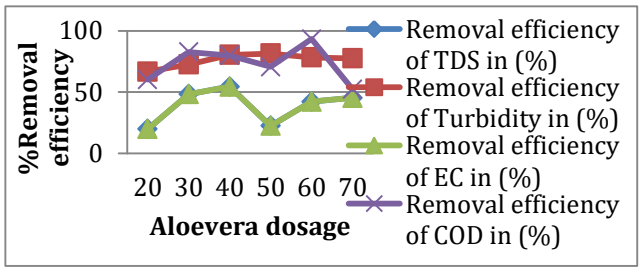
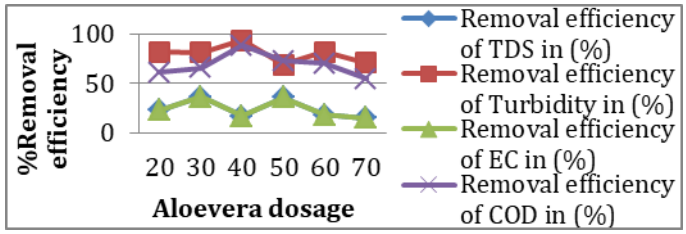


Chart 3: Graphs showing the variation of TDS, Turbidity, EC, COD for different dosage of Aloevera and Neem (pH6, 80rpm, Contact time 30 min).

The chart 3 shows the variation of TDS, Turbidity, EC, COD for different dosage of Aloevera and Neem, at pH6, at 80rpm, Contact time 30 min. When used in conjunction with aloe vera and neem, water contaminants can be effectively removed under certain conditions (pH 6, 80 rpm, and 30 minutes of contact time). At 40 mg/L, aloevera exhibits peak removal rates for turbidity (80.33%) and TDS (54.46%), where as at 60 mg/L, COD removal reaches 93.25%. Neem exhibits good removal of TDS (52.07%) and turbidity (90.27%) at 40 mg/L in addition to efficient removal of COD (82.67%). The variation in elimination efficiency emphasizes how important the right dosage is to improving treatment results.



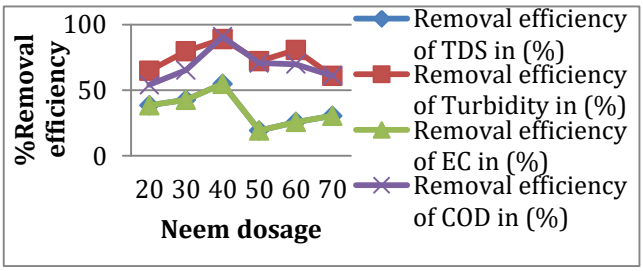
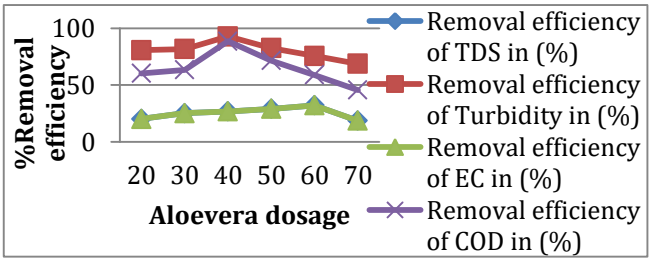


Chart 4: Graphs showing the variation of TDS, Turbidity, EC, COD for different dosage of Aloevera and Neem (pH6, 80rpm, Contact time 60 min).

The chart 4 shows the variation of TDS, Turbidity, EC, COD for different dosage of Aloevera and Neem, at pH6, at 80rpm, Contact time 60 min. In wastewater treatment, aloevera and neem show notable efficacies in eliminating pollutants at pH 6, 80 rpm, and 60 minutes of contact time. At 40 mg/L, aloevera may remove up to 93.20% of turbidity and 88.05% of COD. Neem performs admirably as well, removing 54.85% TDS and reducing COD by 90.78% at the same dosage. The potential for environmentally friendly water filtration technology is demonstrated by both plants.



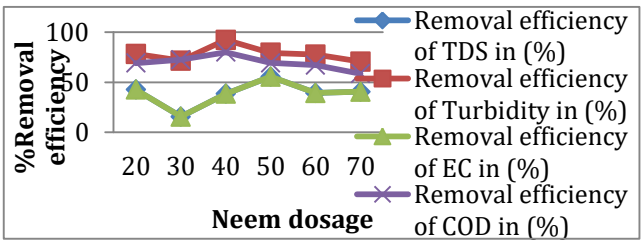
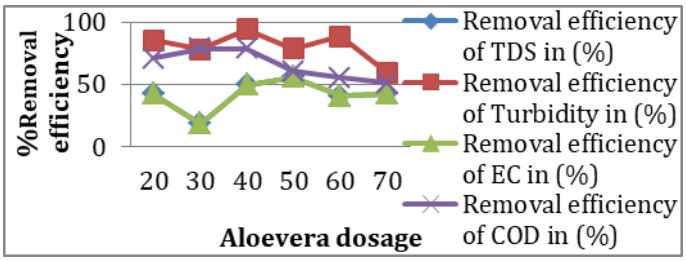


Chart 5: Graphs showing the variation of TDS, Turbidity, EC, COD for different dosage of Aloevera and Neem **(**pH8,100rpm, Contact time 30 min**)**.

The chart 5 shows the variation of TDS, Turbidity, EC, COD for different dosage of Aloevera and Neem, at pH8, at 100rpm, Contact time 30 min. When used in wastewater treatment, Aloevera and Neem demonstrate efficient pollutant removal at pH 8, 100 rpm, and 30 minutes of contact time. Aloevera demonstrates its potency in clarifying water by achieving its maximum turbidity removal of 92.78% and COD reduction of 88.60% at 40 mg/L. Neem is also effective; at 50 mg/L, it may remove up to 55.64% of TDS and reduce turbidity by 92.33%. When combined, these plants offer viable, sustainable solutions for raising the quality of the water.



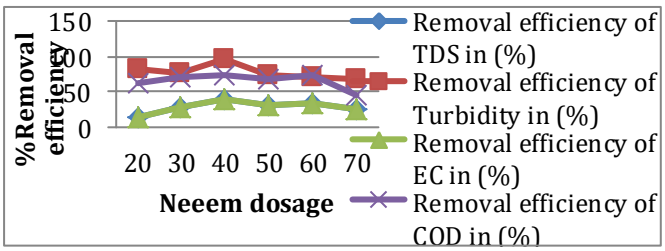
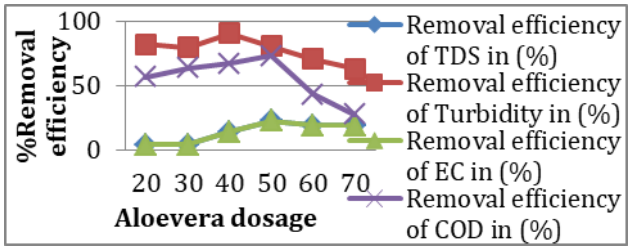


Chart 6: Graphs showing the variation of TDS, Turbidity, EC, COD for different dosage of Aloevera and Neem (pH8, 100rpm, Contact time 60 min).

The chart 6 shows the variation of TDS, Turbidity, EC, COD for different dosage of Aloevera and Neem, at pH8, at 100rpm, Contact time 60 min. Aloevera and neem exhibit encouraging pollutant removal efficiency at pH 8, 100 rpm, and 60 minutes of contact time. Aloe vera exhibits significant coagulation capabilities as it achieves its greatest turbidity removal of 94.38% and TDS reduction of 49.40% at 40 mg/L. Neem also works well, efficiently clearing water with a maximum turbidity removal of 96.43% at 40 mg/L. When combined, these plants provide long-term ways to raise the quality of the water.



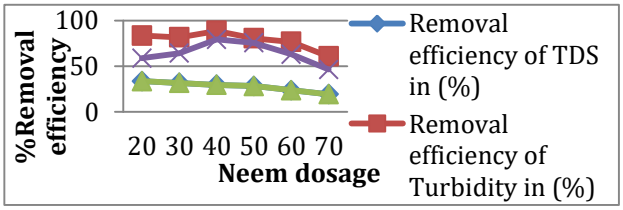


Chart 7: Graphs showing the variation of TDS, Turbidity, EC, COD for different dosage of Aloevera and Neem (pH 8, 80rpm, Contact time 30 min).

The chart 7 showing the variation of TDS, Turbidity, EC, COD for different dosage of Aloevera and Neem, at pH 8, at 80rpm, Contact time 30 min. Effective pollutant removal is demonstrated by Aloe vera and Neem at pH 8, 80 rpm, and 30 minutes of contact time. At 40 mg/L, aloe vera may remove up to 90.66% of turbidity and reduce COD by 72.82%, demonstrating its potent ability to clarify water. Neem exhibits good performance in wastewater treatment, as evidenced by its peak turbidity reduction of 88.76% and COD removal of 79.27% at 40 mg/L. When taken as a whole, they offer long-term fixes for raising water quality.

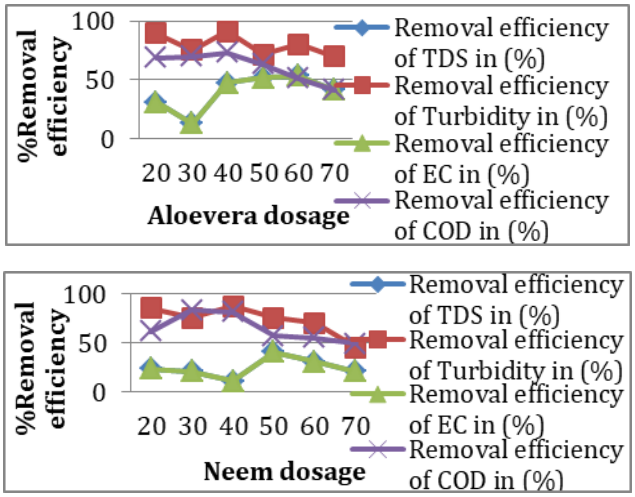


Chart 8: Graphs showing the variation of TDS, Turbidity, EC, COD for different dosage of Aloevera and Neem (pH8, 80rpm, Contact time 60 min).

The chart 8 showing the variation of TDS, Turbidity, EC, COD for different dosage of Aloevera and Neem, at pH8, at 80rpm, Contact time 60 min. Aloe vera and neem are natural coagulants that work well for treating water. They have been shown to remove turbidity, chemical oxygen demand (COD), electrical conductivity (EC), and total dissolved solids (TDS) with notable efficiency. Aloevera demonstrated substantial flocculating characteristics, as seen by the highest removal rates, with 91.29% turbidity reduction at a dosage of 40 mg/l. Neem exhibits noteworthy performance as well, with an 83.25% removal rate in COD reduction at 30 mg/l, underscoring its potential for long-term, sustainable water filtration. Overall, these plants offer practical solutions for improving water quality in an environmentally responsible way.

4. CONCLUSIONS

A number of variable factors, including pH, dosage, contact time, and agitation time,were taken into account throughout the execution of this investigation. Aloevera and neem were used as natural coagulants. All of the experimental results, figures, and observations are included. Conclusions have been drawn based on these performances.

- The maximum removal efficiency of Aloevera on EC, turbidity, and COD are 55.80% (at pH 8, dose 50 mg/l, 100RPM, contact time 60 min), 96.83% (at pH 6, dose 40mg/l, 100RPM, 30 min), and 95.74% (at pH 6, dose 60mg/l, 100RPM, 30 min) respectively.

- The maximum removal efficiency of Neem on EC, turbidity, and COD are 55.64% (at pH 8, dose 30 mg/l, 100 RPM, contact time 60 min), 90.78% (at pH 6, dose 40mg/l, 80 RPM, 60 min), and 96.43% (at pH 8, dose 40mg/l, 100 RPM, 60 min) respectively.

- Compared to Neem, Aloevera exhibits greater removal efficiency in TDS, turbidity, EC, and COD under ideal circumstances.

- The cost and availability of Neem and aloevera are more affordable and widely available, making them a sensible option for widespread use.

Additional investigation may enhance their utilization and explore more extensive uses.

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