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TREATMENT OF DAIRY WASTEWATER BY USING BANANA STEMS, PAPAYA SEEDS AND JACK FRUIT SEEDS

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Abstract - *In this study, mainly focused on dairy wastewater treatment using natural adsorbents. The dairy industry is one of the major sources of the food processing. These industries produce a huge amount of wastewater. Such wastewater is to be treated by using naturally and easily available adsorbents and then tests are to be carried to check the different characteristics of waste water like BOD, COD, pH and turbidity etc. Natural adsorbents to be used are Banana stem, Papaya seeds and Jack fruit seeds. Natural adsorbents are a naturally occurred. Plants based adsorbents that can be used in adsorption process of wastewater treatment for reducing turbidity. The objectives of this study were to assess the possibility of using natural adsorbents as an alternative to the current commercial synthetic adsorbents such as aluminium sulphate. The final effluent can be readily used for irrigation and the sludge itself becomes a good fertilizer. The efficiency of the adsorption process could be affected by different factors. That is pH, temperature, affinity, solubility, the adsorbent surface area and the adsorbate molecular size. By addition of these adsorbents reduces the pollutants present in the dairy waste water and maintain the COD, BOD, Turbidity and pH. For getting effective results it is better to add banana stem, papaya seed and jack fruit seed in a mixed adsorbent form.*

Key Words: Dairy Wastewater, Banana Stem, Papaya Seed, Jack Fruit Seed, pH, Turbidity, COD, BOD

1. INTRODUCTION

Water pollution is a serious problem in India. That is almost 70% of its surface water resources and ground water resource are contaminated by biological, toxic, organic, and inorganic pollutants. These results in the pollution will affect the quality of the water and aquatic ecosystems. Worldwide water demand is increasing day by day due to rapid population and industrial growth. That time for the use of water, to obtain a solution, that is treatment and reuse of industrial wastewater. Consider a dairy industry, it involve processing of raw milk into products such as milk, yogurt, cheese etc. and generates lot of wastewater which contains very high concentration of organic substances such as proteins, carbohydrates and lipids. In this case so many methods used for the treatment of dairy wastewater. Here dairy wastewater is treated with natural adsorbents (banana stem, papaya seed and jack fruit seed).

Banana is an herbaceous plant of genus Musa Spp. of the family Musaceae. It is one of the most widely grown tropical fruits because of its high food value and important addition to the diet. Naturally occurring coagulants or adsorbents like Banana Stem Juice are usually considered to be safe for human health as opposed to the chemical coagulants and adsorbents, which have health risk in potable water treatment. Papaya fruit contain large number of small black colour seeds. The fruit as well as seeds contain large protein content and have lot of medicinal values. Papaya seed have anti- inflammatory properties, wound healing properties, etc. Papaya seed is a rich source of proteins. Also papaya seed powder has ability to join with solids in water and settle to the bottom. Jack fruit seeds should be used as an effective natural adsorbent since it is eco-friendly and of low cost when compared with the chemical adsorbents. Jackfruit is an important naturalised plant, it contain high amount of starch sources. Water treatment becomes cheaper and can be implemented for different countries.

The adsorption method is used for the water and wastewater treatment. Adsorption involves a surface adhesion phenomenon. In adsorption process if some biological material is used as an adsorbent and the process is known as bio-sorption. This process involves solid and liquid phase interaction. Due to this interaction of the sorbent and sorbate exchange the ions and remove unwanted dissolved species. Higher affinity of sorbent to sorbate species, unwanted ions in the sorbate are attracted to sorbent ions. Solid and liquid phase distribution in sorption process is very important for determining the effectiveness of the process and degree of sorbent affinity. The efficiency of the adsorption process could be affected by different factors. That is pH, temperature, affinity, solubility, the adsorbent surface area and the adsorbate molecular size. Adsorption occurs in many natural, physical, biological, and chemical systems. It is widely used in industrial applications. This process is preferred over to conventional treatment methods because of its low cost, easy sorbent availability and regeneration and minimum biological sludge production. This study focuses to determine the ability of three adsorbents, which banana stem, papaya seed and jack fruit seed as an adsorbent in the wastewater. By the addition of these adsorbents reduces the pollutants present in the dairy waste water and maintain the COD, BOD, Turbidity and pH.

1.1 Objectives

1. To determine the feasibility of banana stem, Papaya seed and Jack fruit seed as natural adsorbents for treating dairy wastewater.
2. To determine the removal efficiency of adsorbent over various parameters such as pH, Turbidity, Total dissolved solids, Conductivity, dissolved oxygen Biochemical oxygen demand and Chemical oxygen demand.

2. MATERIALS AND METHODOLOGY

- Collection of Sample from the Dairy Industry
- Collection and Preparation of Banana Stem Powder
- Collection and Preparation of Papaya Seed Powder
- Collection and Preparation of Jackfruit Seed Powder
- Analysis of Parameters
- Experimental Investigations
- Treatment of Dairy Wastewater
- Analyse the Parameters of Treated Water
- Compare the Treated Wastewater Parameters with Untreated Wastewater Parameters
- Conclusion of the Project

2.1Collection of Dairy Wastewater

Dairy wastewater is collected from the dairy industry Calicut. The samples were collected in sterilized bottles and were preserved in the refrigerator during storage**.**

Fig-1: Collection of Dairy Wastewater

2.2 Preparation of Banana Stem Powder

Matured banana stem was collected, thorns were removed and the pith of the stem was then separated from the foliage. Some amount of banana stem was mixed with water in a mixer. The mixed banana stem is then boiled for 30 minutes and then filtered and juice was extracted. The juice extracted stem is then sun dried for 1 day. After sun drying the material was then oven dried at 105^0C. Dried banana stem is then powdered. After drying, one complete stem of a banana plant had resulted in 10 g of the dried banana stem powder.

Fig-2: Banana Stem Powder

2.3 Preparation of Papaya Seed Powder

The seeds were collected in households. Then the seeds were dried under sunlight for a period of 7 days before crushing. The seed were made into a fine powder using home grinder and powder is collected in sterile bottle with the air tight tap. Then the seed powder was sieved and fine particles were used as an adsorbent.

Fig-3: Papaya Seed Powder

2.4 Preparation of Jack Fruit Seed Powder

Jackfruit seeds were collected from households. Then it is boiled and sundried for 48 hours. Then the seeds were grained to fine powder in grinding mills. The powder was sieved and is stored in an airtight container to prevent the entry of moisture content into it and to avoid loss of its activity. The fine powder was used as adsorbent for analysis.

Fig-4 : Jack Fruit Seed Powder

2.5 Treatment Method

2.5.1 Adsorption by Magnetic Stirrer

A magnetic stirrer is a laboratory equipment that is uses a rotating magnetic field to cause a stir bar immersed in a liquid and spin very quickly, thus stirring it. The rotating field is created by a rotating magnet placed beneath the vessel with the liquid. Adsorption is a process of deposition of molecular substance on a surface. The surface which attracts the molecular substance is called the adsorbent. Here the adsorbents used are the powdered forms of banana stem, papaya seeds and jack fruit seeds. The adsorption process was carried out with the help of a magnetic stirrer.

The dairy wastewater is taken into a 250 m1 beaker and adds varying dosages of banana stem powder, papaya seed powder and jack fruit seed powder separately. The dosages are 0.05g, 0.1g, 0.15g, 0.2g, 0.25g and 0.3 g. The beaker was set into the magnetic stirrer. The mixing was carried out on 100 rpm at 30 minute and contact time is 5 minutes. The supernatant obtained was filtered and its characteristics were determined. Then finally the percentage removal of various parameters of dairy wastewater is determined.

Fig-5: Magnetic Stirrer

3. RESULTS AND DISCUSSION

3.1 Preliminary Analysis

Table-1: Preliminary Analysis

Parameter	Value
pH	6.85
TDS (µs/cm)	691
Conductivity (µs/cm)	1961
Turbidity (NTU)	280
COD (mg/L)	3230
BOD (mg/L)	1770

3.2 Treatment of Dairy Wastewater

The optimum dosage of adsorbents are determined by varying the coagulants dosage of Banana stem powder, Papaya seed powder and Jack fruit seed powder are 0.05g, 0.1g, 0.15g, 0.2g, 0.25g and 0.3g for 250 ml of dairy waste water respectively. The adsorbent dosage and respective parameter such as pH, TDS, Conductivity, turbidity, BOD, COD are tabulated as follows:

3.2.1 Using Banana Stem Powder

Table-2: After treatment using Banana stem powder

Parameters	Dosages (g)					
	0.05	0.1	0.15	0.2	0.25	0.3
pH	6.81	6.89	6.78	6.82	6.77	6.73
TDS (µs/cm)	673	661	654	641	592	587
Conductivity (µs/cm)	1323	1218	1192	1827	1411	1382
Turbidity (NTU)	260	245	210	195	120	110
COD (mg/L)	3021	2853	2512	2080	1434	1389
BOD (mg/L)	832	771	688	569	396	381

3.2.2 Using Papaya Seed Powder

Table-3: After treatment using Papaya seed powder

Parameters	Dosages (g)					
	0.05	0.1	0.15	0.2	0.25	0.3
pH	6.78	6.83	6.75	6.84	6.87	6.74
TDS (µs/cm)	662	649	642	633	596	613
Conductivity (µs/cm)	1203	1198	1152	1486	1458	1487
Turbidity (NTU)	265	250	220	190	165	105
DO (mg/L)	1.9	2.1	2.3	3.5	3.5	3.8
COD (mg/L)	3034	2948	2722	2520	1339	1387
BOD (mg/L)	841	807	745	690	369	353

3.2.3 Using Jack Fruit Seed Powder

Table-4: After treatment using Jack fruit seed powder

Parameters	Dosages (g)					
	0.05	0.1	0.15	0.2	0.25	0.3
pH	6.76	6.79	6.78	6.87	6.77	6.79
TDS (µs/cm)	623	578	558	526	495	481
Conductivity (µs/cm)	1132	1058	1014	956	910	874
Turbidity (NTU)	230	210	180	145	95	85
COD (mg/L)	2813	2766	2563	2029	1338	1256
BOD (mg/L)	778	757	703	552	362	344

3.3 Percentage of Removal Efficiency

The experimental test were carried out for varying parameters to find the percentage of removal efficiency by using natural Adsorbents such as Banana stem powder, Papaya seed powder and Jack fruit seed powder. The following formula was used to determine the removal efficiency.

Removal Efficiency = [(In – Out) / In] x 100

Where,

In = Initial Value of Each Parameter
Out = Treated Value of Each Parameter

3.3.1 Removal Efficiency of Banana Stem Powder

Table-5: Removal Efficiency with varying dosages of Banana stem powder

Removal Efficiency	Dosages (g)					
	0.05	0.1	0.15	0.2	0.25	0.3
pH	0.58	-0.58	1.02	0.43	1.16	1.75
TDS	2.60	4.34	5.35	7.23	14.32	15.05
Conductivity	32.53	37.88	39.21	6.83	28.04	29.52
Turbidity	7.14	12.5	25	30.35	57.14	60.71
COD	6.47	11.67	22.22	35.60	55.60	56.99
BOD	52.99	56.44	61.12	67.85	77.62	78.47

3.3.2 Removal Efficiency of Papaya Seed Powder

Table-6: Removal Efficiency with varying dosages of Papaya seed powder

Removal Efficiency	Dosages (g)					
	0.05	0.1	0.15	0.2	0.25	0.3
pH	1.02	0.29	1.45	0.14	-0.29	1.60
TDS	4.19	6.07	7.09	8.39	13.74	11.28
Conductivity	38.65	38.90	41.25	24.22	25.65	24.17
Turbidity	5.35	10.71	21.42	32.14	41.07	62.5
COD	6.06	8.73	15.72	21.98	58.54	57.05
BOD	52.48	54.40	57.90	61.01	79.15	80.05

3.3.2 Removal Efficiency of Jack Fruit Seed Powder

Table-7: Removal Efficiency with varying dosages of Jack fruit seed powder

Removal Efficiency	Dosages (g)					
	0.05	0.1	0.15	0.2	0.25	0.3
pH	1.31	0.87	1.02	-0.29	1.16	0.87
TDS	9.84	16.35	19.24	23.87	28.36	30.39
Conductivity	42.27	46.04	48.29	51.24	53.59	55.43
Turbidity	17.85	25	35.71	48.21	66.07	69.64
COD	12.91	14.36	20.65	37.18	58.57	61.11
BOD	56.04	57.23	60.28	68.81	79.54	80.56

The Dairy Wastewater is treated by using natural adsorbents such as banana stem powder, papaya seed powder and jack fruit seed powder. The dairy wastewater is containing more pollutants. After the treatment find out that jack fruit seed powder has high removal efficiency. Especially, in the concentration of 0.25 g.

3.4 Effect of Natural Adsorbent on Percentage Removal of pH

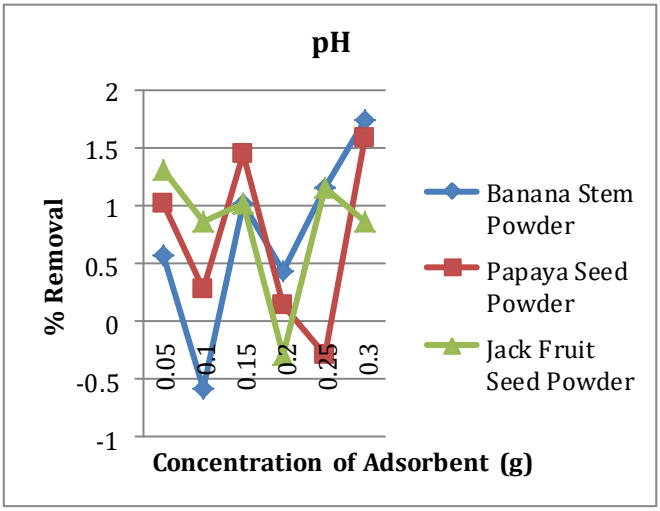

Chart-1: Effect of Adsorbents (Banana Stem Powder, Papaya Seed Powder and Jack Fruit Seed Powder) in Percentage Removal of pH

3.5 Effect of Natural Adsorbents on Percentage Removal of TDS

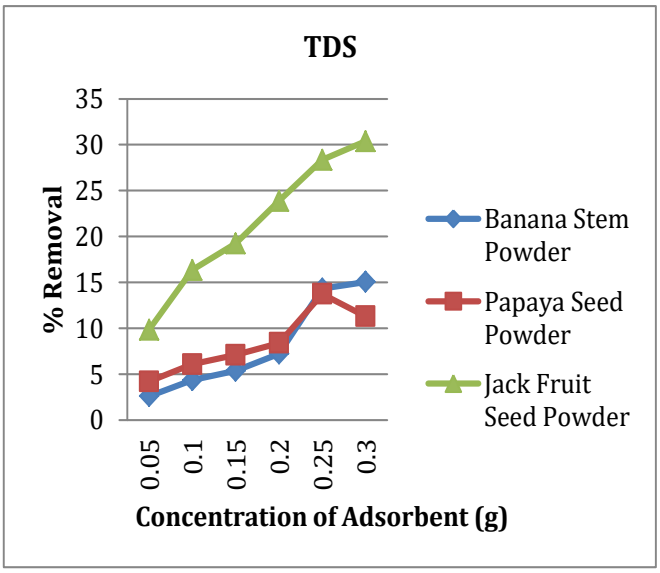

Chart-2: Effect of Adsorbents (Banana Stem Powder, Papaya Seed Powder and Jack Fruit Seed Powder) in Percentage Removal of TDS

3.6 Effect of Natural Adsorbents on Percentage Removal of Conductivity

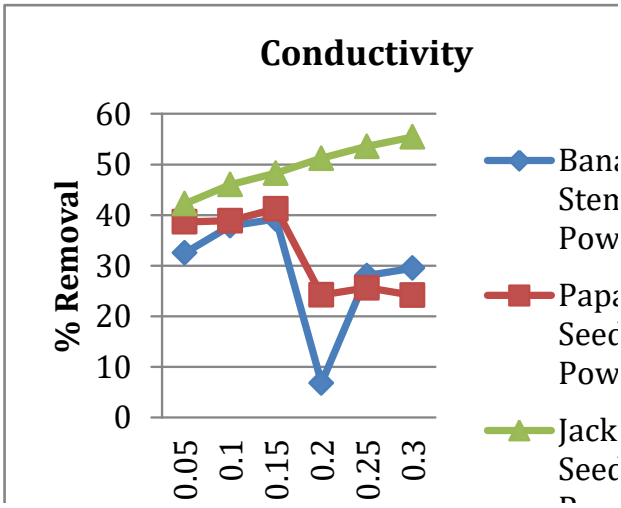

Chart-3: Effect of Adsorbents (Banana Stem Powder, Papaya Seed Powder and Jack Fruit Seed Powder) in Percentage Removal of Conductivity

3.7 Effect of Natural Adsorbents on Percentage Removal of Turbidity

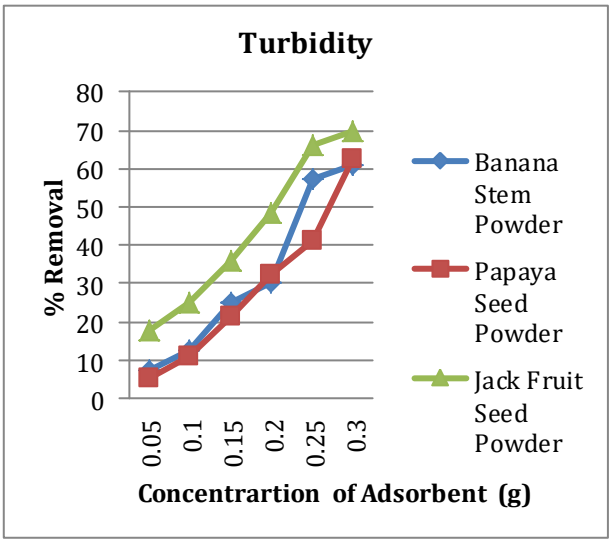

Chart-4: Effect of Adsorbents (Banana Stem Powder, Papaya Seed Powder and Jack Fruit Seed Powder) in Percentage Removal of Turbidity

3.8 Effect of Natural Adsorbents on Percentage Removal of COD

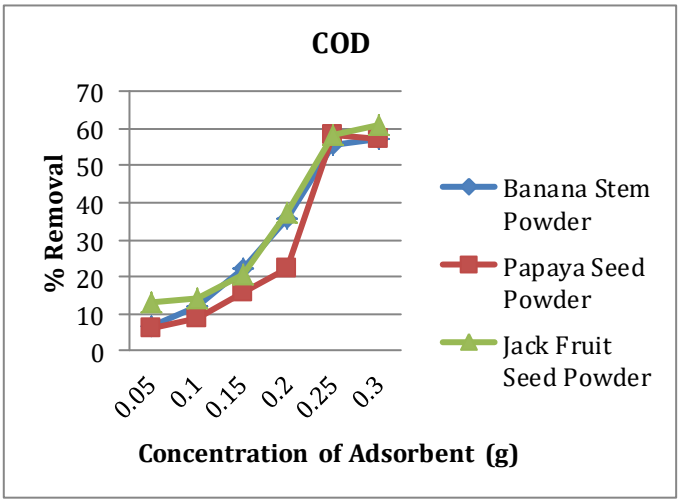

Chart-5: Effect of Adsorbents (Banana Stem Powder, Papaya Seed Powder and Jack Fruit Seed Powder) in Percentage Removal of COD

3.9 Effect of Natural Adsorbents on Percentage Removal of BOD

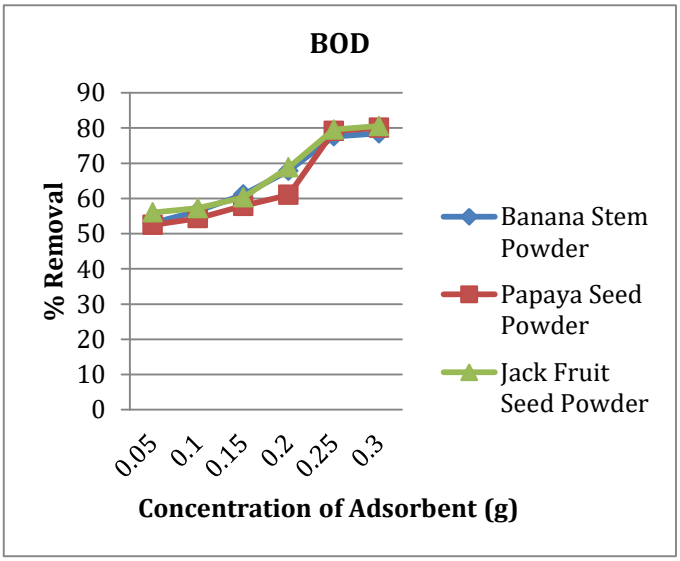

Chart-6: Effect of Adsorbents (Banana Stem Powder, Papaya Seed Powder and Jack Fruit Seed Powder) in Percentage Removal of BOD

4. CONCLUSION

The present work is explores a new approach of development in the field of purification of wastewater through the minimal energy input, less labour and low investment, also proves to be biodegradable and effective compared to synthetic adsorbent and the chemicals. The wastewater from dairy industry can cause land and water pollution. By adopting a method of adding adsorbents like powders of banana stem, papaya seed and jack fruit seed into the wastewater can reduce the amount of organic matters present in the dairy effluent. The process is done through bio adsorption method. The results obtained from the project gives a suitable powder that can be used for the adsorption process. From the results obtained by the comparison study the jack fruit seed powder shows maximum percentage removal. Therefore jack fruit seed powder can be selected as a suitable adsorbent for the removal of organic matter from dairy effluent. From the above analysis it is concluded that maximum removal efficiency was exhibited by jack fruit seed powder at 0.25 g concentration.

REFERENCES

[1] Upadhyay Shreya Rajendra and Asha Rani N R, "Wastewater Treatment Using Banana Pith Powder", International Journal of Innovative Science, Engineering & Technology, Volume 8, Issue 5, May 2021, ISSN 2348 – 7968.

[2] Arya Chandran J and Duithy George, "Use of Papaya Seed as a Natural Coagulant for Water Purification", International Journal of Scientific Engineering and Research, Volume 6, Issue 3, March 2018, pp. 2347-3878.

[3] Hemraj S R, Megha C, Chandhini D, Lathamani C R and Manjunath H, "Experimental Study on Treating Dairy Waste Water Using Jack Fruit Seeds and Aloevera Gel", International Journal of Innovative Research in Science, Engineering and Technology, Volume 8, Issue 5, May 2019, pp. 2347-6710.

[4] Megharaj A, Dr. D P Nagarajappa, Dr. P Shiva Keshava Kumar and Sreekanth N, "Treatment of Dairy Waste Water Using Natural Adsorbents", International Research Journal of Engineering and Technology, Volume 7, Issue 8, August 2020, ISSN: 2395-0072.

[5] Aneesu Rahman, Aswathy Ramesh, Ranjitha O R, Suranya T Jency and Nadayil , "Efficiency of Jackfruit Seed Powder as a Natural Coagulant" , International Research Journal of Engineering and Technology, Volume 5, Issue 3, March 2018, pp.2395-0072.

[6] Arya Chandran J and Duithy George, "Use of Papaya Seed as a Natural Coagulant for Water Purification", International Journal of Scientific Engineering and Research, Volume 6, Issue 3, March 2018, pp. 2347-3878.

[7] N A Akbar, S Sabri, A A Abu Bakar and N S Azizan, "Removal of colour using banana stem adsorbent in textile wastewater", Journal of Physics: Conference Series, Volume 1349, 2019, pp. 1742-6596.

[8] Divya K S, Dr. Syed Ariff, V Vaishnavi, Sadiya Banu A S, G Swetha and Ravi Kiran, "Experimental Study on the Treatment of Dairy Waste Water Using Low Cost Natural Adsorbents", International Journal of Current Engineering and Scientific Research, Volume 6, Issue 6, 2019, ISSN 2393-8374.