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Treatment of Dairy Waste Water using Adsorbents from Solid Waste

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Abstract: ***Dairy industry is a major food processing industry. The waste water from dairy industries are mainly produced in the receiving station, starting, stopping and washing any of the processing units, using the processes pasteurization, homogenization of fluid milk and the production of dairy products. It is estimated that dairy industries generate 2.5 to 10L of wastewater per L of milk processed. Major pollutants found in dairy waste water are organic components like dissolved sugars, carbohydrates, proteins and fat, Suspended Solid, Total Dissolved Solid, Sulfur, Phosphorous and Nitrogen. So the dairy wastewater is considered as high concentration of organic matter and high BOD. Disposal of the waste water is a major challenge for dairy industries. As it produced pungent odor it should be treated before disposal to keep environment free from various problems. In this work, the synthetic dairy waste water was prepared and was treated with activated carbon prepared from waste dried coconut shell. The activated carbon prepared from Coconut shell CGAC could be able to remove COD and BOD of the used water up to satisfactory level at different bed height and contact time. This paper shows the removal efficiency of COD and BOD using the activated carbon. In the experiment, the maximum removal efficiency of COD and BOD from the dairy wastewater was found in bed height 10cm with contact time 2hours.***

Keywords: Synthetic Dairy Waste water, COD, BOD, Bed height, contact time, CGAC

I. INTRODUCTION

Industrialization is an essential part for economical growth of country, [1]. Due to industrialization, pollution is the major problem throughout the world. Among various industries, the food industries are one of the highest consumers of water and are one of the biggest producers of effluent. The dairy industry is an example of food industries. India is the largest producer of milk and dairy products in world and ranked first among the milk producing countries. Every year, the growth rate of dairy industry is expected to 4-5%, [2]. In dairy industries, large amount of fresh water is used throughout all the steps of processing starting from milk receiving station to packaging station. It is estimated that dairy industries generate 2.5 to 10 L of wastewater per L of milk processed, [3]. Effluent production and disposal remain a big issue for the dairy industry. Dairy waste water is identified having high COD, BOD due to high organic contents, and TDS, TSS contents, [4]. Hence, Suitable disposal of effluents in wastewater has been a major challenging issue for the dairy industry in India. In this work, the adsorption method is used for removal of the effluent from the dairy waste water, [5].The adsorbent is prepared from solid waste. The solid waste is the coconut shell collected from temple side.

Table 1: Minimum standards maintained for discharge of effluents from the dairy industry

Parameter	Maximum Value (mg/L)	World Bank Report CPCB, India
pH	6-9	6.5-8.5
BOD5	50	100
COD	250	-
TSS	50	150
Oil & Grease	10	10
Total Nitrogen	10	-
Total Phosphorus	2	-
Temperature Increase	< = 30 C	-
Coliform Bacteria	400 Most Probable Number / 100 ml	-

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II. MATERIAL AND METHODS

A. *Materials*

1) *Synthetic dairy waste water Preparation:*

The synthetic dairy waste water was prepared by mixing different chemicals in 1L of tap water, [7, 8]. The ratio is given in table 2.

Table 2: Quantity of chemicals added in 1L tap water

Sl No.	Name of Chemicals	Quantity (gm)
1	Milk powder	5
2	glucose	2
3	Sodium Nitrate	1
4	Potassium Phosphate	1
5	Calcium Chloride	1

The synthetic waste water of above composition of 10L was prepared to carry out the experimental work.

2) *CGAC Preparation*

The granular activated carbon was prepared from solid waste of coconut shell. Coconut shell was collected from temple and was dried for 15 days in sunlight. It was heated in furnace at 400^0C for 2hours, [9]. After that, it was allowed to cool, ground and sieved to get a particle size of 1mm.Then it was acid washed using Hydrochloric acid to activate its surface, [10]. Its activated characteristic was checked. Coconut shell-based activated carbons are the less dust, predominantly micro porous. So they are well-suited for organic chemical adsorption. This activated carbon has the highest hardness compared to other types of activated carbons, which makes it the ideal carbon for water purification.

Figure 1: Production of Activated Carbon

B. *Methods*

1) *Experimental Set up*

The set up was done in the laboratory. The freshly prepared CGAC was used in this experiment. Five different bed heights 2cm, 4cm, 6cm, 8cm and 10cm of adsorbent CGAC maintained in five cylindrical beds of diameter 3cm. Dairy waste water was allowed to flow through the beds from the top. The particle size for CGAC was taken as 2mm.

Figure2: Experimental set up

The contact time was maintained for 30minutes, 60minutes, 90minutes and 120minutes, respectively. The dairy waste water at inlet and water after passing through the bed was collected from different bed height and taken for COD and BOD analysis.

2) Analytical method for COD

The COD test was carried out using a standard procedure. 50ml of samples were carried out in six flasks, out of which one flask having the untreated water and rest five flasks having treated water by CGAC. Potassium dichromate solution was added to each flask with stirring gently. Solutions were heated in water bath at 100^0C for 1hour. Then samples were removed and cooled. Then potassium iodide & sulphuric acid were added to samples. The samples were titrated with sodium thiosulphate. The COD values were determined.

3) Analytical method for BOD

The BOD tests were done using BOD bottles and BOD incubator. The samples were taken in six BOD bottles, out of which one bottle was filled with untreated water and rest five bottles with treated water by CGAC. The bottles were kept in the incubator maintaining temperature 20^0C for 5 days. After 5days, BOD values were observed.

III. RESULTS AND DISCUSSION

A. Analysis

The initial COD and BOD of the Dairy waste water were obtained as 735.33mg/L and 438.67 mg/L respectively. Experimental results obtained for different bed height of cylindrical beds using freshly prepared CGAC were reported in table 3.

Table 3: COD & BOD Analysis

Bed Height, cm	Contact Time, min	COD, mg/L	COD Removal %	BOD, mg/L	BOD Removal %
2	30	547	30.28	339	22.54
	60	532	32.17	320	26.95
	90	514	34.55	315	28.11
	120	502	36.04	302	30.98
4	30	430	45.15	299	31.76
	60	399	49.11	275	37.16
	90	375	51.8	268	38.87
	120	362	53.87	257	41.32
6	30	387	50.61	197	54.99
	60	354	54.92	183	58.24
	90	340	56.69	173	60.46
	120	312	60.24	159	63.54
8	30	302	61.49	167	61.83
	60	285	63.66	148	66.14
	90	267	65.88	139	68.25
	120	245	68.76	118	73.02
10	30	266	66.03	100	77.12
	60	208	73.46	82	81.18
	90	197	74.88	76	82.59
	120	175	77.6	65	85.10

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B. Comparative Graph.

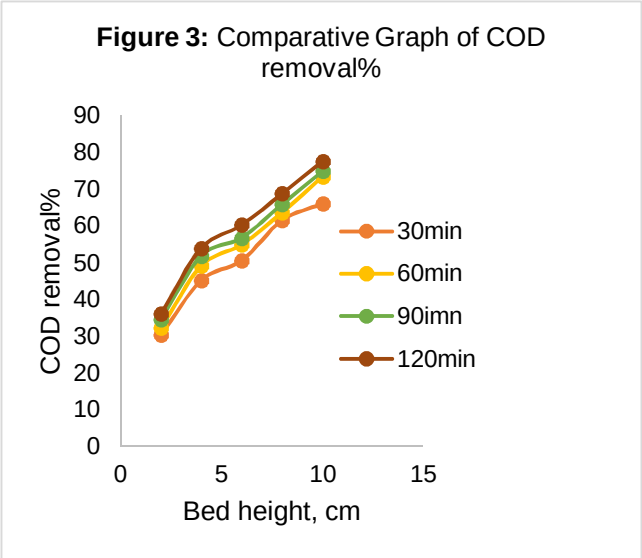


Figure 3: Comparative Graph of COD removal%

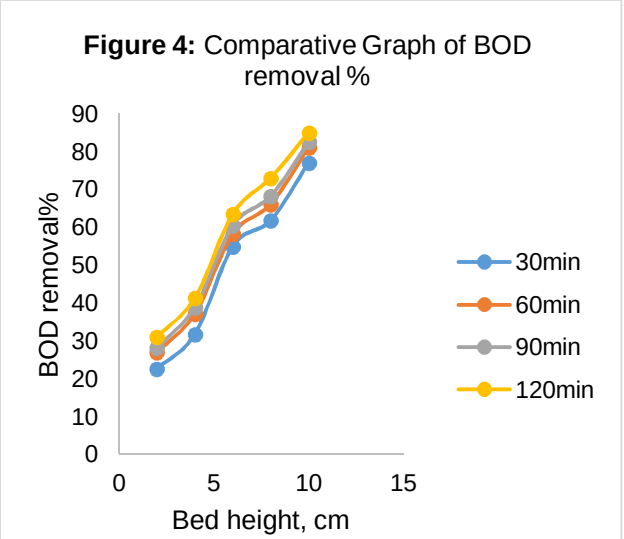


Figure 4: Comparative Graph of BOD removal %

From figure 3, it is observed that when the contact time and the bed height of the CGAC increased, the COD removal % was increasing. The maximum COD removal was 77% at bed height 10cm with contact time 2hours.

From figure 4, it is observed that when the contact time and the bed height of the CGAC increased, the BOD removal % was increasing. The maximum BOD removal was 85% at bed height 10cm with contact time 2hours.

Figure 5: Combined Effect of bed height and time on % removal of COD (H represents bed height in cm, t represents contact time in min)

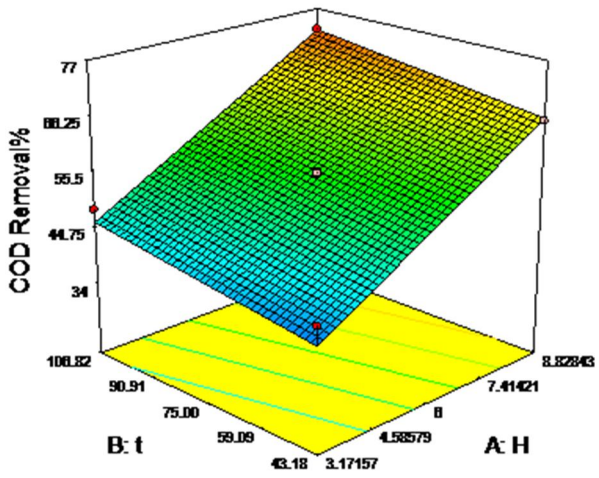
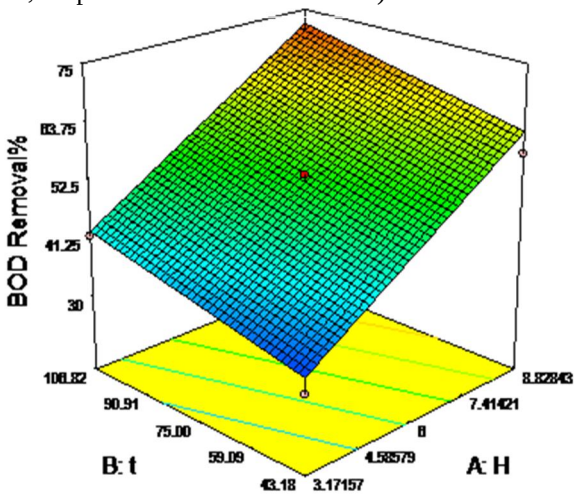


Figure 6: Combined Effect of bed height and time on % removal of BOD (H represents bed height in cm, t represents contact time in min)



The effect of contact time and bed height on COD removal is represented in Fig. 5. The effect of contact time and bed height on BOD removal is represented in Fig. 6.

IV. CONCLUSION

CGAC has the highest hardness compared to other types of activated carbons, which makes it the ideal carbon for water purification.

It is observed from the experiment that by increasing the bed height of adsorbent in the bed and the contact time, the removal efficiency of BOD and COD is gradually increasing. CGAC has the highest hardness compared to other types of activated carbons, which makes it the ideal carbon for water purification.

The experiment can be carried out in continuous manner for industrial application with slight change in the experimental setup.

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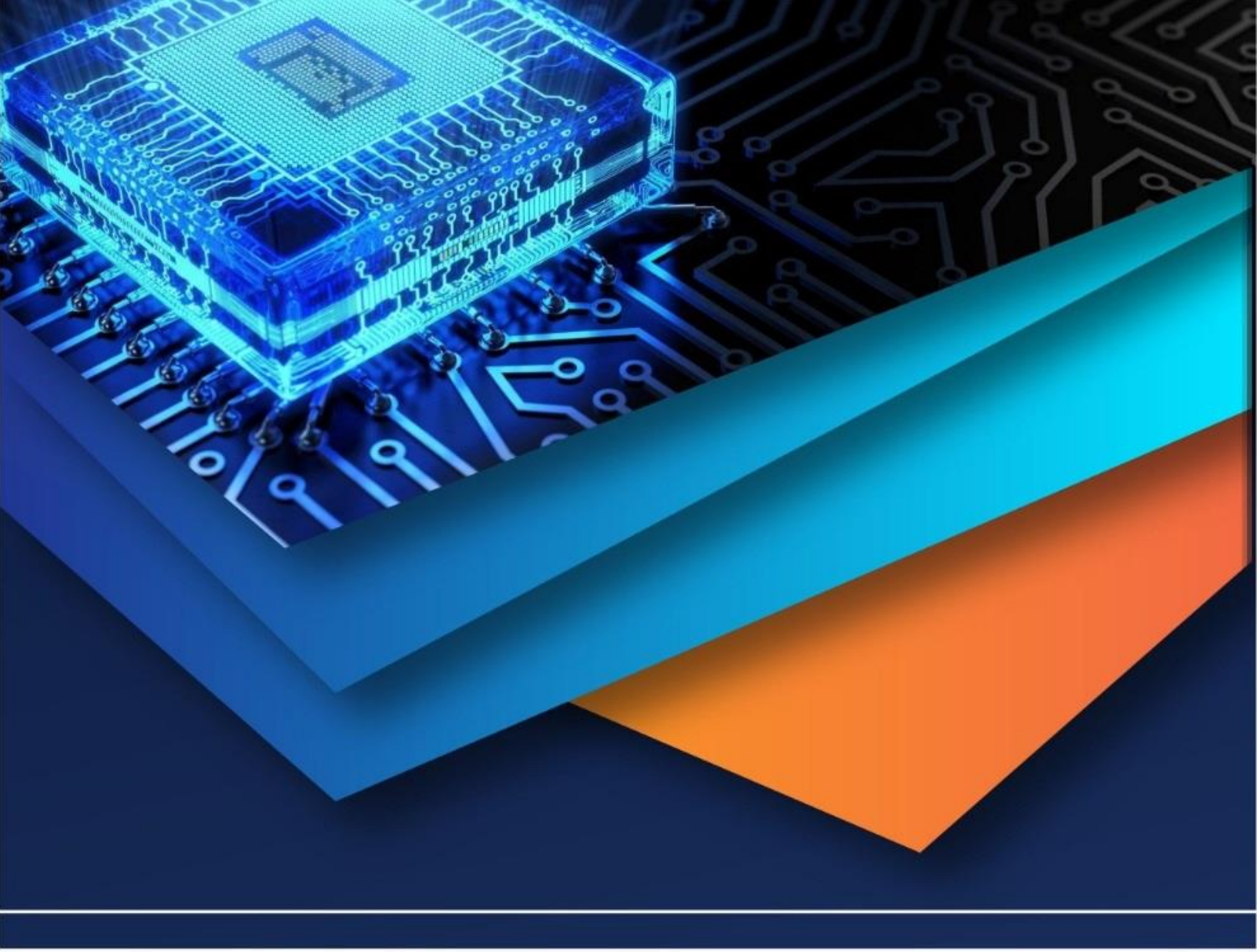

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