International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 06 | June 2019 www.irjet.net p-ISSN: 2395-0072

Dairy Waste Water Treatment Using Coconut Shell Activated Carbon and Laterite as Low Cost Adsorbents

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Abstract – *The main aim of this is the assessments of reduction of chemical oxygen demand(COD) and Biological oxygen demand(BOD) from dairy waste water using low cost adsorbents like Coconut shell activated carbon (CSAC) & Laterite in fix bed stationary phase. The other parameters like Total suspended solids, Turbidity , pH are effectively reducing by Mixed Bed Stationary Phase of different ratios. Treatment efficiencies of Fixed Bed Stationary Phase adsorbents of different ratios are compared. The complete study was done in Column Chromatography to investigate the effect of operating parameter. The result of before and after treatment is compared & optimum operating conditions were determined for maximum reduction.*

Key Words: Dairy waste water, Adsorbents, Coconut shell activated carbon, Laterite, Column chromatography Experiment

1. INTRODUCTION

Industrialization has a big role for development of a country which causes serious pollution problems throughout the earth. With increase in demand for milk and milk products, dairy industries have shown enormous growth in number and size in many countries all around the world. In the dairy industry ,the products are very diverse, which are mainly pasteurized and sterilized milk, yogurt, cheese, cream, butter and milk powder. Dairy wastewater needs complex treatment prior to discharge in order to prevent environmental damage. This is due to the high concentration of organic materials including protein, carbohydrates, fats, grease and minerals that elevate BOD. To reduce the environmental problems proper treatment of dairy waste water is very necessary. Adsorption technique emerges as promising technique in the removal efficiency. It is not recommended that raw dairy wastewater be discharged directly into water bodies because this would lead to different pollution problems including rapid dissolved oxygen depletion due to the high organic loading, which results in anaerobic conditions, the release of volatile toxic substances, aquatic life destruction and subsequent environmental damage. The objectives of treating dairy wastes are, to investigate the organic waste pollution from the dairy industry that may pollute fresh water and influence aquatic environment, Reduce the organic content of the waste water, ,Removing of organic matter by adsorption techniques and optimization of various operating parameters such as ratio of adsorbents ,time interval etc.The main aim of the present study focuses on, the assessments of reduction of chemical oxygen demand (COD) & biological oxygen demand (BOD) from dairy wastewater using low cost adsorbents like coconut Shell Activated Carbon (CSAC) & laterite in Fix Bed Stationary Phase. The other parameters like Total suspended solids, pH, Turbidity are effectively reducing by Mixed Bed Stationary Phase of different ratios. And this investigation is aimed to analyze the physico-chemical characteristics of the both untreated and treated dairy effluent.

2. METHODOLOGY

Dairy waste water is allowed to enter through 3 columns in a certain time period ie, 6minute in the ratio of 1:1 of coconut shell activated carbon to laterite. Then change the time period to 3 minute and 5 minute respectively for the same ratio 1:1 of coconut shell activated carbon and laterite. Then the treated water from the collection tank is tested. Change the adsorbent ratio to 1:2 of coconut shell activated carbon to laterite and allow to enter the waste water for 6minute,3minute,and 5 minute respectively. Treated water from the collection tank is tested. Again change the adsorbent ratio to 2:1 of coconut shell activated carbon to Laterite and allow to enter the waste water for the above same time period of 6minute,3minute,5minute respectively. Again treated water from the collection tank is tested.

2.1 Materials used

For the treatment of dairy waste water treatment ,the natural adsorbents is used. Selection of the precursor for the development of low cost adsorbents depends upon many factors. The precursor should be freely available, inexpensive and non-hazardous in nature. Moreover, for good adsorption results, high contents of carbon or oxygen in the adsorbent are very necessary. Other characteristics include high abrasion resistance, high thermal stability and small pore diameters, which results in higher exposed surface area and hence, high surface capacity for adsorption. The following two natural adsorbents are used as materials.

- Coconut shell activated carbon (CSAC)
- Laterite

2. 2 Preparation of Adsorbents

Natural adsorbents such as Coconut shell activated carbon and laterite are used for the present study.Coconut shell has advantages of its ability to adsorb colour or aroma. Coconut shell is a well known precursor for the production of high quality activated carbon. Generally, coconut production at farmer level is 1ton/Ha, with the coconut shell by product of 0.9ton, which in turn can yield 0.36ton of activated charcoal. coconut shells are collected locally from farmer into heap in open space. Firing and heating crushed coconut shells to 700^0c resulting charred carbon. This is low cost, non hazardous in nature, high surface capacity for adsorption ,high abrasion resistance, high thermal stability and small pore diameters. It removes organic matter, tastes, odours and colours caused by the impurities. Laterite is a red-coloured clay-rich soil found in the tropical & subtropics. In present study we has selected a locally available low cost laterite used for treatment purpose. Before its use as adsorbent ,laterite is washed thoroughly to remove the unwanted material such as decomposed organic matter, worm, sand dust particles, etc and iron containing fine particles and dried in the sun for 2-3 days . Then it is crushed to make adsorbent in different size range 1mm to 2mm. Sieved and washed thoroughly to 15-20 times to remove red colour of iron and finally washed with distilled water. Lastly, the material is dried overnight in hot air oven at 110°C. This is used for acidic adsorption.

2.3 Sample collection

For the analysis, the water samples were collected from the sites, in a clean air tight plastic container of 5 liter capacity for physicochemical measurements included chemical oxygen demand (COD), and biological oxygen demand (BOD).Fresh samples were used for analysis and samples were preserved in refrigerator. While using first it was bring back to the ambient room temperature and then used for analysis.

2.4 Experimental setup

An adsorption study with coconut shell activated carbon & laterite is done in column chromatography experiment . For the column chromatography experimentation following experiment set up is used PVC pipe of 70 cm height & diameter 6.4cm of three numbers, having top inlet tap and interconnection pipe with bottom collection tank. In this, coconut shell activated carbon (CSAC)and laterite are taken in different ratios since weight of coconut shell activated carbon is much less compared to laterite. The waste water is allowed through the three columns in different adsorbent ratio with different time period. The waste water is collected through the collection tank after the treatment. Parameters such as pH, Turbidity, Total suspended solids, BOD and COD were tested.

Fig-1 : Column Apparatus

3. RESULTS AND DISCUSSION

In this present study Coconut shell activated carbon and Laterite are the two natural adsorbents used. Dairy effluent contains soluble organics, suspended solids , trace organics. All these components contribute largely towards their high biological oxygen demand (BOD) and chemical oxygen demand(COD).The dairy waste water characteristics were tested before and after treatment process.

Table -1 : Removal efficiency in 1:1 ratio

Parameter	3min	5min	6min
pH(%)	3.44	5.74	6.89
Turbidity(%)	13.47	19.17	21.76
TSS(%)	16.45	22.66	23.94
BOD(%)	37.90	42.74	44.35
COD(%)	15.62	23.19	29.60

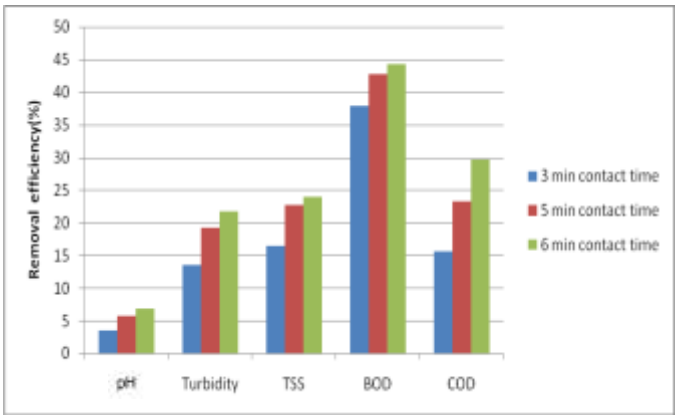

Chart -1:Comparison of various parameter in different contact time

It is observed that the Removal efficiency increases when the contact time increases. Removal efficiency of BOD in 3min contact time is 37.90% in 5 min 42.74 % and in 6 min 44.35 %. ie ,when the contact time increases in 1:1 ratio the removal efficiency is also increasing.

Table -2 : Removal efficiency in 2:1 ratio

Parameter	3min	5min	6 min
pH(%)	10.35	13.79	14.94
Turbidity(%)	26.42	30.56	33.16
TSS(%)	26.14	29.98	31.99
BOD(%)	52.41	58.87	62.08
COD(%)	33.38	38.15	43.91

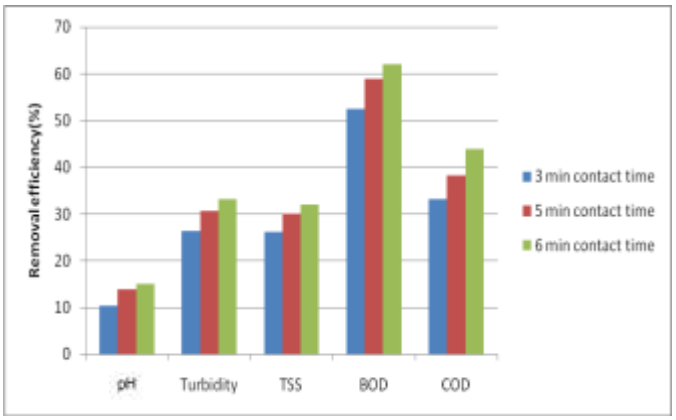

Chart-2: Comparison of various parameters in1: 2 ratio in different contact time

Removal efficiency of BOD in 3 min contact time is 52.41% and in 6 min removal efficiency is 62.08%.Rempval efficiency of other parameters such as Turbidity, pH, Total suspended solids are also increases with increase in contact time.

Table-3: Removal efficiency in 2:1 ratio

Parameter	3 min	5 min	6min
pH(%)	14.95	19.54	20.08
Turbidity(%)	38.34	46.11	52.33
TSS(%)	35.28	40.03	47.53
BOD(%)	62.90	66.53	70.16
COD(%)	46.60	50.49	52.1

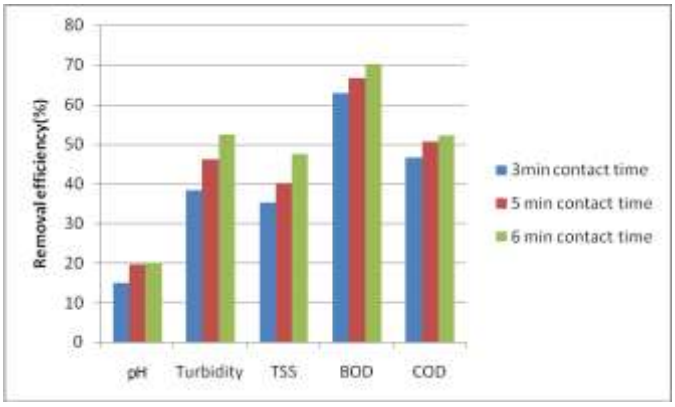

Chart -3 :Comparison of various parameter in 2:1 ratio in different contact time.

Removal efficiency of BOD in 2:1 ratio of coconut shell activated carbon to laterite in 3 min contact time is 62.90 % and in 6 min contact time it is 70.16%.It is observed that the removal efficiency increases when the contact time increases.

4. Conclusion

While comparing all this parameters of changing the ratio of adsorbent and contact time period, the most efficient removal of impurities is for the ratio of 2:1 (CSAC & Laterite) in 6min contact time. This is because of the higher presents of coconut shell activated carbon due to having more surface area and adsorption capacity. While contact time increases removal efficiency of impurities also increases. With this low cost adsorption materials, the impurities in the dairy waste water can be removed most efficiently. The mixed bed stationary phase of coconut shell activated carbon and laterite reduces BOD upto 70.16% and COD upto 52.1% in 2:1 ratio at 6min contact time. And other parameters like pH, Total suspended solids, Turbidity are effectively reduced by mixed stationary bed of ratio 2:1 Coconut shell activated carbon to laterite.

REFERENCES

[1] Abass O. Alade (2011). "Removal of oil and grease as emerging pollutants of concern (EPC) in wastewater stream." IIUM Engineering Journal, Special Issue on Biotechnology: Vol. 12, No. 4.

[2] Ajith Hebbar H, Jayantha K.S (2013). "Oil and Grease Removal from Wastewater Using Laterite as an Adsorbent Material." International Journal of Emerging Technology and Advanced Engineering, Volume 3, Issue

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[3] Baisali Sarkar,PP Chakrabarti,A Vijaykumar (2006). "Waste water Treatment in Dairy Industries-Possibility of reuse",www.sciencedirect.com/science,volume 195,issues 1-3

[4] Imran Ali(2012). "Low cost Adsorbents for the removal of organic pollutants from waste water

[5] Mohamed Nageeb Rashed (2013). "Adsorption Technique for the Removal of Organic Pollutants from Water and Wastewater", http://dx.doi.org/10.5772/54048

[6] Nammam Ali Azadi,Reza Ali Falahzadeh,Shahram Sadeghi(2015). "Dairy waste water Treatment Plant in Removal of Organic Pollution",Environmental Health Engineering and Management Journal volume2 73-77

[7] Sheetal S Karale (2012)."Dairy Waste Water Treatment Using Coconut Shell Activated Carbon and Laterite as Low cost Adsorbents"

[8] Trevor J. Britz and Corne van Schalkwyk (2006). "Treatment of Dairy Processing Wastewaters", tailor and francis group.

[9] Uttarini Prathak (2015). "Treatment of Waste water from a Dairy Industry using Rice Husk as Adsorbent