

COD Reduction Using Low Cost Biosorbent as Part of Cleaner Production

K.Murali*, P.L.Karuppiah**, M.Nithish**, S.Sajith Kumar** and V.Suresh Raja**

* Associate Professor, Department of Civil Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, India

** Department of Civil Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, India

Abstract- Dairy industry is one of the largest food processing industry which causes severe environmental problems due to the generation of wastewater containing high Solid concentration, high BOD and COD. The removal of COD plays a vital role in the treatment design. An attempt has been made to remove COD from dairy wastewater using water hyacinth - low cost biosorbent as a cleaner production option. The wastewater was collected from AAVIN dairy, Coimbatore and analysed for various physico-chemical parameters. The COD value was found to be 2850 mg/l. Batch study was adopted in this investigation and COD reduction was determined. The optimum contact time was found to be 40 minutes for a COD reduction of 65.4% and optimum dosage was observed as 15 g with an removal efficiency of 89.5% .

Index Terms- COD, Biosorbent, Dairy Wastewater

I. INTRODUCTION

Dairy industry is considered to be largest source of food processing industries which cause severe environmental problems because of generation of strong wastewater characterized by high biological oxygen demand (BOD₅) and chemical oxygen demand (COD) [1]. Water is used in all processes in the dairy industry, wastes from dairy industry contains high concentration of organic materials, high BOD and COD, high concentration of Suspended solids and oil grease[2]. All of these require treatments to prevent or minimize environmental problems. The wastewater generated from dairy industry can be separated into two groups namely, the first group comprises wastewater having high flow rates and the second group comprises of the effluents produced in small milk transformation units [3]. The COD of dairy wastewater is mainly due to milk, cream or whey. A number of technologies such as coagulation / flocculation process and oxidation process have been developed over the years to remove organic matter (expressed as chemical oxygen demand, COD) from industrial wastewater. These methods are expensive, time consuming, complicated and requires skilled personnel. The adsorption technique is a promising technique in the removal of COD, the high cost of commercial activated carbon has simulated the search of cheaper alternatives. The application of biosorption in environmental treatment has become a significant research area in the past 10 years. It is widely recognized that biosorption provides a feasible technique for the removal of pollutants from wastewater. There is a continuing search for cheap, high capacity sorbents for colour because the relatively high cost commercial sorbents such as activated carbon and ion-exchange resins

remains a major obstacle to the use of sorption processes[4]. Many agricultural products and byproducts of cellulosic origin have been tested for metal ion adsorption. The removal of copper from effluents has been studied using many sorbent materials such as biomass, kaolinite, dry hyacinth and seafood shell waste[4]. Cleaner production is a positive and integrated solution to pollution prevention by reducing or eliminating pollutants at the source during the production processes. Biosorption is a promising technology in terms of cleaner production. The main objective of the present investigation is to reduce the COD level by using biosorption technique.

II. STUDY AREA

Coimbatore is an important district in western part of Tamilnadu.

AAVIN dairy processing unit is located in the Perur-Siruvani highway surrounded by modest greens. Spread over 10 acres of land, the unit is Coimbatore's most sophisticated processing plant. Milk vans collect milk from even the remote villages and 15 vans report to this particular unit. Nearly 1,10,000 liters of milk is processed at Coimbatore plant and supplied to the near by districts. The wastewater generated from various units namely receiving station, bottling, condensing, creaming and cheese making were collected in a neutralization tank for further treatment. The wastewater for the current study was obtained from AAVIN dairy industry Coimbatore.

The city of Coimbatore consists of the following nine major lakes (wetlands).Singanallur Lake, Kuruchi Lake, Valankulam Lake, Krishnampatti Lake, Muthannan Lake, Seevagasintamani Lake, Periya Kulam, Barathipuram lake and Ammankulam (Disappeared). In an urban ecosystem, these wetlands are the major life-supporting component with high concentrations of birds, mammals, reptiles, amphibians, fish and invertebrate species. The Coimbatore urban wetlands harbor more than 125 species of resident and migratory birds, with August – October being the peak season. Spot-billed Pelican, Painted Stork, Open Billed Stork, Ibis, Spot-billed Duck, Teal, Black Winged Stilt are a few species of the migratory visitors. All the above mentioned lakes, the water is polluted by the Water Hyacinth. The water hyacinth (*Eichhornia crassipes*) is a free floating aquatic weed originated from Brazil and had been introduced in India as an ornamental plant. Water hyacinth was introduced as an ornamental crop species in many countries more than a century ago, because of their attractive blue, lilac to purplish flowers and round to oval leaves. As of now, the lakes in Coimbatore have almost formed a part of the city drainage system. Encroachment

is another serious trouble faced by these lakes, most of the people living nearby, have extended their cultivation lands to these fertile flood plains of these shrinking lakes. Sewage is also discharged into some of the lakes in some places. Over nourishment of water bodies due to the excessive nitrates and phosphates received through runoff from crop fields results into the growth of algae and this condition is known as Eutrophication. Due to eutrophication the lakes got invaded by algal blooms. The algal species quickly complete their life cycle and die there by adding a lot of dead organic matter. The water gets depleted of oxygen due to rapid decomposition of organic matter and fishes were killed. Water hyacinth is blamed for reduction of biodiversity and increased evapotranspiration. It also acts as a good breeding place for mosquitoes, snails and snakes. All most all the lakes in the Coimbatore city are polluted by the water hyacinth. Hence, it is essential to control the problems caused by the water hyacinth in an effective manner. As a part of cleaner production technology the effective utilization of water hyacinth a solution to pollution is taken as an objective in this study.

III. METHODOLOGY

Preparation of Biosorbent : The Biosorbent- Water hyacinth (*Eichhornia Crassipes*) was collected from Vallakulam, Coimbatore. Plant samples were washed and separated into leaves, petioles and roots. Then, they were oven dried at 100^o C for 3days. The dried samples were pulverized using 300 μ sieve. Biosorbent, thus prepared from each part of the plant were then subjected to characterization and batch adsorption studies.

Analysis of Dairy Wastewater: The dairy wastewater was collected from AAVIN dairy industry, Coimbatore and analysed for various physico-chemical parameters as per standard methods.

Batch Study: Batch adsorption studies were conducted using the biosorbents prepared from Water hyacinth. 400ml of sample was taken in a beakers and biosorbent of 5g was added, samples were agitated in a flocculator to reach equilibrium. The contact time of biosorbent was kept as 10 minutes, 20 minutes, 30 minutes, 40 minutes and 60 minutes. Suspensions were then filtered through whatmann filter paper. The filtrates were analysed for COD removal. From which optimum contact time was determined. To get the optimum dosage, time of stirring is kept constant and the dosage is varied from sample to sample. Different dosages of biosorbent from 5 mg/l to 15 mg/l are added[5].

IV. RESULTS AND DISCUSSIONS

The characteristics of dairy wastewater were presented in Table 1.1.

TABLE 1.1 Characteristics of Dairy Wastewater

Parameter	Value
pH	7.8-8.5
Total Solids (mg/l)	2100
Total Dissolved Solids (mg/l)	1900
BOD (mg/l)	1350
COD (mg/l)	2850

Reduction of COD: The results of batch study for determination of optimum contact time and optimum dosage of biosorbent was presented in Table 1.2 and 1.3 respectively.

Table 1.2 Optimum Contact Time

S.No.	Dosage (g)	Time (min.)	COD (mg/l)
1	5	10	2100
2	5	20	1755
3	5	30	1215
4	5	40	986
5	5	60	980

Table 1.3 Optimum Dosage

S.No.	Time (min.)	Dosage (g/l)	COD (mg/l)
1	40	5	986
2	40	7.5	889
3	40	10	684
4	40	12.5	486
5	40	15	298

The optimum contact time was determined by adding 5 g of biosorbent in 400 ml of wastewater and agitated for various time of contacts varied from 10 minutes to 60 minutes. The optimum time was found to be 40 minutes from Table 1.2.

The optimum dosage was determined by keeping the time of stirring as constant for varied dosages from 5 g to 15 g. The optimum dosage was found to be 15 g.

V. CONCLUSION

The present study was aimed at evaluating the potential of water hyacinth for COD reduction in dairy wastewater. In batch study, the untreated dairy wastewater samples having a COD of 2850 mg/l were subjected to find the optimum contact time and optimum dosage of biosorbent. The samples were observed for temporal changes in COD reduction of 65.4% during 40 minutes contact time at 5 g biosorbent and a removal efficiency of 89.5% at 40 minutes contact time, 15g biosorbent. From the present study it clear that utilization of water hyacinth have effectively removed the COD content of dairy wastewater and this is a better solution for achieving cleaner production technology.

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AUTHORS

First Author – K.Murali is a Civil Engineer from VLBJCET, Coimbatore, 1998, with Post Graduate (M.E. – Environmental Engineering) from GCT, Coimbatore, 2000 and has over 13 years of teaching experience. Currently working as Associate Professor in Civil Engineering Department at Sri Ramakrishna Institute of Technology, Coimbatore. He has 15 publications in National / International Conferences, 4 publications in reputed journals and associated with professional bodies as life member.
E-Mail : murali.vlb@gmail.com

Second Authors – Final Year BE Civil Engineering Student of Sri Ramakrishna Institute of Technology, Coimbatore.

Correspondence Author – K.Murali, murali.vlb@gmail.com, +91 98945 18182