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REMOVAL OF ORGANIC MATTER FROM DOMESTIC WASTE WATER BY ADSORPTION

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Abstract— Treatment of domestic sewage and subsequent utilization of treated sewage for irrigation can prevent pollution of water bodies and reduce the demand for fresh water in irrigation sector. It has been estimated that 70 per cent of the water pollution in the state of Maharashtra is due to domestic sewage. The COD of the wastewater is indicator of its purity. In the present work attempt is done to minimize the pollution parameters like colour, COD and BOD by using coconut coir activated carbon in batch and column opearation. Also optimum values of these parameters were obtained. It has been observed that 75-80 percent removal of COD and organic matter can be obtained by coconut coir activated carbon. These values were found to be 2 grams per 100 ml, 90 minutes and 6 respectively.

Index Terms— oraganic matter, COD, BOD.

INTRODUCTION

Affordable and effective domestic wastewater treatment is a critical issue in public health and disease prevention around the world, particularly so in developing countries which often lack the financial and technical resources necessary for proper treatment facilities.Disposal of about 29000 MLD domestic sewage from cities and towns is the biggest source of pollution of water bodies in India. A large number of rivers stretches are severely polluted as a result of discharge of domestic sewage. Treatment of domestic sewage and subsequent utilization of treated sewage for irrigation can prevent pollution of water bodies, reduce the demand for fresh water in irrigation sector and result in huge savings in terms of nutritional value of sewage in irrigation. It has been estimated that 70 per cent of the water pollution in the state of Maharashtra is due to domestic sewage. The COD of the wastewater is indicator of its purity. Various pollutants impart COD to the water.CODremoval is ultimately removal of these impurities from the wastewater. COD removal methods include: adsorption, coagulation, electrochemical, ultraviolet irradiation, and membrane-based technology such as ultrafiltration. Chemical oxygen demand(COD) is the amount of oxygen required for the organic matter for its chemical decomposition and Biological oxygen demand (BOD) is the amount of oxygen required for the biological decomposition.

Varios methods have been tried for COD removal of wastewater. A review on anaerobic treatments for domestic and industrial was carried out by Chan et.al.[1].According to this high rate anaerobic–aerobic bioreactors have been increasingly employed for wastewaters with high chemical oxygen demand. Low cost adsorbents for CODremoval were employed by Gupta and Suhas.([2]. Wastewater treatment by settling cum membrane seperation was tried by Hait and Tare [3]. A bioassay using the luminescent bacterium Vibrio-qinghaiensis associated with solid-phase extraction (SPE) was developed for evaluating the variation of ecotoxicity along with the reduction of organic substances in a domestic wastewater treatment plant employing an oxidation ditch process by Ma et.al [4]. Short- and long-term effects of temperature on partial nitrification in a sequencing batch reactor treating domestic wastewater were studied by Guo et al.[5]. Treatment of municipal solid wastes leachate by means of chemical- and electro-coagulation was carried out by Veli et. al.[6]. Reduction of COD of dyeing effluent from a cotton textile mill by adsorption onto bamboo-based activated carbon was carried out by Ahmad and Hameed. [7].

Treatment of wastewater by using the adsorbent derived from agricultural waste was carried out by Mohan et. al.[8]. COD and BOD reduction from coffee processing wastewater using avacado peel carbon was carried out by Devi et.al.[9]. Treatment of domestic wastewater by using a microaerobic membrane bioreactor was tried by Chu et.al.[10]. Removal of refractory compounds from stabilized landfill leachate using an integrated H_2O_2 oxidation and granular activated carbon (GAC) adsorption treatment was carried out by Kurniawan and Lo.[11]. Treatment of municipal wastewater using laterite-based constructed soil filter was tried by Kadam et.al.[12]. The various aspects of adsorption isotherms are explained by McCabe et. al.[13,1993].

I. AIM AND OBJECTIVE

The aim of the current study is to demonstrate the use of coconut coir activated carbon as an adsorbent for purifying the wastewater. The effects of contact time, adsorbent dose and pH on the adsorption are also studied and optimum values of these parameters are reported. Also Freundlich adsorption isotherm was varified. A packed column study was also carried out to determine ideal adsorption time. The

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ideal adsorption time is the time when the ratio of final to initial concentration of the effluent for a column reaches 0.5. COD, BOD and percentage COD removal were measured as indicator parameters of water quality.

II. METHODOLOGY

A. *Preparation of Adsorbent*

Coconut coir activated carbon was prepared by soaking washed and dried coconut coir overnight in 10% potassium hydroxide solution, followed by washing with distilled water to remove free potassium hydroxide and drying at 105 ± 5°C for 24 h. It was then subjected to activation at 750°C for 30 min. The carbon obtained was repeatedly washed with distilled water and then with 10% hydrochloric acid. The carbon was washed again with distilled water to remove the free acid and then dried at 105 ± 5°C for 24 h. The carbon was ground to a finer size of 0.2-0.3 mm and used in adsorption.

B. *Batch and Column Studies*

For carrying out batch oparation, 100 ml of effluent was taken in a 300 ml beaker and adsorbent was added to it. It was kept on shaker (200 rpm) for required time depending on the batch and filtered with Whatman no.1 filterpaper.The samples were analysed by U.V. spectrophotometer (Elico,SL-159) for absorbance. The percentage COD removal was calculated as percentage reduction in the absorbance. Initial absorbance of wastewater was 0.7. The COD and BOD of the samples were also found experimently. For varification of Freundlich adsorbent isotherm, various amount of adsorbents were taken in the flask for 100 ml of effluent and kept on shaker. The COD was measured after each half hour till the equilibrium is attained.

For column operation, on laboratory scale a column of diameter 5.3 cm and height of 100 cm was taken. Coconut coir activated carbon and sand were mixed in 1:1 proportion and filled in packed column.Before charging the material in the bed, a sand filter was prepared at the bottom of the column and above that the packing material was charged.The effluent was allowed to flow by gravity through the bed. The flow was controlled by using needle valve.Treated effluent was collected at the bottom and analysed. The batch and continuous studies were were carried out at the room temperature of 32^{O}C.

III. RESULTS AND DISCUSSION

A.Effect of Adorbent Dose:

Figure 1 shows the effect of adsorbent dose on COD removal.These studies were carried out to determine the effect adsorbent dose on percentage COD removal. Initial aborbance was of wastewater was observed to be 0.7. Various amounts of adsorbents ranging from 0.5 to 5 grams were taken

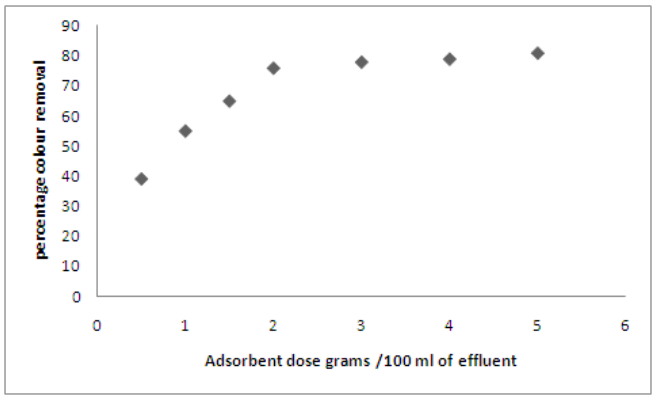

Figure 1: Effect of Adorbent Dose

in a 100 ml of effluent in 300 ml conical flasks and kept on sieve shaker (200 rpm) for 90 minutes. These samples were filtered and analysed. It was observed from the figure that percentage CODremoval increases upto adsorbent dose of 2 grams. This can be attributed to the fact that increase in adsorbent dosage increases surface area for adsorption. Further increase in the adsorbent dose does not affect the CODremoval. It may be because of the fact that high amount of adsorbent sites may not come properly in contact of adsorbate. So 2 grams per 100 ml is found to be optimum dose with COD removal of 76 percent.

B.Effect of Contact Time

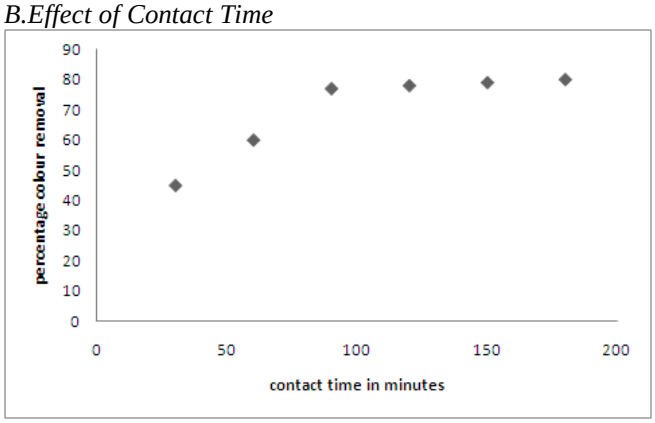

Figure 2: Effect of Contact Time

Figure 2 shows the effect of contact time on COD removal. For studying this effect, 100 ml of the effluent was taken in a 300 ml conical flak. The adsorbent dose of 2 grams was taken.The samples were kept on shaker(200 rpm). They were analysed after each half an hours intervals.The increase in percentage COD removal is significant upto contact time of 90 minutes and attains the optimum value of 77 percent. After that the percentage COD removal remains almost constant. This may be due to the attainment of equilibrium between the adsorbent and adsorbate, hence 90 minutes contact time and 2 grams of the adsorbent dose per 100 ml of effluent are the optimum parameters.

C.Effect of pH

Figure 3 shows the effect of pH on percentage COD removal. The optimum pH was observed to be 6 for the

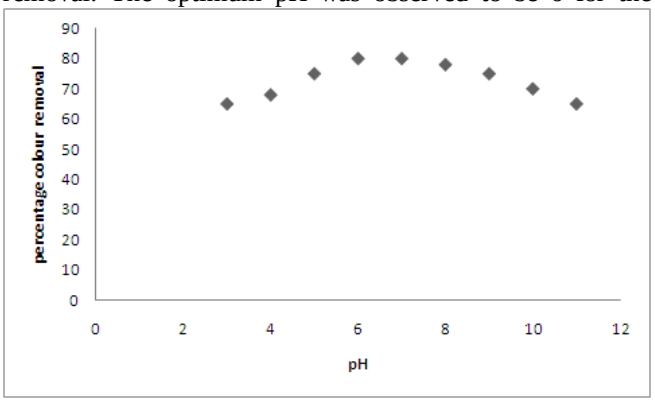

Figure 3: Effect of pH

adsorption purpose. Adsorption phenomenon is analogous to ion exchange process. The pH of the aqueous solution has significant effect on adsorption by the adsorbent. The pH of the solution also influence the actives sites and the solution chemistry. The maximum COD removal was observed to be 79-80 percent at the pH value of 6 .

D. Continuous Column Operation

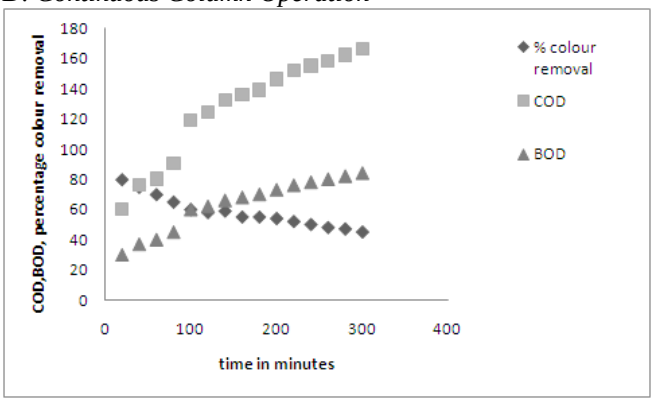

Figure 4: Column Operation

For carrying out continuous column operation, the adsorbent was filled upto 60 cm height in the column. The average adsorbent particle size was 0.25 mm and that of sand was 4.75 mm. The average particle was 2.5 mm. The flow rate was to 60 ml/minute .The pH of the effluent was kept at 6. The effluent samples were collected at 20 minutes interval for analysis. Figure 4 shows the variation of CODremoval with time. Initially there is high COD removal percentage .The percent COD removal decreases steeply in the initial part of the curve. It reaches the value of 50 percent in 200 minutes. Also COD and BOD values of the effluent from the column reaches to half of their initial values in 190-200 minutes. Initial COD and BOD values were observed to be 305 mg/l and 152 mg/l respectively. The initial absorbance was observed to be 0.7. The ideal adsorption time is observed to be 200 minutes.

E. *Adsorption Isotherm:*

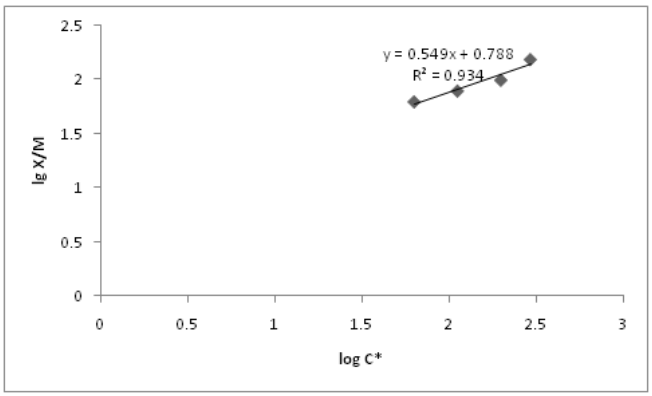

Figure 5: Freundlich isotherm

Figure 5 shows the equilibrium data for Freundlich isotherms on logarithmic scale.Freundlich isotherm is given by the impirical equation:

$$X/M = b\,C^{*m} \quad (1)$$

$$\log X/M = \log b + m \log C^{*} \quad (2)$$

X is the amount of adsorbate adsorbed and M is the amount of adsorbent. X/M is the catalyst loading, C* is the equilibrium concentration of organic matter, b and m are constants. From the figure, the adsorption phenomenon follows Freundlich isotherms. The values of b and m are observed to be 6.137 and 0.549 respectively.

IV. CONCLUSION

The results of present investigation shows that the coconut coir activated carbon has been found to be an effective adsorbent for the removal of organic matter and COD from the effluent. Although higher doses of coconut coir activated carbon are required for the COD and COD removal, the operation is feasible because of low cost of coconut coir activated carbon. In continuous column 75-81 percent COD removal and 78-80 percent COD removal is observed. Further for more effective operation adsorption column in series can be used. Pressure drops are quite high in coconut coir activated carbon column. For reducing pressure drop coconut coir activated carbon can be be used in the form of small pellets.

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