Treatment of Industrial Wastewater by using Amberlite XAD-1180 in A Fluidized-Bed Reactor

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Abstract— The main objective of the work is to reduce COD levels of industrial effluents Using Amberlite XAD-1180 in a fluidization reactor. The experiment runs at the flowrates in the range 2 to 8 LPM. The parameters like flow-rate, time & dosage of XAD have been studied and their effect of COD reduction is analysed, for this experiment COD analysis was done for industrial wastewater which is taken from near by industry. The COD reduction increases with increasing flow rate and adsorbent dosage. The maximum percentage COD reduction is found to be 91.56 %. Maximum adsorption occurs at the flow rate of 8 LPM and with 20 gm of XAD adsorbent.

Keywords— adsorption, Amberlite XAD - 1180, fluidization bed unit.

1. INTRODUCTION

Pollution is one of natural water resources 'biggest issues. Excessive dumping in water bodies of industrial waste makes the water harmful for human requirements. The main problem is water pollution, triggered primarily by the release of heavy metals, dairy waste and fertilizer sector and other chemicals substance. To overcome this problem, Fluidization is a technique used across the world for treatment of industrial effluents. Due to their high efficiency in removing COD, fluidized reactors have attracted considerable importance in wastewater treatment (Jeris et al., 1977; Yoon Chan Choi, Dong Seog Kim, Tae Joo Park, 3Kyung Kee Park- and Seung Koo Song, 1995). High contact effectiveness between the solid and liquid phases and used effectively for both aerobic and anaerobic processes is one of its benefits. (Walker, D.F., andE.P.Austin.1981; Sokoł. W and M. R. Halfani. 1999), for example aerobic/anaerobic starch wastewater treatment (M. Rajasimman, C. Karthikeyan, 2007), Domestic wastewater treatment(Da-wen Gao, Qi Hu, Chen Yao, Nan-Qi Ren,2014), anaerobic real textile wastewater treatment(S.Sen, G.N Demirer, 2003) and anaerobic/aerobic treatment of complex industrial wastewater(Prof. Dr. Ir. Sef. Heijnen, Arnold Mulder, Rene Weltevrede, Pam H. Hols, HansL. J. M . Van Leeuwen , 1990).

The Fludized bed was developed by Fritz Winkler in Germany in the 1920s had an internal draft tube causing the liquid to circulate in the bioreactor due to airlift principle. Right now, some modified fluidized-bed reactors are using for wastewater treatment like IFBR...etc. It has a lot of benefits over fixed bed reactors(Sokol, W 2001).It is particularly suitable for solids processing where good mixing and close temperature control is required. Among its advantages, the main advantage is that the particles are well mixed leading to low temperature gradients, they are suitable for both small and large scale operations. Theimplementation of fluidization has risen significantly in the sector of chemical, biochemical engineering and waste-water treatment and well recognised in chemical, petrochemical, metallurgical, mineral and biochemical operations (MM Bello, AAA Raman, Bello, M Purushothaman, 2017). In the present study we used fluidization technique to reduce COD content of nearby industrial effluent

2. EXPERIMENTAL & RESULTS

Material

XAD is used as an adsorbent in this experiment to reduce COD levels The adsorbent is acquired commercially, which can be used readily in experiments. Potassium Dichromate solution was prepared by dissolving 12.25 g of K2Cr2O7 in 1000ml of Ferrous Ammonium Sulphate and dissolve 98g of FAS in distilled water and then adding 20ml of Concentrated Sulphuric acid and dilute the solution to 1000ml. These stock solutions are used for COD analysis.

Methodology

The Figure shows a scheme diagram of the test set-up. The experiment was conducted in a fluidized bed (FDR) lab-scale plant with diameter of 100mm, height 1240mm and thickness 3mm which is made up of perspex fabric. A weir mesh was placed at the bottom to support the adsorbent and at the top to prevent any escape of adsorbent from the column The industrial wastewater is sent to the fluidized bed reactor through liquid distributer. The monometer is connected to the fluidized bed from the bottom and top connection. For every run the pressure drop is obtained. The pressure taps are evenly spaced at 100mm intervals on the top and bottom of the column and connected to manometers. The column is packed from the bottom of the column with solid particals of a specific size and density for the necessary bed height.

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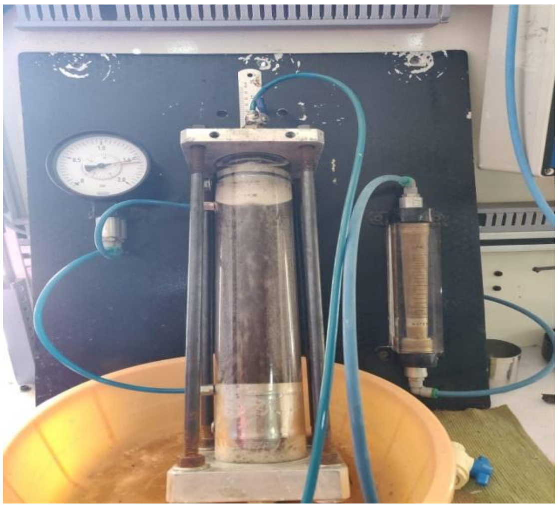

Figure1. Fluidized bed reacter

In the present case **Amberlite XAD-1180 was** taken. The Effluents from nearby industy is used and supplied from the bottom at different flowrates of 2,4,6 & 8 LPM. The sample was drawn at periodic intervals of 60 minutes, up to 6 measurements.

After the adsorption the removal concentration of the COD was determined by COD analysis method. The reduction percent of COD was calculated after treating with XAD

%removal = Co – Ci * 100/ Co

where Co = initial concentration of COD

Ci = final concentration of COD.

RESULT AND DISCUSSIONS

Effect of flowrate on COD removal :

To know the flow-rate effect on removal of COD, the fludization experiment was run at 2 to 8 LPM with adsorbent 20gm of XAD. We observe the increase in removal of COD with increase in flow-rates. The working solution is same for all experiments. It is prepared by adding 2.5lit of industrial effluents to 2.5lit water. The percentage removal of COD was show in fig 2.

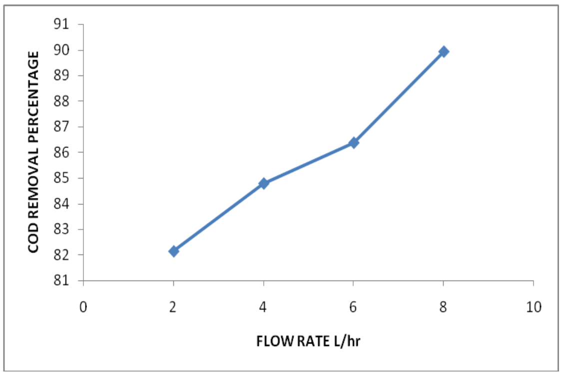

Figure2. flow-rate vs cod removal

Effect of time on COD reduction:

To know the effect of time on COD removal, the fluidization experiment was run for 6 hrs with adsorrbent 20gm of XAD. We observed that removal percentage is increased with change in time. The COD reduction proportion was shown in fig 3..

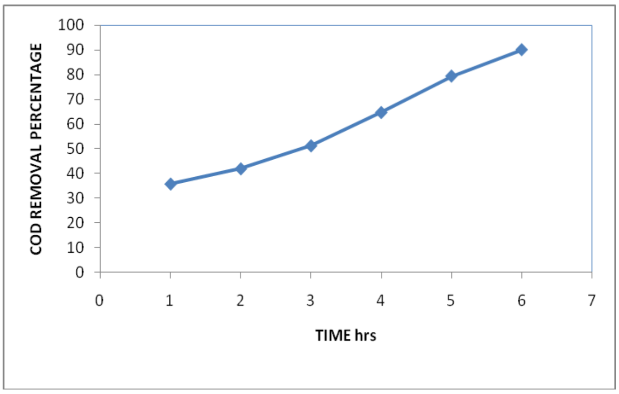

Figure 3. Time vs COD removal

Effect of XAD dosage on COD removal:

To know the effect of dosage on COD removal, the fluidization experiment was run by different amounts of XAD. We got maximum efficiency by using 20gm of XAD with 8 LPM flow-rate. The percentage removal of COD was show in fig4

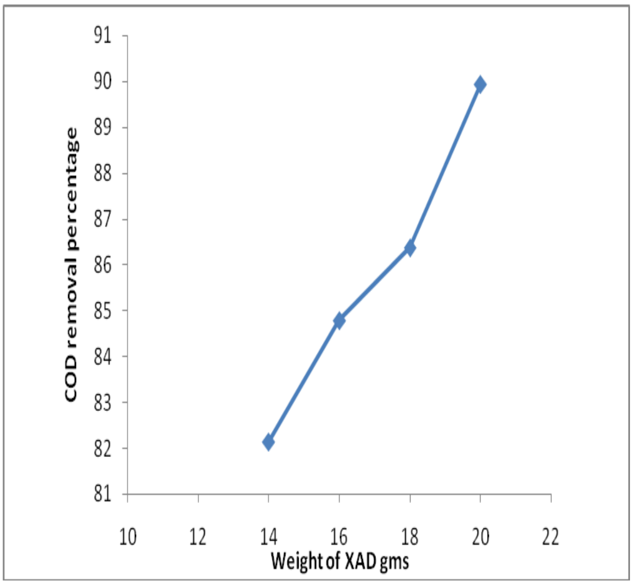

Figure 4. Dosage of XAD vs COD removal

CONCLUSION

How to make the water fit for human consumption by removing the pollutants is a major chellange that faces the science of biotechnology. Waste-water plants shall do proper COD analysis which is the critical step in cleaning pollutant water. The cost benifit ratio and harmful end products are the two major ills effecting many water treatment procesures currently available. The present study aims at reducing the cost and increasing the efficency in removing the harmful materials from industrial pollutad waste-water by using fluidization technique. XAD is the one of the best adsorbent for removal of COD from industrial wastewater Treatment in fluidized-bed reactor. The performance is satisfactory with approximately 91.5% COD levels being reduced. Maximum reduction of COD levels in effluents are seen at 20gm of XAD at flow-rate of 8 lpm.

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