BOD Removal by Adsorption Approach

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Abstract— Biochemical Oxygen Demand is an important factor that is to be dealt carefully in wastewater treatment. Biochemical oxygen demand (BOD) is the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period. Commonly, in treatment plants BOD is removed in various units like trickling filter, activated sludge unit, rotating biological contactors etc. The principle in these methods is to ensure break down of organic materials by micro organisms. In this experiment, a batch flow study was made to monitor removal of BOD by passing restaurant effluent through a pipe column containing grains (less than 10mm) of laterite. BOD reduction in the various samples was monitored for different flow rates and column heights. Fairly good reduction of BOD was observed, to a maximum extent of 91.3%. The reduction in the BOD was due adsorption of organic materials to lateritic grains. This can be viewed as a good pre treatment measure to reduce BOD before actually taking wastewater to treatment plant.

Key words: Laterite and BOD

I. INTRODUCTION

BOD in the wastewater is due to presence of excess of organic pollutants and depletion of Dissolved Oxygen due to bacteriological activities. Often, when industrial wastewater enters the municipal sewage, BOD levels may reach excessively high. This condition is harmful to the survival of aquatic animals.BOD removal in biological reactors is an important part of the treatment. Presence of high BOD may increase size of the reactors.

A batch and column study conducted by researchers showed that adsorption can be very effectively used in removing BOD to an extent of 95% from wastewater using Bagasse Fly ash [1]. Another study revealed that COD and BOD can be reduced from coffee processing wastewater using adsorbent Avacado peel carbon and activated carbon [2]. It was shown that Activated carbon can also remove BOD and COD to a significant extent. It was found that for dosages of activated carbon in the range of 50–150 mg/l, the removal efficiencies for BOD increased from 27–70% to 76–94% [3]. In another study, a textile mill wastewater treatment was carried out using activated charcoal as adsorbent to remove COD and BOD in which various parameters like adsorbent dose, contact duration, temperature and agitator speed were considered. The efficiencies of removal found to be 87.6 %, 81.0% respectively [4].

In this study, before the wastewater is taken to the municipal sewer an attempt is made to reduce BOD of a restaurant effluent, using adsorption process. The organic matters responsible for BOD adsorbed to the Laterite adsorbent. The reduction in the BOD can considerably reduce the load on the treatment plant.

II. METHODOLOGY

Laterite stones taken from local quarry were crushed in to pieces and sieved. Grains passed through 10mm sieve were considered for the study. A polyvinyl chloride of height 3m was taken for vertical column study. The crushed pieces of the laterite were placed inside this column. In order to collect the treated water samples two outlet taps were provided at 1.5m and at bottom of the pipe. This setup was installed outside a chosen restaurant for the study. The usual flow rates of the restaurant effluent were monitored and three similar such flow rates 0.25liters per second (lps), 0.5lps and 0.75lps were considered for the study. Arrangements were made to maintain a constant flow rate during each trial. After screening process, Effluent was allowed to pass through the pipe. Once the flow stabilized, two samples from 1.5m tap and 3m tap were collected and tested for 5 day BOD. A water sample before passing through the column was also collected in order to know the initial BOD concentration. The experiment trials were carried out for all the pre-decided flow rates. For each trial new crushed pieces of laterite were filled in the column. In the second phase, laterite grains of size above 10mm and below 20mm were used for the study. Similar trials were carried out.

In the third phase, in order to assess effect of continuous exposure of wastewater to the adsorbent, 0.5lps of wastewater was continuously allowed to pass through the column for 48hours without replacing the grains. Samples were collected and tested for BOD.

III. RESULTS AND DISCUSSION

The results obtained during three phases are discussed in this section. From Table 1, it is evident that BOD reduction has taken place considerably in Phase I. For a given size of the laterite grain and lowest flow rate, sample drawn from bottom tap gave better results, at an extent of 91.3%. This is due to longer exposure and higher distance travel in the column.

Phase I, Grain size – less than 10mm				
Tap	Initial BOD (mg/l)	Flow Rate (lps)	Final BOD (mg/l)	BOD removal (%)
1	321	0.25	55.5	82.7
2			27.9	91.3
1	321	0.5	65.2	79.7
2			36.9	88.5
1	321	0.75	79.6	75.2

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2			49.4	84.6

Table 1: Bod Removal Efficiency in Phase 1

A similar trend continued in Phase II. But the maximum efficiency remained lower than Phase I, as size of the grain was more (Table 2).

Phase II, Grain size – between 10mm and 20mm				
Tap	Initial BOD (mg/l)	Flow Rate (lps)	Final BOD (mg/l)	BOD removal (%)
1	400	0.25	88	78.0
2			46.8	88.3
1	400	0.5	94.4	76.4
2			68.8	82.8
1	400	0.75	132.4	66.9
2			103.6	74.1

Table 2: Bod Removal Efficiency in Phase 2

In Phase III efficiency went down significantly as compared to Phase I, even though the conditions were similar to Phase I. The maximum efficiency was only 62.2% in this Phase. This depicts that longer exposure has reduced the adsorption rate (Table 3).

Phase III, 48hours continuous flow, Grain size – less than 10mm				
Tap	Initial BOD (mg/l)	Flow Rate (lps)	Final BOD (mg/l)	BOD removal (%)
1	592	0.25	262.3	55.7
2			223.8	62.2
1	592	0.5	296.0	50
2			256.9	56.6
1	592	0.75	328.6	44.5
2			296.6	49.9

Table 3: Bod Removal Efficiency for Continuous Flow

IV. Conclusion

From the results obtained it can be concluded that BOD can be removed using adsorption technique. The results revealed that the organic matters from the effluent adhered better in the case of smaller grain as compared to bigger sized grain. Even flow rate and column height also made influence on the rate of adsorption. However the adsorption decreased after long exposure with adsorbate.

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