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Filtration of Wastewater using Natural Adsorbents

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Abstract - *Domestic wastewater treatment is becoming more critical due to diminishing water resources and thus resulting water scarcity especially during summer in many parts of the country. Treatment of wastewater by adsorption is an effective method for the removal of organic pollutants from wastewater. This paper focuses on the effect of adsorbents on the characteristics of wastewater and the use of these adsorbents in the multimedia filter. Laterite soil, activated carbon, saw dust, sugarcane bagasse are the adsorbents used. A bed height of 20 cm was used for each of the adsorbents. Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Chlorides, Sulphates, Turbidity and pH tests were conducted. Laterite soil is found to be the most efficient in removing the COD of wastewater of 89%, activated carbon 48%, saw dust 15%, sugarcane bagasse 79.7 %. Activated carbon and laterite soil were most efficient in removing the turbidity of wastewater. With these four adsorbents two multimedia filters were designed, first one in which each of the adsorbents were used at a bed height of 5cm and the second one with laterite soil and activated carbon at 7cm bed height and sawdust and sugarcane bagasse at 3cm bed height. The second multimedia filter was found to the most effective with a COD removal of 89.3%.*

Key Words: COD, BOD, Chlorides sulphates, turbidity, pH, wastewater, filtration, multimedia filter

1. INTRODUCTION

The environmental pollution due to rapid industrialization has created more contemporary problems. Industries have large potential to cause lake pollution, stream pollution and river pollution and thereby causing increase in pollutants into the environment. The environmental pollution is occurring from household level to toxic waste emitting industries. It is mandatory to reduce the levels of chemicals in drinking water, wastewater and water used for agriculture and recreational purposes to the permissible limits recommended by World Health Organization (WHO). Filtration technology is a low-cost treatment technology based on physical process to treat wastewater contaminants like colour, odour, hardness, BOD, COD and suspended solid etc. for a wide range of application in domestic as well as industrial application research on alternate filtration media has expanded the options available for improving excellent quality.

2. OBJECTIVE

The main objective is to design a low cost filter for the treatment of wastewater using natural adsorbents by filtration process and to study the performance of multimedia filter with different packing media such as activated carbon sugarcane bagasse, laterite soil and saw dust.

3. METHODOLOGY

3.1. COLLECTION OF WASTEWATER

The samples were collected from a residential area. The collected samples were analyzed and the values obtained were COD-4288mg/L, BOD-1956mg/L, Chlorides-120mg/L, Sulphates-200 mg/L, Turbidity-650 and pH-6. For further treatment the samples were prepared synthetically.

3.2 ADSORBENTS

All the four adsorbents were collected and the adsorbents were laterite soil, activated carbon, saw dust, sugarcane bagasse. The laterite soil, saw dust, sugarcane bagasse are first washed with tap water and oven dried at 103^0C for 24 hours and then washed with distilled water and oven dried at 103^0C for 24 hours and sieved. The laterite soil passing through 2.36 mm and retained on 300 microns are used. Saw dust passing through 2.36 mm was used. Activated carbon is also washed with distilled water.

3.3 FILTRATION TANK

The filtration tank is a rectangular column having length 4cm, width 4cm and height 1.15m. At the base the tank is provided with holes of 1 mm diameter. The tank is provided with an inverted square pyramid with a hole of 1 cm at the bottom.

3.4 ANALYSIS OF WASTEWATER SAMPLE

The samples were analysed for COD, BOD, Chlorides, Sulphates, Turbidity, pH. From the results shown in Table-1 it is clear that the wastewater is not in the permissible limits. It needs to be treated before discharging.

Table-1 Characteristics of wastewater

PARAMETERS	INITIAL VALUE(mg/L)
COD	5360
BOD	2250
CHLORIDE	149.5
SULPHATE	250
TURBIDITY	700
pH	6

3.5 FILTRATION USING ACTIVATED CARBON

The wastewater was filtered through 20 cm thick bed of activated carbon. The results obtained are given in Table-2. From the results it is clear that all the parameter were decreased by more than 45%.

Table-2 Characteristics of wastewater after filtration using activated carbon

PARAMETERS	INITIAL VALUE (mg/L)	OBTAINED VALUE AFTER FILTRATION(mg/L)	PERCENTAGE REMOVAL
COD	5360	2772	48
BOD	2250	1075.33	52
CHLORIDE	149.5	24.75	83.4
SULPHATE	250	125	50
TURBIDITY	700	85	-
pH	6	7	-

3.6 FILTRATION USING LATERITE SOIL

Wastewater was filtered through 20 cm thick bed of laterite soil. The results obtained are shown in Table-4. From the results it is clear that laterite soil has more removal efficiency than activated carbon. All the parameters except Sulphate content were decreased by more than 80%.

Table-4: Characteristics of wastewater filtered through 20 cm thick bed of laterite soil

PARAMETERS	INITIAL VALUE (mg/L)	OBTAINED VALUE AFTER FILTRATION(mg/L)	PERCENTAGE REMOVAL
COD	5360	544	89
BOD	2250	286	87.28
CHLORIDE	149.5	24.75	83.4
SULPHATE	250	225	10
TURBIDITY	700	50	
pH	6	7	

3.7 FILTRATION USING SAW DUST

Wastewater was filtered through 20 cm thick bed of saw dust. The results obtained are shown in Table-5. From the results it is clear that saw dust is not effective in removing COD, BOD, and Sulphates. But the chloride content is decreased by 91.8%.

Table 5: Characteristics of wastewater filtered through 20 cm thick bed of saw dust

PARAMETERS	INITIAL VALUE (mg/L)	OBTAINED VALUE AFTER FILTRATION(mg/L)	PERCENTAGE REMOVAL
COD	5360	4512	15
BOD	2250	1400	37.7
CHLORIDE	149.5	12.25	91.8
SULPHATE	250	250	0
TURBIDITY	700	100	
pH	6	7	

3.8 FILTRATION USING SUGARCANE BAGASSE

Wastewater was filtered through 20 cm thick bed of sugarcane bagasse. The results obtained are shown in Table-6. From the results it is clear that the sugarcane bagasse is effective in removing COD, BOD, Chlorides, and Turbidity.

Table- 6: Characteristics of wastewater filtered through 20 cm thick bed of sugarcane bagasse

PARAMETERS	INITIAL VALUE (mg/L)	OBTAINED VALUE AFTER FILTRATION(mg/L)	PERCENTAGE REMOVAL
COD	5360	1088	79.7
BOD	2250	700	68.8
CHLORIDE	149.5	18.5	87.6
SULPHATE	250	150	40
TURBIDITY	700	100	
pH	6	7	

3.9 FILTRATION USING MULTIMEDIA FILTER

Wastewater was filtered through a bed consists of 5 cm of activated carbon, laterite soil, saw dust and sugarcane bagasse each with sugarcane bagasse on the top below that saw dust below that activated carbon and at the bottom laterite soil . The results obtained are shown in Table-7. The multimedia filter showed better removal efficiency than the adsorbents when used alone.

Table-7: Characteristics of wastewater filtered through a bed of 5 cm of activated carbon, laterite soil, saw dust and sugarcane bagasse each.

PARAMETERS	INITIAL VALUE (mg/L)	OBTAINED VALUE AFTER FILTRATION(mg/L)	PERCENTAGE REMOVAL
COD	5360	935.5	82.5
BOD	2250	467.75	79.2
CHLORIDE	149.5	12.25	91.8
SULPHATE	250	150	40
TURBIDITY	700	100	
pH	6	7	

Wastewater was filtered through 7 cm of activated carbon and laterite soil each and 3 cm of saw dust and sugarcane bagasse each in the same order as in the first multimedia filter. The results obtained are shown in Table-8. The second multimedia filter showed better removal of all the characteristics than the first multimedia filter where all the adsorbents were of same bed height.

Table-8: Characteristics of wastewater filtered through a bed consists of 7cm of activated carbon and laterite soil each and 3 cm of saw dust and sugarcane bagasse each

PARAMETERS	INITIAL VALUE (mg/L)	OBTAINED VALUE AFTER FILTRATION(mg/L)	PERCENTAGE REMOVAL
COD	5360	569.5	89.3
BOD	2250	71.325	96.83
CHLORIDE	149.5	12.49	91.6
SULPHATE	250	150	40
TURBIDITY	700	100	
pH	6	7	

4. CONCLUSIONS

From the analysis of wastewater after passing through different filter media it is found that, laterite soil has been found to be an effective adsorbent for the removal of COD, BOD, chlorides, Sulphates, Turbidity and pH. Saw dust has been found to be the least effective for the removal of COD, BOD, chlorides, Sulphates, Turbidity and pH. When compared to others laterite soil and activated carbon gave less turbid effluents and saw dust and sugarcane bagasse helped in reducing chlorides and sulphates content.

All the four adsorbents were used to make the multimedia filter. The multimedia filter was made with all the four adsorbents in equal height with sugarcane bagasse on the top below that saw dust below that activated carbon and at the bottom was laterite soil. The percentage removal of COD, BOD, Chlorides, Sulphates were found to be 82.5%, 79.2%, 91.8%, 40% respectively and the Turbidity was also reduced. The efficiency of this filter was found to be similar when laterite soil was used as adsorbent alone so another multimedia filter with 7 cm of activated carbon and laterite soil each as laterite soil was more efficient in removing the characteristics of wastewater and activated carbon in removing the turbidity and 3 cm of saw dust and sugarcane bagasse each in the same order as in the first multimedia filter is made. The percentage removal of COD, BOD, Chlorides, Sulphates were found to be 89.3%, 96.83%,91.6%, 40% and the Turbidity was also found to be reduced. From these results it is clear that the second multimedia filter with more laterite soil and activated carbon has been found to be effective in the removal of COD, BOD, Chlorides, Sulphates, Turbidity and pH of the wastewater than the multimedia filter with equal bed height of adsorbents. From this study it can also be concluded that multimedia filter may be considered as an efficient pretreatment process for wastewater treatment

5. REFERENCES

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