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RESEARCH ARTICLE

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Treatment of Ayurvedic Industrial Wastewater by Using Banana Peel, Rice Husk and Activated Carbon as Adsorbents

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ABSTRACT

Ayurvedic industries are the leading pharmaceutical industries in world wide. They produce large volume of wastewater during processing and production, which is highly biodegradable in nature. Hence efforts are being made to evaluate the toxicity of herbal pharmaceutical effluents using filtration followed by adsorption using banana peels, rice husk and activated carbon as adsorbents. The reduction in turbidity for the Ayurvedic industrial wastewater is 96%, reduction in BOD is 84% and reduction in COD is 85% by adsorption using rice husk. The reduction in turbidity, BOD and COD is obtained as 83.7%, 77.5% and 72.5% respectively for adsorption using banana peel. By using activated carbon reduction in turbidity and BOD is obtained as 99.9% and COD is 99.7%. The optimum adsorbent depth and optimum time is obtained as 45cm and 90min respectively.

Key Words: Filtration, Adsorption, Turbidity, BOD, COD and DO

I. INTRODUCTION

About 80% of world population are using herbal medicines. Herbal materials, herbs, herbal preparations and finished herbal products are included in herbal medicine. Which contain active ingredients from plants or other plant materials. Of all the sciences, in the field of herbal medicine India possesses the longest and most glorious tradition. Ayurveda, the science of body, mind and long life is said to have divine origin. In the diseases, it uses mostly minerals and medicinal plants to bring back the body equilibrium.

The usage of herbal medicines gained popularity due to their efficacy, cultural acceptability, safety, and lesser side effects. The part of the physiological functions of living flora presents in the herbal medicines as chemical constituents and hence they are believed to have better compatibility with the human body. The herbal medicines are used for age related diseases namely diabetic wounds, osteoporosis, memory loss, immune and liver disorders etc.

The herbal drugs in global market are growing rapidly. Annually, the global market for herbal medicines currently stands at over $ 60 billion. The herbal medicines sale is expected to get higher at 6.4% an average annual growth rate. The market of herbal medicines has grown at an expressive rate due to the contribution of numerous significant factors. According 1991 estimate, the herbal medicine market in the European countries was about $ 6 billion, with Germany accounting for $ 3 billion, Italy $ 0.6 billion and France $ 1.6 billion while in other countries was $ 0.8 billion. In 1996

estimate, the herbal medicine market in the European countries was about $ 10 billion, in India about $ 1.0 billion, in USA about $ 4 million, and in other countries was $ 5.0 billion. In 1997, the European market alone reached about $ 7.0 billion, with German market accounting for $ 3.5 billion, Italy $ 700 million, France $ 1.8 billion, the United Kingdom $ 400 million, Spain $ 300 million, the Netherlands about $ 100 million.

According to WHO, up to 30–50% population depends on herbal medicines and up to 80% of the population in Africa depends on traditional medicine for primary health care. In North America, Europe and other industrialized regions over 50% of population have used traditional medicines to treat their diseases.

In India, around 7000 industries (large, medium and small scale) are manufacturing Ayurvedic pharmaceutical products, which are distributed in all the segments of the country. According to WHO, in both developing and developed countries, a considerable percentage of people use medicinal plant remedies and the number is on the increase, especially among younger generation. Ayurvedic pharmaceutical wastewater is moderately strong with BOD and COD concentration in the range of 1200-15660 mg/l and 21960-26000 mg/l respectively and equally high concentration of SS of 5460-7370 mg/l.

This work aims to enable Ayurvedic industry to make them more eco-efficient, through analysis and evaluation of their wastewaters and implementation for treating these wastewater's using adsorbents. The wastewater treatment study is initiated with filtration process and adsorption process using banana peel, rice husk and activated carbon as adsorbents. This work also evaluate the removal efficiencies of DO, COD, BOD and turbidity.

II MATERIALS

Banana peel and rice husk is prepared by washing these materials with tap water followed by distilled water. Then dried in oven at 100°C for 24 hours and ground to a fine powder and sieved through 300 micron sieve. Activated carbon is collected from market.

III METHODS

***A. Filtration*:** Filtration tank consist of 4 layers of filter media. The first two layers are plastic scrubber and sand. Fine sand particles passing through IS 2.36 sieve are used with a depth of 80mm. The next layer is aggregates, which retain on 20mm IS sieve and pass through 10mm IS sieve. The bottom most layer of the filter is filled with 20mm gravels with a filtration depth of 80mm. After filtration, the filtered water is used for adsorption.

Fig 1. Set up of Filtration Tank

B. Adsorption: The column apparatus is filled with adsorbent of 45 cm height. At first 1000 ml of distilled water were added into the apparatus and kept for 30 minutes with the outlet closed. After 15 minutes 950 ml water is collected when the outlet was opened. The waste water is kept in the overhead tank and then allowed to flow into column apparatus through inlet by drop by drop. After keeping for a retention period of 30 minutes with the outlet closed, then water were collected from the collection tank. Then, the removal efficiency was determined. Also the test is conducted by varying retention time of 60 and 90 minutes. Similarly the above procedure was repeated with varying height of adsorbent of 15 and 30 cm.

IV RESULTS & DISCUSSION

A. Wastewater Characteristics

Waste water is collected from Keraleeya Ayurveda Samajam at Shornur. The wastewater characteristics were tested before the commencement of the project and the various characteristics like DO, COD, BOD and turbidity were tested and were compared with the limit. Table I shows the initial characteristics of wastewater.

Table I: Initial Wastewater Characteristics

Sl. No.	Parameter	Value
1	Turbidity in NTU	380
2	BOD in mg/l	2900

3	COD in mg/l	4416
4	DO in mg/l	0

B. Filtered Water Characteristics: Table II shows the water characteristics after filtration. The initial value of parameters has been decreased after filtration.

Table II: Water Characteristics after Filtration

Sl. No.	Parameter	Value
1	Turbidity in NTU	376
2	BOD in mg/l	2330
3	COD in mg/l	3528
4	DO in mg/l	1.3

C. Effect of Adsorbent Depth : The filtered Ayurvedic wastewater was treated with different depth of adsorbent to study its effect on turbidity, BOD, COD and DO content present in the waste water.

Table III: Activated Carbon as Adsorbent with Varying Depth

Sl. No.	Parameter	Values at depth of		
		15cm	30cm	45cm
1	Turbidity in NTU	4.6	3.9	1.6
2	BOD in mg/l	34	20	6
3	COD in mg/l	127	93	21
4	DO in mg/l	6.9	7.8	9.5

Table IV: Rice Husk as Adsorbent with Varying Depth

Sl. No.	Parameter	Values at depth of		
		15cm	30cm	45cm
1	Turbidity in NTU	48	42	26
2	BOD in mg/l	796	626	519
3	COD in mg/l	1212	1016	863
4	DO in mg/l	3.3	4.9	6.2

Table V: Banana Peel as Adsorbent with Varying Depth

Sl. No.	Parameter	Values at depth of		
		15cm	30cm	45cm
1	Turbidity in NTU	118	96	74
2	BOD in mg/l	1028	958	732
3	COD in mg/l	2236	1999	1475
4	DO in mg/l	3.2	3.8	5.2

The depth of adsorbent affects the removal percentage of contaminants to a large extent. There is a fall in the turbidity, BOD, COD and DO with the increase in the adsorbent depth. From the analysis, it is clear that maximum reduction is obtained at an adsorbent depth of 45cm.

D. Effect of Retention Time

The optimum time is found out from the optimum depth. The optimum depth that has been obtained as 45cm. The optimum depth was obtained by conducting tests under varying depths of 15cm, 30cm and 45cm.

Table VI: Activated Carbon as Adsorbent with Varying Time

Sl. No.	Parameter	Values at time of		
		30min	60min	90min
1	Turbidity in NTU	3.1	1.6	1
2	BOD in mg/l	12	6	2
3	COD in mg/l	74	21	13
4	DO in mg/l	8.2	9.5	11.7

Table VII: Rice Husk as Adsorbent with Varying Time

Sl. No.	Parameter	Values at time of		
		30min	60min	90min
1	Turbidity in NTU	39	26	18
2	BOD in mg/l	623	519	461
3	COD in mg/l	923	863	698
4	DO in mg/l	5.8	6.2	7.6

Table VIII: Banana Peel as Adsorbent with Varying Time

Sl. No.	Parameter	Values at time of		
		30min	60min	90min
1	Turbidity in NTU	86	74	62
2	BOD in mg/l	899	732	654
3	COD in mg/l	1806	1475	1210
4	DO in mg/l	4.1	5.2	6

Keeping adsorbent depth as 45 cm and retention time have been varied. The samples are taken out for estimation of turbidity, BOD, COD and DO after every 30 minutes. It has been noticed that rate of adsorption is lower at the beginning and then it increases with the increasing time. This may be due to the availability of less adsorption sites in the beginning. The optimum retention time was found to be 90 minutes because the percentage

reduction in the parameters is high at 90 minutes of adsorption.

E. Percentage Reduction in Parameters after Adsorption: The optimum depth of adsorption and optimum retention time is obtained as 45cm and 90min respectively. Fig. 2 shows the Percentage reduction in parameters after adsorption with activated carbon.

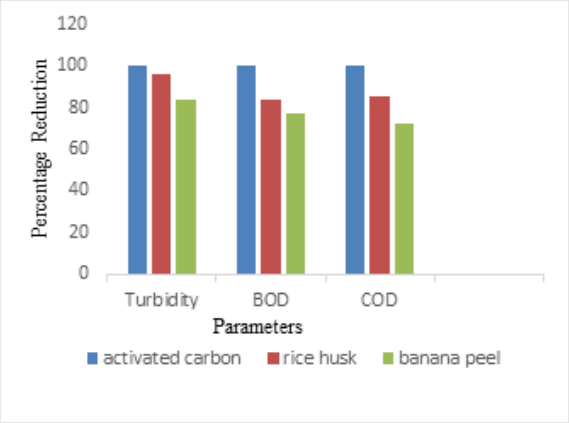

Fig 2. Percentage reduction in parameters after adsorption

From the graph, it can concluded that the highest removal efficiency is obtained for the adsorption by activated carbon and the minimum highest removal efficiency is obtained for the adsorption by banana peel. The reduction in turbidity for the Ayurvedic industrial wastewater is 96%, 83.7% and 99.7% respectively for rice husk, banana peel and activated carbon. The BOD removal is obtained as 84%, 77.5%, and 99.9% respectively for rice husk, banana peel and activated carbon. The COD removal efficiency for rice husk, activated carbon and banana peel is obtained as 85%, 99.7% and 72.5% respectively.

V CONCLUSIONS

Adsorption is one of the fundamental process in physio-chemical treatment of wastewater. The advantage of adsorption method comparing with other system is that, it needs lower sensitivity to diurnal flow and concentration variations and to toxic substances, lower land area requirements, potential for significant heavy metal removal, greater flexibility in operation and design and organic waste removal. Treatment of pharmaceutical wastewater collected from the industry in shornur was carried out using activated carbon, banana peel and rice husk. From this study, it can be concluded that, activated carbon is the best adsorbent for the treatment of Ayurvedic wastewater. It was observed substantial reduction in the pollutants in terms of COD, BOD, DO and turbidity. The optimum retention time and adsorption depth was observed to be 90 minutes and 45cm respectively. With increase in depth of the adsorbent and retention time, the percentage reduction in turbidity, COD and BOD was increased. The DO content was also increased with increase in time and depth.

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