A STUDY ON EFFECT OF FLY ASH AND CASUARINA EQUISETTIFOLIA AGAINST DYE WASTE AND SYNTHETIC SOLUTION

M. Madhu Mathi

PG Scholar Department of Civil Engineering, Pandian Saraswathi Yadav Engineering College, Sivagangai, India

Abstract

The purpose of the study was to investigate the potentiality of fly ash in its natural form and Casuarina Equisettifolia wood activated carbon, to adsorb COD and colour from synthetic solution and dye waste. Batch adsorption studies were performed with synthetic solution and dye effluent. The dye effluent was collected from near bank of Vaigai River, located at Madurai. Fly ash and Casuarina Equisettifolia wood activated carbon samples with different proportions were employed to study the effect of contact time on their COD and colour removal capacity. The optimum dosage was determined and then the ability of fly ash and CE bark wood activated carbon, to adsorb COD and colour from dye effluent was also determined.

Keywords: *COD, Colour, Adsorbent, Batch Study.*

Introduction

Activated carbon adsorption is a promising technique for the removal of organic and inorganic pollutants from wastewater. Colour and COD are the major pollutants from Textile, Tannery, Dyeing and other industries, which dispose their wastes into the inland water bodies. The concentration of colour and COD must be brought within the threshold limit before discharging into the ecosystem. The commercial activated carbon adsorption technique is not an economical method for removal of organic and inorganic constituents from wastewater. In the present study, an attempt was made to replace commercial activated carbon with other low cost adsorbents for effective removal of colour and COD.

Materials and Methods

Collection and Preparation of Sample

The wastewater from the common effluent treatment plant located in Madurai was taken for the study of colour removal and synthetic solution was prepared to study the COD removal efficiency.

Adsorbent

The bark of Casuarina Equisettifolia wood and fly ash was selected as adsorbent for this study. he wood and fly ash are available in abundance, which is disposed as refuse. The materials selected for adsorbent will reduce the quantity of waste generated as well as will be of low cost, to that of commercial activated carbon.

Preparation of Bark of Casuarina Equisettifolia Wood activated Carbon

The bark of Casuarina Equisettifolia was taken from sawmill. The bark was shredded and sieved using 600 micron sieve. Initially the material is mixed with concentrated sulphuric acid and heated in a muffle furnace by slowly raising the temperature upto 108^0C for 8 hours. During this process the bark of Casuarina Equisettifolia was converted into char. The char was subsequently washed with distilled water. The washed material is soaked in 1% of Sodium bicarbonate solution prepared using distilled water for 8 hours to drive of CO_2, CO and other acetic acid vapour. The material was washed with distilled water to make it free from burnt matter. Then the elemental carbon was dried in oven. Thus the obtained product is called as the sulphonate activated carbon.

Fly Ash

Thermal power generation through coal combustion produces minute particles of ash that causes serious environmental problems. It is known as Fly ash. These ash particles consists of SiO_2, Al_2O_3, oxides of iron, Ca, Mg and toxic heavy metals like Pb,Ar,Co,Cu. Fly ash was collected from thermal power plant , Tamilnadu. It is finely divided CCB collected by electrostatic precipitators from the flue gases.

Batch Adsorption Studies

Generally adsorption process is done in two ways namely,

- Batch flow system
- Continuous flow system

Colour Removal

The batch adsorption has been employed in the present study due to its simplicity wherein a predetermined quantity of adsorbent (5gm, 10gm, 15gm, 20gm) is mixed with known amount of dye waste (200ml), in four beakers. The rate of agitation is kept constant, throughout the experiment. The percentage of colour reduction is noted at a periodic interval of 3days, 7days, 10 days using spectrophotometer. All these experiments were carried out at the ambient temperature. Wastewater sample were also analysed for pH, colour, turbidity, electrical conductivity, total hardness, chlorides and alkalinity before and after the treatment. The experiment is also repeated for the activated carbon, under identical conditions and the removal capacity of fly ash is compared with that of activated carbon.

COD Removal

The evaluation of fly ash for the COD removal has been done in batch mode, because of its relative simplicity. The batch experiments were run in different glass flasks of 1000ml capacity, using flocculator. The rate of agitation is kept constant through the experiment ensuring equal mixing. All the experiments were carried out at a ambient temperature.

Results and Discussions

The adsorbent fly ash collected from thermal power plant and Casuarina Equisettifolia wood activated carbon was replaced for commercial activated carbon and percentage of COD and colour removal was observed.

The synthetic solution was prepared using potassium sulphate and dye effluent was collected from Vaigai River, at Madurai.

Table 1 Physico – Chemical characteristics of the Dye Waste (Before Treatment)

S.No.	Parameter	Unit	Observed Values
1	Colour	no unit	Dark blue
2	pH	no unit	5.67
3	EC	µs/cm	6.38
4	Turbidity	NTU	4
5	Total hardness	Ppm	173.2
6	Chlorides	ppm	280
7	Hydroxyl alkalinity	ppm	0
8	Carbonate alkalinity	ppm	0
9	Bicarbonate alkalinity	ppm	30

Table 2 Physico – Chemical characteristics of the Dye Waste (After Treatment)

S. No.	Parameter	Unit	Observed Values
1	Colour	no unit	Colorless
2	pH	no unit	7.86
3	EC	µs/cm	7.34
4	Turbidity	NTU	1
5	Total hardness	ppm	219
6	Chlorides	ppm	215
7	Hydroxyl alkalinity	ppm	475
8	Carbonate alkalinity	ppm	850
9	Bicarbonate alkalinity	ppm	0

Percentage of COD Removal From Aqueous Solution

Adsorbent Initial COD –60 ppm

Dosage in gms	Fly Ash				Bark of CE Wood				Commercial Activated Carbon			
	5 min	10 min	20 min	30 min	5 min	10 min	20 min	30 min	5 min	10 min	20 min	30 min
5	40	60	80	100	25	30	45	60	60	86	100	100
10	60	70	90	100	45	65	75	88	78	92	100	100
15	60	80	100	100	62	78	90	96	86	100	100	100

Fly Ash			Bark of CE Wood			Commercial Activated carbon		
Contact Time	**COD ppm**	**% Reduction**	**Contact Time**	**COD ppm**	**% Reduction**	**Contact Time**	**COD ppm**	**% Reduction**
5	560	6.67	5	585	2.50	5	286	52.33
10	400	33.33	10	462	23.00	10	162	73
15	320	46.67	15	396	34.00	15	12	98
20	320	46.67	20	378	37.00	20	0	100
25	240	60.00	25	302	49.67	25		
30	160	73.33	30	212	64.67	30		
35	160	73.33	35	186	69.00	35		
40	80	86.67	40	124	79.33	40		
45	0	100.00	45	76	87.33	45		
50			50	22	96.33	50		
55			55	0	100.00	55		

Percentage of Colour Removal

Time in days	Fly Ash				Bark of CE Wood				Commercial Activated Carbon			
	5 min	10 min	15 min	20 min	5 min	10 min	15 min	20 min	5 min	10 min	15 min	20 min
3	-	2.31	16.2	56.5	-	-	3.68	18	58.3	64.8	81	81.5
7	0.93	4.16	24	59.7	-	1.63	28.3	36.8				
10	1.85	6.94	30.55	65.27	2.48	9.56	34.6	52.8				

Discussions

The most important experimental data from the adsorption study were discussed as follows. The wastewater characteristics before and after treatment shows a vigorous change.

- The colour of the wastewater sample was removed at higher rate.
- The pH of the solution before the treatment is acidic and changes to alkalinity stage, after treatment.
- Electrical conductivity and turbidity shows a marginal change after the treatment.
- The chloride content present in the sample reduces after the treatment.
- The total hardness increases after the treatment.

Conclusion

The results obtained for adsorption of colour, using fly ash and Casuarina Equisettifolia wood activated carbon shows an increase in the removal capacity.

References

1. Midori Kawake et.al (1997), "Factors Determining Chemical Oxygen Demand in Tokyo Bay" – Journal of Oceanography, Vol 53, pp 443-453.
2. Kottiah (1994), "Environmental Engineering Laboratory Manual", Charoter Publishing House Anand, New Delhi.
3. VijenderSahu, "Fly ash based Low cost method for Cod removal from Dye astewater".
4. Sanghi et.al.(2004), " Review on decolourisation of aqueous dye solutions by low cost adsorbent", Journal of Environmental Science and Engineering, Vol 46, No. 2, pp 172-178.
5. Metcalf and Eddy, "Wastewater Engineering Treatment Disposal and Reuse",Tata McGrawHill Publishing Company Limited, New Delhi.
6. J.Vijayaragavan, T.B. Pushpa, S.J.S Basha, J.Jehan, Removal of a basic dye from aqueous solution by Gracilariacorticata, J.Environ. Biotechnol. Res. 1,(2015)30-35.
7. D. Sud, G.Maharajan,,M.Kaur, Agricultural waste material as potential adsobent for Sequentering heavy metal ions, from aqueous solution-A review,Bioresour. Technol.99, (2008) 6017-6027.
8. N. Subbarao, C. Rodriguez-Barrueco. Casuarina, Science Publishers, Inc., LaBombard Road North, Lebanon, 1995.
9. H.M.F. Freundlich, Over the adsorbtion solution, J.Phys. Chem. 57, (1906) 385-470.
10. Y.S.Ho. McKay, sorbtion of dye from aqueous solution by peat, Chem.Eng. Div. 89,