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Removal of Refractory COD from Petrochemical Industry waste water using Various Agro Based Activated Carbon: A Comparative Study

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ABSTRACT

The present study was undertaken to compare the adsorption efficiency of removal of refractory organic compound which is responsible for refractory COD from petrochemical industrial waste water form agro based activated carbon prepared from banana tree root residue, teak wood saw dust and commercial available activated carbon (180 & 120 MB value).Activated carbon prepared by impregnation with $ZnCl_2$ and carbonization at 600ºC.Adsorption capacity has been tested for de-colourisation of aqueous solution contain Methylene blue. The experimental examinations of adsorption were carried out with various contact time and various doses of activated carbon to determination of optimum dose and effective time to removal of Refractory COD. The agro based activated (banana tree root residue give 8.76 % removal efficiency at 8.5 gram dose with 50 min contact time and Teak wood saw dust activated carbon achieved 23.96% removal efficiency at 7.5 gram dose with 50 min contact time. The optimum dose of 180 & 120 MB Value Commercial available activated carbon was 7 and 17 with 50 min effective contact time and COD removal efficiency was 36.19% & 21.96 % respectively.

Key Word: Adsorption, Agro Based Activated Carbon, Refractory COD, Banana Tree Root Based Activated Carbon, Teak Wood Saw Dust, Adsorption Efficiency.

Introduction

Pollution of water by organic and inorganic chemicals is of serious environmental concern. Industrial wastewaters result from spills, leaks, and product washing and water resulting from cooling processes. The organic content of wastewater is traditionally measured using lumped parameters such as biological oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS) and total organic carbon (TOC). These parameters as such do not show any chemical identity of organic matter. In recent years increasing awareness of the environmental impact of COD has prompted a demand for the purification of industrial wastewaters prior to discharge into natural waters. This has led to the introduction of more strict legislation to control water pollution in terms of COD. Conventional treatment technology have not been adopted by various industries as they are not economic viable and technically feasible

to achieve the required standard set for the disposal effluents on surface water body hence, it is worthwhile, to explore the possibility of using non conventional material in their natural and chemically activated form for removal of various parameters.

A number of conventional treatments have been considered for treatment of wastewater contaminated with organic substances. Among them adsorption process is found to be the most effective method for wastewater treatment process during recent years. However, due to its high cost and about 10 - 15% loss during regeneration, unconventional adsorbents like fly ash, peat, lignite, root, wood, stem, bagasse pith, wood, saw dust, periwinkle shells, etc. have enhanced the several investigations and adsorption characteristics have been widely investigated for the removal of refractory materials (Pandey et al., 1985; Badmus et al., 2007; Mall et al., 1994) for varying degree of success. This paper deals with the results of the batch adsorption tests to establish adsorption capacity of the activated carbon prepared from Banana tree root residue and teak wood saw dust for the removal of COD in wastewater.

This study is aimed to analyze the adsorption capacity of activated carbon prepared from Banana tree root residue and Teak wood saw dust for the removal of organic and inorganic compounds from petrochemical industrial wastewater effluent and also comparative study on the adsorption efficiency of activated carbon as an alternative media over commercial available activated carbon.

Materials and Methods

Banana tree root residue and teak wood saw dust used to prepare Activated carbon. Since banana tree roots do not have any further use and it required to be disposed off at the end of the crop season The Experimental parameters considers in this study are given below table.

parameters	Banana tree root base activated carbon	Teak Wood Saw Dust	Commercial available activated carbon	Commercial available activated carbon
Passing From Sieve Size	150 µ (micron)	150 µ (micron)	150 µ (micron)	150 µ (micron)
MB Value	122	148	180	120
Moisture content (%)	9.32	6.78	4.79	5.12

The wastewater sample used was collected at the point of discharge from the industry. Containers used for sample collection were pretreated by washing with distilled water. The method of analysis of waste water was consistent with the standard methods (APHA, Standards methods for water and waste water analysis). The samples were stored at ambient temperature and parameters were measured in the laboratory. The COD of the samples were estimated before and after adsorption giving different treatment.

Adsorption Studies

Experiments were carried out at ambient temperature in batch study. Batch study was selected because of its relative simple. The batch experiments were run in different glass flask of 250 ml capacity using speed shaker. Prior to each experiment, a predetermined amount of adsorbent was added to each flask. The stirring was kept constant for each run throughout the experiment ensuring equal mixing. Each flask was filled with a known volume of sample and various adsorbent doses. The flask containing the sample was withdrawn from the shaker at the predetermined time interval, filtered through whatmann No. 44 filter paper. The experiments were carried out under different laboratory conditions for best results.

Adsorbent Dose

The Experimental studies were carried out by various amount of adsorbent dose. 1000 ml of wastewater sample was treated with different doses of prepared from agro based activated carbon (Banana tree root residue and Teak wood saw) – 2 to 9 gram/L. The 180 MB Value CAC dose apply for 1 to 7 gram/L and 120 MB value CAC apply 2 to 18 gram/L.

Contact Time

The studies were conducted by agitating 1000 ml sample with best adsorbent dose in and agitating it for different time period, 5 – 60 min. After the predetermined time intervals, the samples were withdrawn, filtered and analyzed.

Results & Discussion

The wastewater sample was characterized in terms of the below parameters (Table 1).

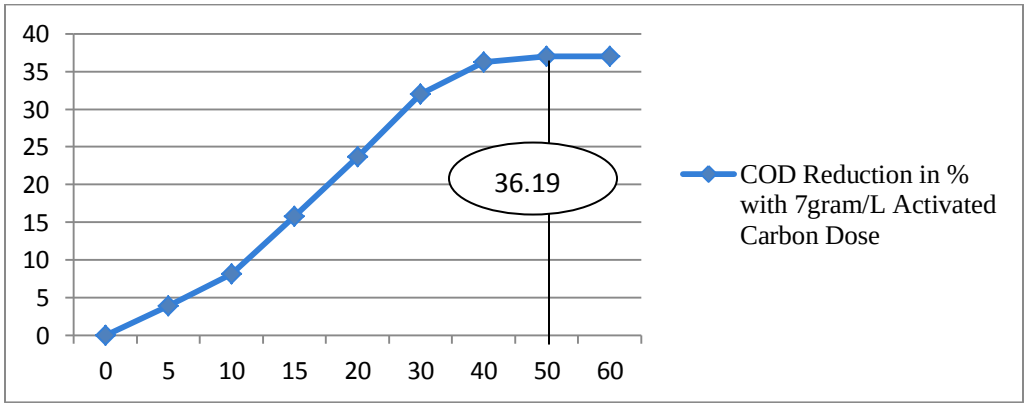
Parameters	Average value
pH	8.09
Temperature	27º-29º
Total Dissolved Solid (mg/l)	1800-2000
Turbidity (NTU)	8.8
Phosphate (mg/l)	5
Ammonical Nitrogen (mg/l)	10-15
Chloride (mg/l)	890
Nitrate Nitrogen (mg/l)	12.5
Chemical Oxygen Demand (mg/l)	1860

Effect of Adsorbent Dose

Results of COD removal value for 180 MB value for various dose and various contact time are shown below. As rate of reduction of COD was very high during 40 to 50 minutes for 6 and 7 g/l dose, So, this 50 minute is consider as effective time for 7 g/l dose.

Table :2 COD Reduction Value for 180 MB Commericial available Activated Crabon

Contact time in (Minute)	COD removal in % at 1 g/l	COD removal in % at 2 g/l	COD removal in % at 3 g/l	COD removal in % at 4 g/l	COD removal in % at 5 g/l	COD removal in % at 6 g/l	COD removal in % at 7 g/l
0	0	0	0	0	0	0	0
5	0.87	1.21	1.78	2.35	2.92	3.46	3.89
10	2.02	3.48	3.48	4.62	5.75	7.34	8.12
15	5.48	6.32	7.46	10.86	13.14	15.66	15.81
20	9.51	9.73	11.43	15.97	19.38	22.32	23.71
30	11.82	15.97	19.38	20.52	26.19	31.75	32.03
40	12.40	15.97	19.95	26.76	31.87	35.08	36.23
50	12.40	16.54	21.65	27.33	32.44	36.19	36.97
60	12.40	16.54	21.65	27.33	32.44	36.19	36.97

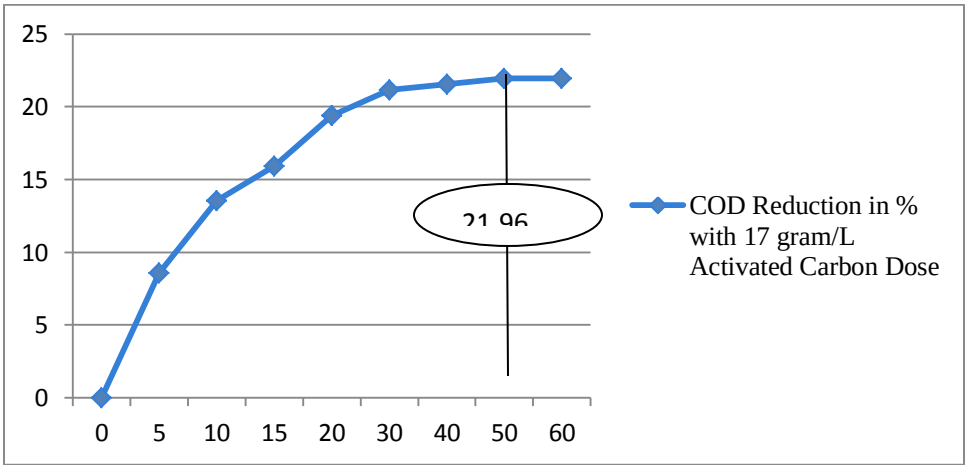


Graph :1 COD Reduction in % for 7 gram/L 180 MB Value Activated Carbon Dose

Table :3 COD Reduction Value for 120 MB Activated Carbon

Contact time in (Min)	COD removal in % at 2 g/l	COD removal in % at 4 g/l	COD removal in % at 6 g/l	COD removal in % at 8 g/l	COD removal in % at 10 g/l	COD removal in % at 12 g/l	COD removal in % at 14 g/l	COD removal in % at 16 g/l	COD removal in % at 17 g/l	COD removal in % at 18 g/l
	0	0	0	0	0	0	0	0	0	0
5	0.59	1.32	2.00	2.87	3.86	5.88	6.78	8.23	8.56	8.92
10	1.98	2.65	3.44	4.29	5.22	8.00	9.54	13.56	13.56	13.56
15	2.78	3.80	4.48	5.46	6.86	9.49	10.52	15.88	15.91	15.91

20	3.53	5.27	6.28	7.24	8.34	11.79	12.69	17.24	19.40	19.95
30	5.23	6.11	7.87	8.79	9.71	12.66	14.77	19.32	21.14	21.14
40	5.54	6.67	8.11	8.82	9.91	13.87	16.71	21.85	21.56	21.56
50	5.49	6.86	8.25	9.32	10.55	14.13	16.83	21.96	21.96	21.96
60	5.95	7.28	8.95	9.48	11.32	14.83	17.37	22.23	22.33	21.96



Graph :2 COD Reduction in % for 17 gram/L 180 MB Value Activated Carbon Dose

Results of COD removal value for 120 MB value for various dose and various contact time are shown below. As rate of reduction of COD was very high during between 40 to 50 minutes at 16 gram/L , 17 gram/L , 18 gram/L dose, so 50 minute is consider as effective time for 17 g/L dose.

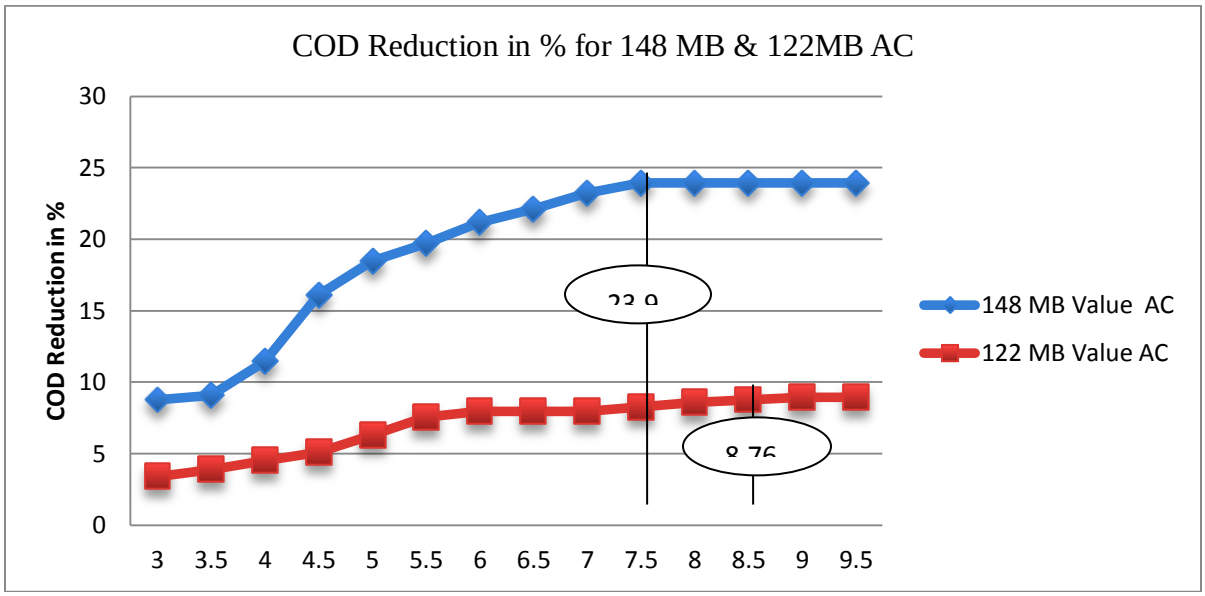
Effect of Contact Time

Table: 3 COD Reduction values for Both Agro based Activated Carbon

Sr no	Dose (mg/L)	COD Reduction in % for (148 MB Teak Wood Saw Dust Based AC)	COD Reduction in % for (122 MB Banana Tress Root Based AC)
0	0	0	0
1	3	8.78	3.41
2	3.5	9.10	3.87
3	4	11.47	4.52
4	4.5	16.12	5.11
5	5	18.49	6.29
6	5.5	19.69	7.54
7	6	21.17	7.96
8	6.5	22.11	7.96
9	7	23.23	7.96
10	7.5	23.96	8.27
11	8	23.96	8.57
12	8.5	23.96	8.76

13	9	23.96	8.96
14	9.5	23.96	8.96

The result obtained shows that the mixing time had greater impact on COD removal. At an optimum time between 40 to 50 min, give maximum COD reduction in % for both commercial and agro based activated carbon. But as agro based activated carbon is new and unknown activated carbon we are considering higher contact time for determination of optimum dose. So that for agro based activated carbon (prepared from banana tree root residue and teak wood saw dust) considering 50 min as effective time for determination of optimum dose.)



Graph :1 COD Reduction in % at 122 MB AC & 148 MB

COD Reduction is achieved by 148 MB Value Teak wood based Activated Carbon with 50 min contact time is 23.96% and Banana Tree Root based (122 MB Value) Activated carbon is 8.76%.

Conclusion

The following conclusions were drawn from the present study. Teak wood saw dust based Activated carbon competed favorably with commercial activated carbon. The results obtained showed that Teak wood saw dust based Activated carbon and Banana tree root based activated carbon can be used in the reduction and removal of refractory COD from petrochemical industrial wastewaters. The effective time for all activated carbon is 30 minute but the optimum dose is varying with each activated carbon. Trend of COD removal by 180 MB Value commercial available activated carbon (CAC) is 36.97% at 7 g/L optimum dose and for 120 CAC is 21.96% at 17 g/l ,which is comparable with teak wood based (148 MB Value) & Banana tree root based (122 MB value) with 23.96% at 7.5g/L dose & 8.76 % at 8.5 g/L dose efficiency respectively. These results show that activated carbons prepared from agricultural waste can be used with greater effectiveness for organic matter removal from industrial wastewater. This

would be of benefit not only to the manufacturing industry in terms of minimizing cost of COD treatment, but also to minimize the impact on the environment.

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