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Utilization of prepared activated carbons in color removal of real textile effluent

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ABSTRACT

Three activated carbons are prepared from peels of selected citrus fruits and are tested in color removal of C.I. reactive red 2 dye. These activated carbons are used in color removal of textile effluent collected from Sri Sairam textile industry, Mangalgiri, Guntur district, A.P., India. Effect of adsorbent dose was studies while taking other control parameters at their optimum conditions. 100% color removal was observed for all three sorbents.

Key words: Activated carbons, textile effluent, citrus fruits, reactive red 2.

INTRODUCTION

Modern environmental legislation is becoming much more internationally coherent and less prescriptive, and focused on prevention of pollution through control of hazardous materials and processes as well as on protection of eco-systems. commercial reactive azo dyes are intentionally, designed to resist biodegradation, i.e., the wastewater originated from reactive dye processes is characterized by poor biodegradability, passing unaffected through conventional treatment systems and discharging into the environment [1-3]. Traditional wastewater treatment technologies have proven to be markedly ineffective for handling the effluents containing synthetic dyes because of the chemical stability of these pollutants [4]. In comparison with conventional processes such as coagulation, flocculation, and biological methods, adsorption has proved to be more versatile and efficient method [5]. In the present study, the prepared activated carbons used in the color removal of textile effluent collected from Sri Sairam textile industry, Mangalgiri, Guntur district, A.P., India, in which reactive dyes are also used for textile coloring.

EXPERIMENTAL SECTION

Materials and Methods:

The activated carbon adsorbents viz., NCDC, NCMC and NCAC are prepared form the peels of citrus documana, citrus medica and citrus aurantifolia fruits respectively. The method of preparation and its equilibrium and kinetic studies in removal of C.I. reactive red 2 dye from aqueous solution, are discussed in the previous paper [6]. All the experiments were carried out in 250 ml conical flasks with 100 ml textile effluent at room temperature (25±2^{o}C). The flasks, along with test solution and 3 g of the adsorbent were shaken in horizontal shaker at 120 rpm for 60 min. Applying German standard method [7], i.e., measurement of color absorbance (in m^{-1}) was done at the standard wavelengths of 436 nm, 525nm and 620nm and by increasing the adsorbent dose, the effluent is treated until the acceptable limit of 7, 5 and 3 m^{-1} [8] absorbance reached at the standard wavelengths of 436, 525 and 620 nm respectively. The collected samples were filtered prior to their treatment with adsorbents to remove any suspended particle.

The color intensity of the sample was expressed as absorption coefficient calculated from the equation

$$\text{Color (absorbance, m}^{-1}\text{)} = \frac{\text{absorbance X dilution factor}}{\text{path length (m)}} \ldots\ldots\ldots\ldots (1)$$

RESULTS AND DISCUSSION

The effluents are highly colored with offence odour. They contain few suspended particles. Samples 1 and 2 are in red color and reaming sample 3 is in blue color. The pH, COD, BOD and the color absorbance values are given in Table 1. High values of COD and BOD are observed for all the three samples. After treating with activated carbons great reduction in COD and BOD values is observed (shown in table 2). However, little decrease in the pH of each effluent is noted. From tables 3 &4, it is obvious that moderate color removal was observed for all samples for all three carbon adsorbents. In order to fix dyes to the fibre strongly, different type of chemicals are used as fixing agents, may be a cause of this moderate percent removal and not only that it may be due to the factors, (i) interaction between the dyes and other components in the effluents, (ii) change of adsorbent surface due to adsorption and (iii) competition of other components of the effluent for active sites on the carbon surface where displacement effects replace the other components from the adsorption sites.

To achieve better results like 7, 5 and 3 m^{-1} absorbance at wavelengths of 436, 525 and 620 nm respectively, and the dose of adsorbents increased for treatment of three effluents at same contact time of 60 min. The effect of increase in adsorbent dose was shown in Figures 1, 2 and 3 for samples 1, 2 and 3 respectively. In all cases, it is observed that as the adsorbent dosage increases the percent removal of color of the effluents also increased.

Table 1. Textile effluents characteristics before treating with carbon adsorbents

Samples	pH	COD (mg l^{-1})	BOD (mg l^{-1})	Color absorbance (absorbance m^{-1})		
				436 nm	525 nm	620 nm
Sample 1	7.7	1015	380	115	96	82
Sample 2	6.4	1040	402	154	112	137
Sample 3	8.2	240	23	102	98	125

Table 2. The pH, COD and BOD of textile effluents after treating with carbon adsorbents

Samples	pH	COD (mg l^{-1})			BOD (mg l^{-1})		
		NCDC	NCMC	NCAC	NCDC	NCMC	NCAC
Sample 1	6.2	48	160	165	5.8	18	21
Sample 2	6.1	224	80	256	18	21	11
Sample 3	7.3	56	48	112	6.1	5.6	12

Table 3. The color absorbance of collected samples at standard wavelengths after treating with carbon adsorbents

Samples	Color absorbance (absorbance in m^{-1})								
	NCDC			NCMC			NCAC		
	436 nm	525 nm	620 nm	436 nm	525 nm	620 nm	436 nm	525 nm	620 nm
Sample 1	50.6	37.4	23.8	44.9	39.4	30.3	40.3	47	33.6
Sample 2	57	38.1	42.5	72.4	42.6	45.2	64.7	47	48
Sample 3	43.9	27.4	45	46.9	40.2	47.5	53	36.3	55

Table 4. The percent removal of color of textile effluents after treating with carbon adsorbents

Samples	% color removal								
	NCDC			NCMC			NCAC		
	436 nm	525 nm	620 nm	436 nm	525 nm	620 nm	436 nm	525 nm	620 nm
Sample 1	56	61	71	61	59	63	65	51	59
Sample 2	63	66	69	53	62	67	58	58	65
Sample 3	57	72	64	54	59	62	48	63	56

In case of sample 1, the percent removal increased from 56 to 93 % at 436 nm, 61 to 94 at 525 nm and 71 to 95 % at 620 nm observed for NCDC by increasing the dose up to 8 g and at 9 g dose 100% percent color removal is observed. The percent removal increased from 61 to 92 % at 436 nm, 59 to 96 % at 525 nm and 63 to 93 % at 620 nm observed for NCMC by increasing dosage up to 9 g and 100% percent color removal is observed at 10 g. The percent removal increased from 65 to 92 % at 436 nm, 51 to 96 % at 525 nm and 59 to 91 % at 620 nm observed for NCAC by increasing dosage up to 9 g and 100% percent color removal is observed at 10 g.

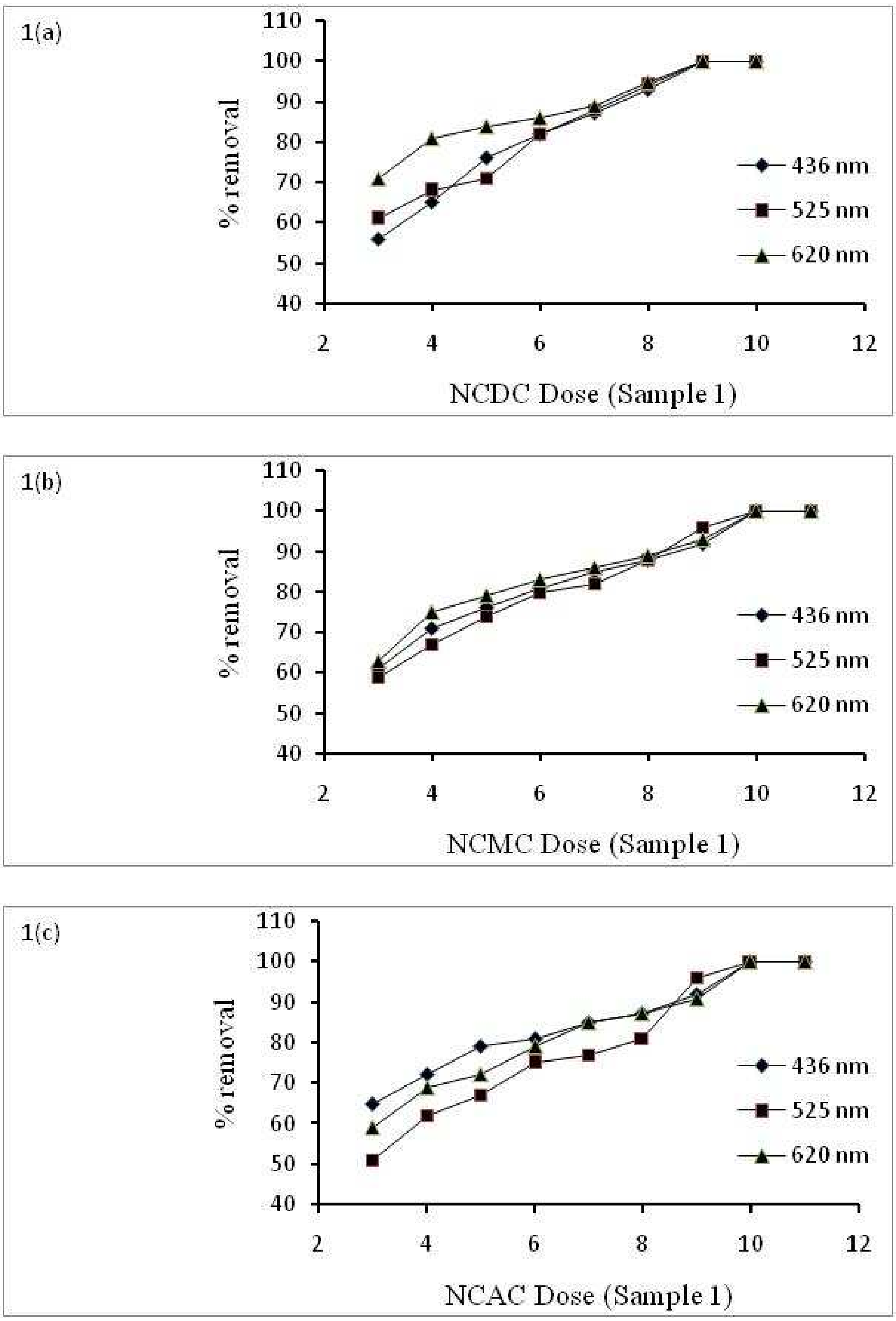

Figure 1. Effect of adsorbent dose on Sample 1 represented as (a) NCDC, (b) NCMC and (c) NCAC

In case of sample 2, the percent removal increased from 63 to 96 % at 436 nm, 66 to 97 at 525 nm and 69 to 98 % at 620 nm observed for NCDC by increasing the dose up to 9 g and at 10 g dose 100% percent color removal is observed. The percent removal increased from 53 to 97 % at 436 nm, 62 to 96 % at 525 nm and 67 to 98 % at 620 nm observed for NCMC by increasing dosage up to 10 g and 100% percent color removal is observed at 11 g. The percent removal increased from 58 to 95 % at 436 nm, 58 to 97 % at 525 nm and 65 to 98 % at 620 nm observed for NCAC by increasing dosage up to10 g and 100% percent color removal is observed at 11 g.

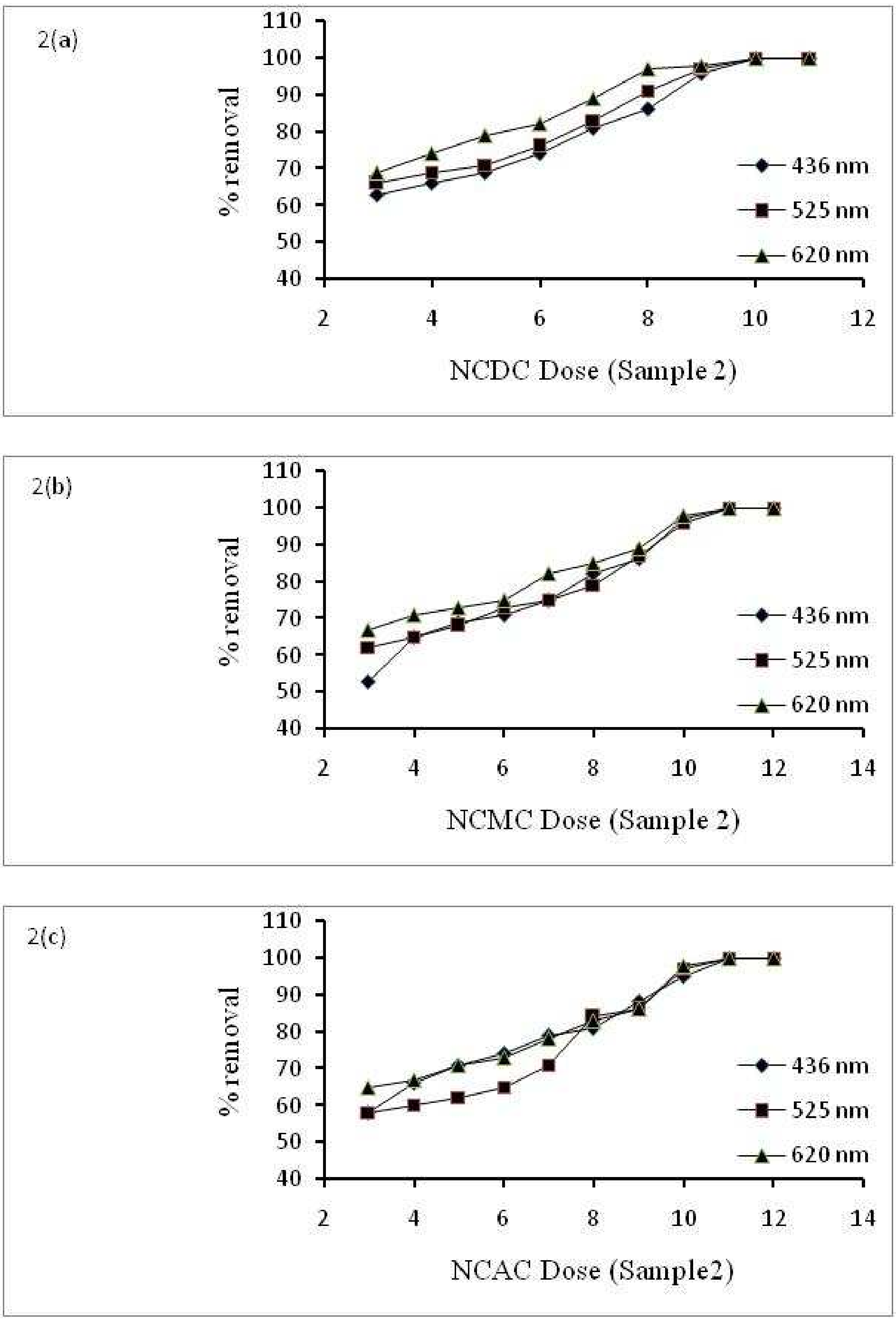

Figure 2. Effect of adsorbent dose on Sample 2 represented as (a) NCDC, (b) NCMC and (c) NCAC

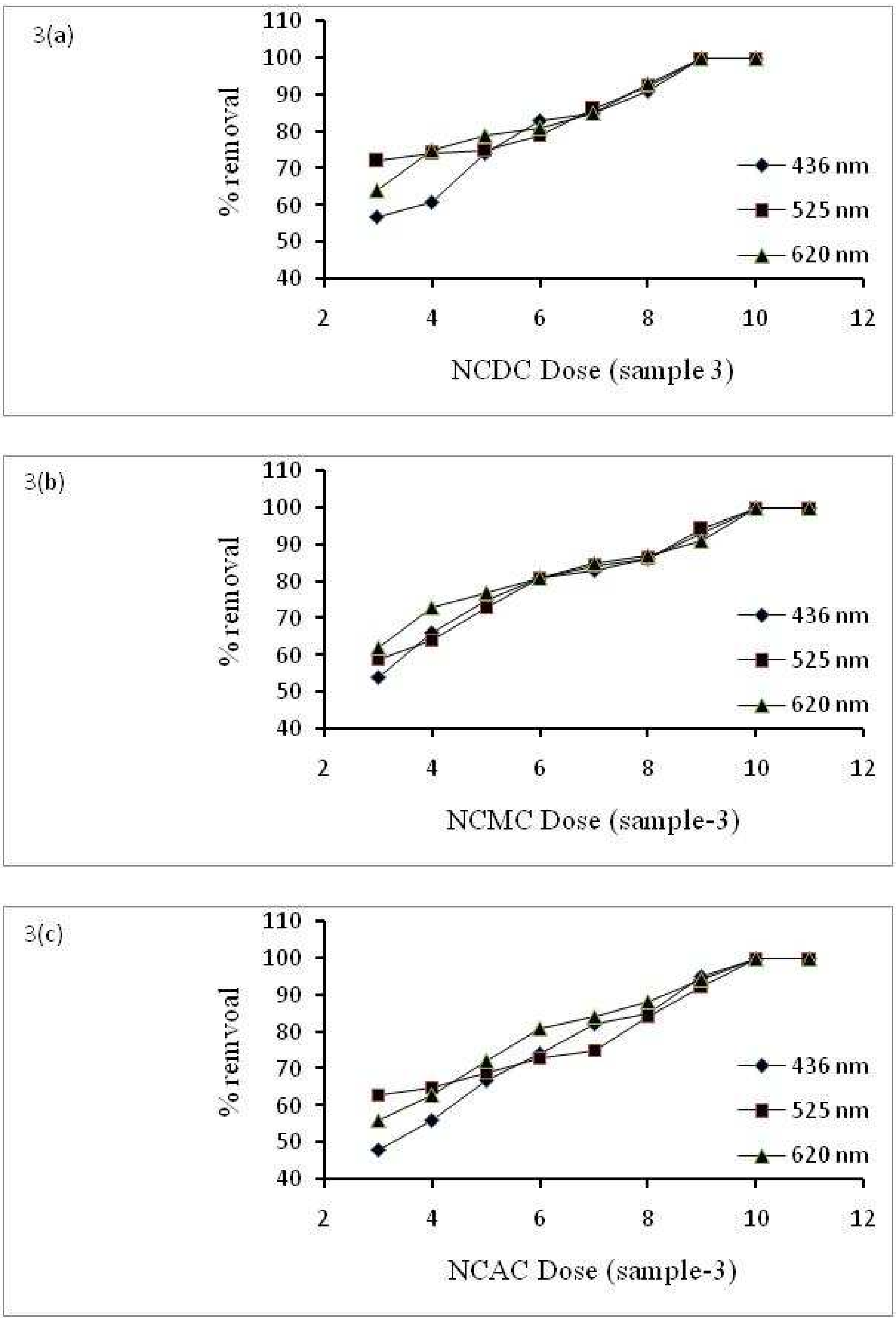

Figure 3. Effect of adsorbent dose on Sample 3 represented as (a) NCDC, (b) NCMC and (c) NCAC

In case of sample 3, the percent removal increased from 57 to 91 % at 436 nm, 72 to 92 at 525 nm and 64 to 93 % at 620 nm observed for NCDC by increasing the dose up to 8 g and at 9 g dose 100% percent color removal is observed. The percent removal increased from 54 to 93 % at 436 nm, 59 to 94 % at 525 nm and 62 to 91 % at 620 nm observed for NCMC by increasing dosage up to 9 g and 100% percent color removal is observed at 10 g. The percent removal increased from 48 to 95 % at 436 nm, 63 to 92 % at 525 nm and 56 to 94 % at 620 nm observed for NCAC by increasing dosage up to 9 g and 100% percent color removal is observed at 10 g.

Good response is observed by increasing the adsorbent dosage in decolorization of textile effluents. As these carbons are prepared from peels of citrus fruits which is a waste material, more dose of adsorbents may not be an economical limiting factor. The decolorized water can be reused for further dyeing process.

CONCLUSION

All the effluents are highly colored and prior treatment is always necessary before discharging. The prepared activated carbons successfully removed the color of the effluents. It is observed that besides removal of color, there is concurrent reduction of COD and BOD of the effluents. The effluents treated until the acceptable limit of 7, 5 and 3 m^{-1} absorbance reached at the standard wavelengths of 436, 525 and 620 nm respectively. 8 g of NCDC and 9 g of NCMC, NCAC is required for samples no 1 & 3 and 9 g of NCDC and 10 g of NCMC, NCAC required for sample no.2 for decolorizing effluents.

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