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Research pedagogy

KAZA'S Carbons- Tools of Decolourisation of Aqueous Waste Effluent Water

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ABSTRACT

The impact of modern environment on human population is a major concern to the environment. Different types of dyes are used to colour various materials especially in textiles, leather, pharmaceutical, food industries etc. Over a decade an up-surging attention has been directed to the treatment of dissolved dyes in coloured waste water. Many of dyes are carcinogenic and toxic towards human beings and animals. For decolorization of waste water and industrial effluents- many chemical, physical and biological methods are there. With this aim, the other method had investigated the utility of low cost activated KAZA's Carbons as adsorbents that are renewable agricultural resource, cheap and available in plenty. The KAZA's Carbons are used for the removal of Methylene Blue and Rhodamine B and other dyes. These carbons also used successfully for the removal of colour from textile industrial aqueous effluents collected from many Textile industrial areas.

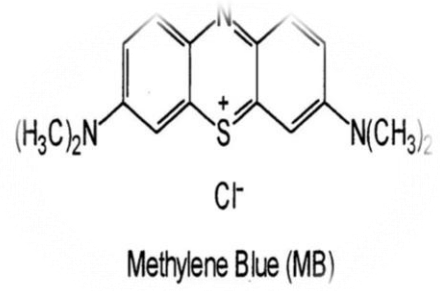
Keywords: KAZA's Carbon, Methylene Blue.

INTRODUCTION

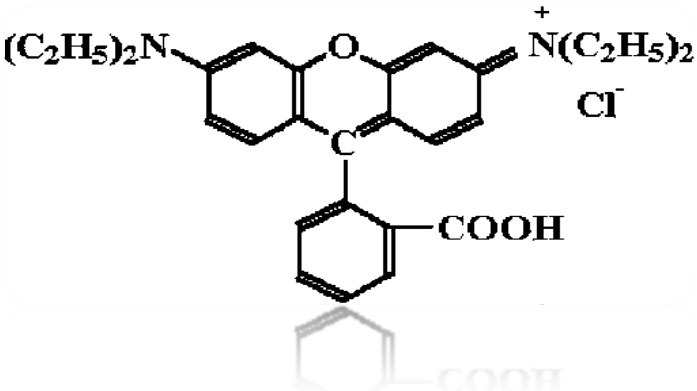
Dyes and Health Hazards: Out of many number of pollutants, synthetic dyes are one of the major pollutants in industrial wastewater. Textile industries consume large volumes of water for wet processing of textiles. The usage of synthetic dyes in textile industries is $7X10^5$ tones of dyestuffs produced annually. So textile industrial effluents contain some percentage of these dyes. Even very low concentration of dyes in effluents imparts high color. Discharge of industrial effluents to nearby water bodies lead to pollution hazards and the COD level of water increases to a greater extent. The colored dye reduces the penetration of Sunlight into water. So the photosynthetic activity of plants will be disturbed. This water is not suitable for domestic or even for agriculture. Use of synthetic dyes has an adverse effect on all forms of Life. Presence of sulphur, naphthol, nitrates, acetic acid, soaps and many heavy metals like Cu, As, Pb, Cd, Hg, Ni, Co etc., and certain auxiliary chemicals all collectively make it highly toxic [1]. About 40%, of globally used dyes contain organically bound chlorine, a known carcinogen. Evaporated chemicals cause allergic reactions and affect Children. It also results in impairment of important functions like respiration, osmoregulation, reproduction and even mortality [2].

Synthetic dyes used in the textile industry are broadly split into 11 groups. They are Basic dyes, Direct dyes Vat dyes, Reactive dyes, Azoic dyes, Sulphur dyes, Mordant dyes, Acid dyes, Oxidation dyes,

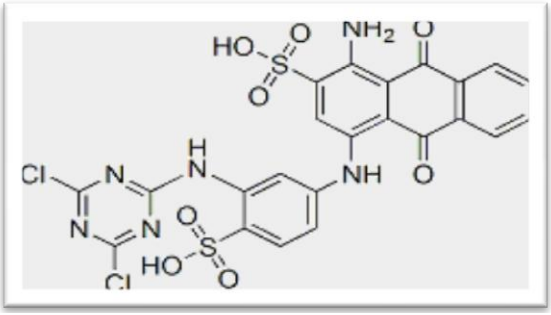
Disperse dyes, Mineral and pigment dyes. Some of the dyes used in our decolorization work are given below with structures' (Reactive and Basic dyes).



Structure of Methylene Blue
Formula: $C_{16}H_{18}ClN_3S$, Colour- Blue

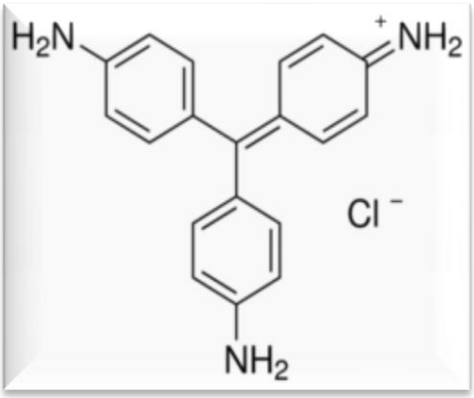


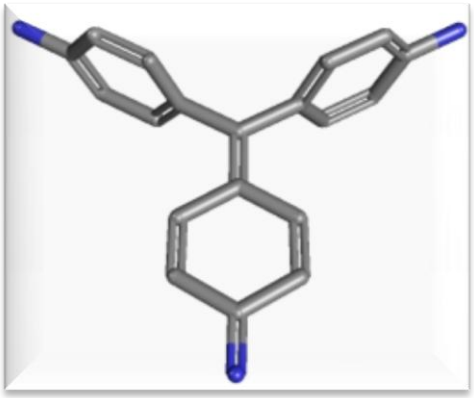
Structure of Rhodamine B
Formula: $C_{28}H_{31}N_2O_3Cl$, Color- Red



Structure of Blue MR dye
Formula: $C_{23}H_{14}Cl_2N_6O_8S_2$, Color: Blue

Structure of Red M5
Formula: $C_{19}H_{10}Cl_2N_6Na_2O_7S_2$, Color: Red





2D Structure 3D Structure

Molecular structure of Basic Fuchsin, (Basic Dye). Colour is Blue.

Methods of Decolorization: General methods are -Membrane filtration, electrochemical methods, reverse osmosis flocculation- coagulation etc. These methods are highly expensive and operational costs are high. Adsorption is a key technique to remove this color easily. Activated Carbon adsorbent is a good removal of wide variety of dyes. The commercial activated carbons still remain an expensive material.
So alternative methods are to be investigated for this purpose. Our group prepared activated carbons indigenously from bio-waste materials. The materials are collected, washed with water to remove the adherent dust, dried under sunlight and finally crushed to small pieces and are carbonized in uniform nitrogen flow in a horizontal tube furnace electrically heated at 600^{o}C for 4 h and cooled to room temperature. The carbons are washed with deionized water and chemically treated with nitric acid or alkali for liquid phase activation. The carbons washed with deionized water till the carbon is free from acidic nature. Finally the activated carbon is dried in air at 120^{o}C for 12h. The activated carbon powdered to obtain powder carbon of particle size range 45µ.These carbons are called as KAZA's carbons after the Name of Kaza Somasekhara Rao [3]. Various activated carbons are listed in table 1.

Table 1.Kaza's carbons prepared from different materials

S.No.	Botanical Name	Parts used	Name of the Kaza's carbon
1	*maize*	Shells	MZSC
2	*dolichos lablab*	Arial part	NDLC
3	*brassica juncea*	Arial part	NBSC
4	*cajanus cajan*	Arial part	NCCC
5	*typha angusta*	Arial part	NTAC
6	*ficus benghalensis*	Prop roots	FBC
7	*phaseolus mungo*	Arial part	PMC
8	*citrus nobilis*	Peels	CNC
9	*citrus documana*	Peels	NCDC
10	*citrus medica*	Peels	NCMC
11	*citrus aurantifolia*	Peels	NCAC
12	*phaseolus trilobus*	Grass	NPTC
13	*leucena leucocephala*	Branches	NLLC
14	*casuarina*	Branches	NCC
15	Jack Fruit Pichiparai	Fruit wastes	Jk_{HNO3}

Dyes used for Decolorization study: Basic dyes Methylene Blue, Rhodamine B and Basic Fuchsin [6] are used

Unit operations of Kaza's Carbon Method

- Optimum amount of activated carbon (KAZA'S Carbon) prepared from bio-waste added to a beaker
- Spiked with 5mg L^{-1} of coloured solution of mentioned dyes and pH maintained
- Stir solution → contact developed for dye solution with carbon
- Keep the system for 30min -1h to settle carbon
- Filter out water
- Determine the dye content

The results of maximum percent removal at optimum conditions for methylene blue using KAZA's carbons are given in table 2 [4] and of Rhodamine B are presented in table 3 [5].

Table 2. Maximum percent removals observed at optimum conditions in batch mode adsorption studies of methylene blue solution using Kaza's carbons

S.No.	Name of the Kaza's carbon	Optimum adsorbent dosage (g)	Optimum contact time (min)	Optimum Initial Conc.(mg l^{-1})	Optimum pH	Maximum percent removal
1	MSC	0.8	25	40	3-8	99
2	NDLC	1	5	80	3-10	98
3	NBSC	1	5	40	3-10	93
4	NCCC	1	5	60	3-10	90
5	NTAC	1	5	70	3-10	81.2
6	FBC	10	10	40	6	95
7	PMC	10	10	40	6	97
8	CNC	10	10	40	6	95
9	NPTC	2	30	20	7	89
10	NLLC	2	30	20	7	85
11	NCC	2	30	20	7	81

Table 3. Maximum percent removals observed at optimum conditions in batch mode adsorption studies of rhodamine B solution using Kaza's carbon

S.No.	Name of the Kaza's carbon	Optimum adsorbent dosage (g)	Optimum contact time (min)	Optimum Initial Conc. (mg l^{-1})	Optimum pH	Maximum percent removal
1	MSC	0.6	30	30	8	99
2	NPTC	2	35	30	8	85
3	NLLC	2	35	30	8	79
4	NCC	2	35	30	8	74

Application: The KAZA's carbons were applied to real samples. The effluent samples were collected from Textile Industries in Mangalagiri area (Guntur Dt.) and in Dharmavaram (Anantapur Dt.) for removal of colour.

Procedure: German standard method is used for the measurement of color absorbance (in m^{-1}) was done at the standard wavelengths of 436, 525 and 620 nm and by increasing the adsorbent dose. The effluent is 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. The characteristics of effluents are given in tables 4-6.

Table 4. Textile effluents characteristics before treating with carbons

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 5. Textile effluents characteristics after treating with activated carbons NCDC, NCMC and NCAC

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 6. Decolorization results of textile effluents after treating with activated carbons NCDC, NCMC and NCAC

Samples	Color absorbance (absorbance m^{-1})									% color removal								
	NCDC			NCMC			NCAC			NCDC			NCMC			NCAC		
	436 nm	525 nm	620 nm	436 nm	525 nm	620 nm	436 nm	525 nm	620 nm	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	56	61	71	61	59	63	65	51	59
Sample 2	57	38.1	42.5	72.4	42.6	45.2	64.7	47	48	63	66	69	53	62	67	58	58	65
Sample 3	43.9	27.4	45	46.9	40.2	47.5	53	36.3	55	57	72	64	54	59	62	48	63	56

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 and **3;** and **9** g of NCDC and **10** g of NCMC, NCAC required for sample **no.2** for decolorizing effluents. The samples collected from Dharmavaram Textile industries are also removed colour successfully with JK_{HNO3}.

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I thank my research group for their hard work and ingenuity in executing blue print of research plans in pollution abatement programmes.

APPENDIX

Mangalagiri sarees are attractive in design and a trade mark of richness. Weavers are using different dyes for dye bath. Weaving of silk sarees on looms is the livelihood for many people in Mangalagiri. Some industries are situated at household level. The photos Fig A1-

Fig A1. Textile industry in Mangalagiri

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