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ADSORPTION AND DISCOLORATION ON VAT DYE EFFLUENTS USING VARIOUS METAL CHLORIDE SAMPLES COLLECTED NEAR TEXTILE DYE INDUSTRY

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Abstract:

In dyeing wastewater treatment adsorption is one of the most gifted discoloration techniques. Adsorption techniques for wastewater treatment have become trendier owing to their efficiency in the removal of pollutants too stable for biological methods. Dye adsorption is a result of two mechanisms (adsorption and ion exchange) and is influenced by many factors such as dye -adsorbent interaction, adsorbent's surface area, particle size, temperature, pH, and contact time. Adsorption reduces the procedure cost which helps to manufacture low-cost materials. The present review initially introduced the technology process, research history and research hotspot of adsorption. Then, the application of adsorption in treatment of dyeing wastewaters in the past decades was summarized, enlightening the inspiring changes in modes, trends, and conditions. From this review article, the different philosophy of synthesis of adsorbent materials becomes apparent.

Key Words: Adsorption, Dyeing Wastewater, Sustainability, Past & Future

Introduction:

Among the different pollutants of aquatic ecosystem, dyes are a major group of chemicals [1–4]. Many industries like textiles, leather, cosmetics, paper, printing, plastics, *etc.*, use many synthetic dyes to color their products. Thus, effluents from these industries contain various kinds of synthetic dyestuffs. For instance dyes used in the textile industries are classified into three classes: (a) anionic (direct, acid, and reactive dyes); (b) cationic (all basic dyes); and (c) non-ionic (dispersed dyes). Basic and reactive dyes are extensively used in the textile industry because of their favorable characteristics of bright color, being easily water soluble, cheaper to produce, and easier to apply to fabric [5–7]. They have also provided some important data related to desorption of individual textile dyes and a synthetic dye effluent from dye-adsorbed agricultural residues using solvents [8-9], which is also important. Activated Carbon Amongst all the adsorbent materials proposed in 21st century, activated carbon is the most popular for the removal of pollutants from wastewater [10-11]. In particular, the effectiveness of adsorption on commercial activated carbon for removal of a wide variety of dyes from wastewaters has made it an ideal alternative to other expensive treatment options [11]. Due to their great capacity to adsorb dyes, activated carbons are considered to be the most effective adsorbent. This capacity is mainly due to their structural characteristics and their porous texture, which gives them a large surface area, and their chemical nature, which can be easily modified by chemical treatment in order to increase their properties. Some of the main examples of wastewaters decolorization with activated carbon are given below. The adsorption capacity of activated carbon depends on various factors, such as surface area, pore size distribution, and surface functional groups on the adsorbent, polarity, solubility, and molecular size of the adsorbate, solution pH and the presence of other ions in solution, and so on. The most widely used activated carbons are microporous and have high surface areas, and as a consequence, show high efficiency for the adsorption of low molecular weight compounds and for larger molecules.

Material and Methods:

Water sample collected near textile dye industryreservoir at a depth of one feet using polyethylene bottles of two liter capacity. The collected water samples were immediately bought to the laboratory and analysed. All the physico-chemical parameters Colour, pH, Turbidity, TDS, Alkalinity, COD, BOD, Chloride, Residual free Chlorine, Sulphate, Sulphide, Nitrate, Nitrite, Barium, Copper, Iron, Manganese, Zinc, Aluminum, Calcium, Magnesium, Sodium, Potassium and phosphate were carried out as per the standard methods [12-13]. The conditions of the experiment are shown in Table 2. Adsorption studies were carried out at two different metal chlorides of mass (1, 2, 3,4 and 5 g). A series of 250 ml Erlenmeyer flask containing 200 ml of dye solution and required amount of shale were mixed using the shaker at constant agitation speed of 150 rpm. The sorbent was then separated by filtration. The filtrated dye concentrations were physico-chemical parameters are tested. As shown in table 1and 2, the dye adsorption capacities of metal chlorides were increased with an increasing of the concentration of metal chloride in grams. The adsorption capacity of metal chloride was quite rapid in the first 48 hrs

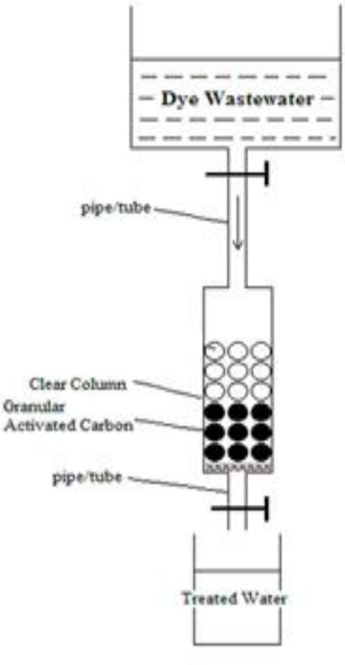


Fig : 1

Results and Discussion:

The results of variations in physico-chemical parameters of Vat dye effluents were grouped in to presented in thetables 1and 2.

pH: The pH value recorded ranges between 10.62 to 7.43in$SrCl_2$. The pH value recorded ranges between 9.72to 7.72in$MgCl_2$.The maximum pH was recorded during increasing of the concentration of metal chloride in grams.

Turbidity: In the present study the minimum value of 18.21 to 12.62 NTU in $SrCl_2$.The minimum value of 16.71 to 10.92NTU in $MgCl_2$ was recorded during as turbidity was decreased towards increasing of the concentration of metal chloride in grams.

TDS: level of TDS ranges between 5678 to 2342 mg/lin $SrCl_2$. The minimum amount of TDS was recorded in 4662 to 2242 mg/l$MgCl_2$. The variability of TDS value may be due to dissolved soil minerals, surface run off etc.

Total Alkalinity: In the present investigation, the total alkalinity ranges from 2746 to 1556 mg/lin$SrCl_2$. Total alkalinity ranges from 2542 to 856 mg/lin$MgCl_2$.It was observed that the sampling station is highly productive from the view point of alkalinity. The maximum alkalinity was observed due to increase and carbonates and bicarbonates in the Vat dye effluents.

Calcium: Calcium hardness values ranged between 1678 to 932 mg/l in $SrCl_2$.Calcium values ranged between 1556 to 852 mg/l in $MgCl_2$.Decrease of calcium hardness may be due to calcium being absorbed by living water organisms. The maximum Calcium hardness was recorded during increasing of the concentration of metal chloride in grams.

Magnesim: The amount of magnesium recorded in ranged between 478 to 88 mg/l in $SrCl_2$. values ranged between 436 to 96 mg/l in $MgCl_2$. Decrease ofmagnesium hardness may be due to calcium being absorbed by living water organisms. The maximum of magnesium hardness was recorded during increasing of the concentration of metal chloride in grams.

Nitrite: The values of nitrite content varied between 136 to 72 mg/l in $SrCl_2$.The values of nitrite content varied between 156 to 75 mg/l in $MgCl_2$. In the present study, the content of nitrite value was high in due to human activities. The nitrite was recorded during increasing of the concentration of metal chloride in grams.

Chloride: The values of chloride content varied between 1856 to 986 mg/l in $SrCl_2$.The values of chloride content varied between 1542 to 742 mg/l in $MgCl_2$. Relatively higher concentration of calcium in surrounding rocks and soils of sampling station might have also contributed to the rich calcium level.Thechloride was recorded during increasing of the concentration of metal chloride in grams.

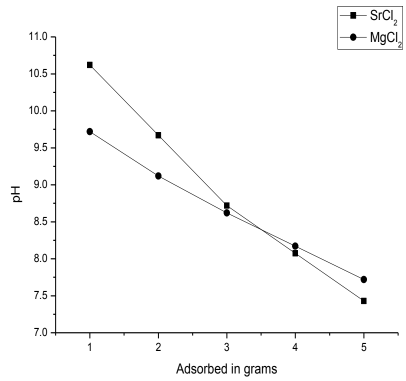
Phosphate: In the present study, amount of phosphate ranges between 184 to 77 mg/lin$SrCl_2$. The amount of phosphate ranges between 166 to 72 mg/lin$SrCl_2$. The high phosphate concentration of the water body (0.59 mg/l) may be due high rate of water evaporation and washing activities.

Tables 1: Variation of physiochemical properties of vat dye effluent on adding SrCl2

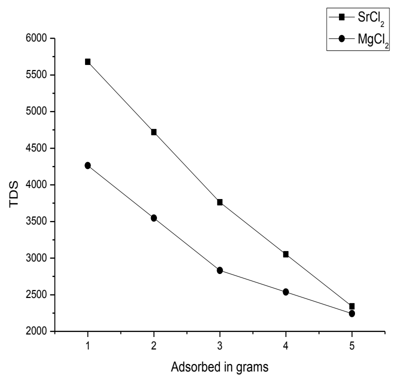
S.No	Parameters	Unit	1g	2 g	3g	4 g	5 g
1	Colour	nm	10.71	9.27	7.82	6.77	5.71
2	pH		10.62	10	8.72	8	7.43
3	Turbidity	NTU	18.21	17.17	16.12	14.37	12.62
4	TDS	Mg/L	5678	4720	3762	3052	2342
5	Alkalinity	Mg/L	2746	2449	2152	1854	1556
6	COD	Mg/L	721	579	436	386	336
7	BOD	Mg/L	426	379	332	261	189
8	Chloride	Mg/L	1856	1599	1342	1164	986
9	Residual free Chlorine	Mg/L	742	654	566	501	436
10	Sulphate	Mg/L	536	439	342	314	286
11	Sulphide	Mg/L	84	70	56	48	39
12	Nitrate	Mg/L	662	544	426	384	341
13	Nitrite	Mg/L	136	114	92	72	52
14	Barium	Mg/L	176	149	122	109	96
15	Copper	Mg/L	110	96	82	70	58
16	Iron	Mg/L	92	80	68	56	43
17	Manganese	Mg/L	78	67	55	47	38
18	Zinc	Mg/L	132	110	88	67	46
19	Aluminum	Mg/L	542	389	236	201	166
20	Calcium	Mg/L	1678	1457	1236	1084	932
21	Magnesium	Mg/L	478	410	342	215	88
22	Sodium	Mg/L	762	653	543	390	237
23	Potassium	Mg/L	562	475	388	340	292
24	Phosphate	Mg/L	184	152	119	98	77

Tables 2: Variation of physiochemical properties of vat dye effluent on adding $MgCl_2$

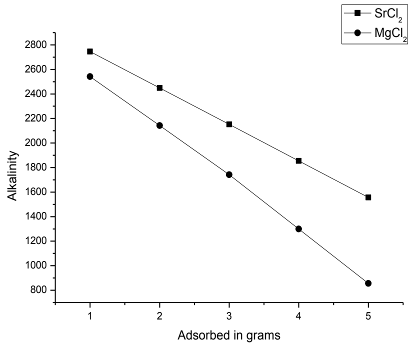
S.No	Parameters	Unit	1 g	2g	3 g	4 g	5 g
1	Colour	nm	12.72	10.27	7.82	6.62	5.42
2	pH		9.72	9.12	8.62	8.17	7.72
3	Turbidity	NTU	16.71	14.57	12.42	11.67	10.92
4	TDS	Mg/L	4262	3547	2832	2537	2242
5	Alkalinity	Mg/L	2542	2142	1742	1299	856
6	COD	Mg/L	678	620	562	439	316
7	BOD	Mg/L	342	279	216	192	168
8	Chloride	Mg/L	1542	1260	978	860	742
9	Residual free Chlorine	Mg/L	842	705	568	457	346
10	Sulphate	Mg/L	466	444	422	395	368
11	Sulphide	Mg/L	62	53	43	41	38
12	Nitrate	Mg/L	548	445	342	309	276
13	Nitrite	Mg/L	156	137	118	97	75
14	Barium	Mg/L	124	111	98	87	76
15	Copper	Mg/L	86	73	59	48	36
16	Iron	Mg/L	83	74	64	56	48
17	Manganese	Mg/L	56	50	43	39	34
18	Zinc	Mg/L	118	96	73	61	48
19	Aluminum	Mg/L	432	387	342	304	266
20	Calcium	Mg/L	1556	1359	1162	1007	852
21	Magnesium	Mg/L	436	349	262	179	96
22	Sodium	Mg/L	680	575	470	351	232
23	Potassium	Mg/L	412	324	236	207	178
24	Phosphate	Mg/L	166	144	122	97	72



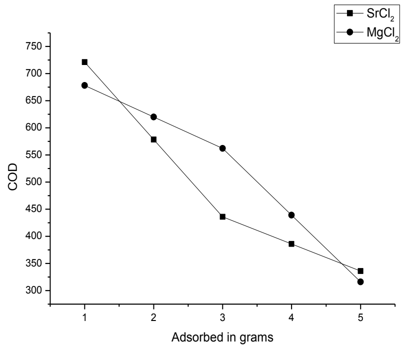
Effect of pH on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



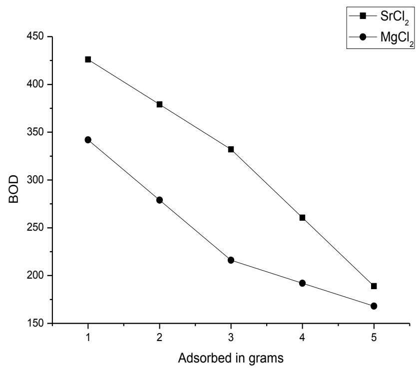
Effect of TDS on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



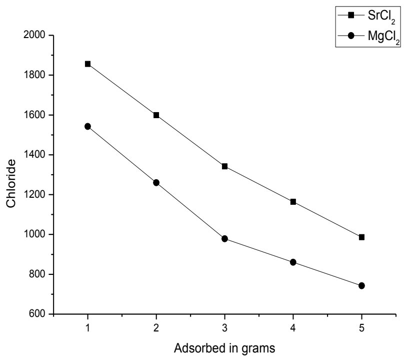
Effect of Alkalinity ion on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



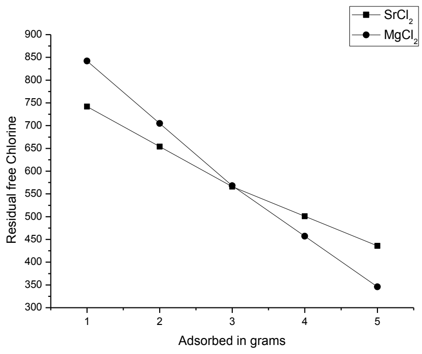
Effect of COD on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



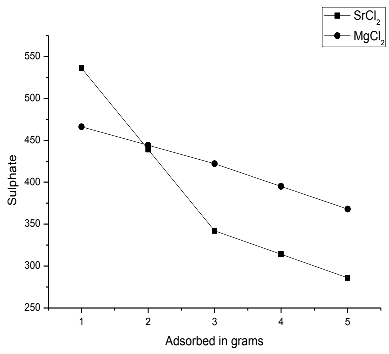
Effect of BOD on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



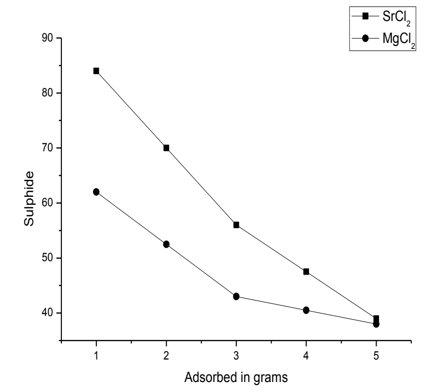
Effect of Chloride ion on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



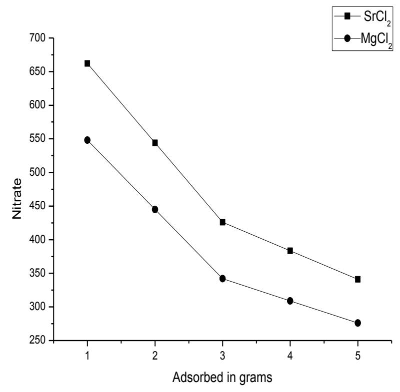
Effect of Residual free Chlorine ion on adsorption of Vat dye varies metal (Adsorbents) dosage at room temperature 273K



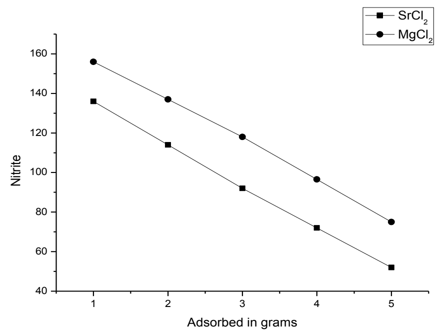
Effect of Sulphateion on adsorption of Vat dye varies metal chlorides chlorides (Adsorbents) dosage at room temperature 273K



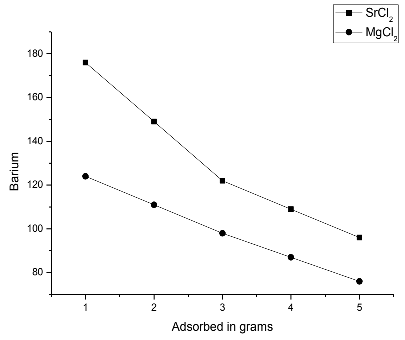
Effect of Sulphide ion on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



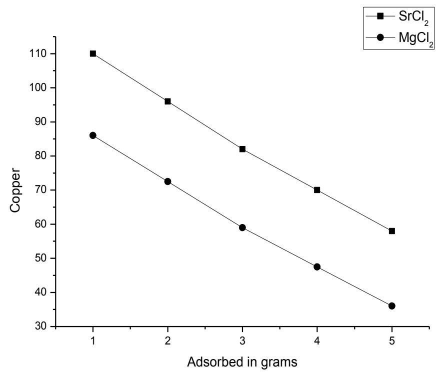
Effect of Nitrate ion on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



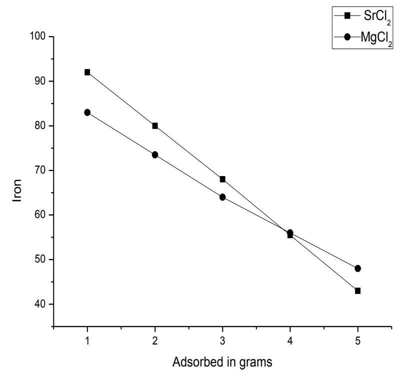
Effect of Nitrite ion on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



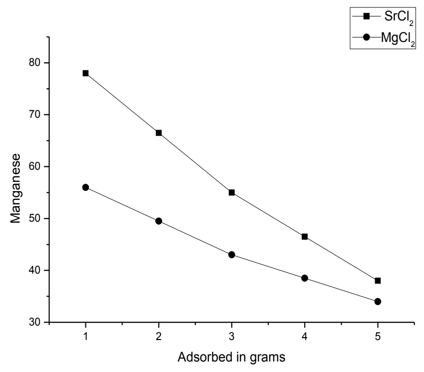
Effect of Barium ion on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



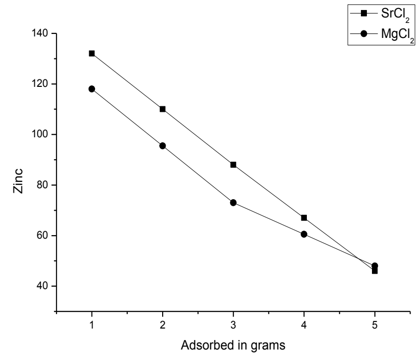
Effect of Copper ion on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



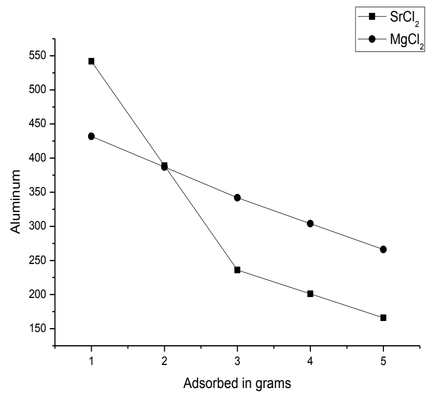
Effect of Iron ion on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



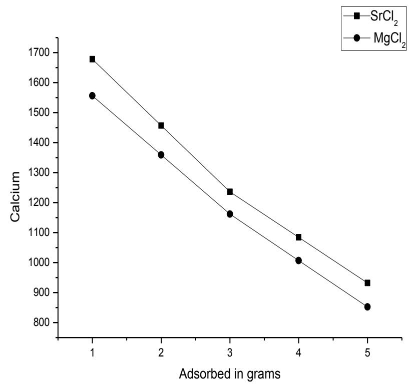
Effect of Manganese ion on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



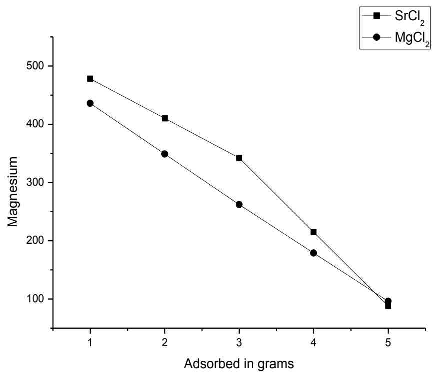
Effect of Zinc ion on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



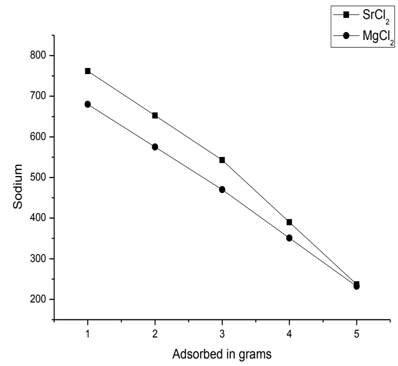
Effect of Aluminium ion on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



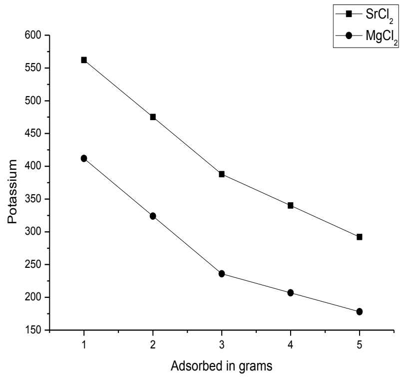
Effect of Calcium ion on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



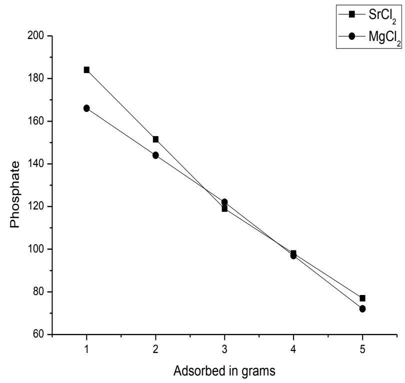
Effect of Magnesium ion on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



Effect of Sodium ion on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



Effect of Potassium ion on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K



Effect of Phosphate ion on adsorption of Vat dye varies metal chlorides (Adsorbents) dosage at room temperature 273K

The graphical representation is shown below in Figure 2 and 23. It was found that adsorption was found decreasing further with increase in dosage in both the case of adsorbents.

Conclusion:

The present study suggested that most of the all the physico-chemical parameters Addition of equimolar concentrations of two different metal chloride reduced the removal of Colour, pH, Turbidity, TDS, Alkalinity, COD, BOD, Chloride, Residual free Chlorine, Sulphate, Sulphide, Nitrate, Nitrite, Barium, Copper, Iron, Manganese, Zinc, Aluminum, Calcium, Magnesium, Sodium, Potassium and phosphate hardly influenced the removal.

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