Available on line www.jocpr.com

Journal of Chemical and Pharmaceutical Research

ISSN No: 0975-7384
CODEN(USA): JCPRC5

J. Chem. Pharm. Res., 2011, 3(3):842-848

Adsorption of textile dyes from aqueous solutions with porous polymeric adsorbent duelite 171

***R. S. Dave[1], G. B. Dave[1] and B. B. Patel[2]**

[1] Shri U. P. Arts, M. G. Panchal Science and V. L. Shah Commerce College, Pilvai
[2]Sheth M. N. Science College, Patan, India

ABSTRACT

In the era of industrial growth, it is necessary to find out complete and reliable methods for removal of dyes from dyeing house waste solution with the use of different adsorbants, like clay, zeolite, and synthetically prepared adsorbants like Amberlite and duelite. In the present work, different parameters like Effect of concentration, Effect of resin dosage, Effect of contact time were studied and The results are observed have been confirmed with analytical studies and spectrophotometrically. Textile effluents are highly toxic as they contain a large number of metal complex dyes.

Key word : *Duelite 171, adsorbent does, contact time, initial dye concentration, metal complex dyes.*

INTRODUCTION

Waste water from dying and finishing operations associated with the textile industry are highly contaminated in both colour and organic content. Colour removal from textile effluents has been the target of great attention in the last few years, not only because of its potential toxicity, but also due to visibility problems [1].Various physicochemical and biological techniques have been employed to remove dyes from waste water. They include membrane filtration, coagulation/ flocculation[3,4], adsorption[2-5], ion- exchange[6-9], advanced oxidation[10], and biological treatment (bacterial and fungal biosorption, biodegradation in aerobic or anaerobic conditions)[11,12]. The technical ad economical feasibility of each technique is determined by several factors such as dye type, waste water composition, operation costs and generated water products. Also the use of one individual technique is not sufficient to achieve complete decolouration. Therefore dye removal strategies consist of a combination of different techniques. Amongst various techniques, adsorption is superior in simplicity of design, initial cost, ease of operation and insensitivity to toxic substance. Adsorption has often been used as a method to

remove dissolved contaminated organic compounds[13]. A large number of suitable adsorbents such as activated carbon[14,15], polymeric resins[16] or various low cost adsorbents (non-modified or modified cellulose biomass, chitin, bacterial biomass, etc) have been studied[17-21]. Identification of a potential dye adsorbent must be in good agreement with its dye binding capacity, its regeneration properties, its requirements and limitations with respect to environmental condition[22].

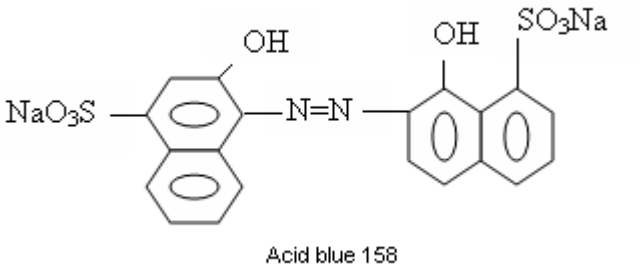
EXPERIMENTAL SECTION

The dye (Acide Blue 158) sample was collected from Varahi Dye, Vatva – Ahmedabad in commercial purity.We were used without further purification. A.R.grade chemicals were used for experiment. The dye shown in the figure was used as commercial formulation. The dye stock solution was prepared by dissolving accurately weighed dyes in distilled water to the concentration of 100 mg/L. The experimental solutions were obtained by diluting the dye stock solution in accurate proportions to needed initial concentrations. Aqueous solutions of the tested dye were prepared in final concentrations of 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 ppm.

The concentrations of dyes in the solution were determined by using systronics UV-VIS spectrophotometer-119 model at the maximum adsorption of dyes.

Dye	**Abs.**(max) nm	**F.W.**
Acid blue 158 [$C_{20}H_{12}N_2Na_2O_8S_2$]	580	518.43

Table:1 The dye adsorption maxima in nm of dye solution in distilled water



Acid blue 158

Fig :1 Chemical stature of Acid blue 158

Typical physical properties of duelite 171 resin is summarized in table 2.

Table :2 Physical properties of duelite 171 resin

Appearance	Hard, spherical opaque beads
Solids	55%
Porosity	0.41% mLpore/mLbead
Surface area	300 M^2/g
Mean pore diameter	90 Å
True wet density	1.02 g/Ml
Skeletal density	1.08 g/mL
Bulk Density	40 lb/ft^3 (640 g/L)

The calibration curves of dyes at concentration 10,20, 30,40, 50, 60, 70,80,90,100 ppm were obtained.

Table: 3 Concentration v/s Absorbance

Concentration (ppm)	Abs
10	0.298
20	0.562
30	0.851
40	1.120
50	1.409
60	1.620
70	1.840
80	2.040
90	2.261
100	2.500

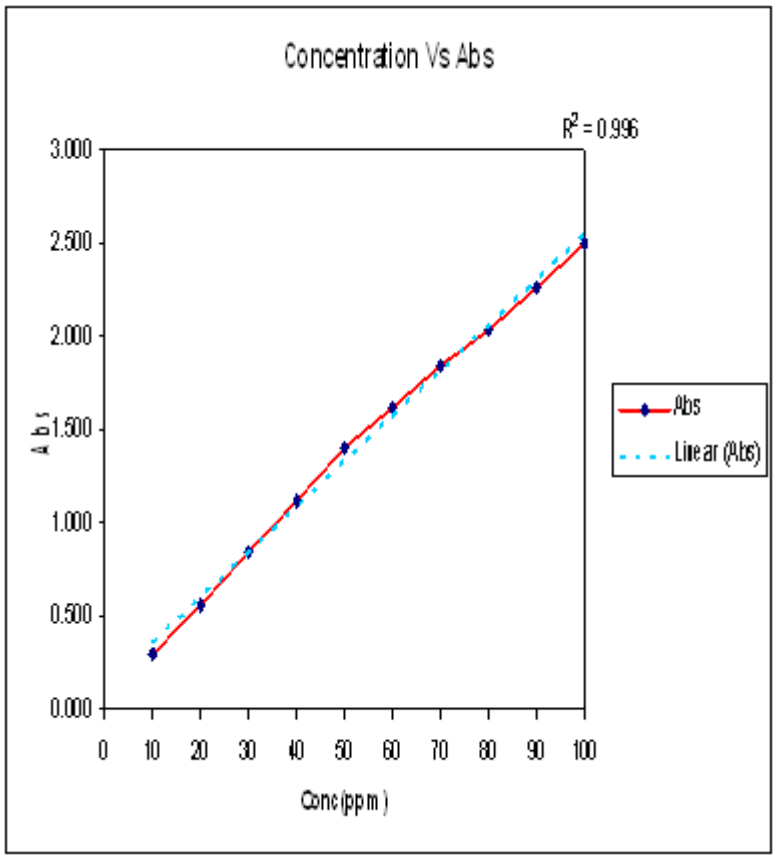


Fig:2 Concentration v/s Absorbance

Batch adsorption:

The adsorption of dye onto duelite 171 resin was studied in batch adsorption experiments by mixing 1.0 g of adsorbent with 100 ml of a given adsorbate solution in glass Stoppard bottles. These were agitated in shaker with a constant speed. The flasks were withdrawn from the shaker a pre determine time intervals. The adsorbate was separated from the adsorbent by filtration using whatmann filter paper or micropipette. The removals of dyes were determined spectrophotometrically by measuring absorbance value of dye.

The amount of dyes adsorbed by the adsorbent was calculated using the following equation.

$$Qe = \frac{(Co - Ce)\,V}{m}$$

Where, Qe = The amount of dye adsorbed by adsorbent (mg/g)
Co = Initial concentration of dye (mg/L)
Ce = Dye concentration at given time(mg/L)
V = Volume of dye solution (L)
m = Weight of adsorbent (g)

RESULTS AND DISCUSSION

Effect of Contact Time

In adsorption studies, effect of contact time plays vital role irrespective of the other experimental parameters affecting adsorption kinetics. The adsorption studies were carried out at different contact time at constant initial concentration of dye with a fixed dose of adsorbent(1.0 g). The data (Table :5) reveals that initially, adsorption is rapid and becomes slow and stagnates with increase in time.

Duelite 171 : 1.0 g AB-158 volume : 100 ml
λmax : 580 nm Temp : 30˚ c

Table:4 Variation of contact time

Time (min)	10ppm % Uptake	20ppm % Uptake	30ppm % Uptake	40ppm % Uptake	50ppm % Uptake	60ppm % Uptake	70ppm % Uptake	80ppm % Uptake	90ppm % Uptake	100ppm % Uptake
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.36	10.36	15.48	16.43	12.21	8.39	12.65	15.45	15.64	18.11
10	12.14	21.07	21.90	24.46	19.86	14.88	16.94	21.16	21.15	21.15
20	26.07	33.04	32.38	33.66	29.14	23.39	25.05	29.42	29.29	29.15
30	36.43	43.75	41.90	41.52	36.64	29.82	30.46	36.27	34.96	34.68
40	48.57	52.68	50.24	50.71	45.00	37.68	38.42	41.74	41.31	40.97
50	55.71	57.86	56.07	56.96	50.64	42.98	43.78	46.65	46.31	46.01
60	60.00	62.86	61.55	61.70	56.50	47.74	49.13	51.83	51.43	51.07
70	66.79	68.57	66.43	66.43	60.93	53.04	54.13	56.70	56.27	55.90
80	70.36	72.50	70.12	70.45	65.21	58.04	58.88	60.45	60.00	59.65
90	73.93	76.07	73.93	74.46	69.64	61.79	62.70	64.42	63.21	63.61
100	78.57	80.00	78.33	77.86	73.57	65.71	66.79	67.81	67.38	67.01
110	81.07	82.68	80.95	80.45	76.64	69.17	70.10	70.76	69.64	69.90
120	83.57	84.82	83.21	83.04	79.07	72.02	72.91	73.44	73.02	72.65
130	85.36	86.61	85.00	84.73	81.14	74.70	75.71	75.58	75.16	74.82
140	86.79	87.86	86.43	86.70	83.29	76.79	77.65	77.63	77.26	76.92
150	87.50	89.11	87.74	88.04	85.36	78.75	79.74	79.60	79.33	79.10
160	88.57	90.00	89.05	89.20	86.86	80.77	81.68	80.80	80.91	80.96
170	89.29	90.54	89.25	90.00	87.57	82.44	83.32	82.05	82.14	82.17
180	89.29	91.25	90.48	90.36	88.21	83.57	84.39	83.57	83.29	83.04

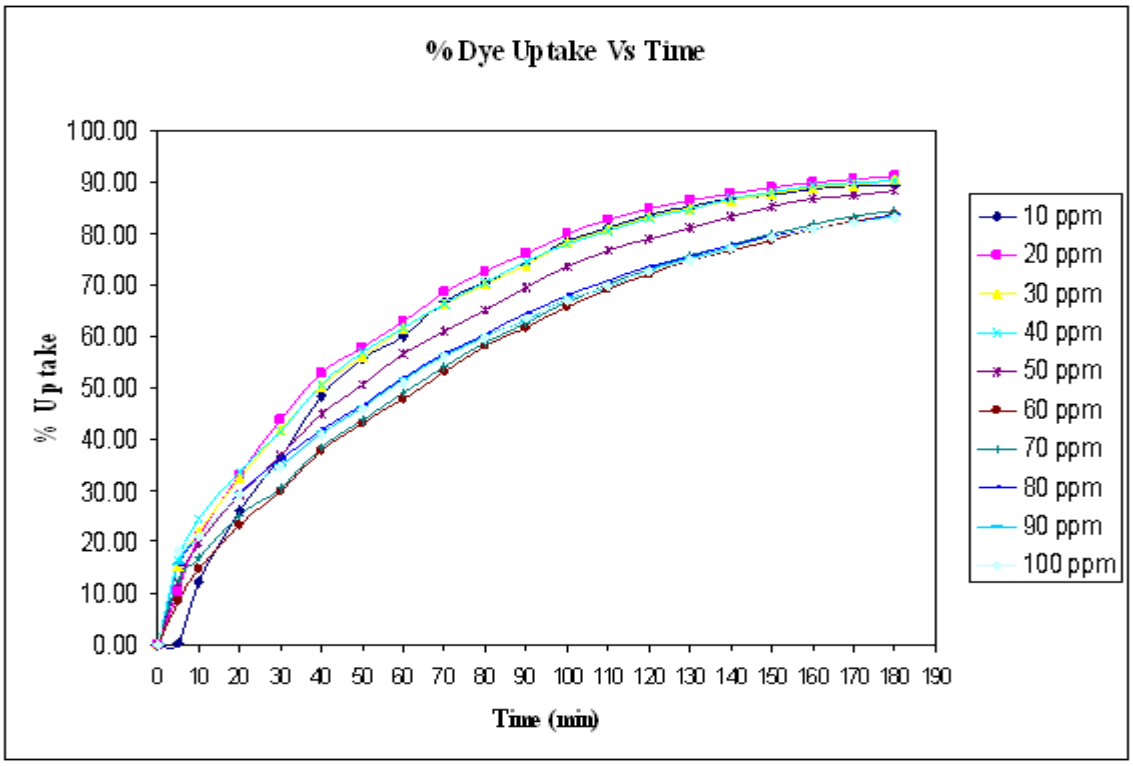


Fig:3 Variation of contact time

Effect of adsorbent does

The variation of adsorbent is studied at fixed does of adsorbent i.e. with a constant initial concentration of dye with optimum contact time. The adsorption increases exponentially with increasing amount of adsorbent. This might be due to increase in availability of the active sites due to the increases in the surface area. The result are tabulated in Table:6

AB conc : 10 ppm AB-158 volume : 100 ml

λmax : 580 nm Temp : 30˚ c

Table:5 Effect of adsorbent does

Time min	1.0g % Uptake	2.0g % Uptake	3.0g %Uptake	4.0g %Uptake	5.0g % Uptake
0	0.00	0.00	0.00	0.00	0.00
10	12.14	17.86	31.79	41.43	43.93
20	26.07	36.43	52.50	62.50	69.29
30	36.43	57.86	67.50	82.50	89.29
40	48.57	73.21	83.21	92.86	94.64
50	55.71	82.14	90.00	94.29	95.36
60	60.00	86.43	91.79	95.00	95.36
70	67.14	89.29	94.29	95.71	96.07
80	70.36	92.14	95.36	95.71	96.07
90	73.93	94.29	95.36	95.71	96.07
100	78.57	95.36	95.71	95.71	96.07
110	81.07	95.36	95.71	96.07	96.07
120	83.57	95.71	96.07	96.07	96.07
130	85.36	95.71	96.07	96.07	96.07
140	86.79	95.71	96.07	96.07	96.07
150	87.50	96.07	96.07	96.07	96.07
160	88.57	96.07	96.07	96.07	96.07
170	89.29	96.07	96.07	96.07	96.07
180	89.29	96.07	96.07	96.07	96.07

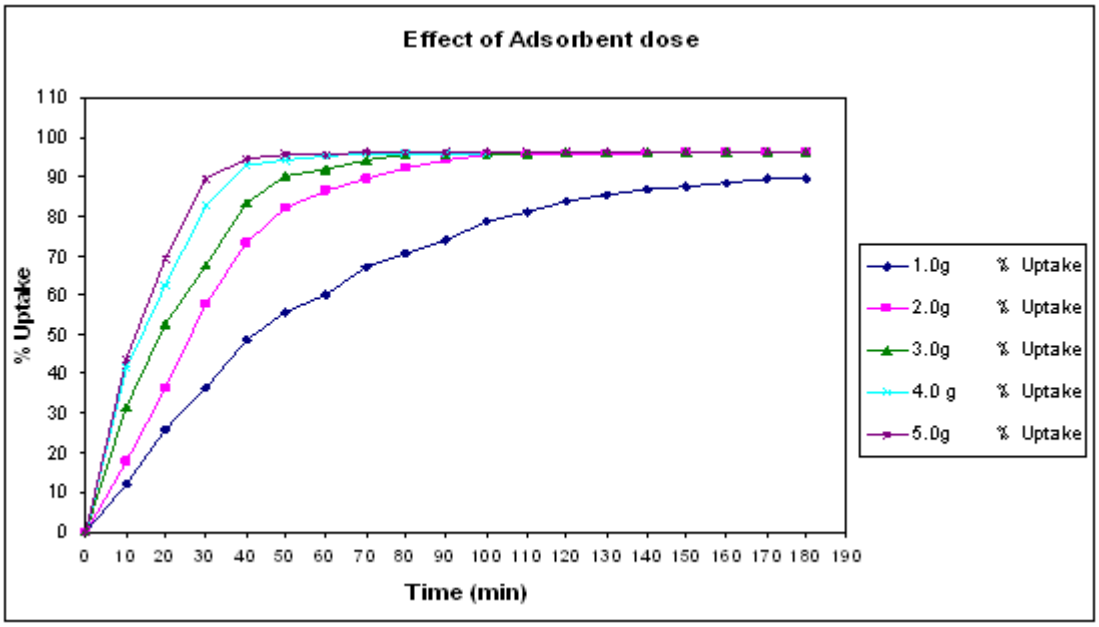


Fig:4 Effect of adsorbent does

Adsorption Isotherm

Langmuir isotherm is represented by,

$$Ce/(X/m)=1/(bVm) + Ce/Vm$$

Where X is the amount of adsorbate, m is the amount of adsorbent, Ce is the equilibrium concentration of the adsorbate in the solution, b is a constant that represent adsorption bond energy and Vm a constant that represents maximum adsorption capacity corresponding to a monolayer covering the surface of the adsorbent. If the process follows the Langmuir pattern polt of Ce/Qe vs Ce is a straight line. Further from the above plot b and Vm are calculated from the slop and intercept. Based on R^2 values it is observed that adsorption process follows the Langmuir pattern for acid blue 158.

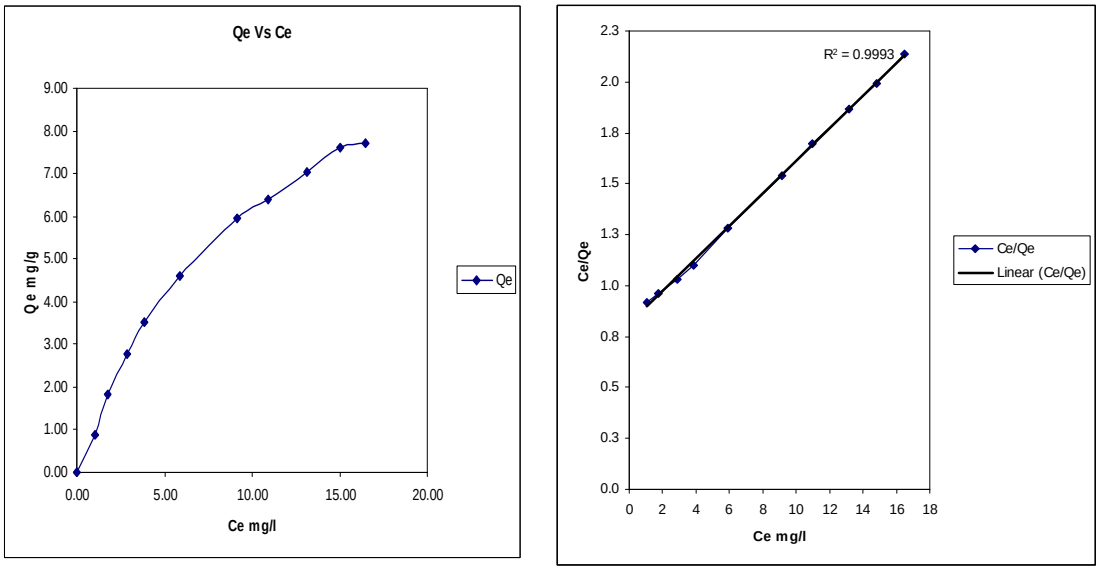


Fig 5 : Langmiur adsorption isotherm of AB 158 towards duelite 171.

CONCLUSION

The polymeric adsorbent duelite 171 was shown to be effective in removing the acid blue 158 metal complex dye. The degree of dye adsorption depends on dye concentration, adsorbent dose. The removal is highly depends on initial concentration of the adsorbate and higher removal % has been observed in lower concentration range.

REFERENCES

[1] E. Voundrias, K. Fytianos, E. Bozani, "*Globle Nest", Int. J.*, **(2002)**, 4, 75.
[2] J. I. Taraskevich, *Natural adsorbents in waste water treatment, Naukova Dumka,Kiev,* **(1981).**
[3] G. Mecay, S. J. Allen, I. P. Mc.Concey, J. H. R. Wallters, *Ind. Eng. Chem. Process Design Dev.,* **(1984)***, 221.*
[4] V. Meshko, L. Morcovaska, M. Minkcheva, V. Cibulic, *J. Ser. Chem. Cos.,* **(1998)** *, 891.*
[5] G. M. Walker, L. R. Weartherley, *Water. Res.* **(1997),** *2093*.
[6] G. Mackay, M. S. Otterburn, A. G. Sweeney, *water. Res.,* **(1980),***14, 15.*
[7] G. Mckay, H. S. Blair, J. R. Gardner, *J. Appl. Polym. Sci.,* **(1982)**,27, 3043.
[8] Y. C. Wong, Y. S. Szeto, W. H. Cheung, G. Mckay,*Process. Biochem.* **(2004)**, 39, 693.
[9] M. Dogan, M. Alkan, *Chemosphere***.,(2003)**,50, 517.
[10] M. S. El Gyendy, *Adsorption Science Technology,* **(1991)**, 8, 217.
[11] M. M. Nassar, E. A. Ashour, Y. H. Magdy, *5 th Int. Con. On Energy and Environ.,Cairo, Egypt*., **(1996)**, 993.
[12] Sumanjit Kaur, B. S. Lark, Pravin Kumar, *J. Environ. Poll.,* **(1998),** 5, 59.
[13] D. Mall, S. N. Upadhyaya, *Ind. J. Environ. Health***.,(1995),** 37, 1.
[14] D. Mall, S. N. Upadhyaya, *J. Pulp Paper Technol. Assoc. (1995) 7, 51*.
[15] P. K. Malik, *Dyes Pigments.,* **(2003),** 56, 239.
[16] Sumanjit Kaur, N. Prasad, *INd. J. Chem. Sec. A.* **(2001)**, 40, 388.
[17] S. J. Allen, *Fuel.,* **(1987),** 66, 1171.
[18] C. Namasivayam, D. Prabha, M. Kumutha, *Bioresor. Technol*., **(1996),** 64, 77.
[19] C. Namasivayam, N. Muniasami, K. Gayathri, M. Rani, K. Rananathan, *Bioresor. Technol***. (1996),** *57, 37.*
[20] Sumanjit Kaur, Prabhpreet Singh, *Colourage***., (2007),** 54(3), 52.
[21] Sumanjit Kaur, Prabhpreet Singh, *J. Environ. Poll.,* **(2001)**, 8, 229.
[22] Sumanjit Kaur, Kamaldeep paul, *Poll. Res*. **(2001),** 2(4), 557.