

## Removal of Two Azo and Two Anthra- Quinone Dyes from the Textile Effluent Using an Activated Carbon of Tunic of *Allium Cepa*.

Sumalatha Mallipudi <sup>1</sup>

N.T.Rajeeva Lakshmi <sup>2</sup>

Meena Vangalapati <sup>3</sup>

<sup>1</sup>Research scholar, Dept of Chemical Engineering, Andhra University, Visakhapatnam, A.P, India.

<sup>2</sup>M.Tech, Dept of Chemical Engineering, Andhra University, Visakhapatnam, A.P, India.

<sup>3</sup>Associate professor, Dept of chemical Engineering, Andhra University, Visakhapatnam, A.P, India,

### Abstract

Textile effluents are the one most calumnious threat to the environment, which have a lot of chronic effect towards the human beings. Color is the main experimental variable to recognize the water has contaminated. Out of many techniques, Adsorption is attaining a specific place of importance due to its scope choosing naturally available materials. Activated Carbon from Tunic of *Allium cepa* (ACTAC) had been chosen as an Adsorbent, as it is abundantly available. ACTAC was used for optimization studies for the removal of selected dyes from the Textile effluents. The selected dyes are safranin, Indigoid, Alizarin Red S and Crystal violet belongs to the Azo and Anthraquinone family dyes respectively. These dyes are selected as they are not degradable easily and are very toxic in nature. The optimum percentage removal of selected dyes from the textile effluent was reported as 80, 70.95, 45 and 74 respectively.

**Key words:** Adsorption, Azo dyes, Anthraquinone dyes, Textile effluent, Optimization, Activated Carbon, *Allium cepa*.

### 1. INTRODUCTION.

Most of the Industries releases the effluent with a load of color with it and is released in to the nearby water bodies. Especially, the textile industries discharge the effluent with a lot dyes and organic matter in it. Now days, treating the textile effluents

are becoming an environmental concern due to scarcity of water, chronic effects. Treating the effluents can be done in so many conventional methods likely ion exchange, reverse osmosis, coagulation and flocculation, Ozonation, Fungal decolorization, adsorption etc. Dyes exist in two forms one is True color and the other is Apparent color. Apparent color can be removed very easily where as True color is very hard to treat. Since Organic content reduces the Dissolved Oxygen content in the water and becomes a threat to the Aquatic life and dyes used in textile industries are very carcinogenic, mutagenic and toxic in nature leads to the chronic effects towards human beings.

Among the several conventional methods, Adsorption has been taking a specific place in the research of effluent treatment techniques from the decades. This importance is due to its simple working structure, low maintenance cost and effective towards the removal of pollutants from the waste water. Either the commercial activated carbon or the natural available materials are used as adsorbents. Commercial activated carbon has been found its limitations due to its high cost. Commercial activated carbon [13, 1] has been replacing with abundantly available natural adsorbents mainly sourced from agricultural waste such as rice husk [17, 11], Mango seeds [16], peanut husk [15], Moringaoliefera seeds [14], Coffee grounds [5], Neem dust [7], Mytilusedulis shells [12], Sagaun saw dust [10], eucalyptus [9], Pine apple leaves [8], Subabul seeds [4], Bahama grass [3] feldspar [6]. The natural adsorbents are chemically or magnetically treated to get high efficiencies for the removal of pollutants from the textile effluents [5, 15].

This part of a research work, an Activated carbon from Tunic of *Allium cepa* (ACTAC) was used to remove the dye stuff from the Textile effluent. The dyes concentrated belong to the family of Azo and Anthroquinone namely Safranin, Indigo carmine, Alizarin Red S and Crystal Violet respectively. The below mentioned table 1 gives the details of the selected dye stuff.

**Table.1: Details of Dyes selected Safranin, Alizarin Red S, Indigoid and Crystalviolet.**

Selected Dyes	Chemical Name (formula)	Type	M.W	C.I.no & λ (nm)
Safranin	Basic Red 2 (C <sub>20</sub> H <sub>19</sub> N <sub>4</sub> Cl)	Cationic / Direct / Azo	350.84	50240 516
Alizarine Red S	Mordant Red3 (C <sub>14</sub> H <sub>7</sub> NaO <sub>7</sub> S)	Anthra-quinone	342.26	58005 518
Indigoid	Carmine indigo (C <sub>16</sub> H <sub>8</sub> N <sub>2</sub> Na <sub>2</sub> O <sub>8</sub> S <sub>4</sub> )	Anionic / Azo	466.36	73015 612
Crystal Violet	Basic Violet 3 (C <sub>25</sub> H <sub>30</sub> N <sub>3</sub> Cl)	Anthra-quinone / Basic	408.0	42555 591

Tunic of *Allium Cepa* (TAC) is very abundantly available in the local market of Visakhapatnam. ACTAC was used to study the optimized conditions for the removal of selected dye stuff from the textile effluent. The optimized conditions which are studying in this paper are pH, contact time, dosage of adsorbent, particle size along with the optimum percentage removal. The effects of the optimized parameters are discussed.

## 2. MATERIALS AND METHODS.

**2.1. Selection of Adsorbent and Adsorbate:** The adsorbent, TAC was collected from the local market of Visakhapatnam. TAC was cleaned with double distilled water, dried in an oven at 100°C for one hour. Dried TAC was kept in a muffle furnace for a period of six hours at 600 °C and was ground and

sieved into fractions of different particle sizes. ACTAC stored in dry place. The effluent collected from a textile industry near srikakulam, India. The dyes are calumnious to environments and they show a high list of undesirable effects which is shown in below mentioned table 2.

**Table 2. An Acute and Chronic Undesirable effects of the selected dye stuff.**

Dye	Acute	Chronic
Safranin	irritation to mouth, tongue and lips. Mucous Build up in the throat, Vomiting Sensation, irritation in eyes and nausea.	pneumoconiosis (breathlessness is a prime symptoms)
Alizarin Red S	Emphysema, bronchitis	Asthma, Carcinogenic, reported to be mutagenic.
Indigoid	Emphysema, damage to nervous system.	Pneumoconiosis, possibility of producing mutation
Crystal Violet	Methaemoglobinemia. conjunctiva, blood congestion, and discharge of pus to total clouding, necrosis, and sloughing of the cornea. Redness, swelling and blistering towards skin.	Pneumoconiosis, teratogenesis, nausea, headache, vomiting and nose bleed. tumorigenic and mutagenic. cause severe cytogenic toxicity in vitro

### 2.2. Optimization studies:

Parameters like pH, Contact time of the Adsorbent, Dosage of the Adsorbent, and size of the Adsorbent were studied to obtain highest removal percentage of selected dye stuff from the textile effluent and the procedures were as follows.

#### 2.2.1 Optimization of Contact time of Adsorbent:

Optimum Contact time was investigated by taking a 100 ml of effluent sample taken in four conical flasks (namely 1, 2, 3, 4, 5 and 6). To the conical flasks 1gm of PTAC was added simultaneously to all the four conical flasks. The conical flasks were in shaker for four different time periods as 30, 60, 90, 120, 150 and 180. After the completion of contact time, supernatant of each individual sample was taken at their respective time and their concentrations of the selected dye stuff were noticed at their respective wavelength.

#### 2.2.2 Optimization of PTAC for Effluent:

Optimum PTAC was investigated by taking 100 ml of effluent sample in four individual conical flasks (namely 1, 2, 3, 4, 5 and 6). Different amounts of adsorbent (0.5gm, 1gm, 1.5gm, 2gm, 2.5gm and 3gm) was added to the above four conical flasks simultaneously. Then after, the conical flasks were kept for shaking in a shaker for about a period of 2hrs. The supernatant was collected for each of individual sample and their concentrations of the selected dye stuff were noticed at their respective wavelength.

### 2.2.3 Optimization of pH:

The value of optimum pH was determined by adjusting the pH in the five conical flasks (namely 1, 2, 3, 4, 5 and 6) and pH was varied in the range of 2.5 to 4.5 by using HCL and NaOH. 100 ml of effluent was taken in above mentioned five conical flasks and then pH also adjusted. Five conical flasks were kept for shaking in shaker for 2hrs and concentrations were observed for the selected dye stuff at their respective wavelength for the collected supernatants of each individual sample.

### 2.2.4. Optimization of Particle size:

Optimum particle size was investigated by taking the different sizes of adsorbent such as 75 $\mu$ m, 106  $\mu$ m, 125 $\mu$ m, 150  $\mu$ m and 180  $\mu$ m were added to the 1, 2, 3, 4 and 5 named conical flasks respectively. Conical flasks were kept for shaking for about a period of 2hrs. Then after, supernatants were collected to observe the concentration of the selected dye stuff for different particle sizes at their respective dye stuff.

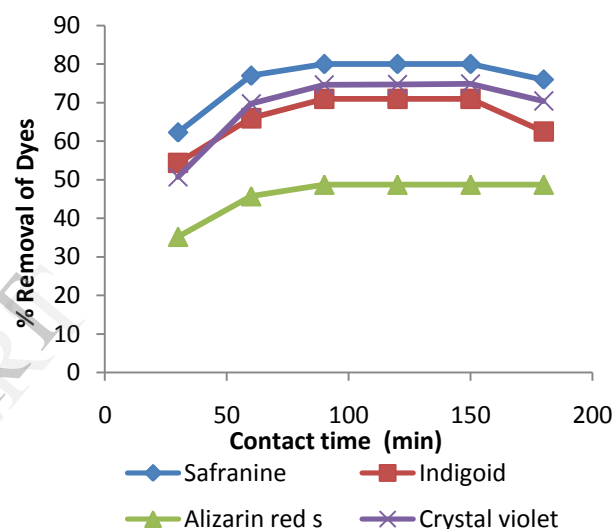
## 3. Results and Discussions

Parameters like Contact time, Particle size, Amount of Adsorbent, pH, initial concentration of dye etc, play a crucial role in study of adsorption technique. With these parameters, Recovering of adsorption can be done, efficiency of adsorption and yield can be increased enormously.

### 3.1 Effect of Contact time:

Effect of contact time for the removal of selected dyes from the effluent was shown below mention fig 1. The parameters to be maintained were temperature and the Adsorbent dosage fixed at 30°C and 1gm per 100ml respectively. With the increase in the time of contact, the removal of selected dye

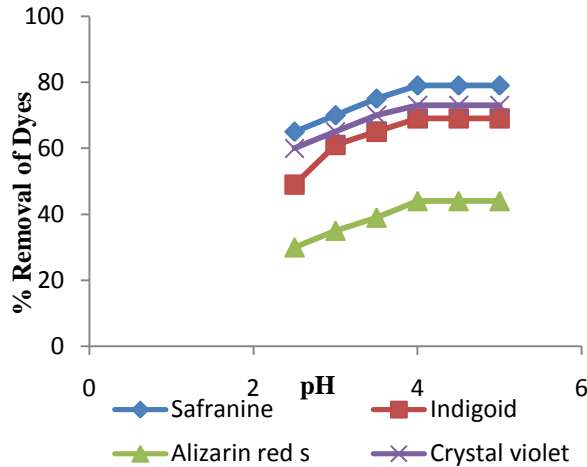
stuff increases till the removal reaches an equilibrium phase. Safranin was showing high removal right from the initial point. Whereas the other dyes, Alizarin Red S had lowness in the removal. The selected four dyes had shown a proper behavior towards the removal. Here in the optimization of the contact time, removal of dyes were getting stabilized after the completion of 120 min and the values for each dye after completion of 120 min were mentioned in the below table.



**Fig. 1 Influence of contact time on % of removal of dyes**

### 3.2 Effect of pH:

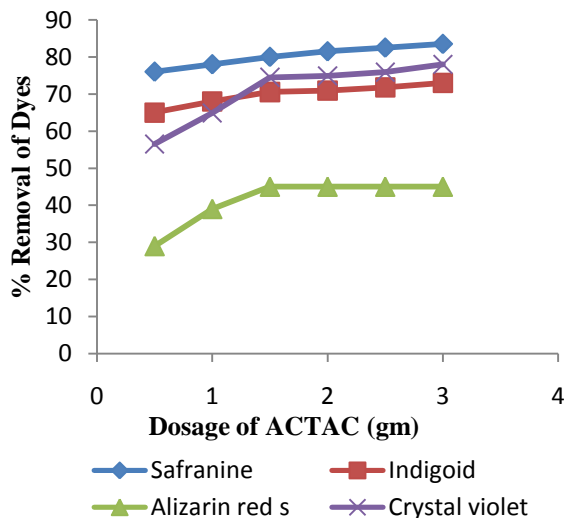
The effect of pH on the removal of selected dye stuff on the PTAC was studied where the temperature, contact time and amount of PTAC fixed at 30°C, 120 min and 1 gm respectively. The influence of pH was studied from the range of 2.5 - 4.5. With the increase in pH, there was a change in removal can be noticed. Safranin was showing an equilibrium phase from pH 4 to 5 and shown high removal than other dyes. Alizarin Red S had shown quite less amounts of removal.



**Fig. 2 Influence of the pH on % removal of Dyes.**

### 3.3 Effect of Dosage of Adsorbent:

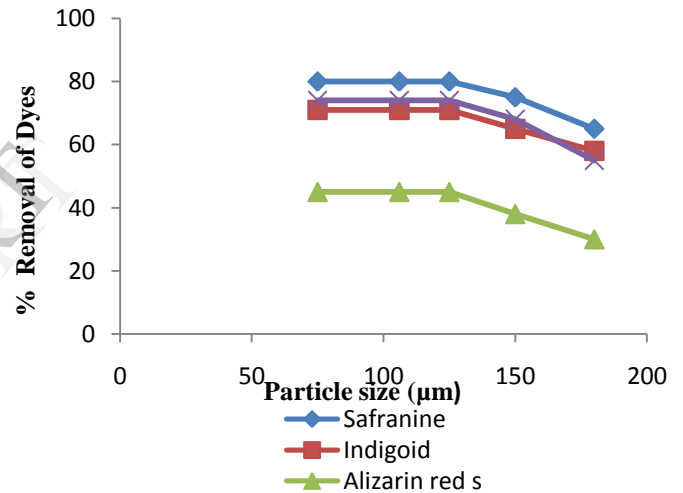
In this work, the effect of Dosage of Adsorbent for the removal of Safranin from the effluent was studied and is shown in below mentioned figure. While the parameters like contact time, temperature and pH fixed at 120 min, 30°C, and 4 respectively. Due to the availability of high amt of ACTAC, this increases the active sites for adsorption increases dye removal. Safranin was shown the highest removal and Alizarin Red S shown lowest removal.



**Fig. 3 Influence of Dosage of PTAC on %removal of dyes.**

### 3.4 Effect of Particle size:

In this study, the parameters to be maintained were temperature, adsorbent dosage and the contact time fixed at 30°C, 1.5gm and 120 min respectively, to find out the particle size which suits to further process. From the below mentioned figure, the removal of dye decreases with the increases in the size of adsorbent. This entails that the lesser size of ACTAC gave the high removal of selected dye stuff from the effluent. The selected dye stuff showed similar type of effect while on the removal with the adsorption of ACTAC.



**Fig. 4 Influence of Particle Size (µm) on % Removal of dyes.**

After the completion of the optimization process. With the obtained optimum parameters, an experiment had conducted to know the optimum percentage removal of selected dye stuff from the Textile industry effluent and the values were shown in the table3.

**Table 3. Optimum conditions for the removal of selected dye stuff through Adsorption**

Dye / Parameters	Contact Time (min).	pH	Particle Size ( $\mu\text{m}$ ).	ACTAC Dosage (gm).	% Removal of Dye.
Safranine	90	4	125	2	80
Indigoid	90	4	125	2	70.95
Alizarin Red S	90	4	125	1.5	45
Crystal Violet	90	4	125	2	74

#### 4. Conclusions:

This present part of research study reveals that the ACTAC can use as an Adsorbent for the removal of selected dye stuff from the textile effluent. The removal of Dye adsorbed varies with the contact time and particle size. From this optimization process, ACTAC shows an efficient way to replace the commercial activated carbon for the removal of dyes textile effluent. Overall, the results suggest that the ACTAC can be an efficient adsorbent for the removal of dyes from the textile effluent. The optimum conditions for the removal of Safranine, Indigoid, Alizarin Red S and Crystal Violet from the textile effluent on to the ACTAC were 80, 70.95, 45 and 74 respectively.

#### REFERENCES:

[1] M. Ghaedi, A. Najibi, H. Hossainian, A. Shokrollahi and M. Soyak, "Kinetic and equilibrium study of Alizarin Red S removal by activated carbon," *Toxicological & Environmental Chemistry*. Vol. 94: pp 40–48, 2012.

[2] H. V. Jadhava, S. M. Khetre and S. R. Bamane, "Removal of Alizarin red-S from aqueous solution by adsorption on nanocrystalline  $\text{Cu}_{0.5}\text{Zn}_{0.5}\text{Ce}_3\text{O}_5$ ," *Der Chemica Sinica*. Vol. 2: pp 68-75, 2011.

[3] J. Samusolomon and P. Martin Devaprasath, "Removal of Alizarin Red S (Dye) from aqueous Media by using Cynodondactylon as an Adsorbent," *J. Chem. Pharm. Res.* Vol. 3: pp 478-490, 2011.

[4] A.K.Patil and S. VinodShrivastava, "Kinetic and Equilibrium Studies on the Adsorption of Crystal Violet Dye Using *LeucaenaLeucocephala*(Subabul) Seed Pods as an Adsorbent," *Journal of Applied Chemical Research*. Vol. 6: pp 24-36, 2012

[5] Ivo Safarik, Katerina Horska, BarboraSvobodova and MirkaSafarikova, "Magnetically modified spent coffee grounds for dyes removal," *Eur Food Res Technol*. Vol. 234: pp 345–350 2012.

[6] NamalPriyanthaand SujeewaPerera, "Removal of Sulfate, Phosphate And Colored Substances In Wastewater Effluents Using Feldspar," *Water Resources Management*. Vol. 14: pp 417–433, 2000.

[7] S. D. Khattri and M. K. Singh, "Colour Removal from Synthetic Dye wastewater Using A Bioadsorbent," *Water, Air, And Soil Pollution*. Vol. 120: pp 283–294, 2000.

[8] SagnikChakraborty, Shamik Chowdhury and Papita Das Saha, "Insight into biosorption equilibrium, kinetics and thermodynamics of crystal violet onto *Ananascomosus* (pineapple) leaf powder," *Appl Water Sci*. Vol. 2: pp 135–141 2012.

[9] Luis M. Cotoruelo, Mari'a D. Marque' s, Francisco J. Di'az, Jose' Rodri'guez-Mirasol, Juan J. Rodri'guez, and Toma' s Cordero, "Lignin-Based Activated Carbons as Adsorbents For Crystal Violet Removal from Aqueous Solutions," *Environmental Progress & Sustainable Energy*. Vol.31: pp 386-396 2012.

[10] S. D. Khattri and M. K. Singh, "Use of Sagaun Sawdust as an Adsorbent for the Removal of Crystal Violet Dye from Simulated Wastewater," *Environmental Progress & Sustainable Energy*. Vol. 31: pp 435-442 2012.

[11] Rajeev jain, meghamathur and shalinisikarwar, "Removal of indigo carmine from industrial effluents using low cost adsorbent," *Environmental Progress & Sustainable Energy*. Vol.31: pp 258-263 2012.

[12] Maghri, A. Kenz, M. Elkouali, O. Tanane and M. Talbi, "Textile Dyes removal from industrial waste water by mytilusedulis shells," *J. Mater. Environ. Sci*. Vol. 3: pp121-136 2012.

[13] Chang SookKeng, ZulkarnainZainal and Abdul Halim Abdullah, "Removal of Cationic and Anionic Dyes by Immobilised Titanium Dioxide Loaded Activated Carbon," *The Malaysian Journal of Analytical Sciences*. Vol. 12: pp 451 – 457 2008.

[14] Beltra'n-Heredia, J. Sa'nchez-Marti'n, and A. Delgado-Regalado, "Removal of Carmine Indigo Dye with *Moringaoleifera*Seed Extract," *Ind. Eng. Chem. Res.*Vol.48: pp 6512–6520 2009.

[15] Ivo Safarika and MirkaSafarikova, "Magnetic fluid modified peanut husks as an adsorbent for organic dyes removal," *Physics Procedia*.Vol. 9: pp 274–278 2010.

[16] Mohamad RasoolMalekbala, Salman MasoudiSoltani, Sara KazemiYazdi, and SorayaHosseini, "Equilibrium and Kinetic Studies of Safranin Adsorption on Alkali-Treated Mango Seed Integuments,"

International Journal of Chemical Engineering and Applications. Vol. 3: pp 160-166 2012.

- [17] Papita Das Saha and Rahul Mishra, "Adsorption of safranin onto chemically modified rice husk in a upward flow packed bed reactor: artificial neural network modeling," Elixir Pollution. Vol. 44: pp 7579-7583 2012.

- [18] M.Sumalatha, N.T.RajeevaLakshmi and Meena.V," Removal of Two Azo and Two Anthroquinone dyes from Textile Effluent using Tunic of *Allium cepa*," International journal of innovative research in science engineering and technology.(In Press).

IJERT