Available online at www.derpharmachemica.com

ISSN 0975-413X
CODEN (USA): PCHHAX

Der PharmaChemica, 2016, 8(19):445-449
(http://derpharmachemica.com/archive.html)

Investigation on de-colorization of textile industry dye effluent using sugarcane bagasse

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ABSTRACT

In recent years, the industrial dye wastewater causes major pollution in environment. As the waste-water discharged into the water bodies, it produces major issues to the society and responsible for water-borne deceases. Therefore, it is necessary to reduce the pollutant content before discharging the textile dye effluent. The objective of the study is to remove the pollutant, color from industrial dye effluent with cost effective adsorbent, sugarcane bagasse. In order to know the favorable condition/parameters for color removal, effects of adsorbent dosage, pH and particle size of adsorbent on dye decolorisation were investigated. The decrease in color intensity of industrial dye effluent was examined by UV-vis spectrophotometer.

Keywords: Sugarcane Bagasse, UV visible spectrum, Dye Effluent

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INTRODUCTION

Dye solutions are extensively used in various industries such as paper, pulp, textile and leather for coloring purpose. The dye effluents disposed to surface water and land causes severe pollution problem owing to its toxicity nature [1-2]. The de-colorization of dye effluent by chemical and biological methods namely electrochemical oxidation, adsorption, flocculation, coagulation, precipitation and microbial sorption is a challenging task in order to make pollution free environment [3]. Moreover, over-utilization, disproportionate agriculture, unprocessed effluents and wastes have caused deterioration in groundwater quality. The wide range of industrial behavior and urbanization leads to the contamination of the aquifer.

Hetero-cyclic aromatic chemical compound, methylene blue is extensively applied in textile, acrylic, silk, wool, paper and pulp industries [4]. Attempts had been made to investigate color removal studies with suitable cost effective adsorbents such as coal, silica gel, wheat shell [5], fly ash [6], modified rice straw [7], rice husk [8-10] and sugarcane bagasse [11].

Owing to cost of operation, simplicity in nature, potential pollutant removal, easy to reduce pollutant content even at high concentration and minimizing sludge formation, adsorption is excellent dye de-colorization method among various treatments mentioned earlier. In this present work, decolorization efficiency of textile industrial dye was treated using sugarcane bagasse as cost effective adsorbent. The suitable conditions/parameters were found to achieve the maximum efficiency.

MATERIALS AND METHODS

The textile dye effluent was collected from Thiruppur district, Tamilnadu. The physic-chemical characteristics of industrial dye effluent were listed in Table 1. The concentration of dye in industrial dye effluent is unable to find out. Based on the color intensity of industrial dye effluent observed using UV-Vis spectra, maximum wave length was chosen for color removal. The effect of various parameters namely dosage of adsorbent, pH and particle size on color removal were studied. The intensity of color was examined using UV-Vis spectrometer after adsorption studies. The color intensity was drastically decreased. The percentage of COD removal also investigated from the experimental studies.

Table.1. Physico-chemical characteristics of industrial dye effluent

Parameters	Magnitude
pH	8.2
Temperature (^{0}C)	30
Chemical oxygen demand (COD), ppm	3540
Biological oxygen demand (BOD), ppm	4790
Total dissolved solids, ppm	6254
Chlorides, ppm	5280

RESULTS AND DISCUSSION

3.1.UV Visible Spectra

Double beam spectrometer device is used for identifying the presence of colored substances in the textile waste sample. This gives a detailed knowledge about the textile waste. The device plot a graph between wavelength along x-axis and OD of the sample we use. Thus the wavelength for identifying initial optical density of the effluent is known well with respect to the peak point from the graph plotted. The color intensity was examined at a particular maximum wavelength (540nm) obtained by UV-vis spectrophotometer.

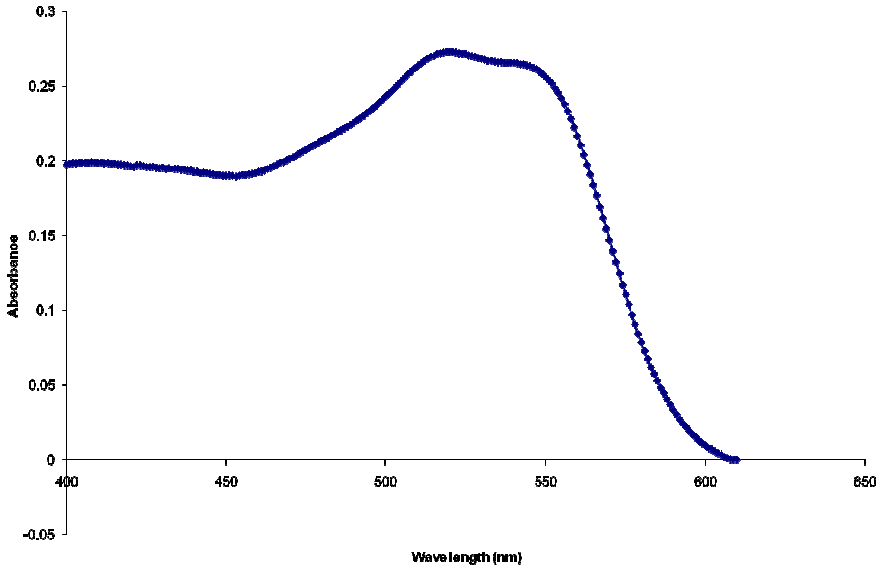

Fig.1. UV- Vis spectra of industrial dye effluent before treatment

3.2. Amount of adsorbent

Generally, high dosage of adsorbent causes low adsorption capacity. The different doses of adsorbent (1-8gm) were introduced in to 100 ml of textile effluent. The agitation speed was maintained at 150 rpm in an orbital shaker shown in Fig.2. It is observed that adsorption was found decreasing further with increase in dosage. Five gram of adsorbent exhibited maximum color removal efficiency (77.94%) at 167 h. However, less efficiency (27.94%) was observed

when one gram of adsorbent was used at length of time. Therefore, five gram of adsorbent was selected as a dosage and used in further studies.

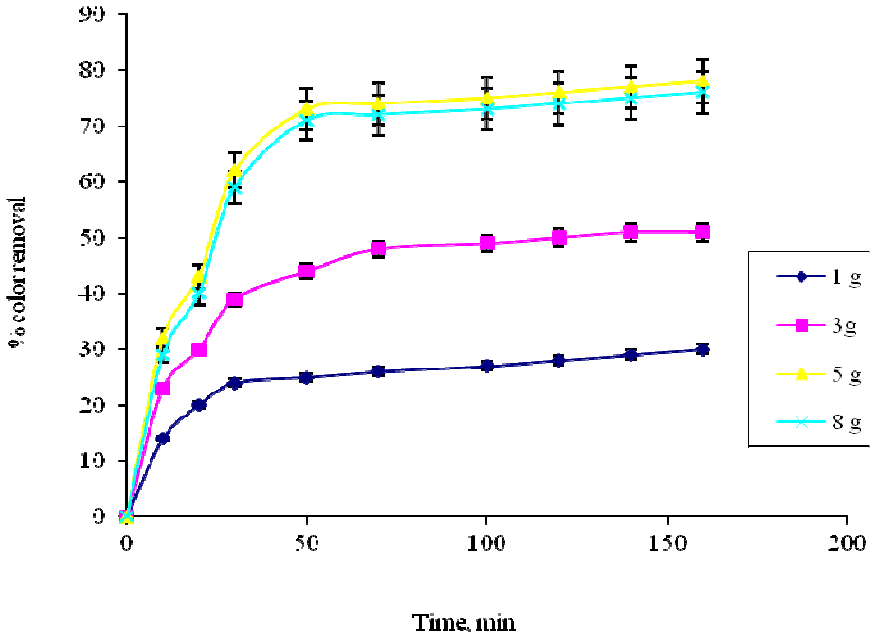

Fig.2. Effect of adsorption dosage on % color removal using industrial dye effluent

3.3. Effect of pH

The adsorption capacity is greatly influenced by changing pH [12]. The dye effluent pH was adjusted from 4 to 9 using 0.1N sulfuric acid/0.1N sodium hydroxide. Fig. 3 explains the effect of pH on percentage color removal with different length of time. The maximum removal (77.94%) of color from textile dye effluent was observed at pH 5 using five gram of adsorbent. The dye removal rate is relatively low at extremely low and high pH. This indicates that dye removal is not highly influenced by electro-static force between adsorbent and dye molecule [12].

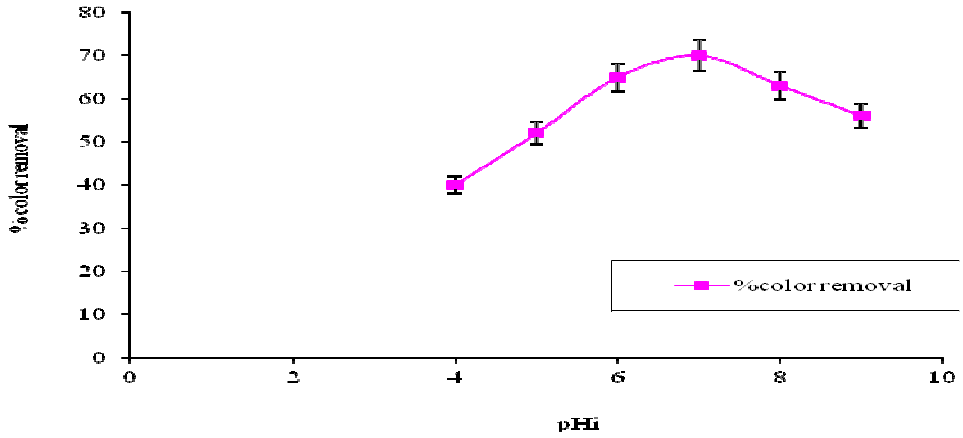

Fig.3. Effect of initial pH on % color removal using industrial dye effluent (dosage = 5 g)

3.4. Particle size

Particle size is an important factor for removal of color using adsorption. Generally, high particle size offers low specific surface area and vice versa. The optimum particle size depends upon the nature of particle and pore size. The maximum color removal efficiency (66.6%) was recorded with BSS ≠ 10 – 4.78. The graphical representation is shown below in Fig.4.

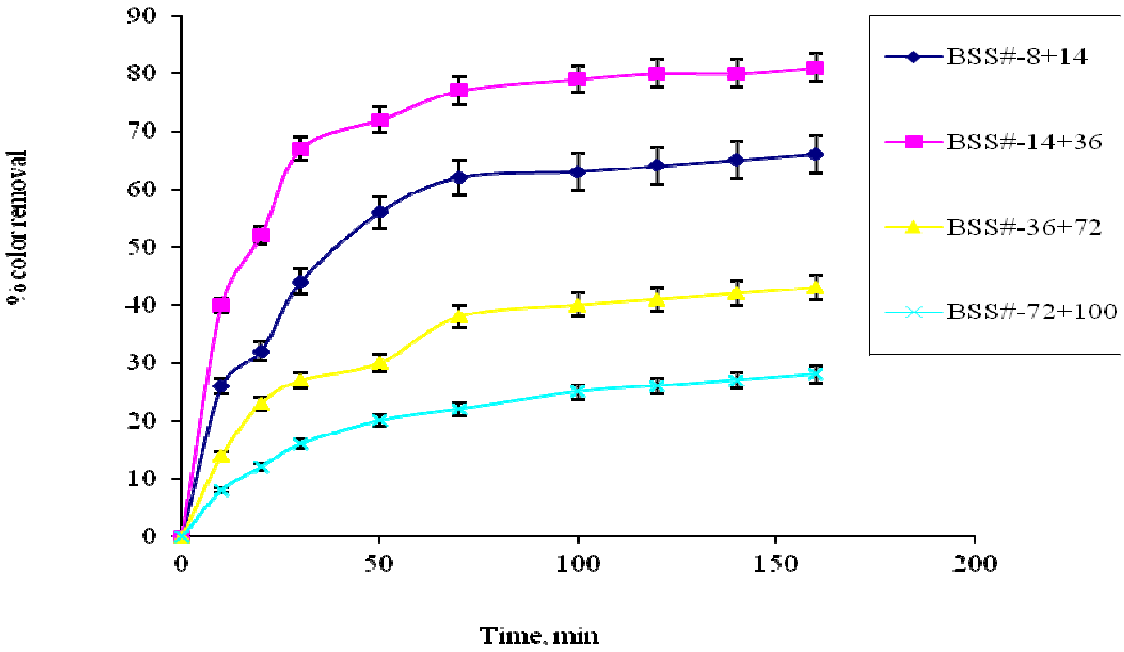

Fig.4. Effect of particle size on % color removal using industrial dye effluent (pHi=7; dosage=5 g)

The final treated effluent was subjected to Uv-vis. Spectrophoto metric study. The absorption peak at 540 nm was drastically decreased (Fig.5).

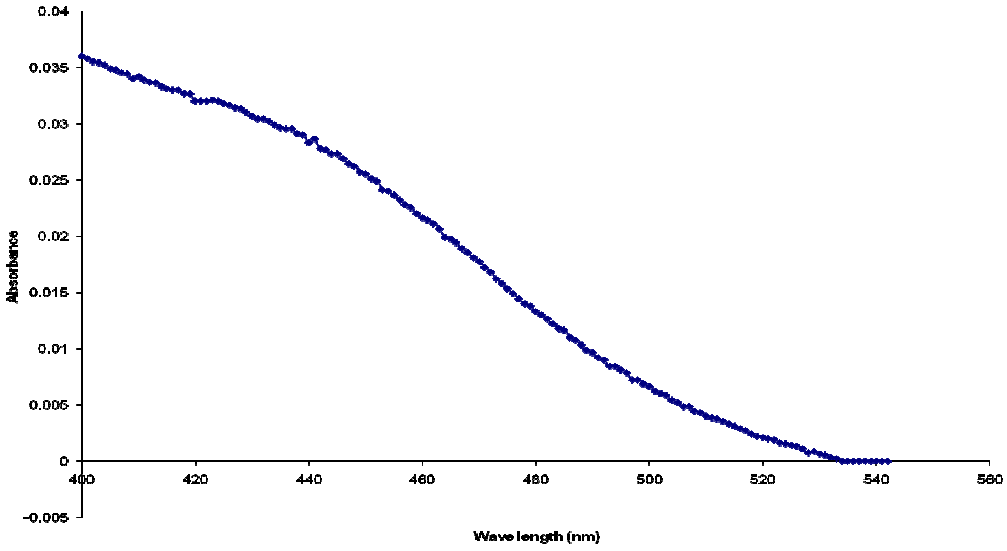

Fig.5. UV- Vis spectra of industrial dye effluent after treatment

CONCLUSION

In this study, the decolorization efficiency of sugarcane bagasse as an adsorbent and used as a substitution of high cost materials such as activated carbon has been studied. The parameter varies were pH, amount of adsorbent and their particle sizes. The suitable condition/parameters were obtained as follows: dosage: 5 gm; pH: 5; particle size: BSS ≠10- 4.78. Even though the adsorption capacity of treated sugarcane bagasse is less than that of activated

carbon, it is cheaply available. It is an agro-industry waste. With this cheap and eco friendly adsorbent considerable dye removal can be achieved.

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