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Valorization of Fibrous Waste for the Wastewater Discoloration

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The aim of this work is the discoloration of the water dyeing unit DBK by waste cotton fiber as adsorbents. The dyes used are reactive dyes According to the results, it is found that the rate increases with increasing fading of the fiber mass (the adsorbent) and the contact time with the colored solution and the stirring time.

Key Words: Fibrous waste, Discoloration, Adsorption, Wastewater.

INTRODUCTION

The importance of ecological risks associated with the development led to industrial concern advantage of waste generated raised the awareness in Algeria[1]. Aqueous industrial effluents are the main sources of pollution. Streams from different processes are mixed and give a final effluent whose characteristics result from a complex combination of factors, such as fiber type and presentation of material treated, the techniques used and the types of chemicals and additives used. Among the compounds present in effluents, dyes are particularly problematic. This research project is in this context because it is the fading of textile effluents by using fiber waste as an adsorbent.

The synthetic dyes currently represent a relatively large group of organic chemicals found in virtually all spheres of our daily lives. World production is estimated at 700,000 tonnes/year, including 140,000 tonnes effluent discharged into the various stages of implementation and making. These releases toxic compounds, surfactants, biocidal compounds, suspended solids, dispersing agents and wetting, dyes and trace metals are toxic to most living organisms. The heterogeneity of their composition makes it difficult or almost impossible to obtain pollution limits at or below those imposed by environmental standards, after treatment with traditional techniques[2].

The compounds of the family triphenylmethanes are compounds as genotoxic in bacterial and mammalian cells[3-7] have established that the malachite green, dye commonly used in industry and as an antifungal agent, a compound is strong lycytotoxic to mammals.

Colour, turbidity, odour: The accumulation of organic matter in rivers induces the appearance of bad taste, bacterial growth, foul odours and staining could be perceived by the human eye from 5×10^{-6} g/L. Apart from the unsightly, colouring agents have the ability to interfere with the transmission of light in water, thus blocking the photosynthesis of aquatic plants.

Synthetic dyes are organic compounds, used in many industrial sectors. They are found as well in the automotive, chemical, paper and especially the textile sector, where all the lines and shades chemical family are represented. The affinities between textiles and dyes vary the chemical structure of dyes and fiber type on which they are applied. It is not uncommon to find that during the dyeing process from 15 to 20 % of dyes and sometimes up to 40 µ for sulfur dyes and reagents, is discharged with the effluent that are most directly able time rejected into waterways without treatment.

Their releases has a colorful cosmetic health problem because many of these dyes is toxic[8]. The appearance carcinogenic speaks for most of them, by their metabolites resulting from enzymatic digestion in the intestinal walls of mammals.

EXPERIMENTAL

The aim of this work is the discoloration of the water dyeing unit DBK by waste cotton fiber as adsorbents. Dyeing is carried out according to the periodic process and with the same revenue as that used in the unit.

Process for dyeing

Solution dyeing dyes: Blue cibacrone P3RL: 40 g/L, yellow cibacrone RMP: 40 g/L. Red cibacrone P4B: 2 g/L, Na_2CO_3 : 20 g/L, NaCl: 30 g/L, liquor ratio 1/10.

Procedure: Treating the goods in the solution containing the reactive dye and NaCl for 30-45 min. Then added to the dyebath Na_2CO_3 and treated for 60-90 min. After dyeing, the fabric is subjected to washing for removal of unfixed dye.

Washing is done as follows: The cold water, hot water (T = 80-90 ºC) for 0.5 h. Lathering in the solution containing 2 g/L of STA to the temperature close to boiling (90 ºC) for 0.5 h.

Rinsing with cold water: After harvesting of the water bath exhaustion and the washing water is determined the dye concentration by spectrophotometry and by using the calibration curves established for each dye screen and their mixture to determine the initial concentration.

These colored waters are used for discoloration of waste fibers. The fibers are unbleached adsorption is therefore zero or increases their hydrophilicity with scouring detergents, which allows us to reuse the water tissue preparation. In this study, we took into account the weight of the adsorbent (fiber waste) and time offading. Furthermore the experiments were made in a static state and with stirring.

Influence of contact time and amount of the fibrous mass on the adsorption of direct dyes and reagents in a static state: The main purpose of this study is to determine the fiber mass and the time after which the adsorption of the dye by the adsorbent (waste cotton fibers) is maximum.

Procedure: We introduced 0.5, 1, 1.5, 2, 2.5 and 3 g of fiber waste scoured cotton in flasks containing 100 mL of the effluent of each dye which dye concentration were determined using curves calibration. The results are given in Table-1.

Determining the amount of dye remaining after 15, 30, 60, 90, 120 and 180 min using a UV/visible and calibration curves.

RESULTS AND DISCUSSION

The results are shown in Figs. 1-4. It is noted that the removal rate increases with the fiber mass and the contact time and that, for the three dyes and their mixture. However, the rate of fading is insufficient (40 %) even with a mass amount of high fiber (3 g) and a maximum contact time (3 h). This result can be explained by the hydrolysis reaction of reactive dyes.

The hydrolysis reaction is a competitive reaction leading to inaction reactive groups (OH groups react with water) this reaction can reduce the yield therefore a significant amount of dye remaining in the wastewater. This can be avoided by the judicious choice of the alkaline agent and the dyeing system.

Moreover, it is also observed that the rate of discoloration does not stabilize. So it is advisable to increase the fiber mass may be, the contact time with the waste coloured solutions or prevent the hydrolysis reaction by changing the pH of the medium.

The same trend is observed for the three dyes and their mixture, rapid adsorption and spreading with a saturation similar to the same time intervals.

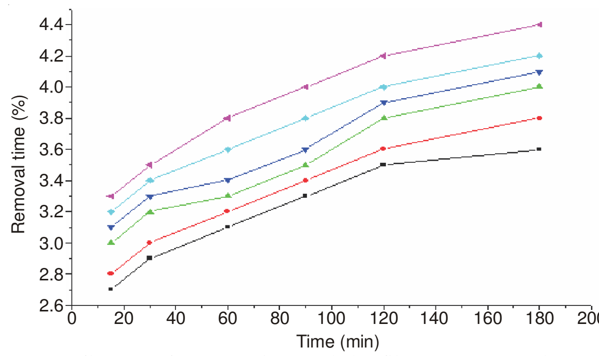

Fig. 1. Influence of contact time and the fibrous mass on the rate of discoloration (blue reactive dyes)

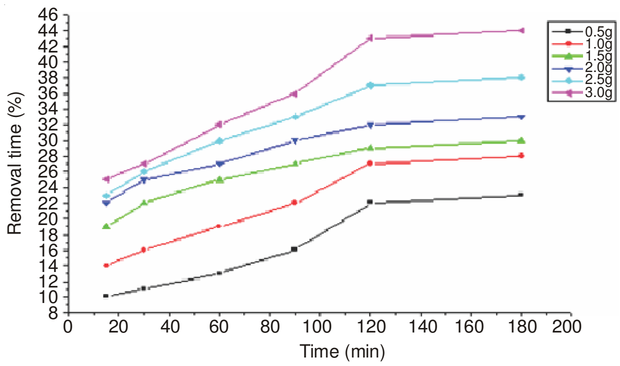

Fig. 2. Influence of contact time and the fibrous mass on the rate of discoloration (red reactive dyes)

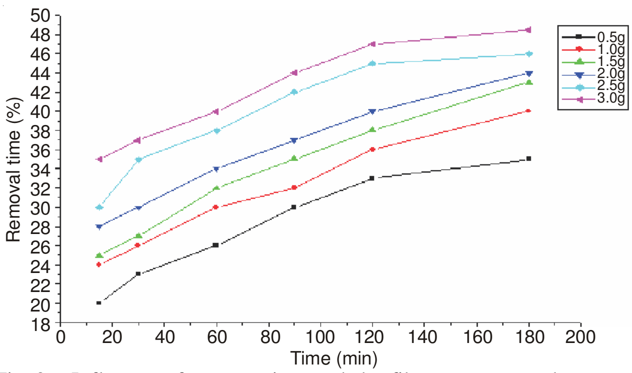

Fig. 3. Influence of contact time and the fibrous mass on the rate of discoloration (yellow reactive dyes)

The influence of the amount of waste on adsorption under the experimental conditions used is evident in the Figs. 1-4.

The elimination rate on an amount of 0.5 g of 120 mn is the order of 30 and 45 %. The adsorption reaction of a solute (dye solution) by a solid (fiber waste) is a phenomenon whose kinetics is often complex. The speed is strongly influenced by several parameters related to the solid state generally having a heterogeneous reactive surface and physico-chemical conditions under which the adsorption is carried out.

TABLE-1
CONCENTRATION OF SOLUTION EXHAUSTION OF DYES REAGENTS

Dyes	Concentration of working solution (g/L)	Optical density of the solution of DO depletion	Solution concentration depletion (g/L)
Reactive red p 6GS	0.6	0.052	0.300
Reactive blue 3 p RL		0.018	0.320
Reactive yellow 4 B p		0.036	0.230
Reactive mixture		0.016	0.235

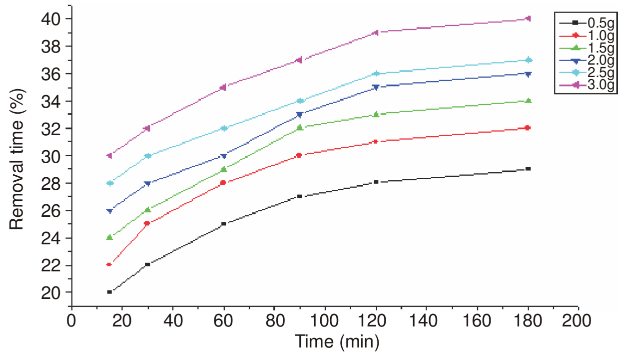

Fig. 4. Influence of contact time and the fibrous mass on the rate of discoloration (mxiture of reactive dyes)

Effect of time of agitation and the amount of the fibrous mass on the adsorption of reactive dyes: The main purpose of this experimental study and find the rate of elimination most important function of the amount of the fibrous mass and shaking time.

Procedure: The procedure is the same as described earlier but the adsorption is performed with agitation. The results are given in Figs. 5-8.

It is suggested from these results that the rate of removal of dyes increases with increase in the amount of fiber and the stirring time of the colored solution and that for all the dyes used. The results show that the discoloration of water for dyeing reactive dyes is possible because the rates of discoloration are satisfactory. This can be explained by the made that the absorption is in a state of agitation resulting in improved performance.

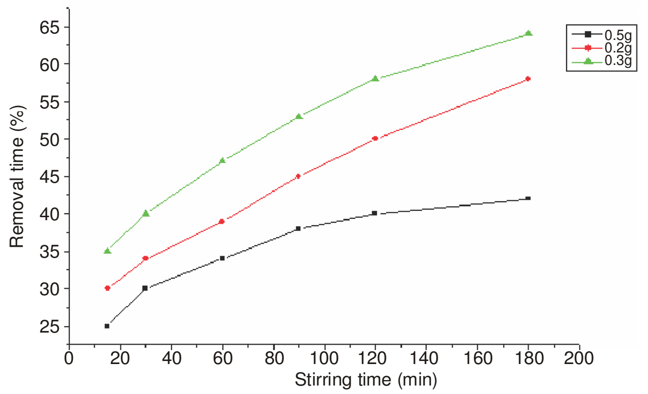

Fig. 5. Influence of agitation time and the fibrous mass on the rate of discoloration (blue reactive dyes)

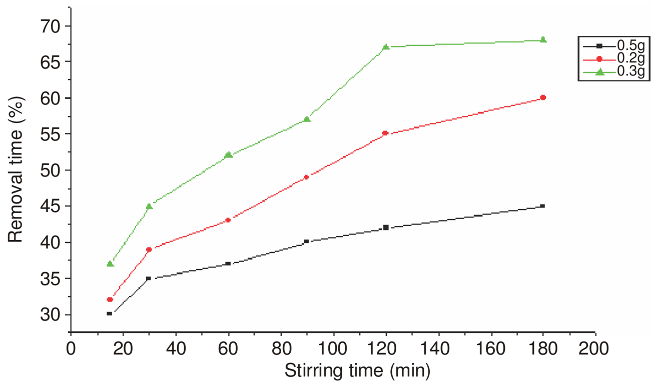

Fig. 6. Influence of agitation time and the fibrous mass on the rate of discoloration (red reactive dyes)

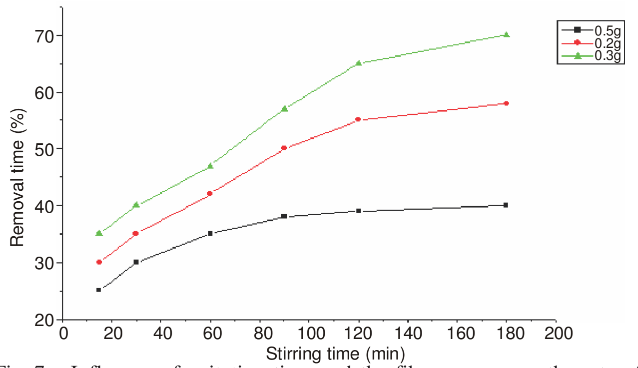

Fig. 7. Influecne of agitation time and the fibrous mass on the rate of discoloration (yellow reactive dyes)

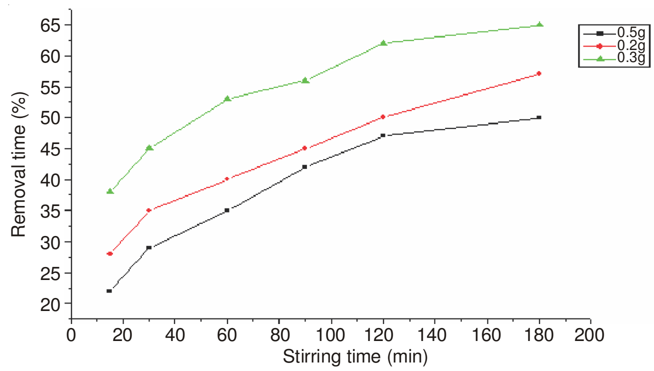

Fig. 8. Influence of agitation time and the fibrous mass on the rate of discoloration (mixture of reactive dyes)

Effect of time of agitation and the amount of the fibrous mass on the adsorption ofreactive dyes: The main purpose of this experimental study and find the rate of elimination most important function of the amount of the fibrous mass and shaking time.

Procedure: The procedure is the same as described earlier but the adsorption is performed with agitation. The results are given in Figs. 5-8.

It is noted from these results that the rate of removal of dyes increases with increase in the amount of fiber and the stirring time of the colored solution and that for all the dyes used.

The results show that the discoloration of water for dyeing reactive dyes is possible because the rate of discoloration are satisfactory. This can be explained by the made that the absorption is in a state of agitation resulting in improved performance.

So, it is concluded that the discoloration of water for dyeing reactive dyes is positively influenced by the phenomenon of agitation.

Conclusion

From these results, we found that the rate of fading increases with increasing fiber mass (the adsorbent) and contact time with the colored solution. It is obvious if we assumed that the discoloration is the result of a adsorption, since the latter is proportional to the mass of the adsorbent. It is also noted that the mixture of dyes has not greatly influenced the behaviour of each dye, so there is no interaction between these dyes that are in the same bath. The slight difference can be explained by the inhomogeneous distribution of impurities in the waste fiber. The decolorization rate is proportional to the amount of the fibrous mass and time of agitation of the solution. The results showed that the agitation would positively influence the performance of fading, which could be explained by the fact that the transfer of the dye particles to the surface of the adsorbent (waste cotton fiber) requires a certain energy which is carried out by agitation. The fading rate is inadequate for the direct dyes, this result can be explained by the hydrolysis reaction of reactive dyes.

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