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Research Article

Process Sorption for Removal of Titan Yellow Dye With *Parthenium* Plant Powder

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Abstract: The current examination is on the expulsion of Titan yellow dye from watery arrangements utilizing *Parthenium* powder as sorbent. The aggregate impacts of working boundaries, for example, biosorbent size, dye concentration, pH of the arrangement, biosorbent dose and temperature on the dye biosorption were dissected utilizing UV Spectrophotometer. Tentatively the ideal arrangement of conditions for greatest rate biosorption of Titan yellow color are discovered to be at biosorbent size = 53 μm, pH = 7, biosorption dosage (w) = 25 g/L, beginning dye Concentration (C0) = 20 mg/L and temperature = 303 K and the biosorption determined at these qualities was discovered to be 85%. The advanced qualities acquired through focal composite plan and each factor in turn measure is in acceptable understanding.
Keywords: Sorption of dyes, pH, time, temperature, size and dosage.

Introduction

Water consumption has increased worldwide in every economic sector. In recent years, water pollution has improved by industrial development. Therefore, population increases without any planning urbanization. Several kinds of pollutants could be found in industrial wastewater in huge amounts. The aquatic ecosystem is suffering from piles of organic pollutants including dyes causing toxic and carcinogenic effects on the human beings. For example, just textile industry uses around 10,000 different types of dyes; its annual production is higher than 7 × 105 tons. It has been estimated that 10–15% of dyes are lost in dying textile water. Some of them are hard to remove from aqueous phase because of their solubility. For this reason, dyes removal is an important challenge for the environmental chemistry. Recently, the concern about finding other methods for organic compounds degradation has been substantially increased [01–04].

Materials and Methodology

The present experimentation is carried out in batch-wise, on biosorption of Titan yellow (TY) dye from aqueous solution onto *Parthenium* powder.

Reagents and Chemicals

Titan yellow (TY) is used as source of dye stock solution.

Preparation of the bisorbents

Parthenium was collected from AU Engineering college campus in Visakhapatnam city, Andhra Pradesh, India. The collected plants were washed with distilled water several times until the dirt particles are removed. After through washing with distilled water, sorbent was sun dried until it became crispy, cut into small pieces, powdered and sieved. In the present study, 53, 75, 105, 125 and 152 μm size powders was used as sorbent without any other pretreatments.

Figure 1. *Parthenium* plant

Preparation of Dyes stock solutions

Titan yellow (TY), is used as the source for preparing stock solution (synthetic). All the required solution is prepared with double distilled water. 1.0 g of dye was dissolved in 1.0 L of distilled water to prepare 1000 mg/L stock solution. Samples of different concentrations of dye is prepared from this stock solution by appropriate dilutions. 10 mg/L of BCG solution is prepared by proper dilutions. 10 ml of 1000 mg/L BCG stock solution is taken in a 1000 ml volumetric flask and is made up to the mark with distilled water. Similarly solution with different concentrations such as 20 mg/L, 50 mg/L, 100 mg/L, 150 mg/L and 200 mg/L were prepared. The pH of the solution is varied by adding required amounts of 0.1 N HCl and 0.1N NaOH.

Results and Discussion

Effect of Contact Time

The rate biosorption is plotted against contact time in figure 1. The % biosorption is found to increment up to 50 min. The most significant level of biosorption is accomplished at 50 min of disturbance and gets consistent after 50 min with % biosorption of 55. The investigation uncovered that a straightforwardly proportionate connection between the increment in contact time and adsorption measure, and specifically, territories where a lot of colors were adsorbed inside the initial 20 min. It was seen that inside 50 min, the color evacuation proportions for TY had arrived at balance. This outcome proposes two consecutive strides in TY color adsorption on *Parthenium*: (I) A fast TY color move to the outside surface of *Parthenium*; and (ii) A moderately more slow advance of diffusing colors between the *Parthenium* groups [5-6].

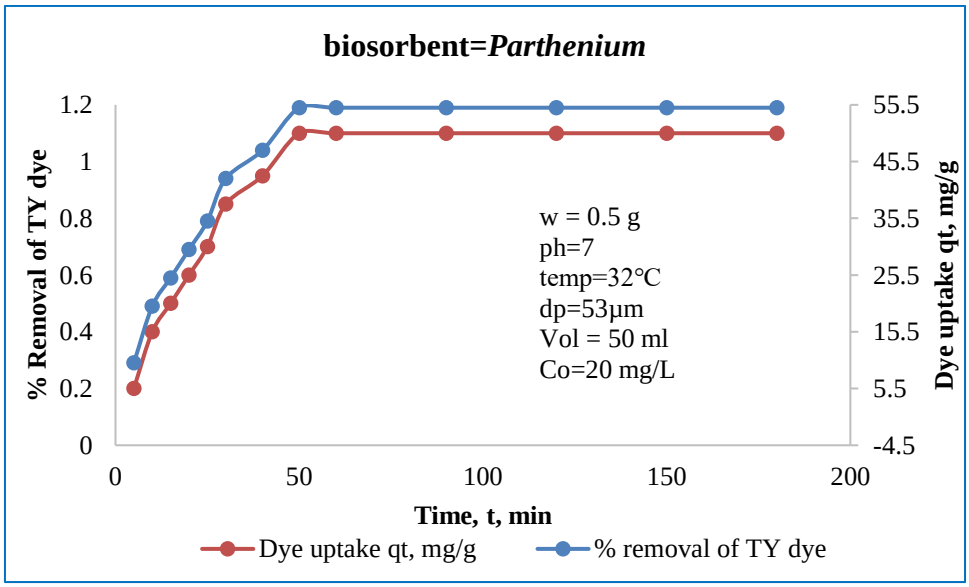

Figure 1. Effect of Contact Time on % removal of TY dye

Effect of Bisorbent Size

Figure 2 addresses the rate biosorption of Titan yellow with the biosorbent size. The rate biosorption is extended from 35 % to 55 % as the biosorbent size is lessened from 152 to 53 µm. As the size of the atom reduces, a surface area of the biosorbent redesigns and extra number of dynamic objections on the biosorbent are open to the biosorbate. The pace of color evacuation shows an expanding pattern as the molecule size diminishes. The most elevated proficiency (55%) was acquired with *Parthenium* with a molecule size of 53 µm [7-8].

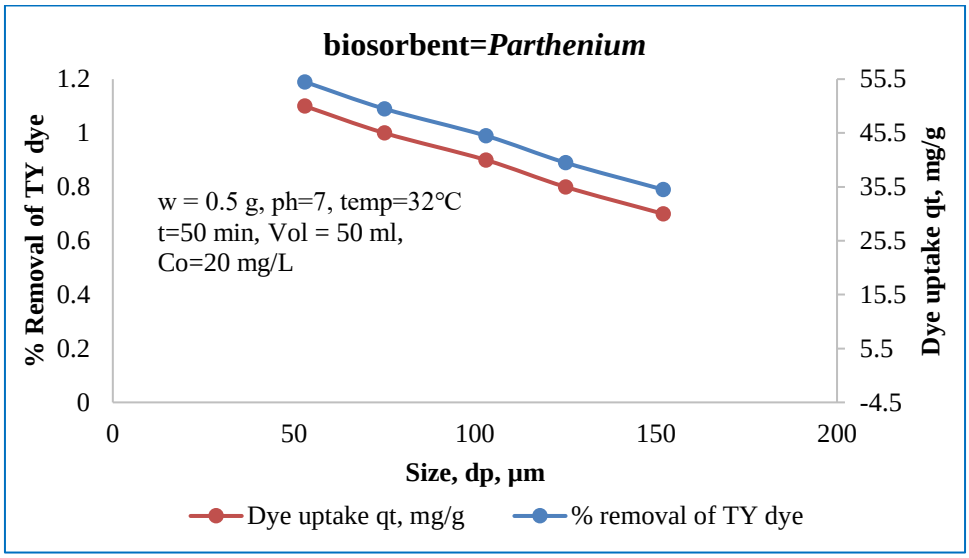

Figure 2. Effect of Bisorbent size on % removal of TY dye

Effect of pH in aqueous solution

The effect of pH of watery game plan on rate biosorption of Titan yellow is introduced figure 3. The rate biosorption is extended from 55 % to 71 % as pH is extended from 2 to 5. The rate biosorption is lessened from 71 % to 50 % as pH increases from 5 to 8. The fundamental factor for color biosorption is the electrostatic power of fascination among biosorbent and biosorbate. At acidic pH esteems, the outside of the biosorbent conveys a positive charge because of the presence of H^+ in the arrangement. This prompts electrostatic aversion between the cationic Titan yellow color and emphatically charged *Parthenium* surface as biosorbent. Unexpectedly, at soluble pH esteems, because of the current of OH^- particles in abundance, the outside of the biosorbent conveys a negative charge. This outcomes in electrostatic fascination between cationic Titan yellow color and adversely charged *Parthenium* surface prompting upgraded adsorption at higher pH esteems [9-10].

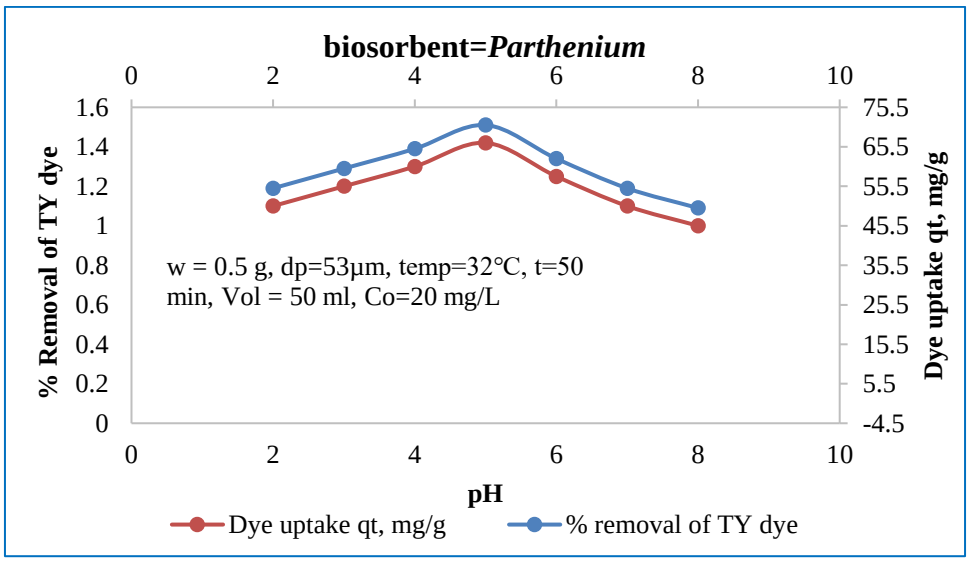

Figure 3. Effect of pH on % removal of TY dye

Effect of Initial Concentration of TY dye

A plot figure 4 with rate biosorption of Titan yellow as a component of beginning grouping of Titan yellow. The rate biosorption is diminished from 71 % to 51 % as the Titan yellow in the fluid arrangement expanded from 20 mg/L to 200 mg/L. A higher starting fixation gives a significant main impetus to conquer all mass exchange protections of the color between the fluid and strong stages, in this manner builds the take-up. Likewise, expanding introductory color focus builds the quantity of crashes between color anions and sorbent, which improves the sorption cycle. At the point when the underlying color fixation expanded from 20 to 200 mg/L, the take-up limit of *Parthenium* expanded from 1.42 to 10.2 mg g^{-1} for TY color at 32 ^{0}C. In any case, higher adsorption yields were seen at lower convergences of each color [11-12].

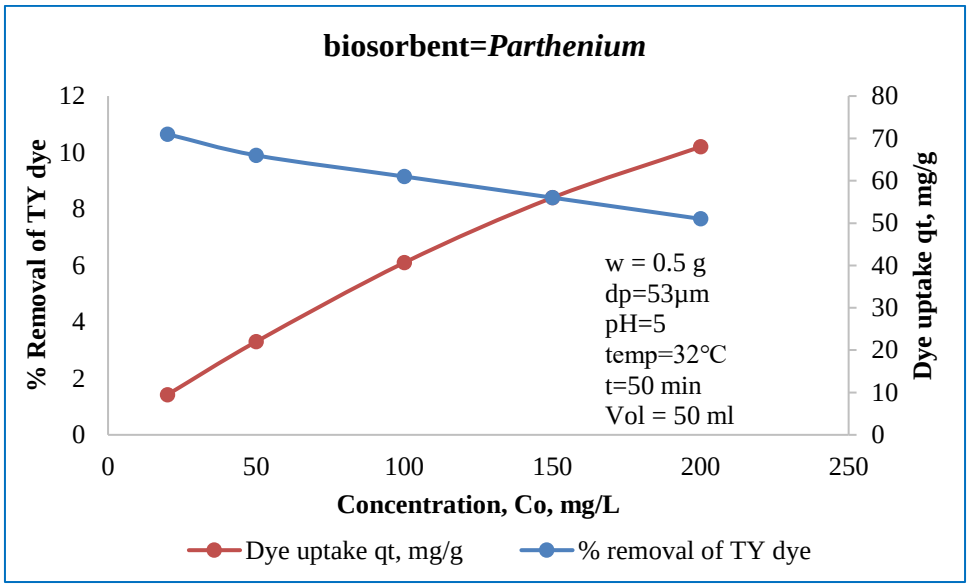

Figure 4. Effect of Initial Concentration on % removal of TY dye

Effect of Bisorbent Dosage

The rate biosorption of Titan yellow is drawn against biosorbent size in figure 5. The rate biosorption increases with expansion in biosorbent estimations. For a biosorbent measurements of 53µm, rate biosorption increases from 71 % to 90.5 %, as dose is expanded from 10 to 70 g/L. To such an extent that it is sure about the grounds that the number of available locales for color evacuation would be more as the dose of the biosorbent expanded [13-14].

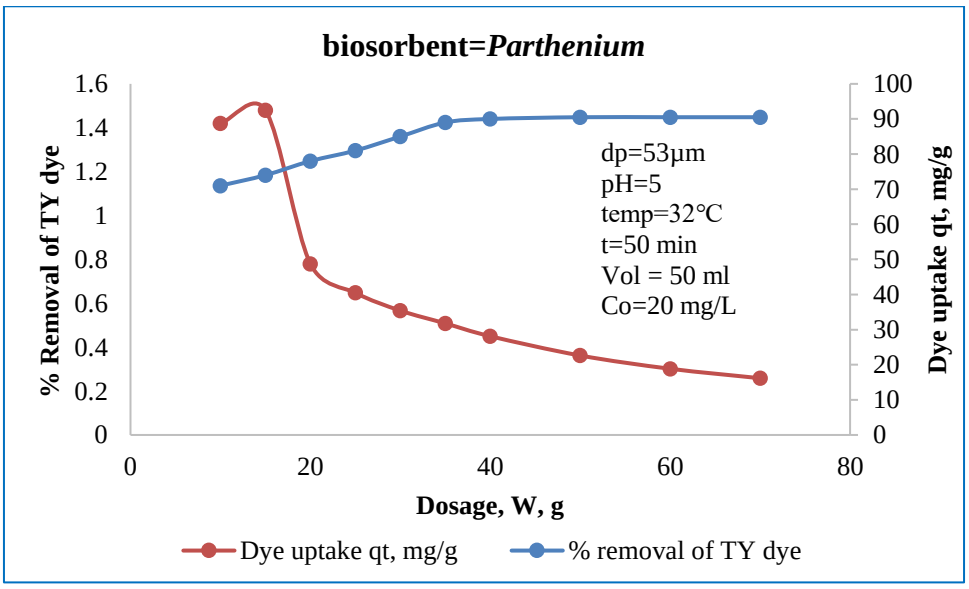

Figure 5. Effect of Bisorbent Dosage on % removal of TY dye

Effect of Temperature

The effect of temperature on the equilibrium shading take-up was basic. The effect of changes in the temperature on the Titan yellow take-up is showed up in figure 6. The biosorption furthest reaches of shading is extended at higher temperatures, which shows that biosorption of tones in this structure is an endothermic cycle. This may be credited to extended passageway of responsive tones inside micropores at higher temperatures or the creation of new unique locales.

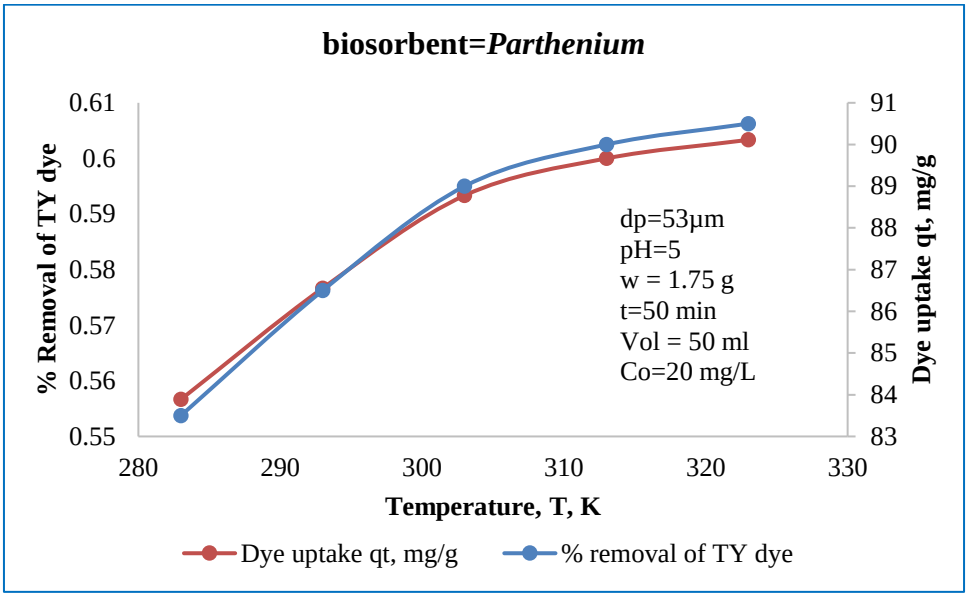

Figure 6. Effect of Temperature on % removal of TY dye

Conclusion

The aim of this investigation is to determine the suitability of *Parthenium* powder as sorbent for the removal of TY dyes from aqueous solutions. The equilibrium, kinetic and thermodynamic studies are carried out for sorption of TY experimentally. The analysis of the experimental data result in the following conclusions:

1) The equilibrium agitation time for TY dye sorption is 25 minutes.
2) Percentage sorption of TY dye from the aqueous solution increases significantly with increase in pH from 2 (40%) to 7 (64%).
3) The optimum dosage for sorption is 25 g/L (1.25 mg/g).
4) The maximum uptake capacity of 15.8478 mg/g is obtained at 303 K.
5) It can be concluded from the above results that *Parthenium* powder is capable of removing Titan yellow dye.

Conflicts of interest

The authors declare no conflicts of interest.

References

1. Doğan, M., Alkan, M., Türkyilmaz, A. and Özdemir, Y. 2004. Kinetics and mechanism of removal of methylene blue by adsorption onto perlite. Journal of Hazardous Materials, 109(1-3): 141-148.

2. Garg, V.K., Kumar, R. and Gupta, R. 2004. Removal of malachite green dye from aqueous solution by adsorption using agro-industry waste: a case study of Prosopis cineraria. Dyes and Pigments, 62(1): 1-10.

3. Wu, F.C., Tseng, R.L. and Juang, R.S. 2001. Kinetic modeling of liquid-phase adsorption of reactive dyes and metal ions on chitosan. Water Research, 35(3): 613-618.

4. Chatterjee, S., Chatterjee, S., Chatterjee, B.P., Das, A.R. and Guha, A.K. 2005. Adsorption of a model anionic dye, eosin Y, from aqueous solution by chitosan hydrobeads. Journal of Colloid and Interface Science, 288(1): 30-35.

5. Ramakrishna, K.R. and Viraraghavan, T. 1997. Dye removal using low cost adsorbents. Water Science and Technology, 36(2-3): 189-196.

6. Kannan, N. and Sundaram, M.M. 2001. Kinetics and mechanism of removal of methylene blue by adsorption on various carbons—a comparative study. Dyes and Pigments, 51(1): 25-40.

7. Ozdemir, O., Armagan, B., Turan, M. and Celik, M.S. 2004. Comparison of the adsorption characteristics of azo-reactive dyes on mezoporous minerals. Dyes and Pigments, 62(1): 49-60.

8. Ho, Y.S. 2006. Review of second-order models for adsorption systems. Journal of Hazardous Materials, 136(3): 681-689.

9. Ho, Y.S. and McKay, G. 1998. Kinetic models for the sorption of dye from aqueous solution by wood. Process Safety and Environmental Protection, 76(2): 183-191.

10. Jain, A.K., Gupta, V.K. and Bhatnagar, A. 2003. Utilization of industrial waste products as adsorbents for the removal of dyes. Journal of Hazardous Materials, 101(1): 31-42.

11. Gong, R., Li, M., Yang, C., Sun, Y. and Chen, J. 2005. Removal of cationic dyes from aqueous solution by adsorption on peanut hull. Journal of Hazardous Materials, 121(1-3): 247-250.

12. Yang, X. and Al-Duri, B. 2005. Kinetic modeling of liquid-phase adsorption of reactive dyes on activated carbon. Journal of Colloid and Interface Science, 287(1): 25-34.

13. Crini, G. 2008. Kinetic and equilibrium studies on the removal of cationic dyes from aqueous solution by adsorption onto a cyclodextrin polymer. Dyes and Pigments, 77(2): 415-426.

14. Kumar, K.V., Ramamurthi, V. and Sivanesan, S. 2005. Modeling the mechanism involved during the sorption of methylene blue onto fly ash. Journal of Colloid and Interface Science, 284(1): 14-21.

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