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REMOVAL OF COLOUR FROM TEXTILE INDUSTRY EFFLUENT USING SEAWEED

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Abstract

The wastewater disposed by textile industries is causing major hazards to the environment and drinking water due to presence of a large number of contaminants like acids, bases, toxic organic, inorganic, dissolved solids and colour. In effect, the discharge of contaminants such as dyes in the environment is worrying for both toxicological and esthetical reasons as damage the quality of the receiving streams and is toxic to food chain organisms. These colored compounds are not only aesthetically displeasing but also inhibiting sunlight into the stream and reducing the photosynthetic reaction. Since many organic dyes are harmful to human, the removal dye from the effluent becomes urgent need. Hence the present study investigated the use of activated non activated carbon black produced from marine algae such as *Hypnea sp.* collected from Kanyakumari in the treatment of textile dye effluent collected from S.R Nagar, Tiruppur, Tamil Nadu. Results revealed that the removal of color from textile effluent was excellent by using activated carbon sample (84.37%) at room temperature (37^{o}C). The optimum speed was found to be 2000rpm and adsorbent dosage was 10mg at pH 5 for 300min. Whereas non activated sample showed maximum reduction of 81.25% at pH 9 and temperature of -4^{o}C at 1500 rpm with adsorbent dosage of 10mg.

Keywords: Adsorption, activated carbon, *Hypnea sp.* dye, textile effluent.

Introduction

An industrial effluent is undesirable by-product of economic development and technological advancement. When improperly disposed off, it affects human health and the environment. Textile effluent is a complex mixture of chemicals varying in quantity and quality. These generate both inorganic and organic waste mixed with wastewater from the production processes, which leads to change in both biological and chemical parameters of the receiving water bodies

[1]. Tightening government legislation is forcing textile industries to treat their waste effluent to an increasingly high standard. Traditional methods such as chemical precipitation, evaporation, electroplating, adsorption and ion exchange processes have been used to remove lead from wastewater [2]. However; these technologies are most appropriate in situations where the concentrations of the heavy metal ions are relatively high. They are either unsuccessful or expensive when heavy metals are present in the wastewater at low concentrations, or when very low concentrations of heavy metals in the treated water are required.

Adsorption techniques are generally used to remove certain classes of pollutants from waters, especially those which are not easily biodegradable. The removal of methylene blue, as a pollutant, from waste waters of textile, paper, printing and other industries has been addressed by the researchers. At present, a combination of biological treatment and adsorption on activated carbon is becoming more common for removal of dyes from wastewater. Although commercial activated carbon is a preferred adsorbent for color removal, its widespread use is restricted due to its relatively high cost which led to the researches on alternative non-conventional and low-cost adsorbents [3]. Use of waste materials as low cost adsorbents is attractive due to their contribution in the reduction of costs for waste disposal, therefore contributing to environmental protection [4]. Numerous researchers worked earlier on variety of adsorpents such as wool fiber and cotton fiber [5], Biogas residual slurry [6], Carbonized coir pith [7], Chitosan [8], Hardwood [9], Mahogany sawdust, rice husk [10], Banana pith [11], Neem (*Azadirachta Indica*) husk [12], Rice husk [13], Rice husk [14], Silk cotton hull, coconut tree sawdust [15], Coir pith[16,17], Gypsum [18], Tuberose Sticks [19], Tamarind Fruit Shell [20], Parthenium hysterophorus [21]. Marine algae have been found to be potential suitable sorbents because of their cheap availability, relatively high surface area and high binding affinity. The use of marine algae for heavy metal removal has been reported by several authors [22].

Materials and Methods

Collection and preservation of Sample

The green marine algae *Hypnea* sp. in the present study was collected from the coastal area of Kanyakumari district, Tamil Nadu, India. The collected algae were washed with tap water and further by deionized water several times to remove impurities. The washed algae were then completely dried in the sun light for seven days. Dry biomass was chopped, milled size fraction of 0.5-1 mm.

Preparation of none activated carbon black

Hundred and twenty gram of dried sample was placed in muffle furnace carbonized at 400^{o}C for 1hr. Then the prepared carbon black was crushed and made into fine powder having particle size of less than 100mesh size. Then it was stored.

Preparation of Activated Carbon

Required amount of dried sample was mixed with 97% H_2SO4 by drop wise. The resulting mixture was kept for 24 h at room temperature followed by refluxing in fume hood for 4 h. At the end of 24 hours the excess solution were decanted off and air dried. Then the materials were placed in muffle furnace carbonized at 400^{o}C for one hour. After cooling, reaction mixture was washed repeatedly with deionized water and soaked in 2% NaHCO3 solution to remove any remaining acid. Then the prepared carbon black was crushed and made into fine powder having particle size of less than 100mesh size. Then it was stored.

Collection of Textile effluent

Textile effluent was collected from S.R Nagar, Thiruppur, Tamil Nadu, and India where it was left into the soil without any treatment. Then the collected effluent was stored in a container at room temperature for further use.

Batch Adsorption Studies

About 100ml of effluent was taken in a 250ml conical flask and treated with activated and non activated carbon black prepared from marine algae with different dosage such as 5mg, 10mg and 25mg of adsorbent at various agitation speeds of 1000rpm, 1500rpm and 2000rpm. During batch adsorption experiments, temperature was varied at three different temperatures i.e.37^{o}C, -4 ^{o}C and 45^{o}C and the pH of 5, 7 and 9 of the solution was adjusted by adding 1N NaOH/1N HCl. The adsorbent was removed by centrifugation and the concentration of dye in the supernatant liquid was measured with the help of calorimeter at 540nm at each 30min time intervals.

Percentage removal of color

The percent removal of color was calculated by the following formula;

$$Percentage\ Adsorption\ \% = \frac{Initial\ OD - \ Final\ OD}{Initial\ OD}\ \boldsymbol{x}\ 100$$

Results and Discussion

The main focus of this project was to evaluate the adsorption potential of the activated and non activated carbon of *Hypnea sp.* and optimize the parameters to attain maximum efficiency of colour reduction from the textile effluent.

Results revealed that the activated carbon has higher efficiency in the reduction of colour. Ten mg dosage of activated carbon showed highest reduction of 84.4% (Fig1-5) at 300min at pH 5 followed by activated carbon at pH 7 (76.6%) and lower reduction was found in pH 9 (52.96%). Hence optimum dosage was found to be 10mg and the pH was found to be 5. These results were extremely good when compared with the oxidative degradation of methyl orange dye [23]. In that oxidative degradation maximum of 22.15% reduction was achieved whereas, this results showed highest reduction (84.4%).

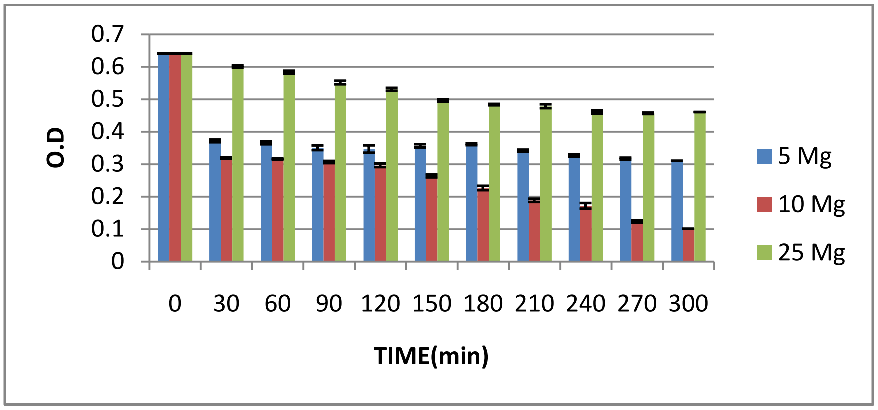

Fig.1 OD of treated dye effluent by activated carbon at pH 5.

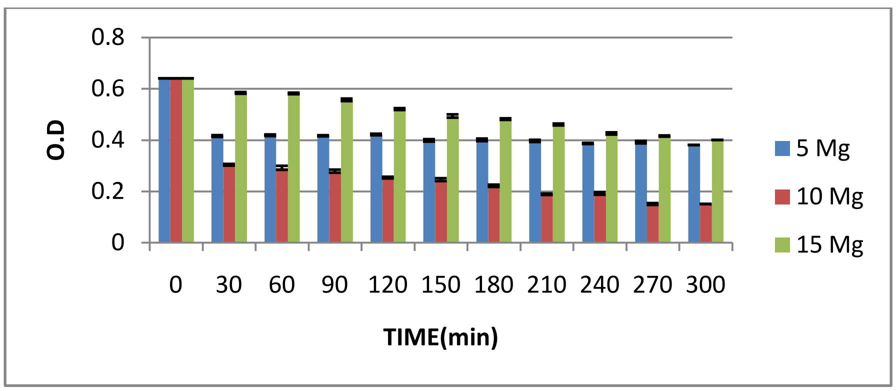

Fig.2 OD of treated dye effluent by activated carbon at pH 7.

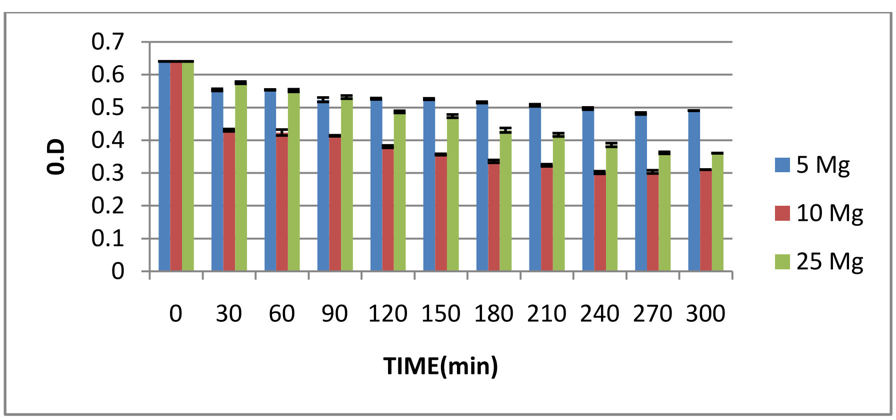

Fig.3 OD of treated dye effluent by activated carbon at pH 9.

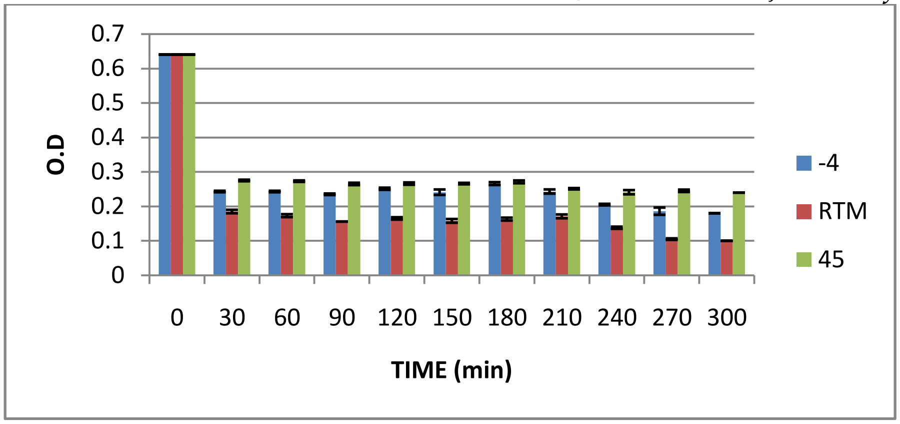

Fig.4 OD of treated dye effluent by activated carbon with 10mg and 5pH.

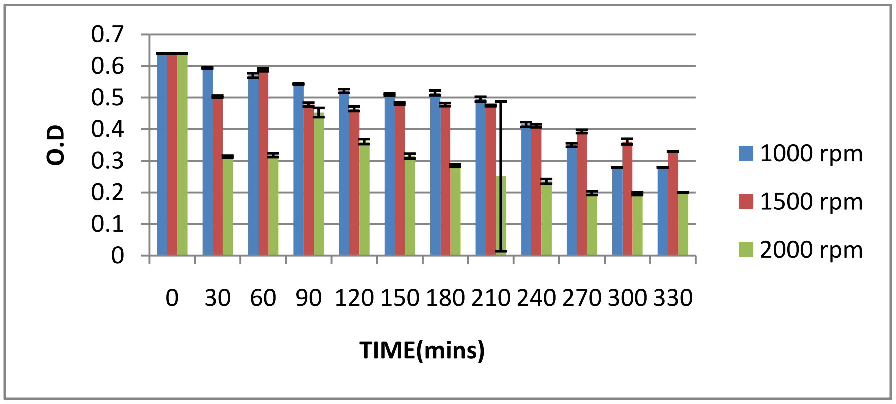

Fig.5 OD of treated dye activated carbon from at Dosage 10 mg at RT (37^{o}C) and pH 5.

In case of non activated carbon sample, maximum reduction (81.25%) was attained at -4^{o}C at 300min which was comparatively lower than the results revealed by Velmurugan et al., [24] Velmurugan et al., achieved 99% color reduction by orange peel as an adsorbent. Optimum dosage was found to be 10mg and pH was 9 followed by 45^{o}C at 270min (72.5%) (Fig 6-10). The least reduction (21.87%) was found at the dosage of 5mg at 300min and pH was found to be 9. Sharmila et al.,[25] studied that the using of *M.oleifera* for removing methyl orange dye which was comparatively lower (75.63%) than this result.

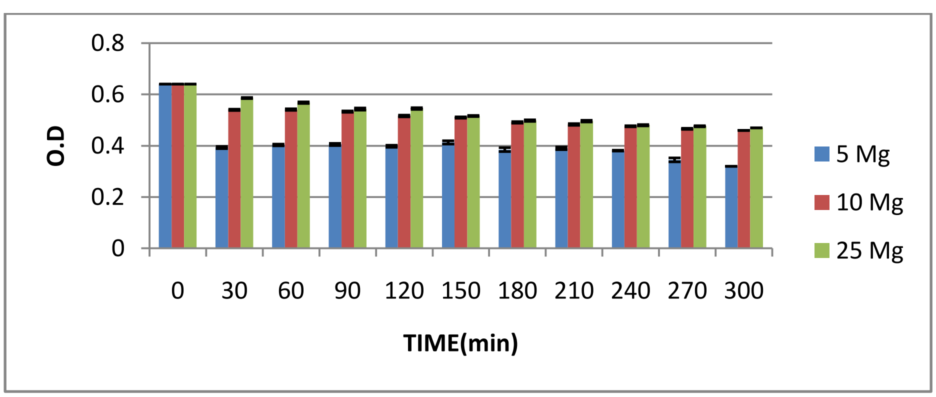

Fig.6 OD of treated effluent by non Activated carbon at pH 5.

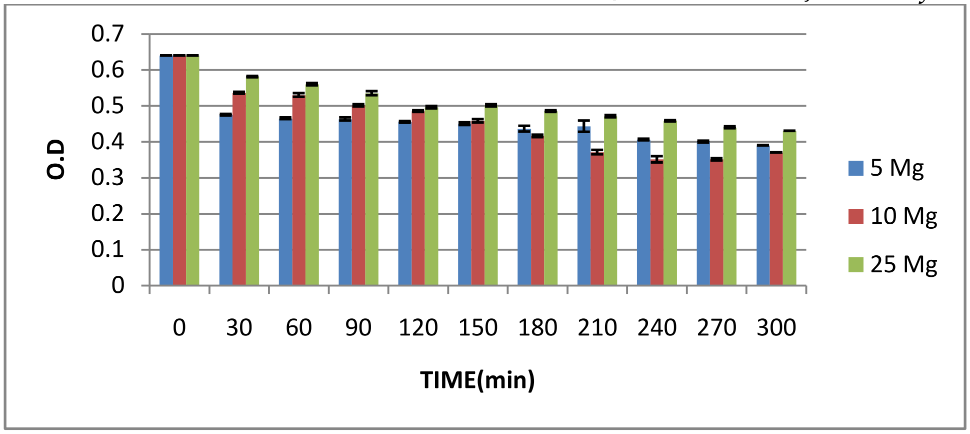

Fig.7 OD of treated dye effluent by non Activated carbon at pH 7.

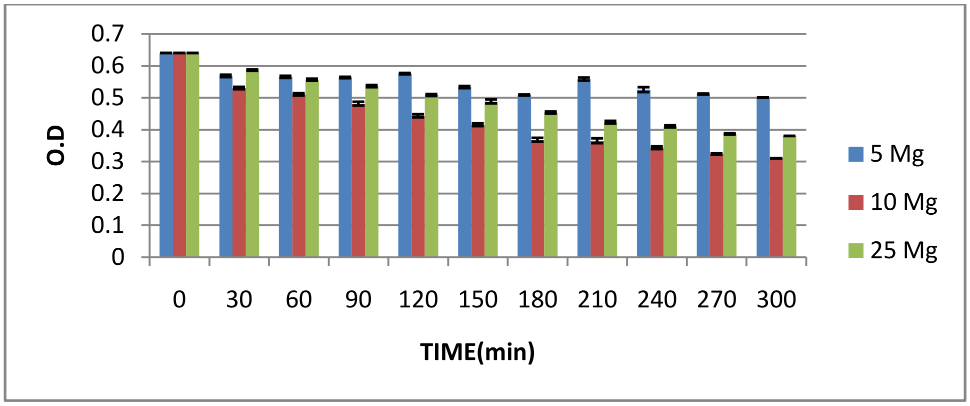

Fig. 8 OD of treated dye effluent by non Activated carbon at pH 9.

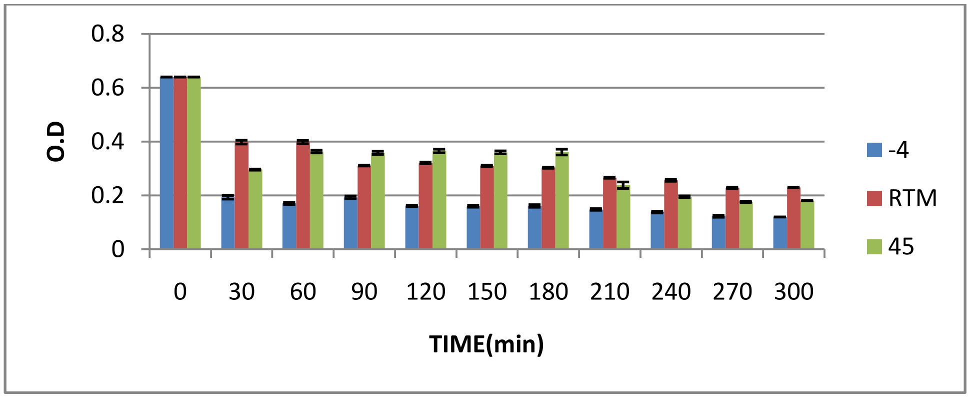

Fig.9 OD of treated effluent by non activated carbon at Dosage 10 mg and pH 9.

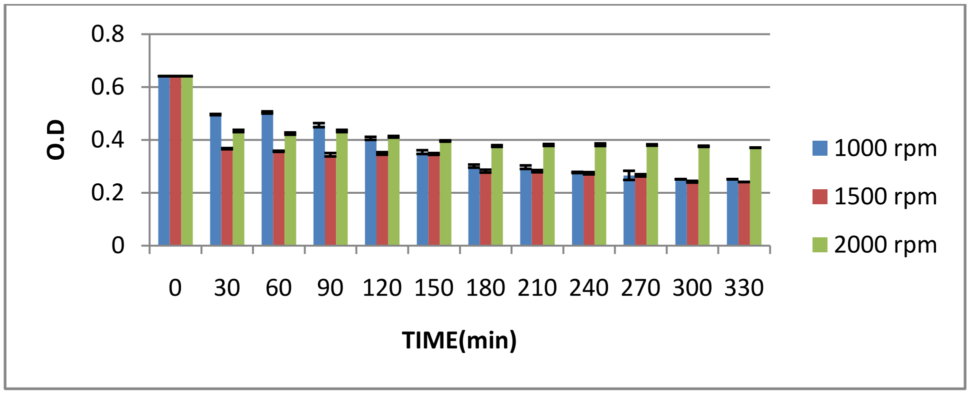

Fig.10 OD of treated effluent by non Activated carbon at -4^{0}c, 10mg and pH 9.

Other researchers used plant leaf powder as an adsorbent to adsorb malachite green dye in which reduction was found in was *Annona squamosa* 75% and *M.zapota* showed 53.13% [26] which was comparatively lower than this study.

Conclusion

Textile effluents cause bio-toxicity in the organisms which lead to growth inhibition and low chlorophyll content in plants. There is a need to find alternative treatments that are effective in removing dyes from large volumes of effluents and are low in cost, such as chemical, biological or combination systems. This study proved that activated carbon produced from seaweed is good alternate for colour removal from textile effluent. In future, further more research may be carried out to improve its efficiency of color removal by optimizing other parameters by economical way.

References

1. N. Gomez, M.V. Sierra, A. Cortelezzi, and A. Rodrigues Capitulo, 2008, Vol 69, pp 472-479.
2. W. Stumm, and J.J. Morgan, 1981.
3. Mohd Rafatullah, Othman Sulaiman, Rokiah Hashim, and Anees Ahmad, 2010, Vol 177, pp 70–80.
4. A. Bhatnagar, and M. Sillanpaa, 2010, Vol 157: pp 277–290.
5. A. Rasheed Khan, Hajira Tahir, Fahim Uddin, Uzma Hameed, 2005, Vol 9(2), pp 29 – 35.
6. C. Namasivayam, R.C Yamuna, 1992a, Vol 65(12), pp 133-139.
7. C. Namasivayam, R. Radhika, S. Subha, 2001a, Vol 21(4), pp381-387.
8. R.S. Juang, R.L. Tseng, F.C. Wu, S.J. Lin, 1996, Vol 31(2), pp 325-338.
9. H.M. Asfour, O.A. Fadali, M.M. Nassar, M.S. ElGeundi, 1985, VoL 35(1), pp 21-27.
10. C. Namasivayam, R.T.Yamuna, 1992b, Vol 53(2), pp 153-157.
11. C. Namasivayam, and N. Kanchana, 1993a, Vol 1(1), pp 33-42.
12. K.K. Alau, C.E. Gimba, J.A. Kagbu, 2010, Vol 2(5), pp 456-461.
13. D.K. Singh, N. Srivastava, 2001, Vol 8(2), pp 133-139.
14. Y. Guo, S. Yang, W. Fu, J. Qi, R. Li, Z. Wang, 2003, Vol 56(3), pp 219-229.
15. K. Kadirvelu , M. Kavipriya, C. Karthika, M. Radhika , N. Vennilamani, S. Pattabhi, 2003, Vol 87(1), pp 129-132.
16. C. Namasivayam, M. Dinesh Kumar, Selvi K., Ashruffunissa Begum, T. Vanathi, R.T.Yamuna, 2001b, Vol 21(6), pp 477-483.

17. C. Namasivayam, D. Kavitha, 2002, Vol 54(1), pp 47-58.
18. A. Muhammad Rauf, I. Shehadeh, Amal Ahmed, Ahmed AlZamly, 2009, Vol 55.
19. Ahsan habib, Zahidul Hasan, A.S.M. Shajedur Rahman, A.M. Shafiqul Alam, 2006, Vol 7(2), pp 112-115.
20. Papita Saha, 2010, Vol 213, pp 287–299.
21. Rajeshwari sivaraj, V. Subburam, 2002, Vol 85(2), pp205-206.
22. L. Deng, Y. Su, H. Su, X. Wang, and X. Zhu, 2007, Vol 143, pp 220–225.
23. Anjali Goell, Ranjana Bhatt, Neetu Rani, 2012, Vol 2(4), pp 32-36.
24. P.L. Velmurugan, V. Rathina kumar, G. Dhinakaran, 2011, Vol 1(7), pp 1492-1503.
25. S. Sharmila, L. Jeyanthi Rebecca, Merina Paul Das, and Shashi Bala, 2013, Vol 4(2), pp 1267- 1271.
26. S. Sharmila, L. Jeyanthi Rebecca and E. Kowsalya, 2015, Vol 7(2), pp 8914-8918.

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