Research Article

Biosorption of Textile Effluent Using Marine Algae

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ABSTRACT

The textile dyeing industry consumes large quantities of water and produces large volumes of wastewater from different steps in the dyeing and finishing processes. At present, the dyes are mainly aromatic and heterocyclic compounds, with color-display groups and polar groups. The structure is more complicated, resulting in much difficulty to degrade the printing and dyeing wastewater. Many methods have been adopted for colour reduction of synthetic dyes in which adsorption was found to be effective one. In this study carbon black obtained from *Gracilaria corticata* were used as an activated and non activated form to treat textile effluent to remove the color from textile effluent. Results showed that non activated carbon from *G.corticata* and reduced about 84.81% of color where as activated carbon could reduce 80%. Optimum pH was found to be 7 for both activated and non activated form. The optimum dosage of activated carbon was found at 25mg at room temperature and for non activated carbon, it was found to be 5mg at room temperature. Stirring was not shown much reduction than normal shaking of sample with carbon.

Keywords: *Gracilaria corticata,* adsorbent, textile effluent, colour, reduction.

INTRODUCTION

Pollution reaches its most serious proportions in the densely settled urban-industrial centers of the more developed countries[1]. Effluent from textile industry is a complex mixture of chemicals varying in quantity and quality. These industries 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[2]. Control of water pollution has gained increasing importance in recent years. The release of dyes into the environment constitutes only a small proportion of water pollution, but dyes are visible in small quantities due to their brilliance.

Tightening government legislation is forcing textile industries to treat their waste effluent to an increasingly high standard. The effluent treatment method is broadly classified into three main categories: physical, chemical, and biological treatments. There are four stages, preliminary, primary, secondary, and tertiary treatments to treat the textile effluents. The preliminary treatment processes are equalization and neutralization. The primary stages involve screening, sedimentation, floatation, chemical coagulation and flocculation. Secondary stages are used to reduce the organic load, facilitate physical/chemical separation and biological oxidation. Tertiary stages are important because they serve as polishing of effluent treatment.

Adsorption techniques are widely used to remove certain classes of pollutants from waters, especially those which are not easily biodegradable. The removal of MB, as a pollutant, from waste waters of textile, paper, printing and other industries has been addressed by the researchers. Currently, 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].

Many plants were also used for treating various industrial effluents[5].

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[6-8].

In this study, activated and non activated carbon prepared from *Hypnea sp.* was used as adsorbent for the colour removal of textile effluent.

MATERIALS AND METHODS

Collection and Preservation of Sample

Seaweed *Gracilaria corticata* was collected from Tuticorin and was identified by Dr.Baluswamy, Prof.& Head, Dept. of Botany, MCC, Chennai.

The collected algae were washed with water for several times to remove impurities then was completely dried in the sun light for seven days.

Dry biomass was chopped, and milled size fraction of 0.5-1 mm.

Preparation of Non Activated Carbon Black

Dried sample was placed in muffle furnace carbonized at 400°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

Dried algal sample was mixed with 97% H_2SO4 by drop wise.

Then the 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°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 and stored.

Textile Effluent

Textile effluent was collected from S.R Nagar, Thiruppur, Tamil Nadu, 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°C, -4 °C and 45°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 Colour

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

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

RESULTS AND DISCUSSION

Marine algae were used as adsorbent for the removal of colour from synthetic dyes and showed good reduction in colour. In this study marine algae *G.corticata* was used as an activated and non activated carbon form to reduce the colour from textile effluent.

Effect of Adsorbent Dosage and pH

Algae are found to be the best biosorbent for reducing colour from textile waste water. The sorption capacity of algae is relative to their high binding affinity[9]. Properties of cell wall, electrostatic attraction and complexation play major role in biosorption[10]. Growing water salinity of algae was also considered as a main factor in the colour reduction[11].

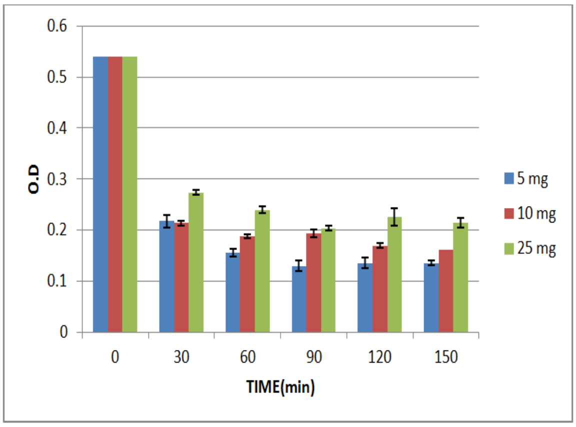

Figure 1: OD of treated dye effluent by activated carbon of *Gracilaria corticita* at pH 5

At pH 7, the maximum reduction of colour was found in activated carbon of *G.corticata* (80%) and the optimum dosage was found to be 25 mg. (Fig.1, 2,3) which was higher than *I.galbana* (55.75%)[12].

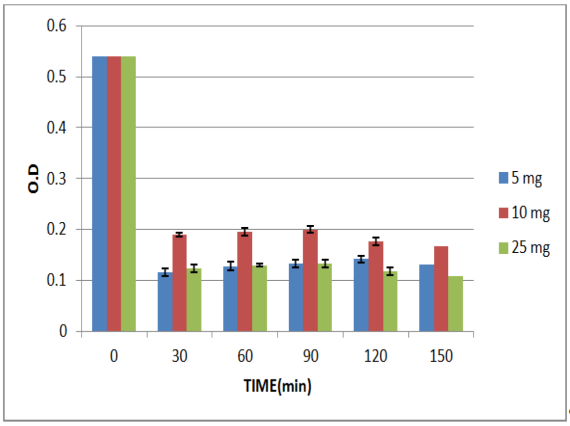

Figure 2: OD of treated dye effluent by activated carbon of *Gracilaria corticita* at pH 7

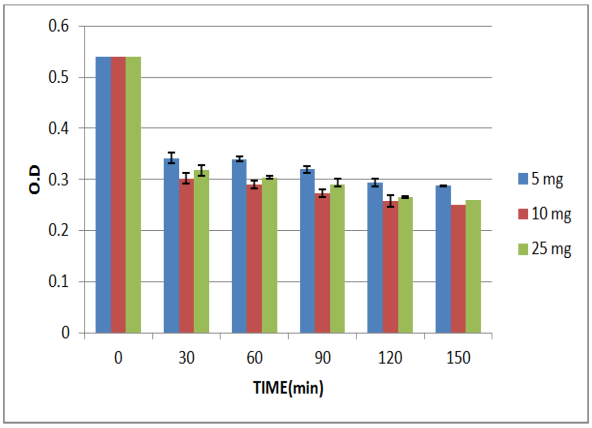

Figure 3: OD of treated dye effluent by activated carbon of *Gracilaria corticita* at pH 9

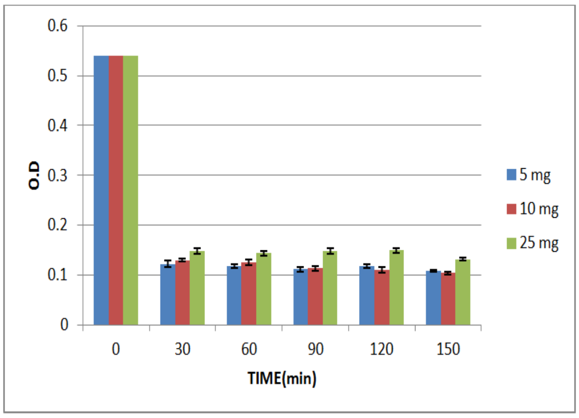

Figure 4: OD of treated dye effluent by non activated carbon of *Gracilaria corticita* at pH 5

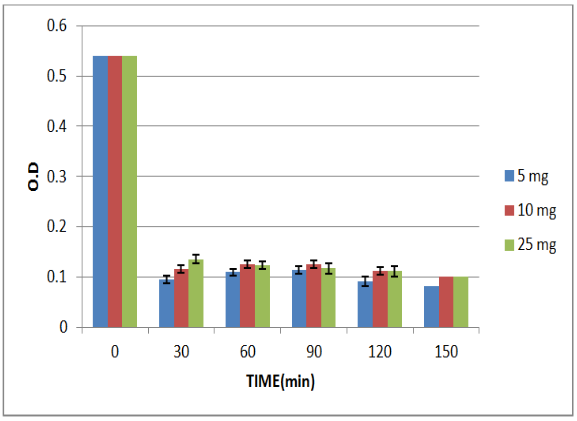

Figure 5: OD of treated dye effluent by non activated carbon of *Gracilaria corticita* at pH 7

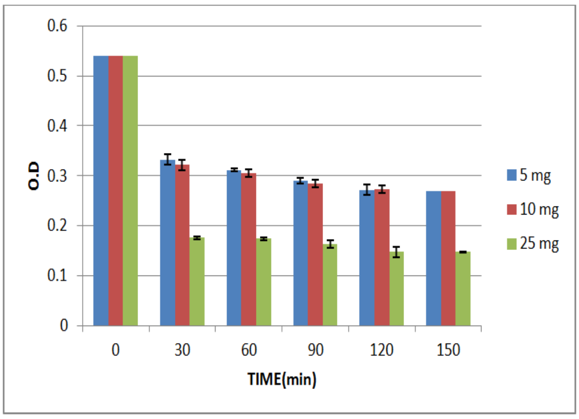

Figure 6: OD of treated dye effluent by non activated carbon of *Gracilaria corticita* at pH 9

In case of non activated carbon of *G.corticata* 5 mg dosage was found to be the optimum in which the maximum reduction was attained (84.81%) at pH 7 under room temperature (Fig. 4,5,6).

Effect of Temperature

Activated carbon of *Gracilaria corticita* showed maximum reduction at -4°C (Fig.7) and only very minimal variations were found in other temperatures whereas for non activated carbon, optimum temperature was found to be room temperature (37°C) (Fig.8). Sharmila[13] stated that using of *M.oleifera* for the biosorption of methyl orange was 75.63% which was comparatively lower than this study (84.81%).

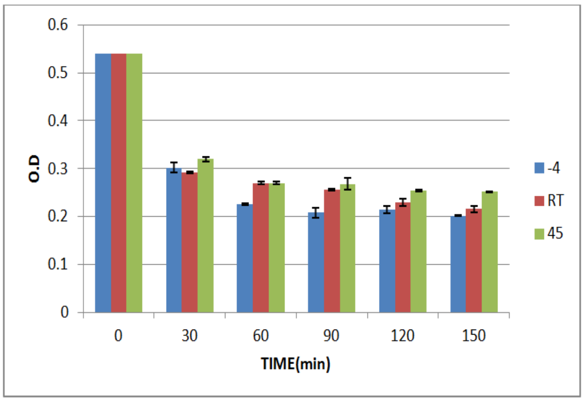

Figure 7: OD of treated dye effluent by activated carbon of *Gracilaria corticita* with 25mg and 7pH

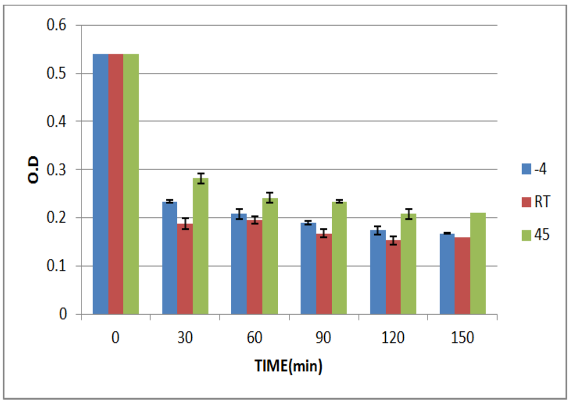

Figure 8: OD of treated dye effluent by non activated carbon of *Gracilaria corticita* with 5mg and 7pH

Effect of Stirring Speed

Stirring didn't produce favourable reduction when compared with non stirring adsorption. In stirring condition, maximum reduction for activated carbon was found to be 42.96% at 1000 and 1500 rpm. In case of non activated carbon only slight variation was found in all the speed and maximum (69.81%) was found at 2000rpm (Fig. 9,10).

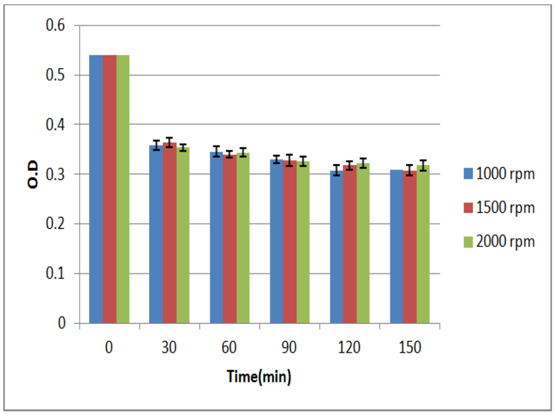

Figure 9: OD of treated dye activated carbon of *Gracilaria corticita* from at Dosage 25 mg at -4°C and pH 7

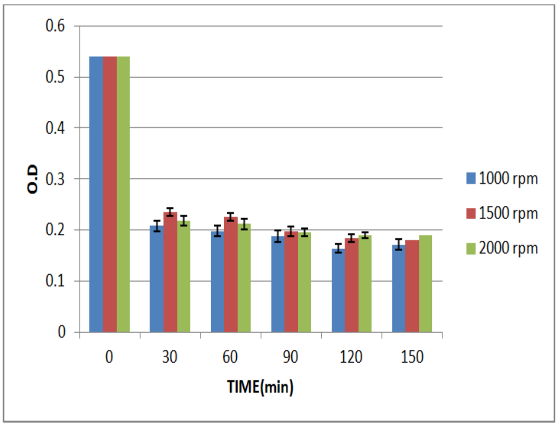

Figure 10: OD of treated dye non activated carbon of *Gracilaria corticita* from at Dosage 5 mg at RT (37^{o}C) and pH 7

CONCLUSION

Marine algae *G.corticata* in the form of both activated and non activated carbon was found to be an effective biosorbent for the colour removal from textile effluent. This study optimized only the basic parameters for effective colour removal In future, further more parameter may be optimized to increase the sorption efficiency in an economical way.

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