Decolourization of Textile Effluent Using Adsorbents from Natural Sources

A review Paper

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***Abstract*—This review discusses adsorption as an effective method for removing dyes from wastewater has been reviewed. It is clear from the literature survey that adsorption can be achieved through different materials such as commercial activated carbon and activated carbon from waste materials. A number of low-cost materials from different sources (orange peels, coconut shell, hysinth, marble powder and fly ash) have been used as adsorbents for dyestuffs in aqueous solutions. The adsorption capacity for each dye-adsorbent system has been determined. The relative costs of dye removal were based on adsorption capacity only.**

***Keywords*— Adsorption, natural sources of adsorbents (orange peels, coconut shell, hysinth, marble powder and fly ash), Dyes, Decolourization**

I. INTRODUCTION

The textile dyeing industry consumes large quantities of water and produces large volumes of wastewater from different steps in the dyeing and finishing processes. Wastewater from printing and dyeing units is often rich in color, containing residues of reactive dyes and chemicals, and requires proper treatment before being released into the environment.

Interest in ecologically friendly, wet-processing textile techniques has increased in recent years because of increased awareness of environmental issues throughout the world. Consumers in developed countries are demanding biodegradable and ecologically friendly textiles. Cotton provides an ecologically friendly textile, but more than 50% of its production volume is dyed with reactive dyes.

Unfortunately, dyes are unfavorable from an ecological point of view, because the effluents generated are heavily colored, contain high concentrations of salts, and exhibit high biological oxygen demand/chemical oxygen demand (BOD/COD) values. In dyeing textiles, ecological standards are strictly applied throughout processing from raw material selection to the final product.

Several chemical, physical and biological methods are used for the removal of dyes from wastewater. However, the chemical and physical methods have several drawbacks such as high cost and release of hazardous secondary waste. While, in comparison with various technologies available for textile wastewater treatment, adsorption is an inexpensive, fast and universal method. Adsorption using the activated carbon is a commercially applicable and effective method for textile dyes removal from textile wastewater.

Although, activated carbons are good materials for adsorption of different dyes but their use is restricted in the view of high cost, regeneration of adsorbent after each sorption cycle and environmental problems such as release eutrophication. Each reactivation process of activated carbon results in 15± 25% loss of the sorbent In order to overcome these problems, low cost adsorbents were always preferred over the activated carbon for textile dye adsorption .

The different sources of activated carbon is used like orange peels, coconut shell, hysinth, marble powder and fly ash are another will ultimately reduce the cost of treatment. These materials are cheap to produce and carry wide range of binding sites for dye molecules. The extent of adsorption depends on the nature of adsorbent especially its porosity and surface areas. The important characteristics of a good adsorbents is its high porosity and consequently a larger surface area with more specific adsorption sites. A better adsorbent is the one with large surface area and which requires less time for adsorption equilibrium. Hence, one generally looks to adsorbents with high surface area and faster kinetics for the removal of dyes. In this study, various adsorption methods of dye removal have been reviewed.

II. LITERATURE REVIEW

Amit Bhatnager et al., (2006) has evaluated the suitability of activated carbon and other alternative adsorbents for waste water Literature review treatment. It is evident from literature survey of researches have gained success to some extent in developing inexpensive adsorbents for water pollution control by utilizing naturally available and waste materials.

Wadood Taher Mohammed et al., (2007), The work was carried to study the capability of activated alumina from bauxite compared with activated carbon adsorption capability to reduce the color content from textile wastewater. Six dyes

were studied from two types (reactive and dispersed) namely (blue, red, yellow) from wastewater and aqueous solutions. Forty eight experiments were carried out to study the effect of various initial conditions (bed height, flow rate, initial concentration, pH value, temperature, and competitive adsorption) on adsorption process.

Jaya Paul (2008), the present study was to investigate the suitability of using activated carbon (AC), limestone (LS) and mixture of both (LS:AC) as low cost media for the post-treatment of treated effluent. The physico-chemical treatment adopted in this study is preferred over the other methods because of its simplicity, easy maintenance and quality control. Four samples were studied i.e. an actual wastewater (final effluent), and synthetic wastewater made from three different types of most commonly used reactive dyes used in the production.

Hakan Demiral (2008) , studied to investigate the mechanism of dye adsorption characteristic, adsorption constants were determined using pseudo first order, pseudo second-order and intra particle diffusion model. Adsorption isotherms of Acid blue 350 (Sandolan blue) on activated carbon were determined and correlated with common isotherms equations. It was found that the Langmuir model appears to fit the isotherm data better than the Freundlich model. The maximum adsorption capacity of dye was 450 mg/g at temperature of 45 ^{0}C and pH value of 2. The study shows that the activated carbon derived from hazelnut bagasse is an effective low-cost adsorbent for the removal of Sandolan Blue from aqueous solution.

Syafalni S. (2012), the work evaluates the removal of COD, ammonia and color in dye wastewater using granular activated carbon (GAC) and zeolite in the column studies. Different surface loading rates, height of adsorbent and empty bed contact time were used to investigate the efficiency of the adsorption process. The best removal of the contaminants among the all adsorption treatment was found using GAC (bottom layer) and zeolite (upper layer) in 6.35 cm diameter column with 59.46% removal of COD, 60.82% removal of ammonia and 58.4% removal of color. For the adsorption with zeolite as the bottom layer and GAC as the upper layer, the data fitted well with the Langmuir model. While for the adsorption with zeolite as the upper layer and GAC as the bottom layer, the data fitted well for both Langmuir and Freundlich isotherms.

Meena Sonil et al., (2012), has carried out work on adsorbent prepared from roots of water hyacinth; an aquatic weed was used to remove the Methylene blue from an aqueous solution. The batch adsorption study was carried out by varying the parameters such as pH adsorbent dose, initial concentration of dye, and contact time to obtained removal kinetic data. At optimum experimental condition maximum 95% removal of dye was achieved. Equilibrium data were best represented by both Langmuir and Freundlich isotherms. The maximum dye uptake was found to be 8.04 mg/g.The adsorption kinetic data are adequately fitted to the pseudo second order kinetic model. On the basis of experimental results WHRP (water hyacinth root powder) was found to be an excellent adsorbent for the MB removal from wastewater.

Deshuai Sun et al., (2013), done study to investigate Activated carbon was prepared from Enteromorpha prolifera by zinc chloride activation. The adsorption behaviors of three reactive dyes (Reactive Red 23, Reactive Blue 171 and Reactive Blue 4) onto this biomass activated carbon were investigated in batch systems. The experimental findings showed that the removal efficiencies of three dyes onto activated carbon were maximum at the initial solution pH of 4.5 - 6.0. Thermodynamic studies suggested that adsorption reaction was an endothermic and spontaneous process. Adsorption isotherm of the three dyes obeyed Freundlich iso-therm model.

Fahim Bin Abdur Rahman,et al.,(2013), has carried out study for utilization of orange peel as adsorbent for the removal of dyes from wastewater and to establish it as a standard wastewater treatment process for composite knit industry. This experiment was performed in the laboratory scale. The materials were obtained and treated for the removal of dyes at different doses. These materials also evaluated for different pH and contact time. This batch adsorption experiment was carried out for finding the effects of adsorbent's amount, pH and retention time on the removal of dyes from the wastewater.

A. K. Inengite et al., (2014) , has proved Water hyacinth (Eichhornia crassipies) to be a menace in water bodies and studies are on, in the direction of solving this problem; one of which is to discover economic uses of water hyacinth. Adsorption of heavy metals and dyes from aqueous solutions by activated carbon derived from water hyacinth is one of such studies. In this study, dried and pulverized water hyacinth shoot was used for the sorption studies. This is in the bid of eliminating the rigours of producing activated carbon, thereby saving time and cost. The adsorption capacity of water hyacinth shoot for Methylene Blue dye was studied as a function of initial metal ion concentration in a batch system. Results showed that adsorption increased with methylene blue dye concentration. Seven adsorption isotherms, namely Langmuir, Freundlich. Isotherm parameters showed that all the isotherms correlated well with the adsorption data. The maximum adsorption capacity of Methylene Blue dye to the dried water hyacinth shoot was found to be 58.14mg/g. The use of dried water hyacinth shoot would appreciably save the time and cost for producing activated carbon but not without some compromise of efficiency.

Porselvi V.M. et al., (2014), study deals with the removal of the textile dye, methylene blue (MB), from aqueous solutions by adsorption using low-cost activated carbons prepared from various plants. Batch adsorption studies were conducted by varying the initial concentration of the adsorbate, adsorbent dosage, contact time, and pH. The experimental adsorption data obtained in this study were fitted with Freundlich and Langmuir adsorption isotherms. The adsorption technique using low-cost activated carbons from various plants are found to be an efficient method for the removal of the dye MB from aqueous solutions.

V. Karthik et al., (2014) has carried out work for removal of dyes from industrial wastes using different methods has been reviewed. Biological treatment requires large area and also less tractability in operation. Chemical treatment is not cost effective. Adsorption process is simple and effective manner. Activated carbon is found to be more effective because of high specific surface area, high adsorption capacity. Activated carbon costs more and efforts have been made for producing it using several waste products.

Dr Radharani Das, et al., (2015) has completed studies on removal of coloured waste from industrial dye effluent is a most perplexing problem to such industries and the environment. On the other hand fly ash is a major pollutant generated from coal based thermal power plants but it has good potential as adsorbents. In this present paper fly ash obtained from thermal Power Plant (West Bengal) has been used to remove the dye, Methylene Blue from aqueous solutions. Experiments were done using the solutions with various concentrations of dyes. The effect of adsorbent amount, contact time, solute concentration and temperature on percent removal of dye has been studied. Result shows that 85- 95% removal of dye may be achieved depending on adsorbent amount and solute concentration.

CONCLUSION

Activated carbon has been found to be effective adsorbent, which can remove dyes efficiently. However, its use is sometimes restricted due to higher cost of activated carbon to overcome this problem, various natural sources of adsorbents which are available as waste source which can be utilized as a good source of low cost adsorbents for dye removal.

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