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SUMMARY AND CONCLUSION

Dyes are extensively used in industries such as textile, leather, paint, cosmetic, pharmaceutical, plastic, paper and pulp etc. All these industries contribute various forms of pollutants to the environment and these pollutants can kill animals, plants, affect human health, imbalance ecosystem, degrade air quality and soil. Thus the present work was carried out to study the "Adsorption of Selected Textile Dyes onto Chemically Activated Carbon Adsorbents Prepared Using Waste Biomass *Bauhinia racemosa* Fruit Pods".

To explain the feasibility of the removal of CV, AB 110, RB 5 and CR dyes, batch mode adsorption studies were carried out by changing the factors that significantly influence the performance of adsorption like Initial dye concentration, Dosage of adsorbent, pH and Temperature.

The percentage adsorption of CV, AB 110, RB 5 and CR dyes from aqueous dye solution revealed a decreasing trend with increase in concentration of dye solution with both the adsorbents BR-SAC and BR-PAC. This may be, because at higher initial dye concentration, lesser number of surface active adsorption sites present on the surface of the adsorbents.

The dye removal efficiency increased when the bio-adsorbent dosage was varied from 50 mg to 200 mg for BR-SAC and 25 mg to 100 mg for BR-PAC adsorbent. The increase in dye removal efficiency with the increase in amount of adsorbent material was caused by enhanced surface area and more number of adsorption sites present on the surface of the adsorbents.

The percentage removal of cationic dye CV from aqueous dye solution was increased rapidly with increase in solution pH. In case of anionic dyes such as AB110, RB5 and CR the percentage removal of dyes decreases with the increase in pH of the dye solution with both BR-SAC and BR-PAC adsorbents.

The dye removal efficiency of BR-SAC and BR-PAC adsorbents increased as the temperature was raised from 30 -50°C. The increase in temperature elevates the mobility of the dye molecules and supply adequate kinetic energy to make good interaction between the dye molecules and surface active sites of the adsorbents.

The adsorption kinetic studies revealed that the adsorption process followed Lagergren pseudo-first order kinetic rate equation. The higher r^2 values obtained indicates, the adsorption of dyes used in this study onto the adsorbents BR-SAC and BR-PAC was effectively described by this model. The Lagergren rate constant k_1 values decreased with increasing dye concentration due to greater competition of adsorbate molecules for the surface binding sites of the adsorbents used in this study.

The intraparticle diffusion plots q_t versus $t^{1/2}$ were linear, did not pass through the origin revealed that the intraparticle diffusion was not the only rate limiting step and other kinetic models concurrently limits the adsorption rate.

The value of initial adsorption rate 'α' in Elovich rate equation increases with increase in concentration of the dye solutions indicated the existence of more active sites on the surface of the BR-SAC and BR-PAC adsorbents for immediate adsorption of dyes from aqueous solution.

The surface properties and the adsorption behavior of the prepared adsorbents BR-SAC and BR-PAC were studied using Langmuir and Freundlich adsorption isotherm models. The high r^2 values obtained in this study indicate suitability of Langmuir isotherm for adsorption of CV, AB 110, RB 5 and CR dyes onto BR-SAC and BR-PAC adsorbents. The equilibrium parameter values obtained was found to be less than one indicates the favourable uptake of dyes onto the adsorbents prepared in this study.

The Freundlich adsorption plots log q_e versus log C_e were found to be linear and the measured K_f values (adsorption capacity) increased with increasing in temperature shows the easy uptake of CV, AB 110, RB 5 and CR dyes onto BR-SAC and BR-PAC adsorbents.

The negative values of ΔG obtained for the adsorption of dyes revealed that the adsorption process is feasible and spontaneous. The positive values of ΔH obtained in this study (2.1 -20.9 kJ/mol) confirms that the adsorption process is endothermic and physical forces like Van der Waal's and hydrogen bonding interactions may be involved in the adsorption. The change in entropy was positive indicating increased disorder at the solid-solution interface during the adsorption of dyes.

The SEM photographs clearly indicates, maximum number of pores present on the external surface of the adsorbents BR-SAC and BR-PAC which are accountable for the adsorption of dyes onto the adsorbents.

The percentage removal of dyes from aqueous dye solution was much higher than from dyeing industrial effluent, because of the adsorption of other pollutants present in the effluent gets adsorbed along with the dyes on the surface of the adsorbents.

Among the two adsorbents BR-SAC and BR-PAC, the dye removal efficiency of the adsorbent BR-PAC was higher and very much closer to the removal efficiency of commercial activated carbon used in this study. This may be owing to the greater surface area of BR-PAC adsorbent.

EDX study is an added support for the higher removal efficiency of the adsorbent BR-PAC used in this study for the removal of dyes (superior activated carbon with high carbon content) .

The measured water pollution parameters of the BR-PAC treated effluents coincide with the Bureau of Indian standards (BIS) permissible limits.

Thus the prepared eco-friendly activated carbon adsorbent (BR-PAC) proved that this adsorbent can be used for dye loaded effluent treatment process.

CONCLUSION

This research work aimed at exploring the utilization of natural wastes as adsorbents after carbonization and activation. Interpretation and analysis of experimental data of the prepared eco - friendly activated carbon adsorbents BR-SAC and BR-PAC clearly indicated that the dye removal efficiency of the adsorbent BR-PAC was higher and very much closer to the removal efficiency of commercial activated carbon. This may be owing to the greater surface area of BR-PAC adsorbent (BET Surface area of BR-PAC 1083.440 m^2/g, BR-SAC 288.700 m^2/g and CAC 1137.962 m^2/g).The measured water pollution parameters of the BR-PAC treated effluents coincides with the Bureau of Indian standards (BIS) permissible limits. Thus this adsorbent can be used for dye loaded effluent treatment process.