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3	PhD Thesis Title	Adsorption of dyes by using agricultural-by-product based activated carbons	
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7	<u>Brief synopsis</u>		

The present work aims at finding out the effectiveness of Malachite Green (cationic) and Remazole Red RGB (anionic) dyes removal using arecanut peel, silk cotton hull, corn stem and banana stem agricultural wastes as activated carbons. This research explores the possibility of using low cost adsorbents for the removal of both dyes from aqueous solution at lower dye concentration and compare with commercial activated carbon.

The low cost activated carbons were prepared in the laboratory by carbonization followed by activation. The prepared carbons were used to remove simulated Malachite Green and Remazole Red RGB dyes from aqueous solution by a batch adsorption technique under varied conditions like concentrations of adsorbate, dosage of adsorbent, contact time and pH of dye solution at particular adsorbent particle size, agitation speed and at room temperature. The equilibrium of adsorption was modeled by using the Langmuir and Freundlich isotherm models, the kinetic parameters were determined for the studied adsorption systems and statistical approach for interpretation of the results using regression analysis is carried out. The physical and chemical properties of low cost adsorbents used in this study were determined.

From the studies, it is found that the arecanut peel carbon dosage of 0.5 g/L is optimum as it removed 91 % of the dye at pH 10 for a contact time of 35 minutes for dye concentration of 5 mg/L for Malachite Green dye and dosage of 0.625 g/L is optimum as it removed 83 % of the dye at pH 4 for a contact time of 45 minutes for dye concentration of 5 mg/L for Remazole Red RGB dye. The silk cotton hull carbon dosage of 0.5 g/l is optimum as it removed 86 % of the dye at pH 8 for a contact time of 40 minutes for dye concentration of 1 mg/L for Malachite Green dye, and dosage of 0.25 g/L is optimum as it removed 81% of the dye at pH 4 for a contact time of 35 minutes for dye concentration of 2 mg/L for Remazole Red RGB dye. The corn stem carbon dosage of 0.75 g/L is optimum as it removed 90 % of the dye at pH 8 for a contact time of 40 minutes for dye concentration of 2 mg/L for Malachite Green dye and dosage of 0.75 g/L is optimum as it removed 83 % of the dye at pH 4 for a contact time of 40 minutes for dye concentration of 3 mg/L for Remazole Red RGB dye. The banana stem carbon dosage of 0.75 g/L is optimum as it removed 99 % of the dye at pH 8 for a contact time of 45 minutes for dye concentration of 2 mg/L for Malachite Green dye and dosage of 0.5 g/L is optimum as it removed 85 % of the dye at pH 4 for a contact time of 35 minutes for dye concentration of 2 mg/L for Remazole Red RGB dye. The commercial activated carbon dosage of 0.5 g/L is optimum as it removed 93 % of the dye at pH10 for contact time of 25 minutes for dye concentration of 4 mg/L for Malachite Green dye and dosage of 0.625 g/L is optimum as it

	removed 88 % of the dye at pH 4 for a contact time of 40 minutes for dye concentration of 4 mg/L for Remazole Red RGB dye. For Frendlich isotherm the value of 'n' found to be more than one for all adsorbents for Malachite Green dye except commercial activated carbons (0.829) and sorption data favorable for all adsorbents except commercial activated carbon. For Remazole Red RGB dye systems values of 'n' was less than one for arecanut peel (0.538) and commercial activated carbon (0.832) indicates unfavorable and for other adsorbents it is favorable. The R^2 values varies from 0.819 to 0.998 for all the adsorbents for both the dyes. For Langmuir isotherm the value of R_L <1for all the studied adsorption systems and value of R^2 were in between 0.816 to 0.971 for both dyes, which is favorable for all the studied adsorption systems. At lower dye concentration the maximum adsorption capacity of Malachite Green and Remazole Red RGB dyes onto the adsorbents used in this study is 27.02 mg/g and 18.51 mg/g by commercial activated carbon, respectively. The least adsorption capacity for Malachite Green and Remazole Red RGB dyes onto the adsorbents used in this study is silk cotton hull (4.85 mg/g) and arecanut peel (3.89 mg/g), respectively. In the present studies all the adsorptive systems were favorable for Langmuir isotherm. For kinetic studies the R^2 values for first order kinetic model varying from 0.8264 to 0.996 and second order kinetics varying from 0.9243 to 0.9998 for all the studied adsorption systems. The calculated q_e values fit quite well with the experimental data. So, all the adsorption process studies obey the second order kinetic model which gives an indication of the chemisorption's nature of the adsorption processes. In the present studies intra particle diffusion is not the only rate- limiting step ($C \neq 0$) for all the adsorbents and dyes used. From the linear regression analysis it reveals that, the most significant controlling parameter of all the adsorption systems for both dyes (except banana stem carbon for removal of Malachite Green dye) affecting percentage of color removal is the pH of the dye solution and the least significance parameter is the contact time. In case of banana stem, Malachite Green dye adsorption shows that slight significant controlling parameter of the system affecting percentage of color removal is the contact time of the dye solution when compared to pH of the dye solution. The correlation coefficient R^2 values of actual and predicted values of percentage of color removal for all the adsorption systems in this present studies were nearly equal to 1. Finally, it can be concluded that the raw materials used for preparation of adsorbents in this study were available in the countrywide, so the use of such low cost materials by small scale dyeing unit using batched or stirred tank flow reactors is recommended for dilute solution.