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Adsorption technique studies for the removal of (Janus green B) dye from industrial waste water on the remnants of tea leaf

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Abstract : The sorption vocation of dye from solution onto the leftovers of black tea leaf (BT) was attests beneath totally dissimilar experimental situations with use (Janus green B) as a sample of dye . To evaluates the proportion of eliminate and therefore the sorption capability, sorbent dose, shaking time, particle size, result of pH and concentration were occurred during a batch mode. Freundlich and Langmuir line models was depicted with investigational isotherm information. an quantity of (0.1) g of (BT) may take away (99.5%) with the shaking time (120) min and particle size (150)μ and maximize the dye from an solution of (50) ppm. the information were conjointly affable to kinetic models such Results depicted that Black tea(BT) may be an occasional price sorbent for the deletion ofdye from solution (JGB).
Keywords : Black tea,Janus Green B, low cost adsorbent, isotherm.

Introduction:

Batik industries rank represent initial within the usages of dyes once comparable different industries like paper, carpet, food and cosmetics. Several processes for removal of color exemplarily involve physical, chemical and biological plans. some techniques, like particle combine extraction and chemistry techniques, are relatively new for textile dump treatment[1]whereas different techniques are utilized in the industry for an extended time as well as sorption[2],advanced chemical reaction processes[3] and microbe degradation[4] are mooted for removal of dyes from industrial waste water. Sorption of dye is one amongst the foremost powerfully ways and activated charcoal with totally different resources is that the most ordinarily used adsorbent[5]. several searchers have proved many low price adsorbent like feather palm shell[6], orange barks[7], yam peels[8], coconut[9,10], coconut fiber[11], apple pulp[12], rice husk[13], Banana shells[14],tires[15],maize stems[16], walnut shell[17], cocoa[18], Ananas[19], pistachio shells[20], protoctist[21], hazelnut shell[22], natural clay[23] as appropriate materials for the removal of dyes. this study is pledge to judge the ability of a tea leaf as adsorbent for removal of dye in waste water thus on style on sorption treatment system. During this paper, we tend to report the implementation kinetic model for the sorption of Janus green B dye on tea leaf as adsorbent.

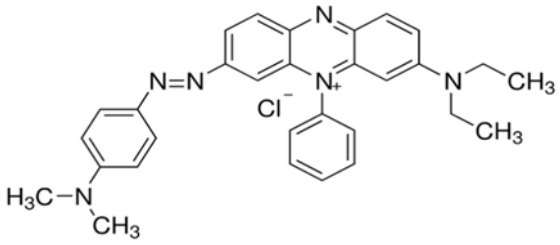
Material and methods :

Preparation of Sorbent:

Dried leaves of tea leaf once poling with water for (10) hours then the fabric was washed with distill water till the colourless . The adsorbent was completed by heating once divestment for one hour in oven at (80) C^0.

Preparation of Adsorbate:

The dye utilized in this study was Janus green B (JGB) having chemical formula (C30H31N6Cl) (Mol. wt. :511.07 g.mol^{-1}) with CI. NO. : 11050 .Figure (1)is given the molecular structure of (JGB). The stock solution of the dye was ready by (1000) mg of (JGB) dissolving in (1) litter $H_2O$is that(1000 mg.L^{-1}). the various initial concentration were obtained by diluting the dye stock solution. For absorbance scaling a UV - VIS photometer (UV / VIS – 1650 laptop SHIMATZU) was utilized. the utmost wavelength λ max. for JGB was deliberated at (611) nm . Concentrations throughout investigational work were dogged from a standard calibration curve .The pH of every sample was attuned with (0.1) M NaOHor HCL exploitation pH –meter to its active sorption pH worth.



Figure(1): Structure of (Janus Green B) dye

Adsorption experiments:-

Batch sorption experiments were officiated at temperature of room exploitation (250) milliliter conical flask containing a given mass of adsorbent and (100) milliliter of the dye solution . The initial concentration of the dye was differed from (10 to 100 mg /L), counting on the conditions of experimental .The conical flask were agitated in shaker instrument for 3 hours then centrifuged at (5000) revolutions per minute for (15) mint. U.V. visible photometer was wont to analysis the sample once collected and diluted at (611)nm. The equilibrium sorption capability and also the removal proportion were calculated severally by equation (1) and (2).

$$q_e = \frac{V}{W}(C_o - C_e) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

$$Removeal\ efficiency\ (\%) = \frac{C_o - C_e}{C_o} \times 100 \dots\dots\dots\dots\dots\dots\dots (2)$$

Where, C_0 represent the initial concentration of dye (mg/L), C_e represent the remaining dye in solution ,qe represent the amount of dye that adsorbate at equilibrium (mg/g).

Calculation of adsorption isotherms parameters:-

The expertise on the study of the sorption equilibrium were taken for (JGB) dye concentration of (10 to 100)ppm throughout sorption. The equilibrium found between dye remaining in solution (C_e) and also the amount of dye adsorb able on the adsorbent (qe). Irving Langmuir and freundlich model represent the isotherms data[24,25].

$$q_e = \frac{q_m K_a C_e}{1 + K_a C_e} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3)$$

$$\frac{C_e}{q_e} = \frac{1}{q_e K_a} + \frac{C_e}{q_m} \dots\dots\dots\dots\dots\dots\dots\dots (4)$$

Where (Ka, qm, Kf, and n) are constant of Irving Langmuir and freundlich isotherms severally, that may be calculated from the liner kinds of the equation in (3) and (4).

$$R_L = \frac{1}{1 + bC_0} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5)$$

$$\log q_e = \left(\frac{1}{n}\right) \log C_e + \log K_f \dots\dots\dots\dots\dots\dots\dots (6)$$

Result and discussion :-

Effect of sorbent dose :-

The impact of adsorbent dose was additionally achieved the elimination of dye from sample (50) ppm. Figure (2a) indicates that the adsorption decrease with increase of adsorbent dose from (0.1 -1.5) gram with keeping alternative parameters are consistent (initial concentration of fifty ppm and make contact with time three hours). The results of proportion removal was(59.3–97.4)%.

The decrease in adsorption capability with increase of adsorbent dose. JGB adsorption capability bit by bit at the sorbent dose of (0.1)gm thru (48.7) mg/g sorption capability and at (1.5) gram thru (1.9)mg/g. These result could also be attributable to the touching of surface assimilation positions as a result of sorbent particle congestion similar result are reportable by [26].Moreover, the high adsorbent dose might suppose a vetting on the dense outer layer of the cells, there at defend the truck age sites from dye[27] figure (2b).

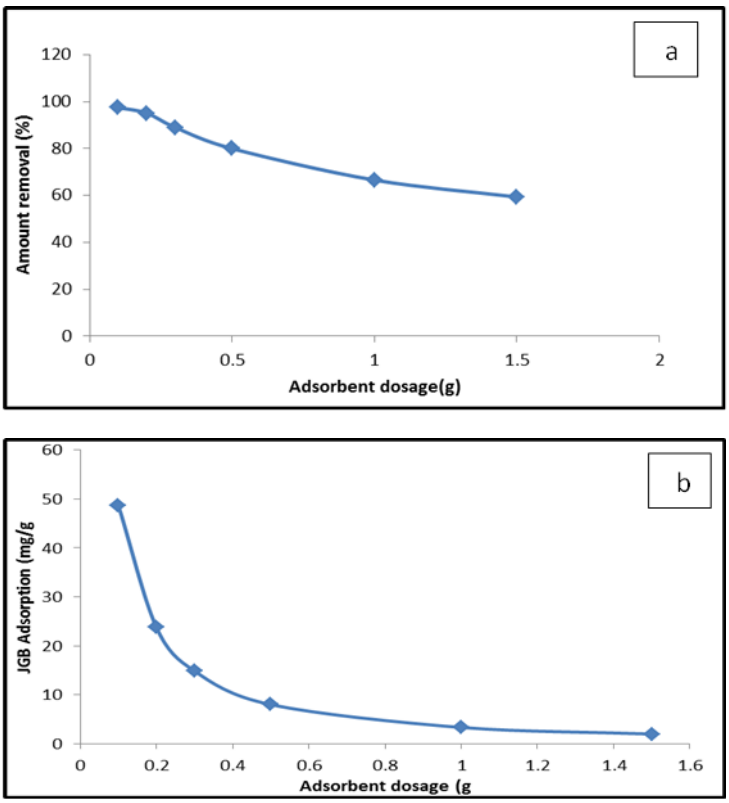


Figure (2): Effect of sorbent dose to eliminate of JGB thru (BT)(a)sorption percentage. (b) Quantity of dye adsorbed(mg/g).

Effect of shaking time :-

Figure (3) refers to removal proportion enhanced with increasing contact time and have become virtually constant at (120) mint of contact once take (100) milliliter from sample of dye (concentration fifty mg/L) and treated with (0.1) gram dose of adsorbent and deferential time (20-180)mint. it's evident from the figure, (BT) treatment resulted in (97.7%) removal of (JGB) dye gave the most effective worth in (120) mint and stay staple to (180) mint. it's as a result of saturation of active sites that don't enable more sorption to require place[28].

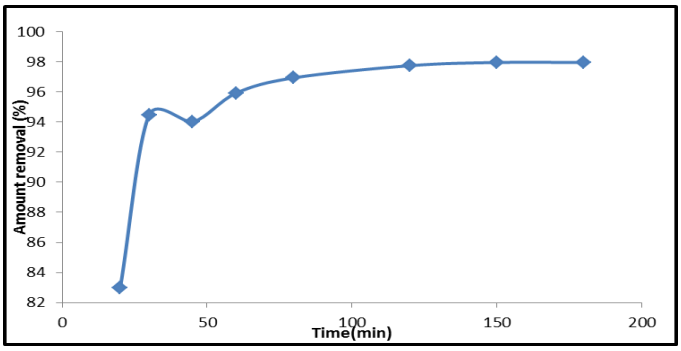
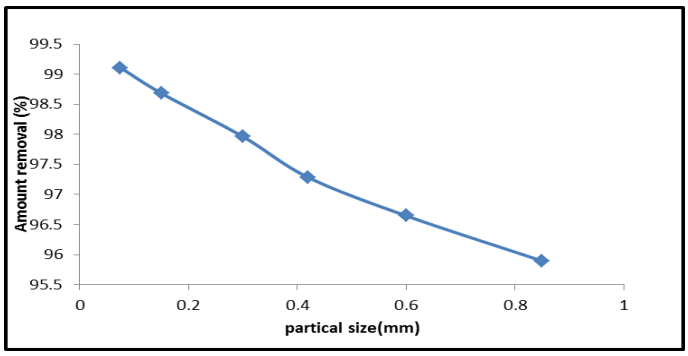


Figure (3) : Effect of shaking time for sorption of (JGB) against (BT) at 50 mg/l dye concentration, 0.1 g sorbent dose and 0.3mm particle size.

Effect of particle size of sorbent :-

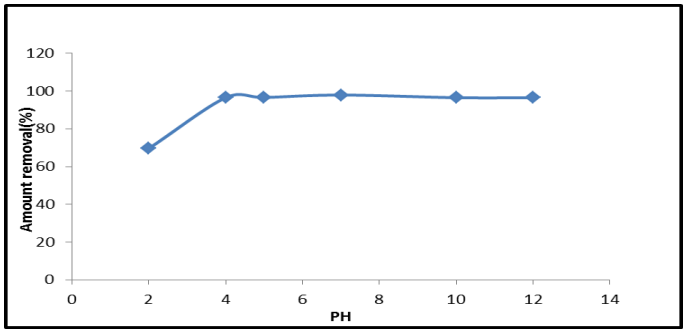
The impact of bit size of BT (sorbent) on sorption of (JGB) dye has been calculated on tea leaf bit of varied size (0.075-0.85) mm. Figure (4) show that quantity of JGB adsorb able decrease with rise in bit size of the sorbent . This check with the smaller bit size for a giver quantity of (BT),the a lot of expanse out there is offered and as a significance the bigger range of binding positionspresented[23,29]



Figure(4) : Effect of bit size on amount removal percentage of (JGB) against(BT) at 50 mg/l initial dye concentration and 0.1gm sorbent dose.

Effect of pH:-

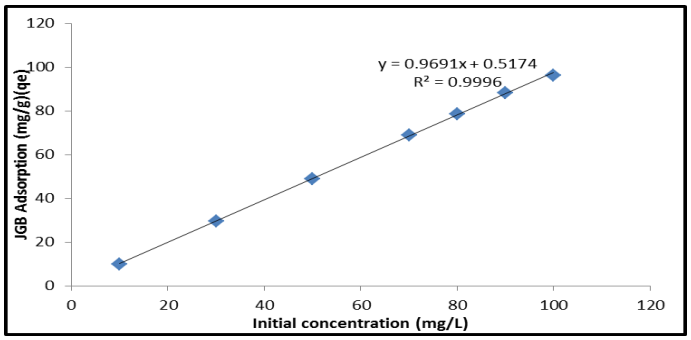
The pH issue is very important within the adsorption method particularly for dye adsorption .The solution of (JGB) dye that having (50) mg/L was treated by (0.1) gram dose of (BT) with pH (2) to (12). the proportion of dye adsorption increase with increase at pH from (2) to (4) and remains constant thenceforth. The result were submitted in figure (5). it's been discovered that the (JGB) removal was raised from (69.6) to (96.5)%. At high pH solution, the adsorbent surface seems charged once the charge at the solution interface decreases[15,30].It result higher (JGB) sorption from higher force of attraction between (JGB) and charged adsorbent surface.



Figure(5) : Sorption of (JGB) by (BT) as a occupation of solution pH at(50 mg/L) initial concentration and(0.1)gmsorbent dose .

Effect of initial concentration :-

Adsorption of dyes by any adsorbent is very passionate about the initial concentration of dye. The sorption of (JGB) was allotted at many initial dye concentration move from(10) to (100) ppm. Figure (6) show that the sorption capability increase from (9.88- 96.19) mg/g once (JGB) concentration increase for the adsorbent of (BT). This could be explained that everyone the bio sorbents includes a restricted range of active sites, that become saturated at sure concentration[31,32]



Figure(6) : Effect of initial concentration on sorption capability of (JGB) against (BT)

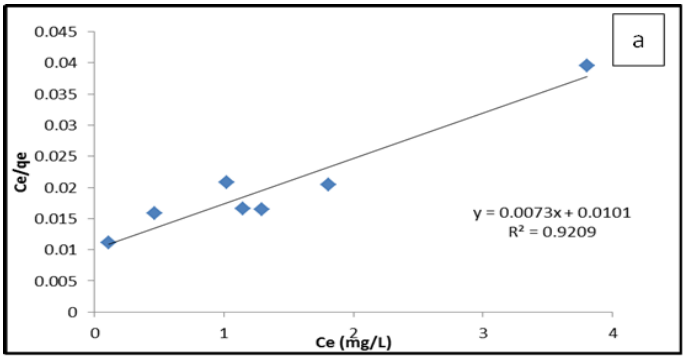
Isothermal analysis:-

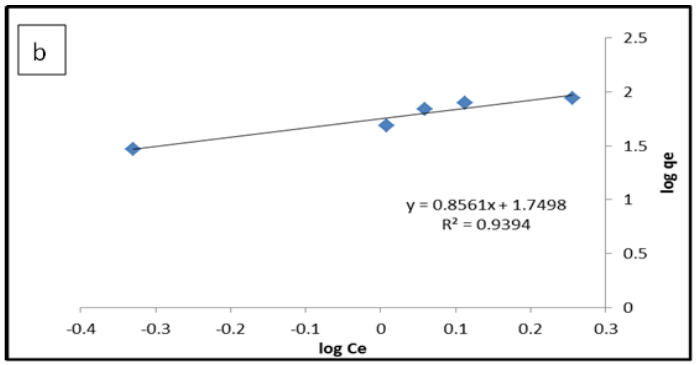
The sorption isotherm were developed from the information collected. during this study, the sorption information of (JGB) were tested with Irving Langmuir and Freundilch isotherm models with in dye concentration rang (10) to (100) mg/L. the various constants of 2 models were calculated and area unit collected in table (1)

Table (1) : Adsorption isotherm parameters for (JGB) dye removal

Langmuir		Freundlich	
q_m (mg/g)	136.98	K_F(mg/g)(l/mg)$^{1/n}$	56.208
K_a (l/mg)	0.7228	1/n	0.8561
R^2	0.9209	R^2	0.9394
R_L	(0.1215 - 0.0136)		

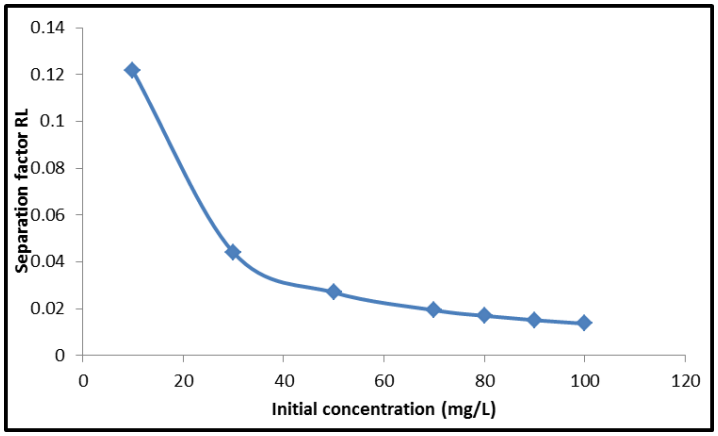
The plate of liberalized from of Irving Langmuir and Freundilch are publicized in figure (7a-b). The Irving Langmuir and Freundilchevenness sorption curves involving solid and liquid section concentration of dye.





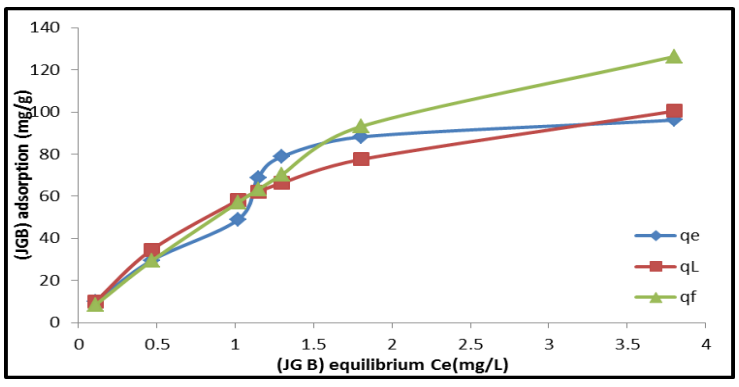
Figure(7): Linearized sorption isotherm models of (JGB) against (BT) (a) Langmuir and (b) Freundlich models

The Langmuir line model presumes monolayer encasement of sorbent on a homogenized sorbent external. The well-fitting of information with Langmuir linedesignates to the homogeneous dissemination of dynamic positions on the sorbent external[33]. Figure (8) refers to the difference of separation issue (RL) thru initial (JGB) concentration. The (RL) worth for the sorption of (BT) are discovered to be within thevary of (0-1), adverting that the sorption was agreeable method.



Figure(8) : Separation factor against initial (JGB) concentration against (BT)

Figure (9) displays the aberration of those Langmuir and Freundlich models from the investigational information. It seems that the sorption of (JGB) dye on motivated (BT) may well be fine fitted by the 2 models. Evidently, the Langmuir equation delivered higher appropriate in relations of RL.



Figure(9): Comparison of investigational and calculated documents by Langmuir and Freundlich equipoise lines for the system (JGB) – (BT)

This consequences designate homogenized nature of (BT) surface, which suggests every (JGB) molecule (BT) has equivalent sorption energy. The consequences additionally validate the construction of monolayer coverage of (JGB) bit at the external surface of (BT).

Conclusion

The conclusions of this exertion disclose that the (BT) that simply and extravagantly accessible agro excess in our country will be easily reborn into sensible sorbent by exploitation easy ways of instigation. an acceptable quantity (0.1g/L) of the (BT) adsorbent may decolor the maximum amount as (97.96%) of the (JGB) from associate solution (50 ppm) with shaking for (120) min. incontestable adequate possible of (BT) as an sorbent for the elimination of the (JGB) dye, from solutions. The sorption of the dye was most round the (pH=7) of the solution of (JGB). On smearing each Irving Langmuir and Freundlich line.

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