Adsorptive Removal of Reactive Yellow4 by Using Pac-Mno_2-Nc Prepared from Passiflora Foetida Seed-Isotherm Studies

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ABSTRACT
The prospective of using Passiflora Foetida seed modified PAC-MnO2-NC to eliminate the dyenamely Reactive Yellow 4 dye are studied. The result of more than a few parameters such as adsorbent dosage, contacttime, temperature, the initial concentration of the adsorbate and pH has been evaluated. Tempkin, Halsey, Langmuir,Dubinin-Radushkevich and Freundlich isotherms are too studied. The course showing that PAC-MnO2-NC is suitable to employ as an adsorbent to carry away Reactive Yellow 4 dye

Keywords: Reactive Yellow 4 dye, PAC-MnO2-NC, Isotherm.

INTRODUCTION
Water as an essential constituent of the planet has been affected by various pollutants such as dyes, heavy metals, organic substances, pesticides, etc[1,2]. Dyes are being extensively used in many fields such as paper, leather, rubber, textile, plastics,etc[3,4]. As a result, they are producing wastewater with high dyes levels that are directly entering the environmental ecosystem, becoming a serious ecological concern [5]. Numeroustechniquehas have been investigating for the exclusion of dyes from wastewaters[6].

Many low-cost adsorbents have been used for the removal of dyes. Also, some waste products from industrial and agricultural operations, natural materials, and biosorbents represent potentially economical alternative adsorbents. Many of them have been tested and proposed for dye removal.

Although biological wastewater is considered the most widely used system to treat wastewater, it is not suitable for many industrial wastes that contain inhibitory substances for the growth of bacteria [7].Therefore, adsorption is considered an vital process in industrial wastewater treatment and can be regarded as the most cost-effective and easy process for removing heavy metals from industrial wastewater [8].Activated carbon has been the adsorbent extensively used over the past years. It is highly effective in removing heavy metals; however, the cost-effectiveness of adsorption technology depends on using a low-cost adsorbent [9].The low-cost adsorbents must be abundant and available in nature, effective and efficient in heavy metal removal. Agricultural wastes are gaining increased attention among low-cost adsorbents as they are abundant in nature and require proper disposal [10]. The majority of the studies described that the adapted adsorbents are capable in compulsory either the cationic (or) anionic group but not equally.In recent years, nanotechnology has been considered as a promising technology to treat water. The study of structures and materials at the nanoscale size is known as "nanoscience." The field of nanoscience deals with the study of very tiny things. The characteristics of nanoparticles are examined in nanoscience. The term "nanoparticles" refers to particles that are smaller than 100nm in diameter[11].In the present study, the adsorption capacity of [PAC-MnO_2-NC] was investigated for removing Reactive Yellow(RY4) dye from an aqueous solution.

EXPERIMENTAL WORK

Flow Chart for the Preparation of PAC-MnO2-NC

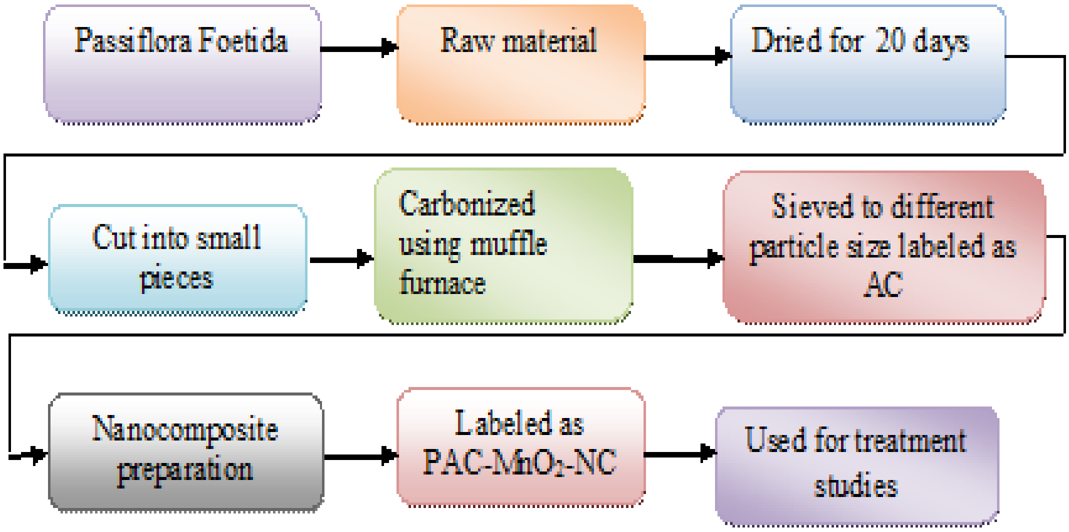


Fig.-1

The Grounding of Activated Carbon

From local area situated at Thindal, Erode District, Tamilnadu, the Passiflorafoetida deposit resources were composed. It is dried for 20 days before it they were cut into small pieces. Lastly, it was full in a steel boat and excited in soften oven. The hotness was raised steadily up to 5000C and set aside it for half an hour. The carbonized material was floor well and sieve to diverse subdivision mass. It was stored in a synthetic bottle for auxiliary studies. In this learning particle size of 0.15 to 0.25mm was worn and it was labeled as PAC.

Groundwork of PAC-MnO_2-NC

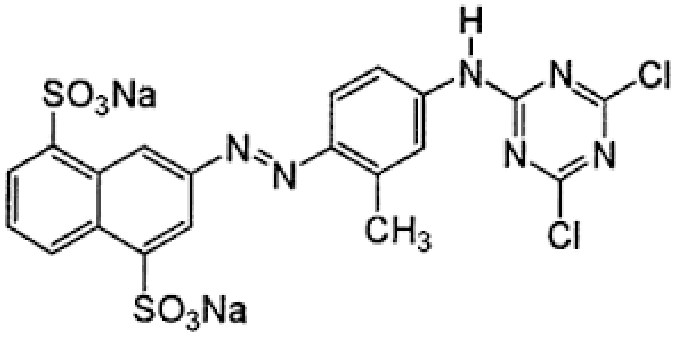
Activated Carbon (3gm) was permitted to enlarge in 15mL of water-free Alcohol and moved for 2 hours at 25^0C to get a homogeneous suspension. At the identical instant, the Manganese dioxide (3gm) was detached into water-free Alcohol (15mL). Then the watery Manganese dioxide was bitten by bit added into the deferment of activated Carbon and stimulated for a further 5 hours at 25^0C.To this, 5mL alcohol and 0.2mL of deionized water was leisurely added. The rousing was sustained for another 5 hours at 25^0C and the consequential deferment was set aside while sleeping in a void oven for 6 hours at 800C.It was labeled as PAC-MnO2-NC.

Preparation of Sorbate

Reactive Yellow 4 is purchased from S.d. fine chemicals. Reactive Yellow 4 has molecular formula C20H12Cl2N6Na2O6S2.The dye absorption in supernatant solution was determined at characteristic wavelength [λmax: 385nm] by twicegrin UV-visible spectrophotometer [Systronics 2202].The element configuration of Reactive Yellow 4 is granted beneath.

EXPERIMENTAL

Batch technique was followed by agitating 50 ml of four dissimilar stain solutions (10, 20, 30 and 40 mgL-1)at their expected pH with 100 mg of PAC-MnO2-NC in 150 ml stoppered tapering flasks at room heat (30.2ºC) in a warmth controlled water soak shaker at 140 rpm. The samples were solitary from the shaker at prearranged occasion intervals and the coloring solution was estranged from the adsorbent by centrifuging at 10 ,000 rpm for 10 min. The absorbance of the supernatant solution was calculated using UV-VIS spectrophotometer (Cyber Lab, 100) at wavelength 500 nm.



Reactive Yellow 4 (RY4) is a soluble dye in water due to the presence of two solubilizing groups (SO3H). High reactivity, can be in 20 to 40 ^{0}C in alkaline medium solid color of the fibers, alkaline hydrolysis, not resistant to acid hydrolysis. Mainly used for cotton, silk, polyamide fiber and viscose, wool fiber dyeing and can be white. Can render cloth dyed ice dye printing.

The quantity of RY4 adsorbed per unit mass was premeditated from the following equation:

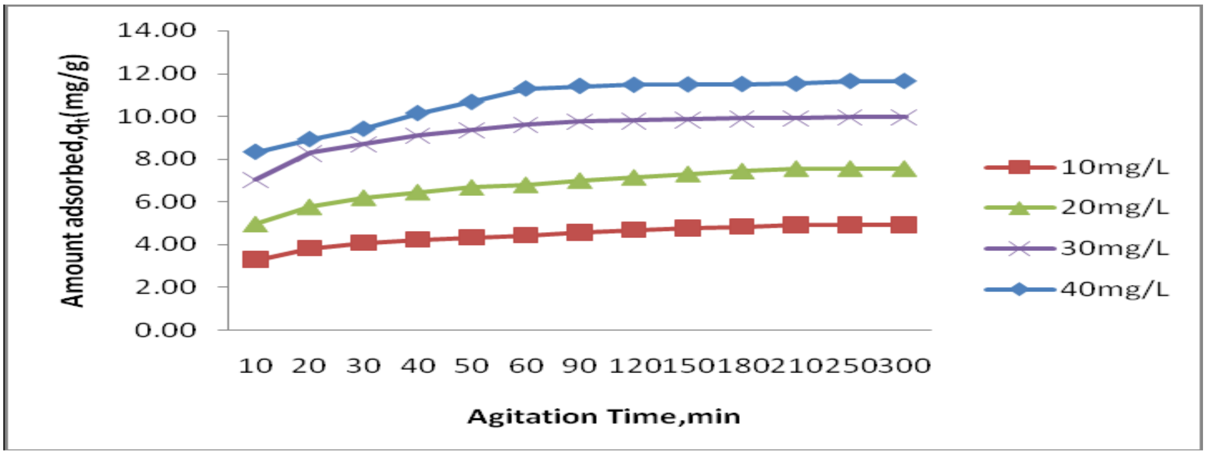
$$qt = (Co - Ct / V) / W \quad (1)$$

Where,W is the adsorbent quantity (mg); Ct the absorption of RY4 solution at moment in time t (min); V the quantity of functioning solution (mL); Co the first concentration of RY4 (mg/L); qt is the sum of dye adsorbed per unit weight of adsorbent (mg/g). Blank with only the adsorbate in 50 ml of distilled water were conducted concurrently at the parallel situation to report for adsorption in using goblet containers. It originated that no adsorption of RY4 by jug stockade occurred. The investigational parameters considered are initial dye concentration, contact time, pH and temperature and adsorbent dosage. Adsorption isotherm were tested with Langmuir Isotherm model, Freundlich Isotherm model, Temkin Isotherm model, Dubinin-Radushkevich Isotherm (D-R) model and Halsey Isotherm model.

RESULTS AND DISCUSSION

Effects of Initial Dye Concentration Vs Agitation Time

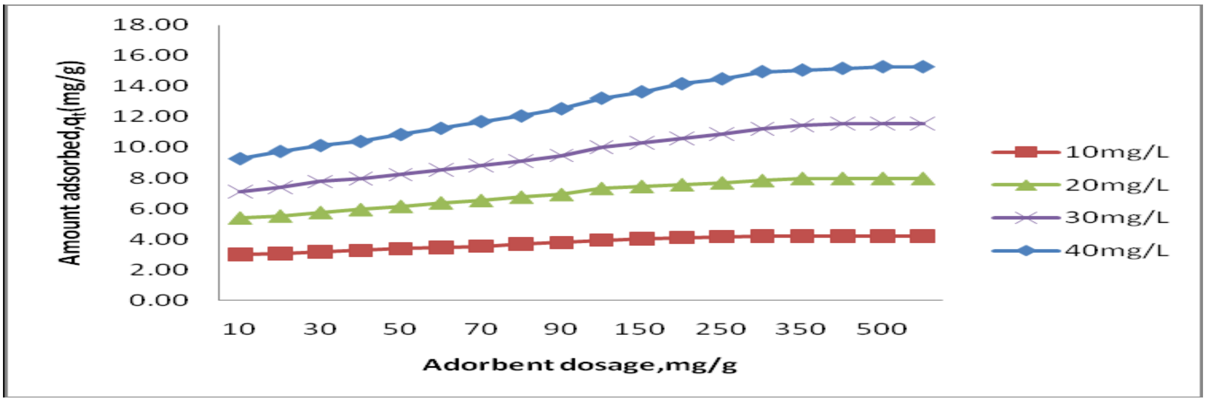
Belongings of initial dye concentration (10, 20, 30 and 40 mg/L) and agitation time on the exclusion of RY4 are offered in Graph-1. The percent elimination of RY4 bloated with raise in agitation time and reached stability at 150 min. The percent stain exclusion at stability decreased from 98.36 to 58.28 as the dye absorption was enlarged from 10 to 40 mg/L. It is lucid that the elimination of dye depends on the opening concentration of the dye. The taking away curves are lone, even and nonstop for most to saturation.



Graph-1: Cause of Concentration and Agitation Time of AG25 on Eliminationof PAC-MnO2-NC

Effect of Adsorbent Quantity

The subtraction of RY4 by PAC-MnO_2-NC at dissimilar adsorbent quantity are existing in Graph-2(10mg to 600mg / 50ml) was experienced for the dye concentration 10, 20, 30 and 40 mg/L. Augment in adsorbent quantity enlarged the percent exclusion of dye which is due to the enlarge in the exterior region of the adsorbent.

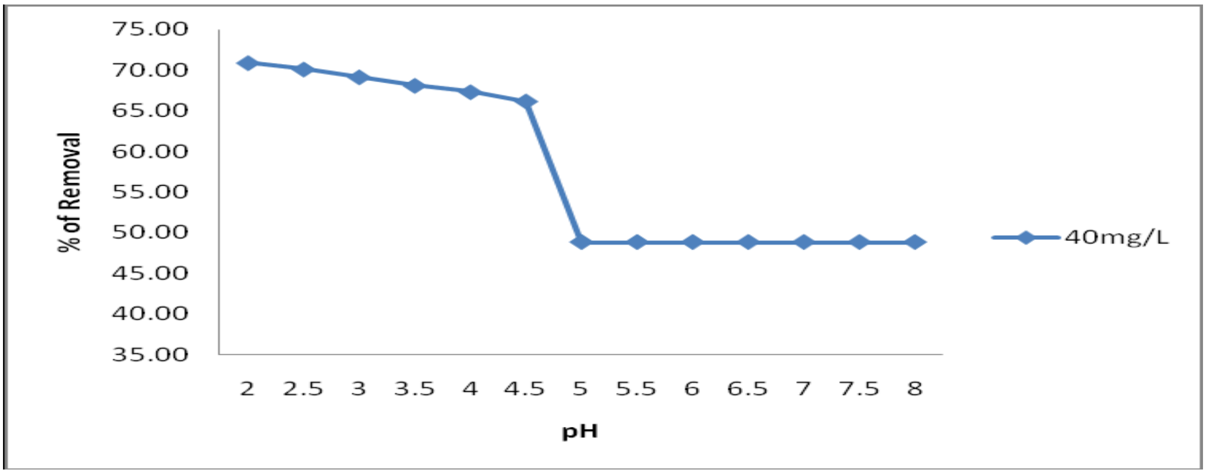


Graph-2: Effect of Adsorbent Quantity on Removal of AG25 by PAC-MnO2- NC

Upshot of pH

The outcome of pH on the exclusion of RY4 by PAC-MnO_2-NC is revealed in Graph-3. Dye adsorption decreases with enlarge of pH from 2 to 10 and no amazing modify thereafter.

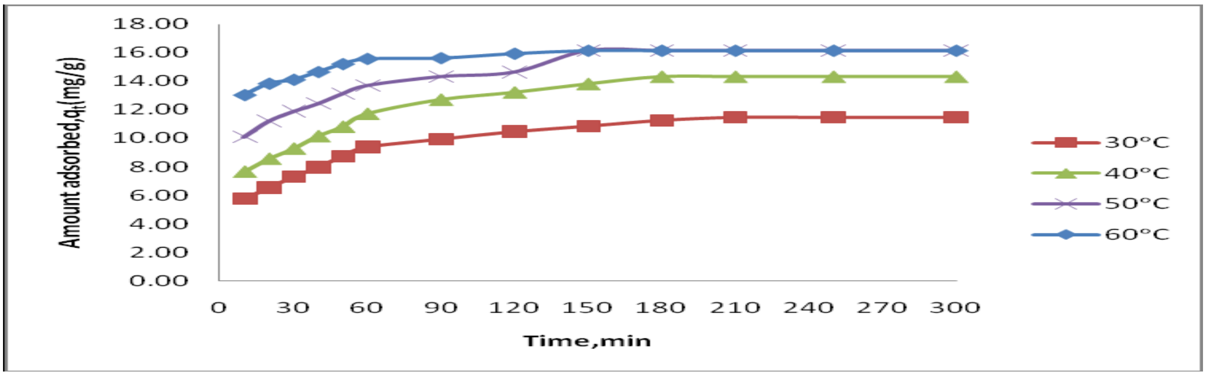
In that case for PAC-MnO_2-NC removal of acidic dye RY4 (reactive dye) the percentage removal of these dyes decreased with increase in pH. The percentage removal of RY4 decreases from 70.90 to 48.82(Graph-3)of initial dye concentration of 40ppm with the increase in initial pH of dye solutions from 2 to 10 with fixed PAC-MnO2-NC concentrations of 100mg/50ml and the studies were carried out for 5hrs.



Graph-3: Cause of pH on Removal of RY4 by PAC-MnO2-NC

Effect of Hotness

The corollary of temperature of adsorption of RY 4 for absorption 40 mg/L adsorbent was acknowledged out at 30°, 40°, 50°and 60°C. The percent crossing out of colorant enlarged from 57.41 to 80.81. This indicates that enlarge in adsorption with raise in heat perhaps due to a boost in the mobility of the huge dye ions. Besides, increasing hotness may construct a swelling effect inside the interior structure of the adsorbent, piercing the bulky dye molecule further.

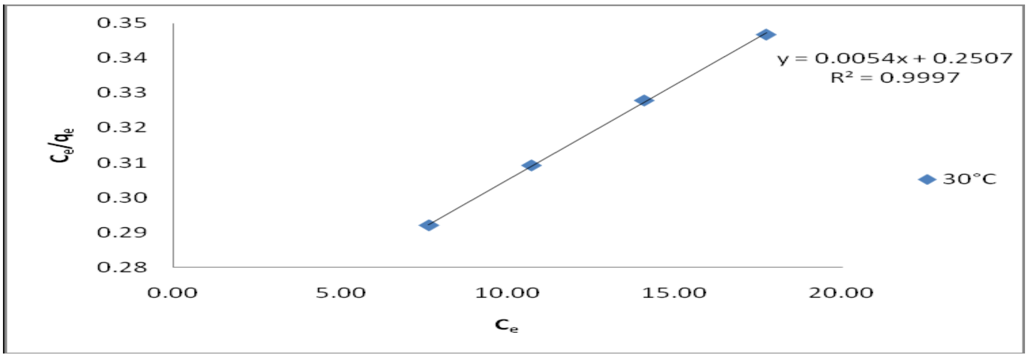


Graph-4: Effect of Heat on Removal of AG25 by PAC-MnO2-NC

Adsorption Isotherm

Langmuir Isotherm model

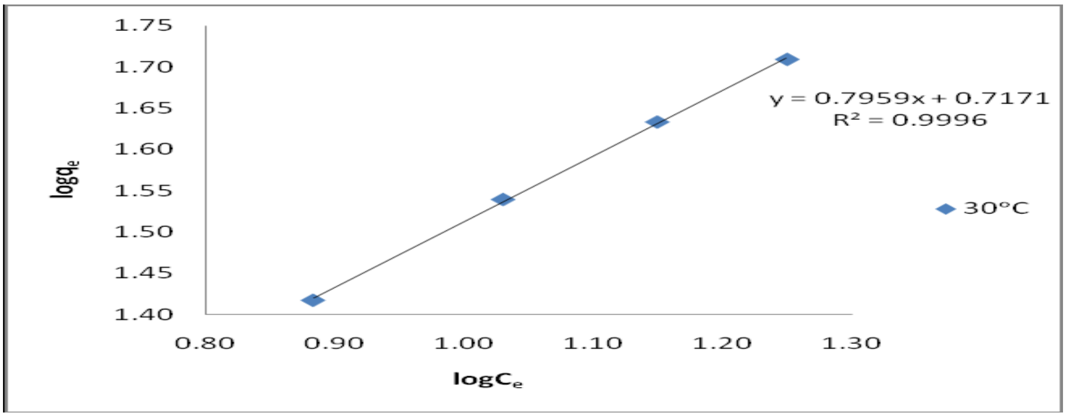
The values of Q0 and b were calculated from the slope and intercept of the linear plots of Ce/qe Versus Ce. The higher correlation coefficient (R2) for the dyes studied / adsorbent systems for the Langmuir isotherm confirms the applicability of this model. The fitting results are presented in Graph 5. Q0 gives the theoretical monolayer saturation capacity. The adsorption capacities Q0 were found to be 200 mg/g for RY4 dye respectively for PAC-MnO_2-NC adsorbent.



Graph-5: Langmuir plot for the Adsorption of RY4 onto PAC-MnO2-NC

Freundlich Isotherm model

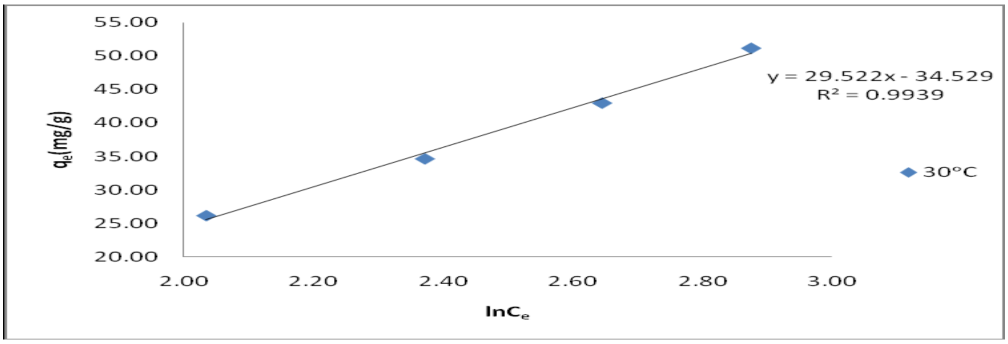
The plots of logqe versus logCe for the adsorption of RY4 onto PAC-MnO_2-NC adsorbent according to the linear forms of the Freundlich isotherms are shown in Graph-6.The values of n were found to be 1 to 10 indicating that the adsorptions of dyes were favorable. The values correlation coefficient R2 of RY 4 for PAC-MnO_2-NC adsorbent follows Freundlich isotherm studies.



Graph-6: Freundlich plot for the Adsorption of RY4 onto PAC-MnO2-NC

Tempkin Isotherm model

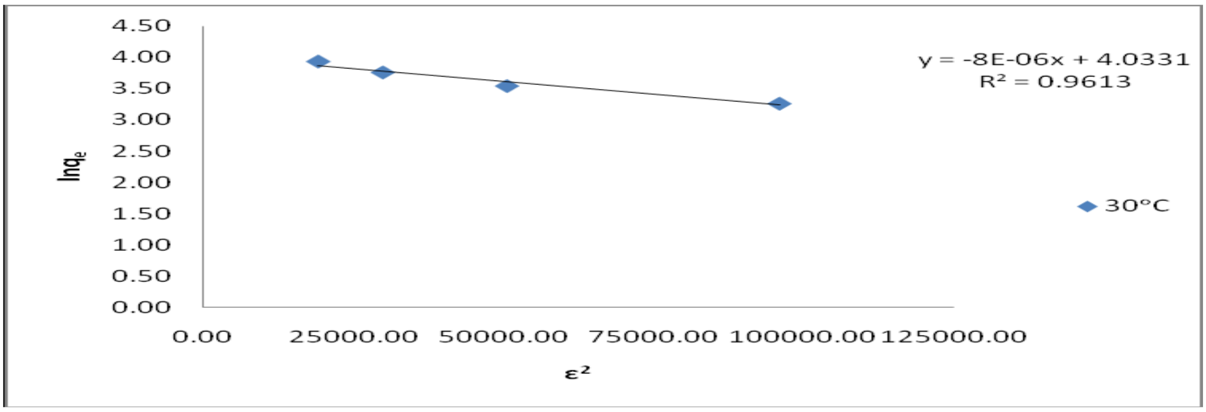
Tempkin isotherm takes into account the effect of indirect adsorbate-adsorbate interaction on adsorption and suggests that the heat of adsorption of all molecules in the adsorbent surface layer would decrease linearly with coverage.The plots of qe versus lnCe for the experimental data obtained on adsorption of RY4 onto PAC-MnO2-NC adsorbent shown in Graph-7. For PAC-MnO2-NC the Tempkin isotherms of the RY4 dye studied were found to be linear over the whole concentration range and the correlation co-efficient R2 were 0.993.



Graph-7: Tempkin plot for the Adsorption of RY4 onto PAC-MnO2-NC

Dubinin-Radushkevich Isotherm (D-R) model

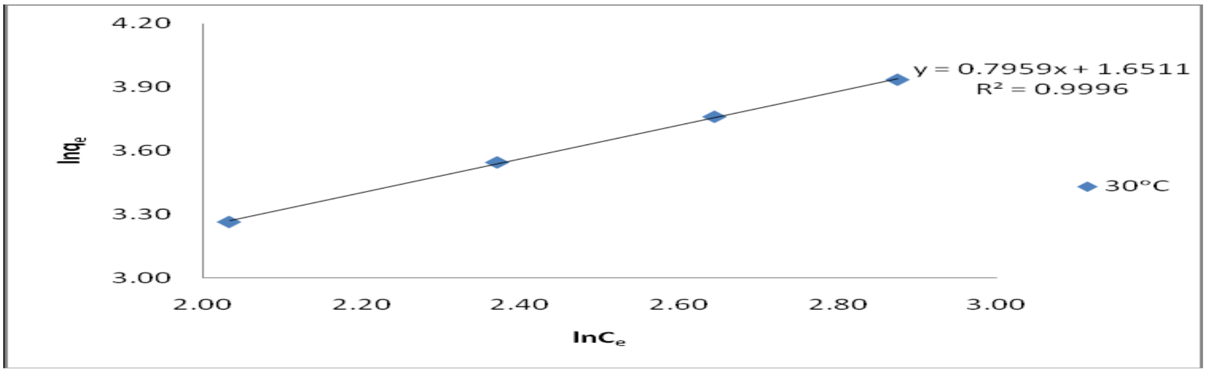
The adsorption data were analyzed according to linear form of the D-R isotherm equation. The D-R isotherms for PAC-MnO_2-NC of the RY 4 dye studied were found to be linear over the whole concentration range and the correlation co-efficient R2, was 0.961 for RY4 dye respectively. In the case of PAC-MnO_2-NC, the plot of lnqe against ε2 is shown Graph-8 and the constants qD and BD were calculated from the slope and intercept respectively. For the RY 4 dye studied by using PAC-MnO_2-NC, the D-R model the value of E lies between 8 and 16kJ/mol the sorption process is a chemisorptions one.



Graph-8: D-R plot for the Adsorption of RY4 onto PAC-MnO2-NC

Halsey Isotherm model

In the cases of PAC-MnO2-NC the plot of lnqe vs lnCe is shown in Graph-8 and the constants KH and nH were calculated from the slope and intercept respectively. The Halsey isotherms of the RY 4 dye studied was found to be linear over the whole concentration range and the correlation co-efficient R2, was 0.999 for RY4 dye respectively for adsorption on PAC-MnO_2-NC.



Graph-9: Halsey plot for the Adsorption of RY4 onto PAC-MnO2-NC

CONCLUSION

The current research illustrates that PAC-MnO_2-NC able to be used as an adsorbent for removal of Reactive Yellow 4. The quantity of dye adsorbed varied with temperature, initial concentration, pH and adsorbent dose. Total removal of the dye can be accomplish with an appropriate dosage of the adsorbent and pH for waste waters. The adsorption equilibrium data well described by the following order: Langmuir> Freundlich > Halsey > Temkin > Dubinin-Radushkevich. This isotherm invariable forecast that the sky-scraping stage mono layer adsorption and stumpy stage multi layer adsorption. The results would be useful for the fabrication and designing of waste water treatment plants for the removal of dye. Since the raw material is liberally obtainable in huge magnitude the treatment method look to be cheap.

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