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Golden Research Thoughts

Abstract:-

The colored textile effluents have a lot of chronic effect on human life .The presence of colour for effluents is due to the utilization of different dyes in textile industry. In the present work easily available low cost adsorbent i.e. corn cob was used to remove malachite green dye from effluent.

Malachite Green dye is selected because it is not easily degradable and is toxic in nature. The effect of different parameters like pH,contact time,adsorbent dose, and temperature were studied .The result showed that 80%dye was removed when pH=9 and contact time is 120 mins. When the temperature increases from 298Kto 308K the adsorption capacity also increases.The Freundlich and Langmuir adsorption isotherm were studied. The amount of adsorption increases with increasing adsorption dose, contact time, pH and temperature. The ultrasonic velocity of the dye solution was also studied. The result showed that, the velocity increases with adsorption. The kinetic study shows that pseudo second order model is more fitted than pseudo first order model.

This effect is observed due to swelling of the structure of the adsorbent which enables large number of dye molecules adsorbed on adsorbent body.

REMOVAL OF MALACHITE GREEN DYE (BASIC DYE) FROM AQUEOUS SOLUTION USING CORN COB AS AN ADSORBENT

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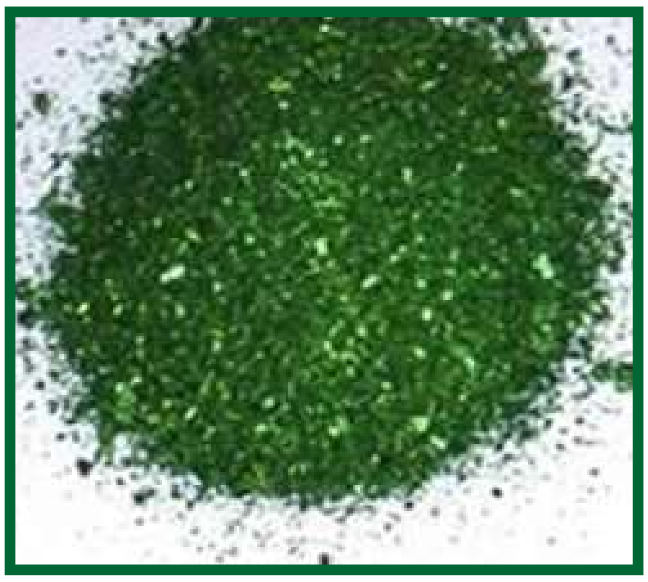


Keywords:

adsorption, Malachite Green, dye, corn cob, adsorption isotherms, adsorption kinetics.

1.0 INTRODUCTION

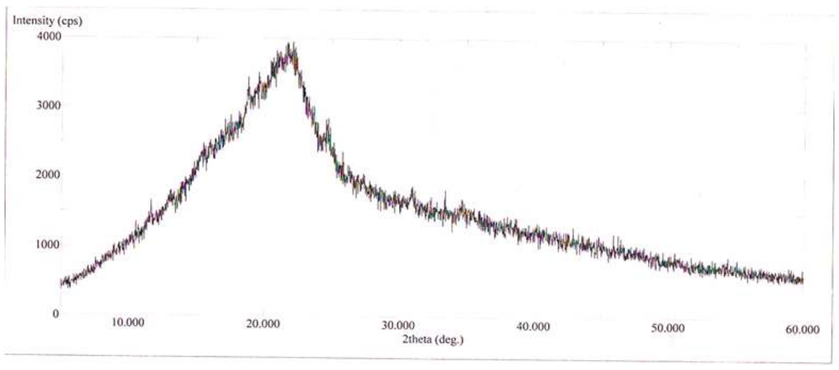
Textile industries always use dyes and pigments to color their products. Color removal from textile effluent is a major environmental problem.(1)Many dyes and their break down products are toxic for living organisms (2)and thus affecting aquatic ecosystem. Dyes have a tendency to produce metal ions in textile water produces micro toxicity in the life of fish. There are many physical and chemical methods for the removal of dyes like co-agulation, precipitation, filtration, oxidation, and flocculation. But these methods are not widely used due to their high cost. Adsorptiontechnique (3) is the best versatile method over all other treatments. Therefore the proposed work will undertake using agriculture waste like corncob forremoving dye material (4to7) from aqueous solution.

2.0 MATERIALS AND METHODS:

2.1. Corn cob was washed with distilled water and dried in an oven at 1200 C. It was thensieved through sieve no. 100 (150µm). The BET surface area of corn cob was 41.m^2/gm. obtained from BET technique. Malachite Green dye used was from Finer chemicals Ltd.

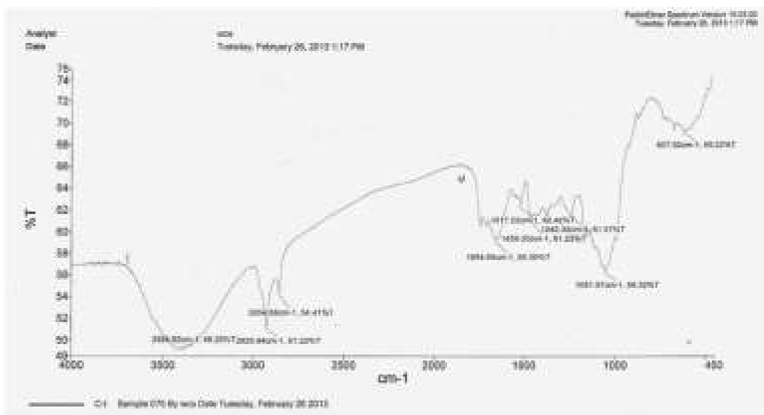
MolecularFormula:$C_{23}H_{25}Cl N_2$

2.2 The X-ray diffraction study of saw dust was carried out by X-ray Fluorescence Spectrometer (Philip model PW 2400). The morphological and XRD study clearly indicates that the adsorbent is porous and amorphous in nature.



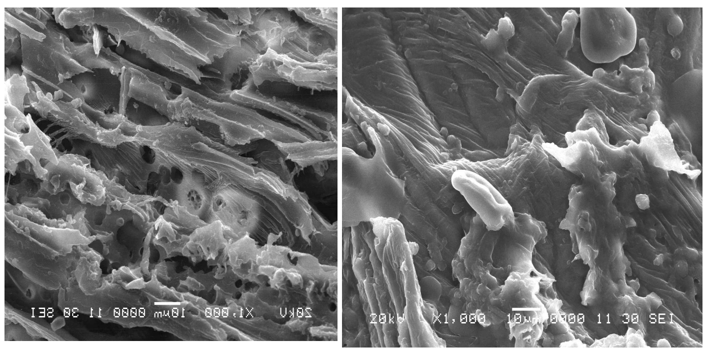
X-ray diffraction pattern of corn cob

2.3 .The IR spectrum of corn cob was also studied.



IR spectrum of corn cob

2.4 From the SEM analysis it was found that there were holes and cave type openings on the surface of adsorbent which would have more surface area available for adsorption(8)as shown in photographs



Corn cob (Before adsorption) corn cob(After adsorption)
Scanning electron micrograph (SEM) of the corn cob adsorbent

2.5 Experimental Procedure :

Batch adsorption experiments were conducted by shaking 150 ml of dye solution having concentration (50mg/l) i.e. 50 ppm with different amount of adsorbent and having different p^H values, at different temperatures as well as different time intervals. The adsorbent was then removed by filteration and the concentration of dye was estimated spectrophotometric ally at $?_{max}$= 600 nm. The amount of dye adsorbed was then calculated by mass balance relationship equation,

$$q_e = \frac{C_o - C_e}{X}$$

Where,

C_o= Initial dye concentration

C_e= Equilibrium dye concentration

q_e= Amount of dye adsorbed per unit mass of adsorbent.

X = Dose of adsorbent.

3.0 RESULTS AND DISCUSSIONS:

For getting highest amount of dye removal various factors were optimized.

3.1 Effect of contact time:

In order to know minimum amount of adsorbent for the removal of maximum amount of dye, the contact time was optimized. The results showed that the extent of adsorption is rapid at the initial stage, after 120 minutes the rate of adsorption is constant. About 80% dye was removed.(fig.1)

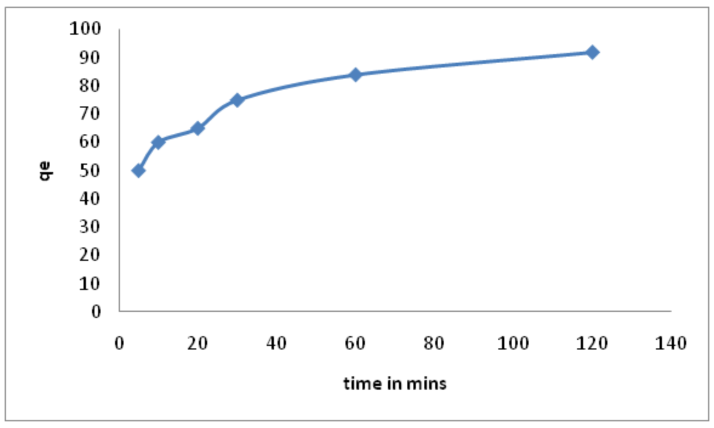


Fig.1 Effect of contact time

3.2 Effect of p^H:

From fig.2 it reveals that when pH of the dye solution increases from 3 to 9 the percentage of dye removal also increases. At p^H= 9, adsorption is maximum. By further increase in p^H adsorption decreases slightly. (9,10)

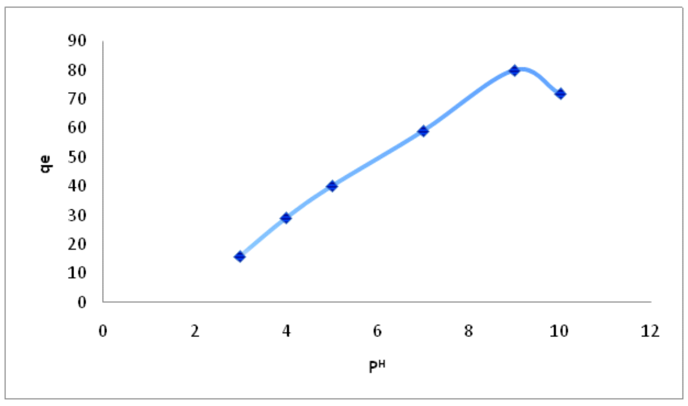


Fig.2 Effect of pH

3.3Effect of adsorbent dose:

The different adsorbent doses were studied from the range 0.5gm to 7.0 gm from the results, it is clear that the optimum dose is 1gm/150ml. (Fig.3). By further increase of adsorbent dose, the removal of adsorbent decreases due to some of the adsorption sites remains unsaturated during the process (11 to14)

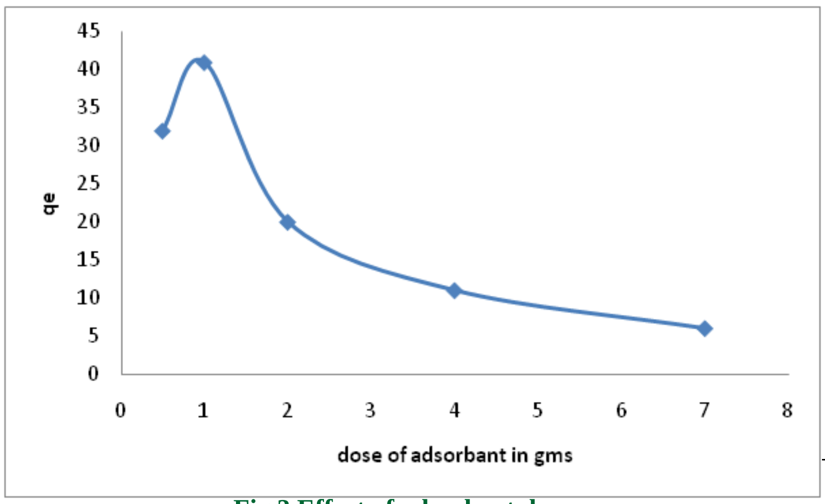


Fig.3 Effect of adsorbent dose

3.4 Effect of temperature:

The perusal of fig.4 it is clear that adsorption capacity of adsorbent increases with increase in temperature, due to increase in the mobility of dye ions. Increasing temperature also causes a swelling effect within the internal structure of adsorbent. So that large number of dye molecules can easily penetrate through it(15,16).

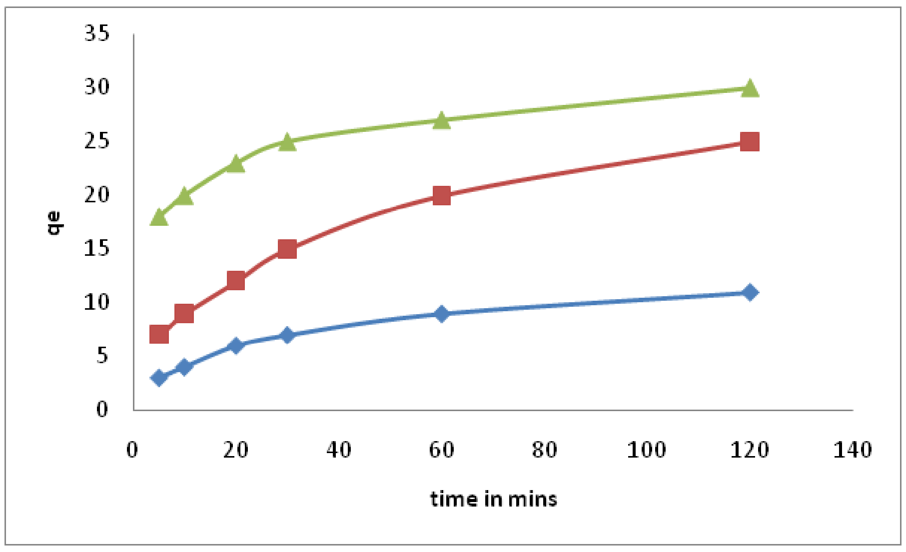


Fig. 4 Effect of contact time

3.5Adsorption isotherm:

3.5.1 Langmuir Isotherm:

In order to study the adsorption of dye according to Langmuir isotherm, following equation was used

$$\frac{C_e}{q_e} = \frac{1}{Q_m \times b} \times \frac{C_e}{Q_m}$$

Where

C_e =Dye concentration at equilibrium(mg/ L)

q_e =Amount of dye adsorbed on the adsorbent (mg/g)

b =Langmuir constant

A graph of C_e/ q_e against C_e was plotted.

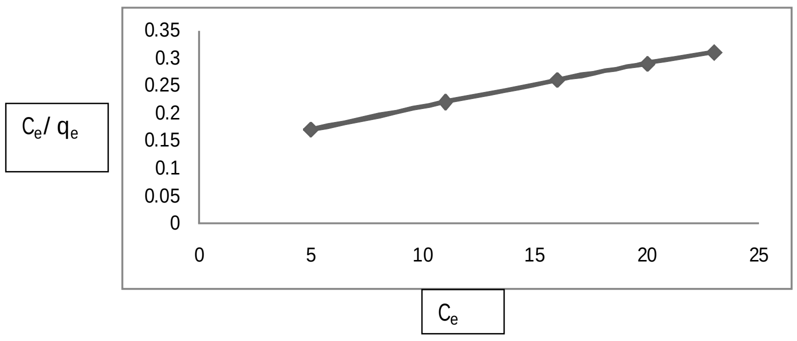


Fig. 5

The correlation factor is closely related to unity, which indicates that the Langmuir isotherm model is applicable (17,18,19). The formation of monolayer takes place on the surface of the adsorbent (20,21)

3.5.2 Freundlich isotherm:

To study the Freundlich isotherm the following equation was used.(22)

$$\log \quad q_e = \log \quad K_f + \log \frac{C_e}{n}$$

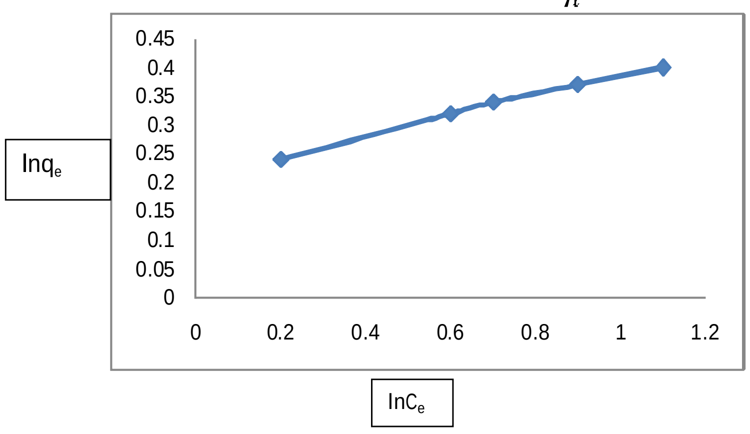


Fig.6

The graph of lnqe against ln C_e was plotted. From the slope, the value of n and correlation factor can be calculated. The value of correlation factor is closely related to one. So it indicates that the Freundlich isotherm also satisfied. The value of n is greater than 1. So the Freundlich adsorption develops appropriately.

3.6 Adsorption kinetics:

3.6.1 Pseudo 1st order model:

The pseudo 1st order kinetics model is used to understand the kinetic behavior of the system(23,24). It is given by the equation.

$dq/dt = k_1(q_e - q_t)$

A graph of $\ln(q_e - q_t)$ vs time was plotted.

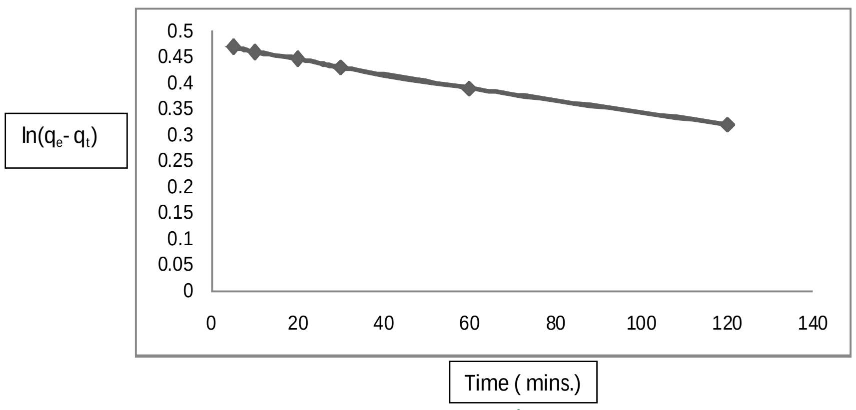


Fig. 7

3.6.2 Pseudo 2nd order kinetics:

The pseudo 2nd order kinetic model was studied using equation

$$\frac{t}{q_e} = \frac{q^2{}_e}{k_2} + \frac{t}{q_e}$$

Where
q_e = dye adsorbed at equilibrium
q_t = dye adsorbed at time t

A graph t/q_t of against time was plotted.

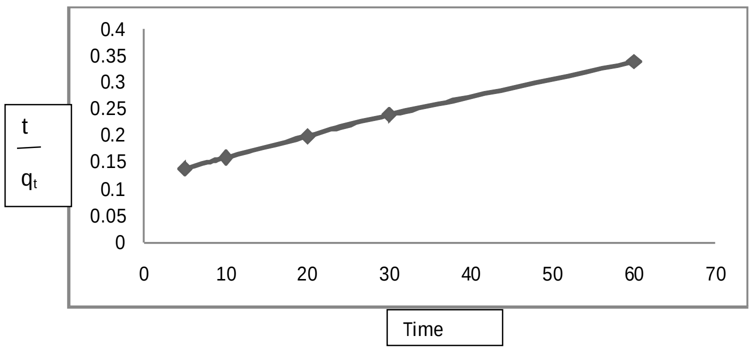


Fig. 8

Slope (K_2)	Intercept (q_e)	Correlation factor
0.00353	0.127	0.99

In case of pseudo 1st order kinetic model, the value of slope and correlation factor are negative. While in case of pseudo 2nd order kinetic model, the value of slope and correlation factors are positive. Which implies that, the system is more fevourable for pseudo 2nd order kinetics.

The ultrasonic velocity increases from $1.5x10^3$ to $1.56x10^3$ m/sec when the adsorbent dose increases from 0.5 gm to 2.5 gm.

4.0 CONCLUSION:

Corn cob acts as abetter effective low cost adsorbent for the removal of basic dye like Malachite Green.Batch adsorption was shown that yield of adsorption increases by increasing adsorbent dose, contact time,p^H,and temperature and ultrasonic velocity. The fittness of Langmuir model shows that there is a formation of monolayer on the adsorbent surfaces. Similarly Freundlich isotherm also develop appropriety. The pseudo second order kinetics is more favorable than pseudo first order kinetics.

5.0 ACKNOWLEDGEMENT

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6.0 REFERENCES:

1.C.Namasivayam and N. Kanchanna, Peranika J.Sci.and Technol. 1(1) (1993) 33-42
2.Nigam P., Armour G., Singh D., Merchant R., Bioresour Technol 72 (2000) 219-226.
3.M.Sarioglu,U.Atay. global nest Journal 8(2) (2006) 113-120.
4.Singh B. K., Rawat N. S., J. Chem. Technol. Biotechnol. 61 (1994) 307-317.
5.McKay G., Prasad G. R., Mowli P. R., Water Air Soil Pollut. 29 (1986) 273-283.
6.Khare S. K., Panday K. K., Srivastava R. M., Singh V. N.,J. Chem. Technol, Biotechnol. 38 (1987) 99-104.
7.Juang R. S., Wu F. C., Tsang R. L., Environ. Technol. 18 (1997) 525-531.
8.Khatri S. D., Singh M. K., Ind. Chem. Technol. 6 (1999) 112-116.
9.D.A Nimkar, S.K Chavan. IJERA, 4(1) (April 2014) 47-51.
10.D.A Nimkar, S.K Chavan. IJERT, 3(4) (April 2014) 1579-1583.
11.Ferro F., Journal of Hazardous Material 142 (2007) 144.
12.K. Bhatt, Z.M Parve Jr.of chemical society of Pakistan 33(2011) 502.
13.Theng B. K. G., Wells N., Appl. Clay. Sci. 9 (1995) 321-326.
14.Garg V. K., Kumar Rakesh, Gupta Renuka,waste Dyes and pigments 63 (2004) 243-250.
15.Yamin Yasin, Mohd. Zobir Hussein, Faujan Hj Ahmad, Malaysian Journal of analytical sciences. 11 (2007) 400-406.
16.R.S Mane, V.N Bhusari IJERA 2(3), (June2012),1997-2004.
17.Sen A. K. and De. A. K., Water Res. 21 (1987) 885.
18.S.Mallipudi et al. International Journal of Engineering Research and Technology, 2(10) (Oct-2013)

4054-4059.
19.Parvathi C. Sivamani S., Prakash C. Colourage Environmental solution. LV I 10 (Oct 2009) 54-56.
20.Arivoli S., Hema N., Int. J. Phys. Sci. 2 (2007) 10-17.
21.Thievarasu C., Mylsamy S. and Sivakumar N., Universal Journal of Env. Research and Tech. 1 (2011) 70-78.
22.Karabulut S. Sep. purif. Tech. 18 (2000) 177-187.
23.Nagada G. K., Diwan A. M., Ghole V. S., App. Eco and Environ. Res. 2 (2007) 1.
24.Paul S. A., Chavan S. K., Oriental J. Chem. 27 (2011) 47-51.