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Comparison of Adsorption of Malachite Green on to Low-Cost Adsorbents - A Review

D. Karthika[1], T. Vimala[2]

[1, 2]Department of Chemistry, Stet Women's College Mannargudi, India

Abstract -The adsorption of malachite green onto Borassus bark and Juliflora bark was studied under various conditions such as concentration of adsorbate, adsorbent dosage, effect of the contact time, adsorbent dosage solution of pH were studied in batch experiment at 30^0C. It was rapid, stable and occurs in less than 60 minutes. Results showed that a PH of 7 is favourable for the adsorption dye. The objectives of this work were to compare the process of adsorption of malachite green with two types of absorbents (Borassus bark and Juliflora bark) and the isothermal data could be well described by the Freundlich. Results showed that Borassus bark and Juliflora bark are suitable for the adsorption of malachite green and could be used as a low cost effective adsorbent in the treatment of the industrial wastewater.

Keywords: Adsorption, malachite green, Borassus bark, Juliflora bark, Modeling, isotherms, Langmuir model, Freundlich model, low cost adsorbent, treatment of industrial wastewater

1. Introduction

Water pollution is beginning to take alarming proportions for both terrestrial waters and seacoast(1). The textile dyeing industry consumes large quantities of water and produces large volumes of wastewater from different steps in the dyeing and finishing processes. Wastewater from printing and dyeing units is often rich in color, containing residues of reactive dyes and chemicals, and requires proper treatment before being released into the environment. "**Color the earth beautiful and kill it with sweet poison** " Strong color of the textile waste water is the most serious problem of the textile industrial effluent(2).

Currently, several physical or chemical processes are used to treat the waste water. However, these processes are costly and cannot be used effectively to treat the waste water (Malik *et al*., 2007). Activated carbons are widely used as efficient and useful adsorbents for the removal of colour and odour in waste water. This paper reports the adsorption of malachite green dye from waste water using Borassus bark carbon (BBC) and Prosopis juliflora bark carbon (PJBC) as an adsorbent(3).

This work aims to study elimination of malachite green using as adsorbent two materials: Borassus bark and Juliflora bark.

2. Theoretical and Experimental Part

a) Adsorption parameters

In order to optimize process conditions for adsorption of malachite green on Borassus bark and Juliflora bark, we studied the influence of some factors which may be involved in the process of this phenomenon such as concentration of adsorbate, adsorbent dosage and effect of pH.

b) Modeling of adsorption isotherms

Freundlich model (van Bemmelen, 1988 [13] Freundlich, 1909 [14]) is the most commonly used. We consider that it applies to many cases, especially in the case of multilayer adsorption with possible interactions between the adsorbed molecules [15]:

$$q_e = K_F.C_e$$

The most common form used is the plot in logarithmic scale variations qe according to Ce:

$$\text{Log } q_e = \log K_F + \log C_e$$

The constant n (adimentionelle) gives an indication of the intensity of adsorption. It is generally accepted that:

R_L values and Types of isotherm

R_L value	Types of isotherm
$R_L > 1$	Unfavorable
$R_L = 1$	Linear
$0 < R_L < 1$	Favorable
$R_L = 0$	Irreversible

- 0.1<n<0.5 characteristic of a good adsorption.
- 0.5<n<1 characteristic of a moderate adsorption.
- n>1 characteristic of a weak adsorption

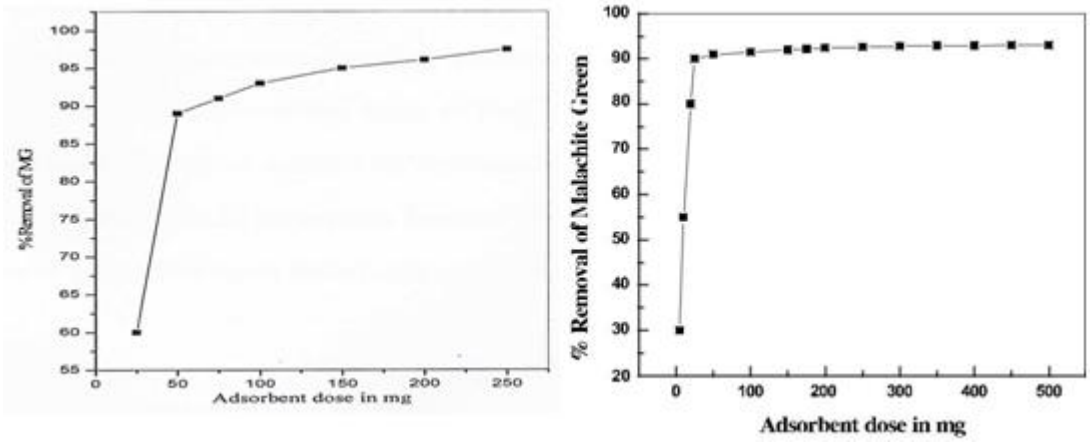
Langmuir model is based on assumptions well known. The initial assumptions are that the solid adsorbent has a limited adsorption capacity (qm), all active sites are identical, they can only complex solute molecule (monolayer adsorption) and there are no interactions between adsorbed molecules. This model can be expressed by equation (1):

$$q_e/q_m = \theta = KL.C_e / (1+ K C) \qquad (1)$$

Isotherms	*Non linear expression*	*Linear expression*
Langmuir	$qe/qm = \theta = KL.Ce / (1+ KL.Ce)$	$1/qe = 1/ (Ce. KL.qm) + 1/qm$
Freundlich	$qe = K_F.Ce.n$	$\text{Log } (qe) = \log (K_F) + n \log (Ce)$

3. Results and Discussions

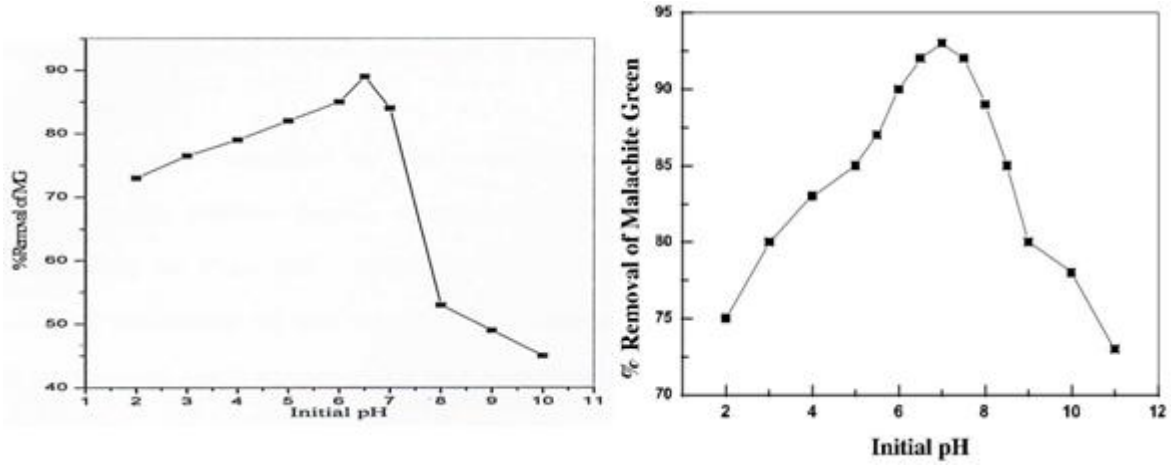
Effect of Dose



(a) Borassus bark carbon (**BBC)** (b)Prosopis juliflora barkcarbon **(PJBC)**

Figure 1: Effect of adsorbent dose for the removal of MG dye -91% [MG] = 50 mg/L; pH = 7; g <0,056 mm; ambient temperature & time

Effect of pH



(a) Borassus bark carbon **(BBC)** (b) Prosopis juliflora barkcarbon **(PJBC)**

Figure 2: Effect of initial solution pH for the removal of MG dye [MG] = 50 mg/L; pH = 6.5; G <0,056 mm; ambient temperature & time

Table 1: Parameters of Langmuir & Freundlich adsorption of malachite green onto *Prosopis juliflora* bark carbon

Temp (°C)	Langmuir		Freundlich	
	Q_m	b	k_f	n
30	410.26	0.0971	84.4112	2.8687
40	418.15	0.1181	95.7856	2.9901
50	491.17	0.1387	109.8753	2.6895
60	429.87	0.2030	124.7383	3.2973

Table 2: Parameters of Langmuir & Freundlich adsorption of malachite green onto *Borassus barkcarbon*

Temp (°C)	Langmuir		Freundlich	
	Q_m	**b**	**k_f**	**n**
30	20.70	0.1792	1.7209	0.5428
40	20.25	0.2096	1.6113	0.4770
50	19.76	0.2020	1.5517	0.4393
60	19.34	0.2347	1.4838	0.3946

The results show that the maximum adsorption capacity (q_m) obtained from Langmuir model increases with decreasing the concentration value of the malachite green. The adsorption is favorable (R_L tends to 0) and moderate (0.5< n <1).The low values of maximum adsorption capacities obtained from the Freundlich model, confirm that the molecule of malachite greenis not strongly adsorbed inside the pores because of its size.

4. Conclusion

This review highlighted the capacities of Borassus bark carbon (BBC) and Prosopis juliflora bark(PJBC) to pretreat raw wastewaters. The extent of dye removal increased with decrease in the initial concentration of dye and particle size of the adsorbents and also increased with increase in adsorbents doses and PH used. The equilibrium adsorption is practically achieved in 60 min. Adsorption data were modelled using the Freundlich and Langmuir adsorption isotherms. The optimal pH for favorable adsorption of MB is 7 by both the adsorption.The n values (0.5428 to 0.3946 for BBC)& (2.6895 to 3.2973 for PJBC) between 0.1< n <0.5 indicate characteristic of good adsorption We can say that Borassus bark carbon adsorb dyes better than Prosopis juliflora bark with a high maximum adsorption capacity in

comparison with Prosopis juliflora bark. The results indicate that both of Borassus bark carbon (BBC) and Prosopis juliflora bark(PJBC)could be employed as low-cost alternative to commercial activated carbon in malachite green wastewater treatment.

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