

Removal of Malachite Green Using Activated *Azadirachta indica*

A. Juss. Powder as Biosorbent (Tama-Kha)

Htay Htay Nyunt¹, Thinzar Nu², Khin Than Yee³

Abstract

This research work concerns with the preparation of neem bark powder (NBP), acid activated neem bark powder treated with 1 %, 2 % and 3 % HCl (AANBP-1, AANBP-2, AANBP-3), and heat treated neem bark powder at 250 °C, 300 °C 350 °C, 400 °C and 450 °C (HTNBP-1, HTNBP-2, HTNBP-3, HTNBP-4, HTNBP-5). The prepared samples were used as sorbent for the removal of dyes (malachite green) from aqueous solution. According to the bulk density, surface area and preliminary sorption properties of prepared samples, neem bark powder (NBP), acid activated neem bark powder (AANBP-2) and heat treated neem bark powder (HTNBP-4) were chosen for further study for removal of dye. The physicochemical properties (moisture content, ash content, pH, bulk density and specific surface area) of prepared samples were determined by conventional methods. The prepared sorbent samples (NBP, AANBP-2 and HTNBP-4) were characterized by modern techniques such as SEM and FT IR. The sorption capacities of prepared NBP, AANBP-2, HTNBP-4 were studied for the removal of dye (malachite green) from aqueous solution with varying parameters of pH, initial concentration of dye solution, contact time and dosage of adsorbent. The removal percent of malachite green was found to be 92.881 %, 93.880 %, 95.828 % for NBP, AANBP-2 and HTNBP-4 at optimum conditions (pH 4, initial concentration 400 ppm, contact time 120 min and dosage of adsorbent 0.2 g). Langmuir and Freundlich isotherms were employed to describe adsorption capacities. In the sorption isotherm studies, Langmuir isotherm indicated that the sorption capacities (Q_0) of NBP, AANBP-2, HTNBP-4 were 370.370 mg g⁻¹, 384.615 mg g⁻¹ and 400.000 mg g⁻¹ for the removal of malachite green respectively. From the Freundlich isotherm studies, the sorption capacity (K_f) of HTNBP-4 is larger than NBP and AANBP-2 for the removal of malachite green. The application of sorbents were investigated for the removal of textile dyes from textile mill effluents collected from drainage of textile mill in North Dagon Township, Yangon Region. The removal percent of textile dye by NBP, AANBP-2 and HTNBP-4 were observed as 55.662 %, 65.470 % and 81.100 %. HTNBP-4 was the more effective and efficient sorbent for malachite green dye and textile effluent. NBP, AANBP-2 and HTNBP-4 could be applied in purifying the environmentally polluted wastewater effluents.

Keywords: neem bark powder, malachite green, wastewater, textile dyes

Introduction

Activated carbon is the most popular adsorbent, which is capable of adsorbing many dyes with a high adsorption capacity (Lin, 1993), but it is expensive and the costs of regeneration are high because desorption of the dye molecules is not easily achieved (Mckay and Ramprasad, 1987).

Dyes are widely used in various industries, such as textiles, paper, plastics, cosmetics and leather, for coloring their final product. The release of colored wastewater from these industries may present an ecotoxic hazard and introduce the potential danger of bioaccumulation, which may eventually affect man through the food chain. Many techniques have been used to remove harmful dyes from colored wastewater (Garg et al., 2004). Currently sorption process is proved to be one of the effective and attractive processes for the treatment of these dye-bearing wastewaters (Gupta et al., 2003) and (Makay and Allen, 1980).

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Neem tree (*Azadirachta indica*) is native to the Myanmar sub-continent. In the present study activated neem bark powder, a waste materials obtained from wood industry have been used as an adsorbents for the removal of malachite green. Malachite green was found to be toxic to human cells and might cause liver tumor formation (Srivastava and Rupainwar, 2010).

The present study is aimed towards the development of an industrially viable, cost effective and environmentally compatible adsorbent for the removal of malachite green from wastewater. To evaluate the efficiency of developed adsorbents, adsorption batch and kinetic studies were performed (Bhattacharyya and Sharma, 2005).

Materials and Methods

Sample collection

Neem barks used in the present work were collected from Thuwunna Ward, Thingangyun Township, Yangon Region. Industrial textile dye wastewater sample from textile dye mill in North Dagon Township, Yangon Region was collected.

Preparation of neem bark powder

The collected barks were washed several times with running tap water to remove dust particles, water soluble materials and coloring materials. The washed materials were then completely dried in an oven at 105-110 °C for 24 h till the barks could be ground into fine powder by the local mixer grinder. The neem bark powder was boiled for 2 h and washed with distilled water for several times until it was free of color and turbidity. Then, the powder was dried in an oven at 80 °C overnight to obtain a fine powder. The fine powder was sieved with 80 mesh to get the particle size range of 105-125 µm. Finally, the product was stored in a vacuum desiccator.

Preparation of acid activated neem bark powder

The neem bark powder was soaked with 1 %, 2 % and 3 % v/v hydrochloric acid for 24 h. Then, it was washed several times with distilled water until the pH 7.0. The sample was dried in oven at 105 °C for 8 h. The obtained acid activated neem bark powder samples (1 %, 2 % and 3 % v/v) were ground in mortar and pestle to obtain fine particle size and sieved with 80 mesh. Finally, acid activated neem bark powder AANBP-1, AANBP-2 and AANBP-3 were obtained.

Preparation of heat treated neem bark powder

The neem bark powder was heated in furnace at 250 °C, 300 °C, 350 °C, 400 °C and 450 °C respectively for 1 h. The heat treated sample of (250 °C, 300 °C, 350 °C, 400 °C and 450 °C) powder was obtained. Then, the obtained heat treated samples (250 °C, 300 °C, 350 °C, 400 °C and 450 °C) were ground in mortar and pestle to obtain fine particle size and sieved with 80 mesh. Finally, heat treated neem bark powder HTNBP-1, HTNBP-2, HTNBP-3, HTNBP-4 and HTNBP-5 were obtained.

Preparation of dye solution

The dye used in this research is malachite green which has chemical formula of $C_{50}H_{52}N_4O_8$ and molecular weight of 927.03. Wavelength of maximum adsorption of this dye is 555 nm.

The stock solution was prepared by dissolving the required amount of dye in double distilled water. Working solutions of the desired concentrations were obtained by successive dilution. Dye concentration was analyzed using absorbance values with a UV- vis spectrophotometer.

Determination of physicochemical properties

According to the bulk density, surface area and preliminary removal percent of prepared sorbent samples, NBP, AANBP-2 and HTNBP-4 were chosen for the selected samples for further sorption study of malachite green. The physicochemical properties such as pH, moisture content, bulk density, ash content and surface area of selected samples were determined by conventional standard method. The physicochemical properties of the selected sorbents are presented in Table 1.

Characterization methods

Fourier Transform Infrared (FT IR) and scanning electron microscope (SEM)

The sorbents were characterized by SEM and FT IR. The surface morphology of sorbent samples are presented in Figure 1. The FT IR spectra of sorbent samples are shown in Figure 2 and the spectral band assignments are presented in Table 2.

Sorption procedure

Sorption studies were performed by the batch technique. Batch sorption studies were performed at pH (2-6), dye initial concentrations (100-600 ppm), contact time (30-180 min) and sorbent dosages (0.05-0.30 g) to obtain equilibrium isotherms.

Sorption isotherms

The adsorption capacities of neem bark powder (NBP), acid activated neem bark powder with 2 % HCl v/v (AANBP-2) and heat treated neem bark powder at 400 °C (HTNBP-4) were studied by Langmuir and Freundlich isotherm models.

Results and Discussion

Physicochemical Properties

Physicochemical properties of NBP, AANBP-2 and HTNBP-4 were determined. The physicochemical properties, such as pH, moisture content, bulk density, ash content and surface area of NBP, AANBP-2 and HTNBP-4 are present in Table 1. It was found that NBP was higher moisture content than those of AANBP-2 and HTNBP-4. The moisture content has no effect on its adsorption power. The pH value of NBP and AANBP-2 have slightly acidic character and HTNBP-4 has more basic character. Raw samples (NBP) was found to have higher ash content than those of AANBP-2 and HTNBP-4. Moreover, it was also found that HTNBP-4 has higher bulk density and surface area than those of other two samples (NBP, AANBP-2). The greater the bulk density and surface area, the larger the adsorption properties of adsorbent samples. The surface area and porosity is the main factor for increasing the adsorption power of an adsorbent sample.

Table 1 Physicochemical Properties of NBP, AANBP-2 and HTNBP-4 Samples

Sample	Moisture (%)	Ash (%)	pH	bulk density (g cm ⁻³)	surface area (m ² g ⁻¹)
NBP	10.8	5.6	6.8	0.364	254.412
AANBP-2	6.3	2.4	6.4	0.420	364.994
HTNBP-4	1.9	0.7	9.2	0.596	460.398

Scanning Electron Microscopy (SEM)

Pore structure and structural change of NBP, AANBP-2 and HTNBP-4 were observed by scanning electron micrographs. SEM micrographs of NBP, AANBP-2 and HTNBP-4 are shown in Figure 1 (A), (B) and (C).

The SEM micrograph of NBP displaced in irregular shape structure. HTNBP-4 has plateaus and lamella structure and then dissimilar morphological structure of other two samples. Moreover, HTNBP-4 has more cavity than other two samples (NBP and AANBP-2).

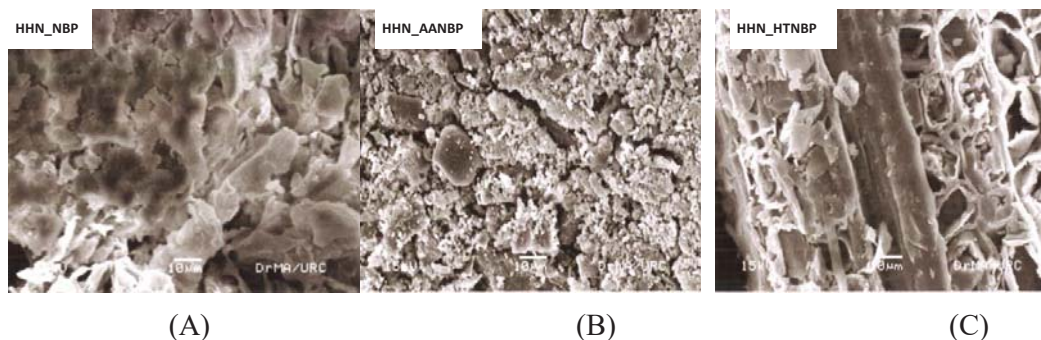
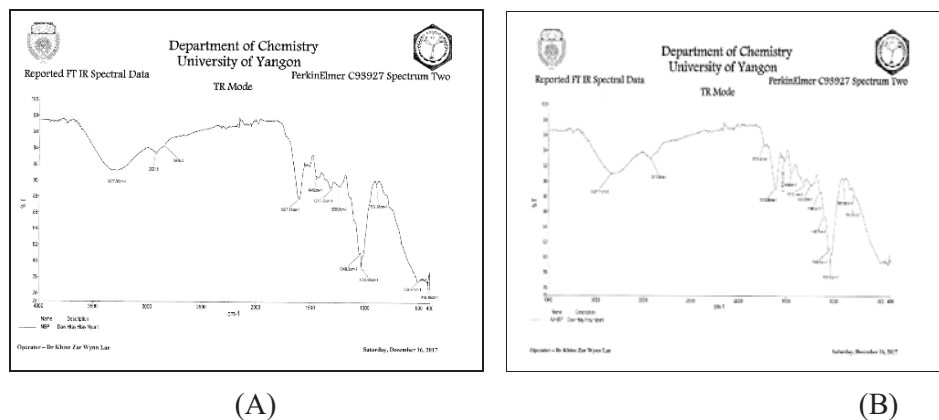
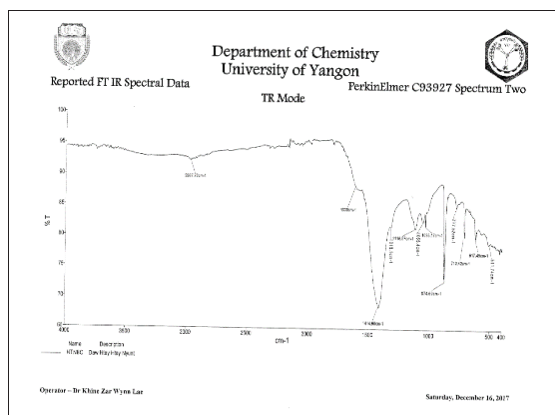


Figure 1 Scanning electron micrographs of (A) neem bark powder (NBP) (B) acid activated neem bark powder (AANBP-2) (C) heat treated neem bark powder (HTNBP-4)

Fourier Transform Infrared (FT IR)

The FT IR spectra of NBP, AANBP-2) and HTNBP-4 were shown in Figure 2 and bands assignment were presented in Table 2.





(C)

Figure 2 FT IR spectrum of (A) neem bark powder (NBP) (B) acid activated neem bark powder (AANBP-2) (C) heat treated neem bark powder (HTNBP-4)

Table 2 FT IR Band Assignment of NBP, AANBP-2 and HTNBP-4

Observed wave number (cm ⁻¹)			Literature wave number (cm ⁻¹)	Band Assignment
NBP	AANBP-2	HTNBP-4		
3277	3337	-	3400-3200	O-H stretching
2921 } 2846 }	2918	2967	2980-2850	C-H stretching
-	1734	-	1785-1730	C=O stretching
1607	1610	1608	1625-1430	C=C stretching
1442	1445	1414	1465-1440	CH ₃ deformation
1317	1318	1318	1320-1210	C-O-C stretching in aromatic ring
1049 } 1032 }	1052 } 1033 }	1055 } 1033 }	1075-1020	C-O-C stretching
892	892	874	835-795	C-C stretching
-	783	712	785-680	C-H bending
-	-	617	720-600	O-H bending in aromatics
508	-	511	520-430	C-O-C bending

*Source- Silverstein and Terence, 1991

Sorption Study of NBP, AANBP-2 and HTNBP-4 on Malachite Green Effect of pH

The results of the experiments done at different pH values, which were conducted to determine the optimum pH range for dye adsorption on NBP, AANBP-2 and HTNBP-4 are shown in Figure 3. The percentage removal of malachite green by NBP, AANBP-2 and HTNBP-4 were optimum at pH 4.0. Several reasons may be attributed to dye sorption behavior of the biosorbent relative to solution pH. The surface of the bark powder may contain a large number of active sites and the solute (dye ions) uptake can be related to the active site and also to the chemistry of the solute in the solution. The adsorption of malachite green increases with decreases in the pH of the solution.

Table 3 Effect of pH on the Removal of Malachite Green by NBP, AANBP-2 and HTNBP-4

pH	Removal percent (%)		
	NBP	AANBP-2	HTNBP-4
2.0	72.179	75.493	80.567
3.0	81.284	83.224	85.612
4.0	86.717	93.567	95.955
5.0	85.806	91.567	94.418
6.0	84.314	90.344	93.388

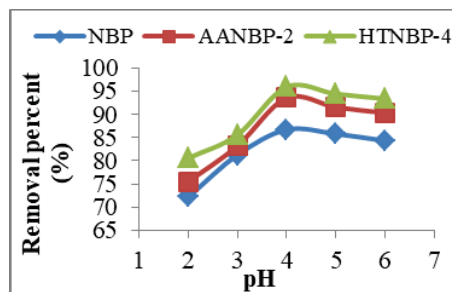


Figure 3 Effect of pH on the removal of malachite green by NBP, AANBP-2 and HTNBP-4

Effect of Initial Concentration of Dye Solution

Table 4 and Figure 4 show the removal of malachite green by a constant amount of sorbents NBP, AANBP-2 and HTNBP-4 (0.1 g) with initial concentration in range from 100 mgL^{-1} to 600 mgL^{-1} of malachite green solution. Figure 4 shows the corresponding data in terms of percent removal with respect to initial concentration. It can be seen that as the percent removal of malachite green decreases with increases in initial concentration. For the initial concentration 400 mgL^{-1} , it was found that after 60 min agitation time, the amount of dye being adsorbed were 70.985 % for NBP, 80.149 % for AANBP-2 and 81.791 % for HTNBP-4.

Table 4 Effect of Initial Concentration on the Removal of Malachite Green by NBP, AANBP-2 and HTNBP-4

Concentration (mg/L)	Removal percent (%)		
	NBP	AANBP-2	HTNBP-4
100	91.791	95.254	97.164
200	87.358	94.060	95.552
300	78.538	90.726	93.711
400	70.985	80.149	81.791
500	70.453	79.803	81.236
600	69.592	79.428	80.552

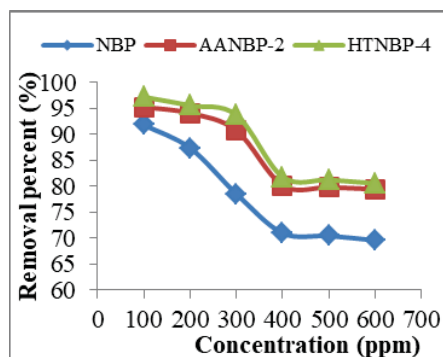


Figure 4 Effect of initial concentration on the removal of malachite green by NBP, AANBP-2 and HTNBP-4

Effect of contact time

The effect of contact time on the removal of malachite green (initial concentration 400 mgL^{-1}) by NBP, AANBP-2 and HTNBP-4 were shown in Table 5. It can be seen from the profiles as shown in Figure 5, that the curve reaches the maximum contact time at about 120 min. After the maximum contact time frame has been reached, the maximum removal percent become independent of time.

Table 5 Effect of Contact Time on the Removal of Malachite Green by NBP, AANBP-2 and HTNBP-4

Contact Time (min)	Removal percent (%)		
	NBP	AANBP-2	HTNBP-4
30	68.866	73.281	77.622
60	71.463	79.537	82.216
90	77.940	84.224	85.604
120	85.388	87.254	90.724
150	85.694	87.694	91.142
180	86.112	88.306	91.552

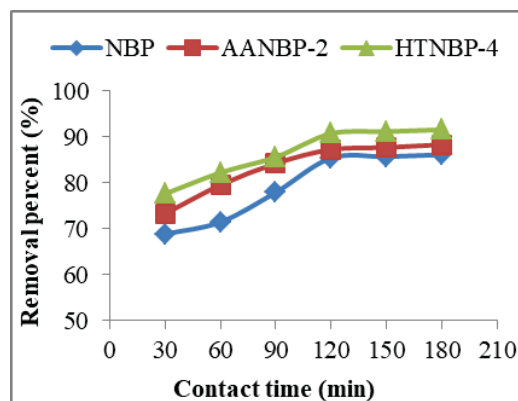


Figure 5 Effect of contact time on the removal of malachite green by NBP, AANBP-2 and HTNBP-4

Effect of dosage

Table 6 and Figure 6 show the removal of malachite green from a constant initial concentration of 400 mgL⁻¹ by the amount of sorbents NBP, AANBP-2 and HTNBP-4 is ranged from 0.05 g to 0.3 g in 25 mL malachite green solution. Figure 6 shows the corresponding data in terms of percent removal with respect to sorbent dose. It can be seen that as the percent removal of malachite green increases with an increases in sorbent dosage. For the sorbent of 0.20 g in 25 mL, it was found that after 120 min agitation time, the amount of dye being adsorbed were 92.881 % for NBP, 93.880 % for AANBP-2 and 95.828 % for HTNBP-4. The higher percent removal capacity may be attributed to the greater quantity of sorbent dose being used. This is due to increase in sorbent dosage attributed to increase in surface area and availability of adsorption site.

Table 6 Effect of Dosage on the Removal of Malachite Green by NBP, AANBP-2 and HTNBP-4

Mass (g/ 25 mL)	Removal percent (%)		
	NBP	AANBP-2	HTNBP-4
0.05	69.873	72.597	79.911
0.10	84.761	87.075	91.224
0.15	90.582	91.485	94.358
0.20	92.881	93.880	95.828
0.25	94.254	95.075	96.828
0.30	95.261	95.881	97.396

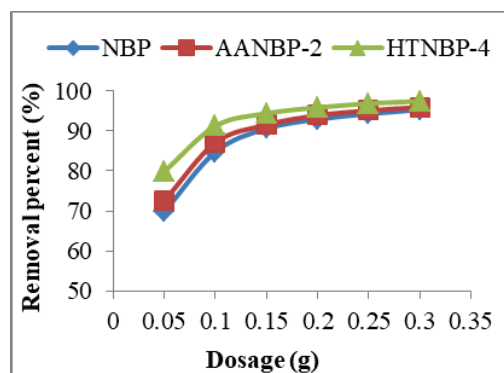


Figure 6 Effect of dosage on the removal of malachite green by NBP, AANBP-2 and HTNBP-4

Adsorption Isotherm Studies

The dosage method is the practical method of assessing the sorption capacity of a sorbent towards an adsorbate. The dosage method involves the use of different masses of sorbent, but a fixed initial concentration of the sorbate at a certain temperature. Here, to reveal the significance of the removal of malachite green, the well-known isotherms were applied, i.e., Langmuir isotherm and Freundlich isotherm.

The Langmuir isotherm is more meaningful and a potential plot. It is based on theoretical concepts. The parameter constants reflect the significance of sorption phenomena.

Table 7 (a,b,c) represent the data and Figure 7 (a,b,c,d,e,f) showed the Langmuir and Freundlich isotherms pertaining to sorption equations. The Langmuir sorption equation was used to fit the experimental sorption data.

$$X = \frac{Q_0 b C_e}{1 + b C_e}$$

Where, X = the amount of sorbate (x) adsorbed per unit mass of sorbent

C_e = equilibrium concentration of the sorbate in solution

Q_0 = the maximum monolayer amount of sorbate per unit mass of sorbent

b = Langmuir constant related to the affinity between the sorbent and sorbate

The linear equation is

$$\frac{C_e}{x/m} = \frac{1}{Q_0 b} + \frac{C_e}{Q_0}$$

Therefore, the plot of $C_e / x/m$ versus C_e gives a straight line of slope $1/Q_0$ and intercept $1/Q_0 b$. Regarding the above equation, Figures 7 (a, c, e) gave the linear plot. The value of the Langmuir constants Q_0 and b with the correlation coefficient are listed in Table 8.

Tables 7 (a, b, c) corresponding Figures 7 (b, d, f) showed the sorption data for the Freundlich isotherm. The Freundlich equation is

$$\frac{x}{m} = KC^{1/n}$$

Where, x is the amount of adsorbate held by the sorbent, and m is the mass of sorbent with which is affected. C is the concentration of substance remaining unadsorbed at equilibrium. The two constant K and $1/n$ are particular to the system, i.e., to both sorbent used and nature of the sorbent. The equation in logarithmic form is:

$$\log \frac{x}{m} = \frac{1}{n} \log C_e + \log K$$

The calculated results of the Langmuir and Freundlich isotherm constants are presented in Table 8. According to the correlation coefficient (R^2) of the two isotherms, the adsorption of malachite green on NBP, AANBP-2 and HTNBP-4 can be modeled well.

The essential feature of Langmuir isotherm can be expressed in terms of a dimensionless constant separation factor or equilibrium parameter, R_L which is used to predict if an adsorption system is favourable or unfavourable.

$$\text{The separation factor, } R_L \text{ is defined by: } R_L = \frac{1}{1 + b C_0}$$

Where, C_0 is the initial concentration (ppm) and b is the Langmuir adsorption equilibrium constant. Based on the effect of separation factor on isotherm shape, the R_L values are in the range of $0 < R_L < 1$, which indicates that the adsorption of malachite green on NBP, AANBP-2 and HTNBP-4 were favourable.

According to Tables 7 (a), (b), (c), the Langmuir and Freundlich isotherm parameters were able to differentiate and classify the three types of sorbents were as follows: HTNBP-4 > AANBP-2 > NBP.

Table 7 (a) Sorption of Malachite Green on Neem Bark Powder (NBP) (Dosage method)

Dosage (g/ 25mL)	C_e (mg L ⁻¹)	x/m (mg g ⁻¹)	$C_e/x/m$ (g L ⁻¹)	log C_e	log x/m
0.05	120.507	139.746	0.862	2.081	2.145
0.10	60.955	84.761	0.719	1.785	1.928
0.15	37.672	60.388	0.624	1.576	1.781
0.20	28.478	46.440	0.613	1.455	1.667
0.25	22.985	37.701	0.610	1.361	1.567
0.30	18.955	31.754	0.597	1.278	1.502

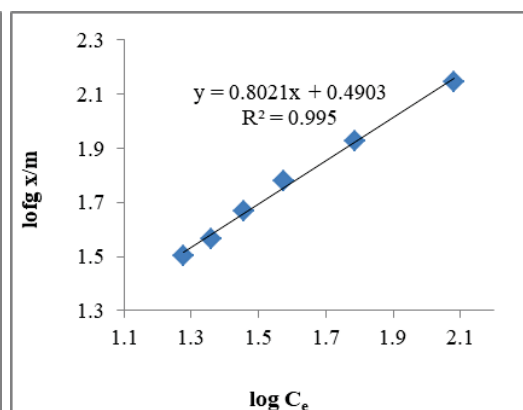
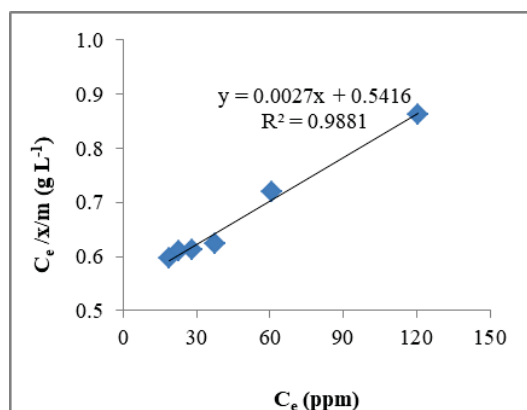


Figure 7(a) Langmuir isotherm of malachite green on NBP

Figure 7(b) Freundlich isotherm of malachite green on NBP

Table 7 (b) Sorption of Malachite Green on Acid Activated Neem Bark Powder (AANBP-2) (Dosage method)

Dosage (g/ 25mL)	C_e (mg L ⁻¹)	x/m (mg g ⁻¹)	$C_e/x/m$ (g L ⁻¹)	log C_e	log x/m
0.05	109.612	145.194	0.755	2.040	2.162
0.10	51.701	87.075	0.594	1.713	1.940
0.15	34.060	60.990	0.558	1.532	1.785
0.20	24.448	46.944	0.521	1.388	1.672
0.25	19.701	38.030	0.518	1.294	1.580
0.30	16.478	31.960	0.516	1.217	1.505

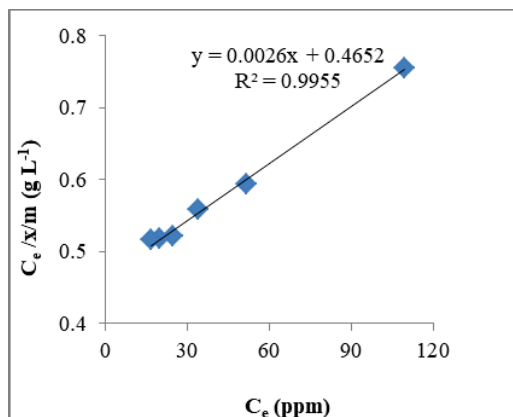


Figure 7(c) Langmuir isotherm of malachite green on AANBP-2

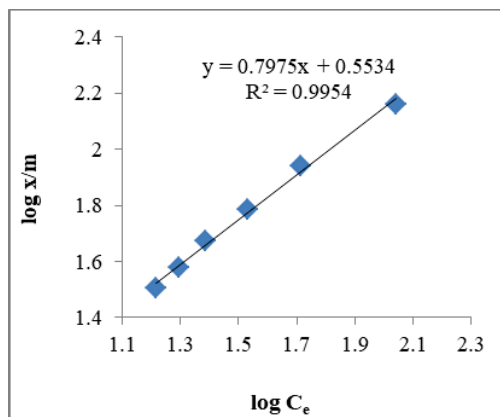


Figure 7 (d) Freundlich isotherm of malachite green on AANBP-2

Table 7 (c) Sorption of Malachite Green on Heat Treated Neem Bark Powder (HTNBP-4) (Dosage method)

Dosage (g/ 25mL)	C_e (mg L ⁻¹)	x/m (mg g ⁻¹)	$C_e/x/m$ (g L ⁻¹)	$\log C_e$	$\log x/m$
0.05	80.358	159.821	0.503	1.905	2.204
0.10	35.104	91.224	0.385	1.545	1.960
0.15	22.567	62.905	0.359	1.353	1.799
0.20	16.687	47.914	0.348	1.222	1.680
0.25	12.687	38.731	0.328	1.103	1.588
0.30	10.418	32.465	0.321	1.018	1.511

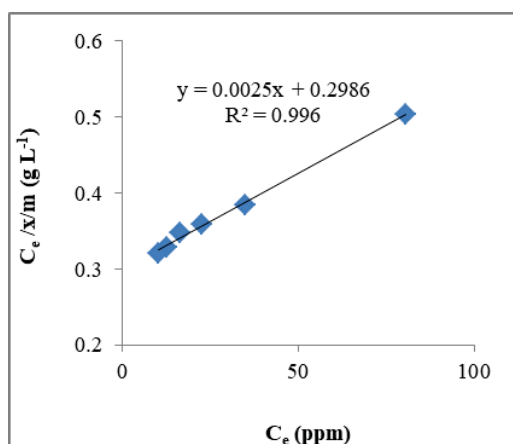


Figure 7 (e) Langmuir isotherm of malachite green on HTNBP-4

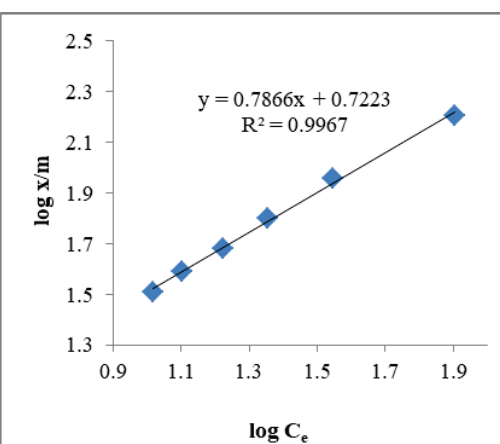


Figure 7 (f) Freundlich isotherm of malachite green on HTNBP-4

Table 8 Langmuir and Freundlich Parameters for the Adsorption of Malachite Green

Sorbents	Langmuir model			R ²	Freundlich model		R ²
	Q _o (mg/g)	b (L/mg)	R _L		K _f (mg/g)	n (L/mg)	
NBP	370.370	0.005	0.333	0.9881	3.092	1.247	0.9950
AANBP-2	384.615	0.006	0.294	0.9955	3.576	1.254	0.9954
HTNBP-4	400.000	0.008	0.238	0.9960	5.276	1.271	0.9967

Table 9 Comparison of Removal Percent of Malachite Green by NBP, AANBP-2 and HTNBP-4

Absorbent	Removal Percent (%)
NBP	92.881
AANBP-2	93.880
HTNBP-4	95.828

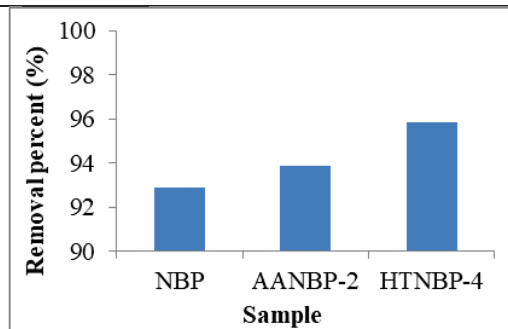


Figure 8 Bar graph for comparison of removal percent of malachite green by NBP , AANBP-2 and HTNBP-4

Application of Neem Bark Powder (NBP), Acid Activated Neem Bark Powder (AANBP-2) and Heat Treated Neem Bark Powder (HTNBP-4) for the Removal of Dye from Industrial Wastewater

Industrial textile dye wastewater sample from textile dye mill in North Dagon Township, Yangon Region was collected. The dye concentration in wastewater was determined by spectrophotometer at $\lambda_{max} = 480$ nm. The content of dye in the wastewater samples was found to be reduced significantly by sorbent materials such as NBP, AANBP-2 and HTNBP-4. However, HTNBP-4 was observed to be the most effective removal of the textile dye. The results are shown in Table 10 and Figure 9.

Table 10 Removal of Textile Dye by NBP, AANBP-2 and HTNBP-4 for 2 h

Sample	Absorbance of original dye solution	Absorbance of sorbent treated dye solution	Removal Percent (%)
NBP	1.254	0.556	55.662
AANBP-2	1.254	0.433	65.470
HTNBP-4	1.254	0.237	81.100

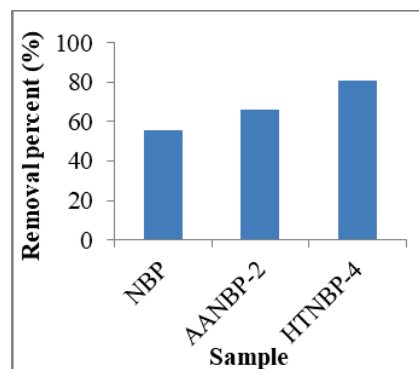


Figure 9 Removal of textile dye by NBP, AANBP-2 and HTNBP-4 for 2 h

Conclusion

Physicochemical properties such as moisture, pH, bulk density, ash content and specific surface area of neem bark powder (NBP), acid activated neem bark powder (AANBP-2) and heat treated neem bark powder (HTNBP-4) were also determined by conventional method. It was observed that NBP have higher moisture content and ash content (10.8 and 5.6 %) than that of AANBP-2 and HTNBP-4. The pH values of NBP, AANBP-2 and HTNBP-4 were found to be 6.8, 6.4 and 9.2, respectively. Heat treated neem bark powder (HTNBP-4) was more basic character. The bulk density and specific surface area of HTNBP-4 (0.596 g cm^{-3} and $460.398 \text{ m}^2 \text{ g}^{-1}$) were found to be higher than that of NBP and AANBP-2. It was also found that the larger the bulk density, the greater the specific surface area and adsorption capacity was also increased. The prepared sorbent samples (NBP, AANBP-2 and HTNBP-4) were characterized by available modern techniques such as SEM and FT IR. According to the surface morphology, HTNBP-4 has lamella structure and more cavity than other two samples (NBP and AANBP-2). From the FT IR spectra, it was observed that there was no broad O-H stretching vibration in FT IR spectrum of HTNBP-4 but that of NBP and AANBP-2 was observed. The effects of sorption parameters (pH, initial concentration of dye solution, contact time and dosage) of each sorbent upon the removal of 25 mL of specified colored dye (malachite green) were investigated. The maximum removal percent of malachite green were found to be 92.881 % of NBP, 93.880 % of AANBP-2 and 95.828 % of HTNBP-4 at optimum conditions (pH 4, initial concentration 400 ppm, contact time 120 min and dosage of adsorbent 0.2 g). Sorption isotherm studies using relevant isotherm equation correspond to Langmuir and Freundlich were applied and significant sorption parameters were evaluated. According to these isotherms, the sorption capacities of malachite green on sorbents in the order of HTNBP-4 > AANBP-2 > NBP were observed. The removal of dye effluent from textile mill in North Dagon Township, Yangon Region by NBP, AANBP-2 and HTNBP-4 were observed as 55.662 %, 65.470 % and 81.100 % at optimum conditions (pH 4, contact time 120 min and dosage 0.2 g) respectively. HTNBP-4 was the most effective and efficient sorbent for malachite green dye and textile effluent. NBP, AANBP-2 and HTNBP-4 could be applied in purifying the environmentally polluted wastewater effluents.

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