APPENDIX

APPENDIX A

PROXIMATE ANALYSIS

A.1. Ash content analysis [53]

1. Crucible is ignited in the muffle furnace at 650 ± 25°C for one hour.
2. The crucible is cooled in a desiccator until the room temperature reached and then its weight is measured analytically.
3. The procedure number 1 and 2 are repeated until the dish has constant weight, with maximum error 0.1 mg.
4. The sample is dried at 105 ± 5°C until it has constant weight.
5. An amount of sample is placed into the crucible.
6. Sample is heated in the muffle furnace at 650 ± 25°C for 30 minutes.
7. The sample and the dish are cooled until the room temperature is reached in a desiccator and then their weight is measured analytically.
8. Procedure number 6 and 7 are repeated until the constant weight is reached.
9. The ash content in percent unit is calculated by the equation:

$$\text{Total ash} = \left[\frac{\text{weight of crucible plus ashed sample - weight of crucible}}{\text{weight of crucible plus original sample - weight of crucible}}\right] x100$$

Sample analysis

Weight of crucible (after constant weight is achieved) = 19.6336 grams

Weight of crucible + jackfruit peel = 20.9433 grams

Weight of crucible + ash = 19.6889 grams

$$\%\ \text{total ash} = \frac{\text{weight of ash}}{\text{initial weight of jackfruit peel}} x100\%$$

$$\text{Total ash, \%} = \frac{19.6889 - 19.6336}{20.9433 - 19.6336} x100\%$$

$$\text{Total ash, \%} = \frac{19.6889 - 19.6336}{20.9433 - 19.6336} x100\%$$

$$= \frac{0.0553}{1.3097} x100\%$$

$$= 4.2223\ \%$$

A.2. Moisture content analysis [54]

1. Crucible is ignited in the muffle furnace at 650 ± 25°C for one hour.
2. The crucible is cooled in a desiccator until the room temperature reached and then its weight is measured analytically.
3. The procedure number 1 and 2 are repeated until the dish has constant weight, with maximum error 0.1 mg.
4. An amount of sample (1g-2g), which has been dried in ash content analysis, is taken and weighed.
5. The sample taken is placed into the dish and then is heated in the oven at 150 ± 5°C for 30 minutes.
6. The sample and the crucible are cooled until the room temperature is reached in a desiccator and then their weight is measured analytically.
7. Procedure number 5 and 6 are repeated until the constant weight is reached.
8. The moisture content in percent unit is calculated by the equation:

$$\text{Total moisture} = \left[\frac{\text{weight of crucible plus original sample - weight of crucible plus dried sample}}{\text{weight of crucible plus original sample - weight of crucible}} \right] x100$$

Sample analysis

Weight of crucible (after constant weight is achieved) = 19.6336 grams

Weight of crucible + jackfruit peel = 20.9433 grams

Weight of initial jackfruit peel = 20.9433 – 19.6336 = 1.3097 grams

Weight of crucible + dried sample = 20.8099 grams

$$\% \text{ total moisture} = \frac{\text{weight of moisture}}{\text{initial weight of jackfruit peel}} x100\%$$

$$\% \text{ total moisture} = \frac{1.3097 - (20.8099 - 19.6336)}{1.3097} x100\%$$

$$= \frac{0.1334}{1.3097} x100\%$$

$$= 10.1885\ \%$$

A.3. Volatile matter content analysis [55]

1. Crucible with its cover is heated in the muffle furnace at 950°C±25°C for 30 minutes.
2. The crucible and its cover are cooled in a desiccator until the room temperature reached and then its weight is measured analytically.
3. The procedure number 1 and 2 are repeated until the dish and its cover has constant weight, with maximum error 0.1 mg.
4. An amount of sample (±1g), which has been dried in ash content analysis, is taken and weighed.
5. The sample taken is placed into the crucible and then is heated in the muffle furnace at 950 ± 25°C for 7 minutes.
6. The sample and the crucible are cooled until the room temperature is reached in a desiccator and then their weight is measured analytically.
7. Procedure number 5 and 6 are repeated until the constant weight is reached.
8. Volatile matter content in percent unit is calculated by the equation:

$$\text{Weight loss} = \left[\frac{\text{weight of crucible, cover, and original sample - weight of crucible, cover, and de - volatilized sample}}{\text{weight of crucible, cover, and original sample - weight of crucible and cover}}\right] x100$$

$$\text{Total volatile matter} = (\text{weight loss} - \text{total moisture})$$

Sample analysis

Weight of crucible + cover (after constant weight is achieved) = 31.7445 grams

Weight of crucible + cover + jackfruit peel = 32.7451 grams

Initial weight of jackfruit peel = 1.0006 grams

Weight of crucible + cover + ignited jackfruit peel = 32.1412 grams

Weight of ignited jackfruit peel = 0.3967 grams

Weight loss of jackfruit peel = 1.0006 – 0.3967 = 0.6039 grams

$$\% \text{ weight loss} = \frac{\text{weight loss of jackfruit peel}}{\text{initial weight of jackfruit peel}} x100\%$$

$$\% \text{ weight loss} = \frac{0.6039 \text{ grams}}{1.0006 \text{ grams}} x100\%$$

$$= 60.3537\ \%$$

% volatile matter = % weight loss - % moisture

= 60.3537 % - 10.1885 %

= 50.1682 %

A.4. Carbon content analysis [55]

The carbon content can be calculated by using following equation:

Carbon = 100% - [Total ash + Total moisture + Total volatile matter]

Sample analysis

% carbon = 100% - (% total ash + % moisture + % volatile matter)

= 100% - (4.223 % + 10.1885 % + 50.1682 %)

= 35.4240 %

APPENDIX B

DETERMINATION OF MAXIMUM WAVELENGTH AND METHYLENE BLUE STANDARD CURVE

B.1. Preparation of Methylene Blue solution

1. Preparation of 20 mg/L Methylene Blue stock solution as much as 0.1 L.

   $$20 \text{ mg/L} \times 0.1 \text{ L} = 0.0020 \text{ gram}$$

   0.0020 gram Methylene Blue was weighed using analytical balance and dissolved with distilled water until its volume was accurately 100 mL.

2. Preparation of solutions for standard curve of Methylene Blue
   a) 4 mL of stock solution was taken and added into measuring flask, and then diluted with distilled water until its volume was 100 mL (0.8 mg/L).
   b) 5 mL of stock solution was taken and added into measuring flask, and then diluted with distilled water until its volume was 100 mL (1.0 mg/L).
   c) 7 mL of stock solution was taken and added into measuring flask, and then diluted with distilled water until its volume was 100 mL (1.4 mg/L).
   d) 9 mL of stock solution was taken and added into measuring flask, and then diluted with distilled water until its volume was 100 mL (1.8 mg/L)
   e) 10 mL of stock solution was taken and added into measuring flask, and then diluted with distilled water until its volume was 100 mL (2.0 mg/L).
   f) 12 mL of stock solution was taken and added into measuring flask, and then diluted with distilled water until its volume was 100 mL (2.4 mg/L).
   g) 14 mL of stock solution was taken and added into measuring flask, and then diluted with distilled water until its volume was 100 mL (2.8 mg/L).

h) 16 mL of stock solution was taken and added into measuring flask, and then diluted with distilled water until its volume was 100 mL (3.2 mg/L).

i) 18 mL of stock solution was taken and added into measuring flask, and then diluted with distilled water until its volume was 100 mL (3.6 mg/L).

B.2. Determination of maximum wavelength

10 mL of stock solution was taken and added into measuring flask, and then diluted with distilled water until its volume was 10 mL so the concentration of Methylene Blue was to be 2.0 mg/L. Maximum wavelength of methylene blue was determined by measuring the absorbance of the solution using survey scan of Shimadzu UV-1201 UV-VIS spectrophotometer in the range of wavelength of 600 – 700 nm

Table B.1. λ and absorbance of 2.0 mg/L Methylene Blue solution

Wavelength (nm)	Absorbance
600	0.195
609	0.244
618	0.260
627	0.273
636	0.310
645	0.380
654	0.472
657	0.494
660	0.509
663	0.515
664	0.516
665	0.514
666	0.513
669	0.495
672	0.454
675	0.391
678	0.318
681	0.255
684	0.205

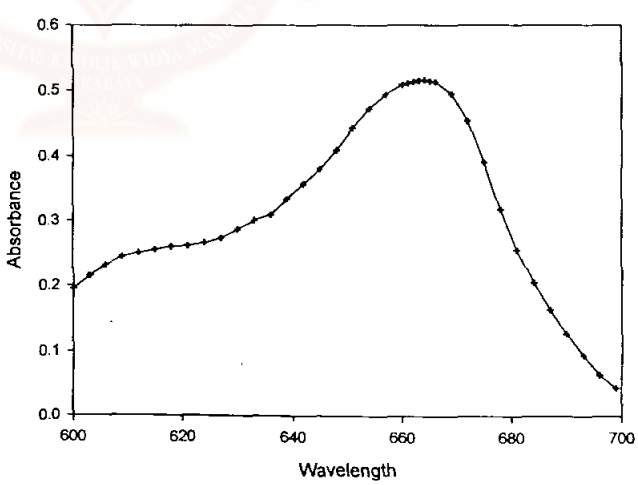

Figure B.1. Methylene Blue Survey Scan

From Table B.1, it can be seen that the maximum wavelength for Methylene Blue analysis is at 664 nm.

B.3. Preparation of standard curve

Absorbance of all solution prepared at step B.1 was measured using Shimadzu UV-1201 UV-VIS spectrophotometer at maximum wavelength which has been obtained from step B.2. Standard curve between absorbance versus dyes concentration was prepared and then linear regression was determined by Sigma Plot software.

Table B.2 Relationship between concentration and absorbance of Methylene Blue

Concentration (mg/L)	Absorbance
0.8	0.2010
1	0.2500
1.4	0.3170
1.8	0.4410
2	0.5160
2.4	0.5670
2.8	0.6190
3.2	0.6980
3.6	0.7921

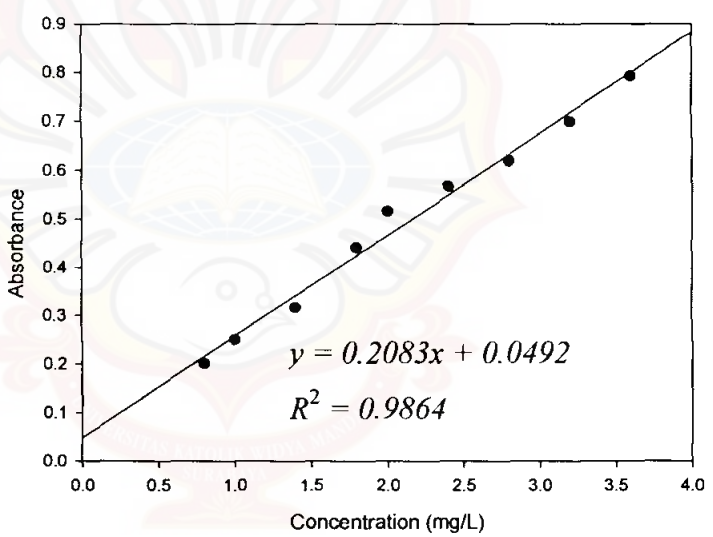

Figure B.2. Standard Curve of Methylene Blue Solution

APPENDIX C

DATA ANALYSES

C.1. Yield of Activated Carbon

Example of calculation for yield of the activated carbon with impregnation ratio (IR) 4:1 (weight of phosphoric acid : weight of precursor) and heat treatment temperature (HTT) 550°C is as follows:

Initial weight of the precursor (jackfruit peel) on a dry basis = 20 grams

Weight of activated carbon = 8.4291 grams

$$\% \text{ yield} = \frac{\text{weight of activated carbon}}{\text{initial weight of jackfruit peel on a dry basis}} x100\%$$

$$= \frac{8.4291}{20} x100\%$$

$$= 42.1455\ \%$$

Using the same calculation above, Table C.1 can be made

Table C.1. Production Yield of Activated Carbon

IR	HTT, °C	Carbon code	Final Weight of JPAC* (g)	Yield, % wt
1:1	350	IR[1]T[350]	11.2494	56.2470
	450	IR[1]T[450]	9.9667	49.8335
	550	IR[1]T[550]	9.3479	46.7395
2:1	350	IR[2]T[350]	10.9378	54.6890
	450	IR[2]T[450]	9.5587	47.7934
	550	IR[2]T[550]	9.1940	45.9700
3:1	350	IR[3]T[350]	10.5616	52.8080
	450	IR[3]T[450]	9.2744	46.3720
	550	IR[3]T[550]	8.8393	44.1965
4:1	350	IR[4]T[350[	9.9806	49.9030
	450	IR[4]T[450]	8.9111	45.5554
	550	IR[4]T[550]	8.4291	42.1455

* JPAC = jackfruit peel activated carbon

C.2. S_{BET} of Activated Carbon [1]

Equation below is the famous BET equation containing two fitting parameters, C and V_m:

$$\frac{V}{V_m} = \frac{C.P}{(P_0 - P)[1 + (C-1)(P/P_0)]} \quad \text{(C-1)}$$

Eq. (C-1) is the famous BET equation, and it is used extensively for the area determination because once the monolayer coverage V_m is known and if the area occupied by one molecule is known the surface area of the solid can be calculated. To conveniently determine V_m, the BET equation can be cast into the form which is amenable for linear plot as follows:

$$\frac{P}{V(Po - P)} = \frac{1}{VmC} + \left(\frac{C-1}{VmC}\right)\frac{P}{Po} \quad \text{(C-2)}$$

The pressure range of validity of the BET equation is *P/Po* = 0.05-0.3. For relative pressure above 0.3, there exists capillary condensation, which is not amenable to multilayer analysis. A plot of the $\frac{P}{V(Po-P)}$ of eq. (3.3-23) versus (*P/Po*) would yield a straight line with a slope

$$\text{Slope} = \left(\frac{C-1}{VmC}\right) \quad \text{(C-3)}$$

And an intercept

$$\text{Intercept} = \left(\frac{1}{VmC}\right) \quad \text{(C-4)}$$

Once V_m (mole/g) is obtained from the slope, the surface area is calculated from :

$$A = V_m N_a a_m (3.3\text{-}24) \quad \text{(C-5)}$$

Where N_a is the Avogadro number and a_m is the molecular projected area. For nitrogen at its normal boiling point, the area of the nitrogen molecule is generally taken to be 16.2 $Å^2$.

C.3. d_{002}, L_c, and L_a Calculation from XRD Patterns

From the XRD patterns, the position of (002) and (10) peak at the abscissa 2θ could be obtained. The width of the peak (002) and (10) peak could also be obtained to calculate half width of the peak in radians, B (002) and B (10).

Table C.2. The Position and the Width of (002) and (10) Peak of the XRD Spectra

Sample	2θ				B (002)	B (10)
	(002) position	(10) position	(002) width	(002) width		
IR[1]T[350]	25	43	12.5	21	0.1091	0.1833
IR[2]T[350]	25	43.5	13	22	0.1134	0.1920
IR[3]T[350]	25	43.5	12.5	21.5	0.1091	0.1876
IR[4]T[350]	25	43	12.5	22	0.1091	0.1920
IR[1]T[450]	25	43.5	13.5	26	0.1178	0.2269
IR[2]T[450]	25	43.5	13.5	27	0.1178	0.2356
IR[3]T[450]	25	43.5	14	27	0.1222	0.2356
IR[4]T[450]	25	43.5	15	28	0.1309	0.2443
IR[1]T[550]	25.5	44	13	22	0.1134	0.1920
IR[2]T[550]	25.5	44	14	24	0.1222	0.2094
IR[3]T[550]	25.5	44	15	26	0.1309	0.2269
IR[4]T[550]	25.5	44	16	27	0.1396	0.2356

The interlayer spacing d_{002} was determined using the Bragg equation as follow:

$$d = \frac{\lambda}{2\sin\theta} \tag{C-6}$$

The (002) and (10) peaks are used to calculate L_c and L_a, respectively. The quantities L_c, stack height, and L_a, stack width, were determined by the Scherrer equation:

$$L = \frac{K\lambda}{B\cos\theta} \tag{C-7}$$

The λ was 0.154 nm for CuKα while $K = 0.9$ and $K = 1.84$ were used for calculation of L_c and L_a, respectively. By the usage of those parameter; θ which was half of (002) position for Bragg equation and was half of (002) and (10) width for L_c and L_a for Scherrer equation; also B (002) and (10) for Scherrer equation; the d_{002}, L_c, and L_a of the activated carbons were obtained.

C.4. Boehm Titration

Example of calculation for Boehm titration of IR[4]T[550] is given as follows:

C.4.1. Basic surface functional group

meq of excess of HCl which can be calculated in reverse titration with NaOH + meq of HCl which had reaction with basic surface functional group = meq initial of HCl

$(V.N)_{NaOH}$ + meq of basic surface functional group = $(V.N)_{HCl}$

(9.860* 0.0433) + meq of basic surface functional group = (10*0.0435)

meq of basic surface functional group in 10 mL solution = 0.0077 meq

meq of basic surface functional group in all of 50 mL solution system = 0.0077meq*50/10

meq of basic surface functional group per gram activated carbon = 0.0382 meq/0.5 gram

meq of basic surface functional group per gram activated carbon = 0.0765 meq/gram

C.4.2. Acidic surface functional group

Carboxylic

$(V.N)_{HCl}$ + meq of carboxyl surface functional group = $(V.N)_{NaHCO_3}$

(9.705*0.0435) + meq of carboxyl surface functional group = (10*0.0502)

meq of carboxyl surface functional group in 10 mL solution = 0.0789 meq

meq of carboxyl surface functional group in all of 50 mL solution system = 0.3943 meq

meq of carboxyl surface functional group per gram activated carbon = 0.3943meq/0.5 gram

meq of carboxyl surface functional group per gram activated carbon = 0.7886 meq/gram

Lactonic

$(V.N)_{HCl}$ + meq of (carboxyl+lactone) surface functional group = $(V.N)_{Na_2CO_3}$

(8.070*0.0435) + meq of (carboxyl+lactone) surface functional group = (10*0.0499)

meq of (carboxyl+lactone) surface functional group in 10 mL solution = 0.1520 meq

meq of (carboxyl+lactone) surface functional group in all of 50 mL solution system = 0.1480 meq * 50/10

meq of (carboxyl+lactone) surface functional group per gram activated carbon = 0.7399meq/0.5gram

meq of (carboxyl+lactone) surface functional group per gram activated carbon = 1.4797meq/gram

meq of lactone surface functional group per gram activated carbon = 1.4797meq/gram - 0.7886 meq/gram

meq of lactone surface functional group per gram activated carbon = 0.6912meq/gram

Phenolic

$(V.N)_{HCl}$ + meq of (carboxyl+lactone+phenol) surface functional group = $(V.N)_{NaOH}$

(7.205*0.0435) + meq of (carboxyl+lactone+phenol) surface functional group = 10*0.0480

meq of (carboxyl+lactone+phenol) surface functional group in 10 mL solution = 0.1666meq

meq of (carboxyl+lactone+phenol) surface functional group in all of 50 mL solution system = 0.8330meq

meq of (carboxyl+lactone+phenol) surface functional group per gram activated carbon = 0.8330meq/0.5gram

meq of (carboxyl+lactone+phenol) surface functional group per gram activated carbon = 1.6660meq/gram

meq of phenol surface functional group per gram activated carbon = 1.6660meq/gram – 1.4797meq/gram

meq of phenol surface functional group per gram activated carbon = 0.1863meq/gram

By the same way of calculation above, volume data obtained from titration as shown in Table C.4 could be used to find the amount of surface functional group as follows:

Table C.3. Experiment Data of Boehm Titration

Sample	$NaHCO_3$ (1)	Na_2CO_3 (2)	NaOH (3)	HCl (4)	meq/g (1)	meq/g (2)	meq/g (3)	meq/g (4)
	V_{HCl} (mL)			V_{NaOH} (mL)				
IR[1]T[350]	8.485	6.965	5.070	10.005	1.3192	1.9604	2.5947	0.0137
IR[2]T[350]	8.630	7.210	5.605	9.855	1.2562	1.8538	2.3620	0.0787
IR[3]T[350]	8.415	6.880	4.520	9.910	1.3497	1.9974	2.8339	0.0548
IR[4]T[350]	8.040	6.030	3.375	9.950	1.5128	2.3671	3.3320	0.0375
IR[1]T[450]	9.025	7.720	6.030	9.990	1.0843	1.6320	2.1771	0.0202
IR[2]T[450]	9.610	8.565	7.370	9.830	0.8299	1.2644	1.5942	0.0895
IR[3]T[450]	9.455	8.380	7.005	9.875	0.8973	1.3449	1.7530	0.0700
IR[4]T[450]	9.360	7.645	6.210	9.915	0.9386	1.6646	2.0988	0.0527
IR[1]T[550]	9.775	8.760	8.070	9.900	0.7581	1.1796	1.2897	0.0592
IR[2]T[550]	10.050	9.100	8.525	9.795	0.6385	1.0317	1.0918	0.1047
IR[3]T[550]	9.810	8.850	8.205	9.825	0.7429	1.1405	1.2310	0.0917
IR[4]T[550]	9.705	8.070	7.205	9.860	0.7886	1.4797	1.6660	0.0765

meq/g (1) = meq/g of carboxyl surface functional group

meq/g (2) = meq/g of (carboxyl+lactone) surface functional group

meq/g (3) = meq/g of (carboxyl+lactone+phenol) surface functional group

meq/g (4) = meq/g of basic surface functional group

meq/g of carboxyl surface functional group = meq/g (1)

meq/g of lacton surface functional group = meq/g (2) – meq/g (1)

meq/g of phenol surface functional group = meq/g (3) – meq/g (2)

meq/g of basic surface functional group = meq/g (4)

By the data calculation above, Table IV.4 showing meq/g of acidic and basic surface functional group could be obtained

C.5. pH Drift

From pH drift experiments by several pH_{init}, several pH_{final} could be obtained as follows:

Table C.4. pH Final of Activated Carbon

pH init	pH final											
	IR[1] T[350]	IR[2] T[350]	IR[3] T[350]	IR[4] T[350]	IR[1] T[450]	IR[2] T[450]	IR[3] T[450]	IR[4] T[450]	IR[1] T[550]	IR[2] T[550]	IR[3] T[550]	IR[4] T[550]
1.5	1.9	2.0	1.9	1.8	-	-	-	-	-	-	-	-
1.6	1.9	2.0	1.9	1.9	-	-	-	-	-	-	-	-
1.7	1.9	2.0	1.9	1.9	1.9	2.0	1.9	1.9	-	-	-	-
1.8	1.9	2.0	1.9	1.9	1.9	2.0	1.9	1.9	2.0	2.0	2.0	1.9
1.9	1.9	2.0	1.9	1.9	1.9	2.0	1.9	1.9	2.0	2.0	2.0	1.9
2.0	1.9	2.0	1.9	1.9	1.9	2.0	1.9	1.9	2.0	2.0	2.0	1.9
2.1	1.9	2.0	1.9	1.9	1.9	2.0	1.9	1.9	2.0	2.0	2.0	1.9
2.2	1.9	2.0	1.9	1.9	1.9	2.0	1.9	1.9	2.0	2.0	2.0	1.9
2.3	1.9	2.0	1.9	1.9	1.9	2.0	1.9	1.9	-	-	-	-
2.4	1.9	2.0	1.9	1.9	-	-	-	-	-	-	-	-
2.5	1.9	2.1	1.9	1.9	-	-	-	-	-	-	-	-

From the data given in the table, pH_{PZC} of the activated carbon could be determined as illustrated in the Figure below.

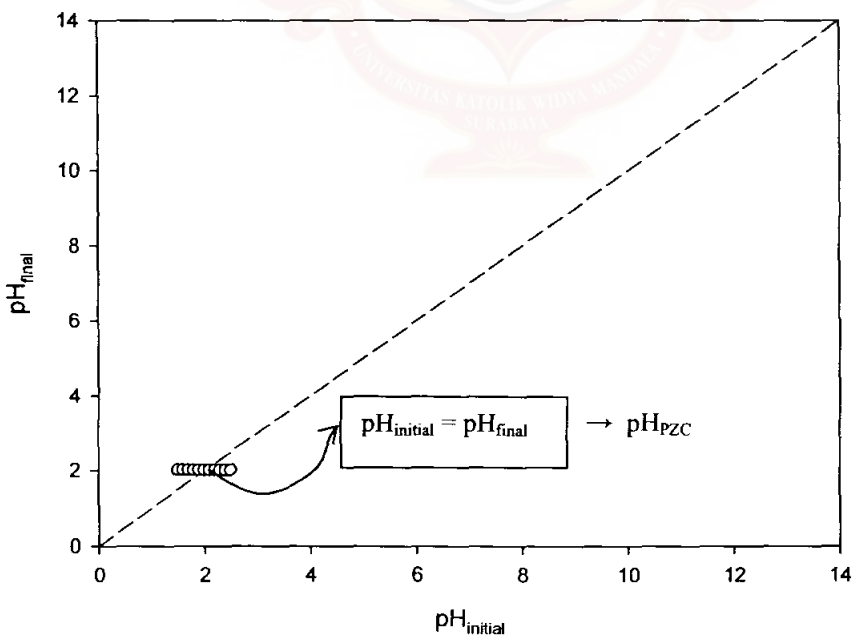

Figure C.1. pH_{PZC} Determination Using pH Drift Method of IR[1]T[550]

C.6. Methylene Blue Adsorption

C.6.1. Methylene Blue Equilibrium Time

In a preliminary experiment, the sample IR[4]T[550] with the weight of 0.05 gram and solution of Methylene Blue with the concentration 50 mg/L were shaken at room temperature. The equilibrium time was obtained when the absorbance of the solution was not decreasing again in the time length of 24 hours.

Table C.5. Experiment Data for the Determination of Methylene Blue Equilibrium Time

Sample	Absorbance (A)			
	24 hours	48 hours	72 hours	96 hours
IR[4]T[550]	0.238	0.124	0.112	0.111

C.6.2. Methylene Blue Removal Capacity for the Activated Carbons

From standard curve of absorbance versus concentration of Methylene Blue (MB) solution, the amount of Methylene Blue which is not adsorbed, C_{excess}, can be determined to find amount of MB adsorbed. Then % Removal could be obtained by dividing amount of MB adsorbed by initial concentration of MB. By such data analysis, Table C.4 could be obtained as follows:

Table C.6. % Removal of the Activated Carbons

Sample	Absorbance (A)	$C_{measured}$ (mg/L)	Dillution (times)	C_{excess} (mg/L)	C_{ads} (mg/L)	Removal (%)
IR[1]T[350]	0.463	1.9880	20	39.7590	10.2410	20.48%
IR[2]T[350]	0.457	1.9595	20	39.1908	10.8092	21.62%
IR[3]T[350]	0.479	2.0637	20	41.2743	8.7257	17.45%
IR[4]T[350]	0.484	2.0874	20	41.7478	8.2522	16.50%
IR[1]T[450]	0.528	2.2957	5	11.4787	38.5213	77.04%
IR[2]T[450]	0.450	1.9264	5	9.6320	40.3680	80.74%
IR[3]T[450]	0.334	1.3771	5	6.8856	43.1144	86.23%
IR[4]T[450]	0.314	1.2824	5	6.4121	43.5879	87.18%
IR[1]T[550]	0.280	1.1214	5	5.6071	44.3929	88.79%
IR[2]T[550]	0.264	1.0457	5	5.2283	44.7717	89.54%
IR[3]T[550]	0.271	1.0788	5	5.3941	44.6059	89.21%
IR[4]T[550]	0.204	0.7616	5	3.8078	46.1922	92.38%

C.6.3. Methylene Blue Adsorption Kinetic of IR[4]T[550] as Adsorbent

From standard curve of absorbance versus concentration of Methylene Blue solution, the amount of Methylene Blue which is not adsorbed, C_{excess}, can be determined to find amount of MB adsorbed in mg/g at time t, q_t.

Table C.7. Data Analyses of Adsorption Kinetic of IR[4]T[550] at Different pH

pH	t (min)	Absorbance (A)	$C_{measured}$ (mg/L)	Dilution (times)	C_{excess} (mg/L)	C_{ads} (mg/L)	q_t (mg/g)
1.5	0		-	-	-	0.0000	0.0000
	30	0.5980	2.6272	10	26.2719	23.7281	47.4562
	60	0.5370	2.3383	10	23.3835	26.6165	53.2330
	90	0.4700	2.0211	10	20.2110	29.7890	59.5781
	120	0.4200	1.7843	10	17.8434	32.1566	64.3132
	180	0.6750	2.9918	5	14.9590	35.0410	70.0821
	270	0.5030	2.1774	5	10.8868	39.1132	78.2264
	390	0.3890	1.6376	5	8.1878	41.8122	83.6245
	1290	0.8490	3.8157	1	3.8157	46.1843	92.3686
	2850	0.4240	1.8033	1	1.8033	48.1967	96.3934
	4230	0.2950	1.1925	1	1.1925	48.8075	97.6151
6.0	0	-	-	-	-	0.0000	0.0000
	30	0.4700	2.0211	10	20.2110	29.7890	59.5781
	60	0.3780	1.5855	10	15.8547	34.1453	68.2906
	90	0.3130	1.2777	10	12.7769	37.2231	74.4463
	120	0.2450	0.9557	10	9.5570	40.4430	80.8860
	180	0.3810	1.5997	5	7.9984	42.0016	84.0033
	270	0.2700	1.0741	5	5.3704	44.6296	89.2592
	390	0.1840	0.6669	5	3.3343	46.6657	93.3314
	1290	0.2170	0.8231	1	0.8231	49.1769	98.3538
	2850	0.1100	0.3165	1	0.3165	49.6835	99.3671
	4230	0.0980	0.2596	1	0.2596	49.7404	99.4807
10.0	0	-	-	-	-	0.0000	0.0000
	30	0.2160	0.8184	10	8.1838	41.8162	83.6324
	60	0.1490	0.5011	10	5.0113	44.9887	89.9774
	90	0.1900	0.6953	5	3.4763	46.5237	93.0473
	120	0.6510	2.8782	1	2.8782	47.1218	94.2437
	180	0.3910	1.6470	1	1.6470	48.3530	96.7060
	270	0.2340	0.9036	1	0.9036	49.0964	98.1928
	390	0.1430	0.4727	1	0.4727	49.5273	99.0546
	1290	0.0470	0.0181	1	0.0181	49.9819	99.9637
	2850	0.0470	0.0181	1	0.0181	49.9819	99.9637
	4230	0.0460	0.0134	1	0.0134	49.9866	99.9732

Data calculation:

Initial concentration of MB = 50mg/L

Concentration of MB adsorbed = 50mg/L - C_{excess}

Concentration of adsorbent = 0.5g/L

$q_t = C_{excess}$, i.e. Concentration of MB adsorbed / Concentration of adsorbent

Then, a plot of q_t versus t can be plotted using Sigma Plot to apply model equation to find fitted parameter q_e and k for each equation.

C.6.4. Methylene Blue Adsorption Isotherm of IR[4]T[550] as Adsorbent

From standard curve of absorbance versus concentration of Methylene Blue solution, the amount of Methylene Blue at equilibrium time, C_e, can be determined to find amount of MB adsorbed in mg/g at each variation of weight of added activated carbon, q_e.

Table C.8. Data Analyses of Adsorption Isotherm of IR[4]T[550] at Different pH

pH	Weight (g)	$C_{adsorbent}$ (g/L)	Absorbance (A)	$C_{measured}$ (mg/L)	Dilution (times)	C_e (mg/L)	C_{ads} (mg/L)	q_e (mg/g)
1.5	0.0101	0.101	0.6090	2.6793	10	26.7928	23.2072	232.0724
	0.0153	0.153	0.4310	1.8364	10	18.3643	31.6357	210.9048
	0.0221	0.221	0.3140	1.2824	10	12.8242	37.1758	185.8789
	0.0298	0.298	0.2050	0.7663	10	7.6630	42.3370	141.1235
	0.0421	0.421	0.4430	1.8932	2	3.7865	46.2135	115.5338
	0.0505	0.505	0.5290	2.3005	1	2.3005	47.6995	95.3991
6.0	0.0908	0.908	0.5440	2.3715	10	23.7149	26.2851	262.8506
	0.1489	1.489	0.6220	2.7408	5	13.7042	36.2958	241.9723
	0.206	2.06	0.3690	1.5429	5	7.7143	42.2857	211.4287
	0.312	3.12	0.4190	1.7796	2	2.6122	47.3878	157.9594
	0.403	4.03	0.3280	1.3487	1	1.3487	48.6513	121.6282
10.0	0.0051	0.051	0.3820	1.6044	20	32.5617	17.4383	348.7665
	0.0097	0.097	0.4190	1.7796	10	17.7961	32.2039	322.0393
	0.0151	0.151	0.5980	2.6272	2	5.3491	44.6509	297.6728
	0.0195	0.195	0.3170	1.2966	1	1.0599	48.9401	244.7006
	0.0247	0.247	0.191	0.7000	1	0.7000	49.3000	197.2000

Data calculation:

Initial concentration of MB = 50mg/L

Concentration of MB adsorbed = 50mg/L - C_{excess}

Concentration of adsorbent = 0.5g/L

$q_e = C_e$ (Concentration of MB adsorbed) / $C_{adsorbent}$ (Concentration of adsorbent)

Then, a plot of q_e versus C_e can be plotted using Sigma Plot to apply model equation to find fitted parameters q_0 and b for Langmuir equation; and K_f and n for Freundlich equation.