BAB V

KESIMPULAN DAN SARAN

5.1 Kesimpulan

Berdasarkan penelitian yang telah dilakukan, maka dapat disimpulkan sebagai berikut:

1. Karbon aktif dapat diperoleh dari tempurung kemiri yang diaktifkan dengan menggunakan zat aktivator berupa H_3PO_4 dengan konsentrasi 2,5 % selama 20 jam. Karbon aktif yang dihasilkan memenuhi standar SNI dengan hasil pengujian kadar air yaitu 5,0577 % dan kadar abu yaitu 5,1274 %. Aktivator H_3PO_4 juga mampu meningkatkan luas permukaan karbon dan mampu meningkatkan gugus fungsional oksigen (fenol dan karboksilat).
2. Nilai kapasitansi spesifik meningkat dalam urutan $Li_2SO_4 > Na_2SO_4 > K_2SO_4$ dikarenakan ukuran ion dan konduktivitas ion yang akan mempengaruhui pergerakan ion dalam pori elektroda untuk membentuk lapisan antarmuka muatan elektroda/elektrolit.

5.2 Saran

Adapun saran untuk penelitian selanjutnya terkait dengan pengaruh elektrolit alkali sulfat terhadap nilai kapasitansi spesifik karbon tempurung kemiri yaitu perlunya modifikasi permukaan karbon dengan H_2SO_4 atau H_2O_2 yang kemudian diukur nilai kapasitansi spesifiknya menggunakan elektrolit alkali sulfat.

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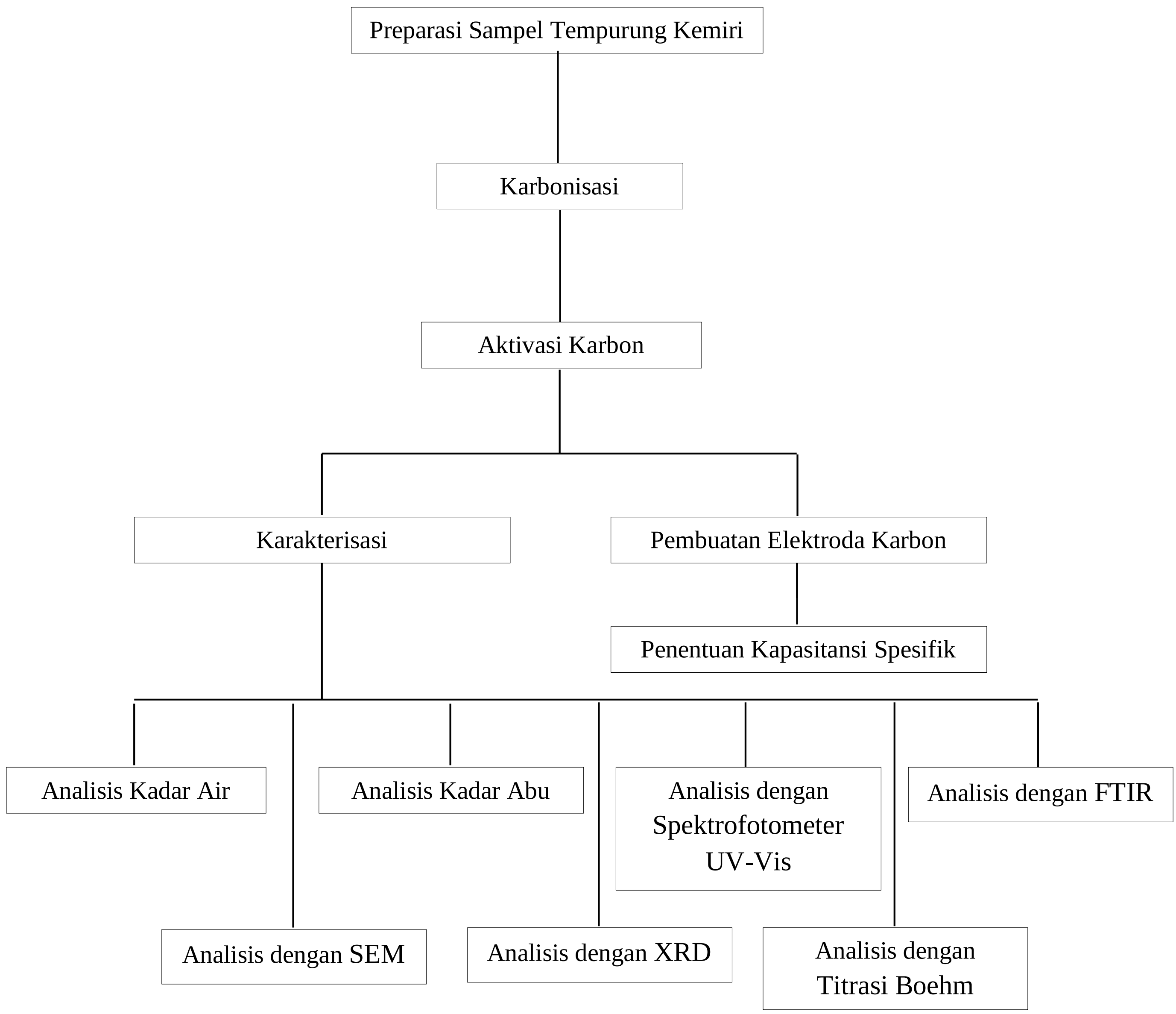
Lampiran 1. Diagram Alir Penelitian



Lampiran 2. Bagan Kerja

1. Pembuatan Karbon Aktif Tempurung Kemiri (Efendi dan Astuti, 2016)

Tempurung Kemiri

- dibersihkan dan dikeringkan dengan cara dijemur.
- dipecah kecil-kecil
- dimasukkan ke dalam cawan porselin lalu dikarbonisasi dalam tanur pada temperatur 750 $^{\circ}$C selama 90 menit
- didinginkan, dihaluskan, lalu diayak dengan ukuran 100 mesh

Karbon Tempurung Kemiri

- Diaktivasi dengan larutan H_3PO_4 2,5 % dengan perbandingan 1:5 (massa karbon : volume H_3PO_4) selama 20 jam
- dicuci dengan akuades berulang-ulang hingga filtrat pH netral dan dikeringkan dalam oven pada suhu 110 $^{\circ}$C selama 2 jam.
- didinginkan dalam desikator.

Karbon Aktif Tempurung Kemiri

2. Analisis Kadar Air (Lestari dkk., 2017)

0,5 Gram Karbon Tempurung Kemiri

- dimasukkan dalam cawan yang telah diketahui beratnya dan dikeringkan dalam oven pada suhu 105 °C selama 3 jam
- didinginkan dalam desikator dan timbang
- dimasukkan kembali ke dalam oven selama 30 menit dan didinginkan kembali dalam desikator hingga bobot konstan

Hasil

Catatan: diulangi prosedur yang sama dengan sampel karbon aktif tempurung kemiri

3. Analisis Kadar Abu (Lestari dkk., 2017)

0,5 Gram Karbon Tempurung Kemiri

- dimasukkan dalam cawan yang telah diketahui beratnya
- dimasukkan dalam tanur dan dipanaskan pada suhu 600 °C selama 6 jam
- didinginkan dalam desikator, kemudian ditimbang bobotnya

Hasil

Catatan: diulangi prosedur yang sama dengan sampel karbon aktif tempurung kemiri

4. Analisis Luas Permukaan (Labbanni' dkk., 2015)

0,3 Gram Karbon Tempurung Kemiri

- dicampurkan dengan 25 mL larutan metilen biru 5000 ppm kemudian distirer selama 90 menit
- disaring
- diukur absorbansinya pada panjang gelombang maksimum

Hasil

Catatan: diulangi prosedur yang sama dengan sampel karbon aktif tempurung kemiri

5. Analisis Morfologi dengan SEM

Karbon Aktif Tempurung Kemiri

- diusahakan dalam keadaan kering dan bebas uap air
- ditempelkan pada sel holder dengan perekat ganda
- dilapisi dengan logam emas dalam keadaan vakum
- dimasukkan pada tempatnya di dalam SEM
- diamati dan dilakukan perbesaran 10000 kali

Hasil

6. Analisis Gugus Fungsi dengan FTIR

1-10 mg Karbon Aktif Tempurung Kemiri

- dihaluskan dan dicampur dengan 100 mg KBr
- dicetak menjadi cakram tipis atau pelet lalu dianalisis

Hasil

7. Analisis Kristalinitas dengan XRD (Kercher & Nagle, 2003; Iguchi, 1997)

Karbon Aktif Tempurung Kemiri

- dibuat dalam bentuk serbuk lolos saringan 100 mesh
- dianalisis menggunakan perangkat XRD

Hasil

8. Analisis Gugus Fungsi Asam dan Basa Total dengan Metode Titrasi Boehm (Goertzen dkk., 2010)

0,1 Gram Karbon Aktif Tempurung Kemiri

- dimasukkan ke dalam 4 buah gelas kimia yang berisi larutan Na_2CO_3 0,05 N, $NaHCO_3$ 0,05 N, NaOH 0,05 N dan HCl 0,05 N masing-masing sebanyak 25 mL
- didiamkan selama 24 jam dan disaring

Filtrat | Endapan

- dipipet sebanyak 10 mL dari larutan Na_2CO_3, $NaHCO_3$ dan NaOH, kemudian ditambahkan HCl 0,05 N berlebih, lalu ditirasi balik dengan menggunakan larutan NaOH 0,05 N
- dipipet sebanyak 10 mL dari filtrat HCl dan ditambahkan NaOH 0,05 N berlebih, kemudian dititrasi balik dengan menggunakan HCl 0,05 N

Hasil

9. Analisis Kapasitansi Spesifik (Vytras dkk., 2009; Wachid dan Setiarso, 2014; Himmaty dan Endarko, 2013)

Karbon Aktif Tempurung Kemiri

- dicampur dengan lilin parafin dengan perbandingan massa karbon/massa lilin parafin adalah 1 : 1 dan diaduk sampai homogen menggunakan spatula pada cawan petri
- dimasukkan ke dalam badan elektroda dengan cara ditekan menggunakan spatula

Elektroda Karbon

Elektroda Karbon | Elektroda Pt | Elektroda Ag/AgCl

- dirangkai dalam alat Potensiostat
- dilakukan dengan nilai laju scan 10, 20 dan 50 mV/s menggunakan larutan elektrolit 0,5 M Li_2SO_4, Na_2SO_4, K_2SO_4 sehingga diperoleh data voltammogram
- dihitung nilai kapasitansi spesifik

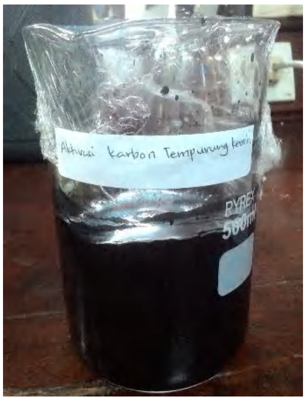
Hasil

Lampiran 3. Dokumentasi Penelitian

Tempurung Kemiri

Karbonisasi Tempurung Kemiri

Karbon Tempurung Kemiri ukuran 100 mesh



Aktivasi Karbon Tempurung dengan H_3PO_4

Penyaringan Karbon Tempurung Kemiri Teraktivasi H_3PO_4

Karbon Aktif setelah Pengeringan pada Suhu 110 °C selama 2 jam

Analisis Kadar Air

Analisis Kadar Abu

Analisis Luas Permukaan

Perendaman Sampel pada Titrasi Boehm

Hasil Titrasi Boehm

Elektroda Karbon

an Kapasitansi Spesifik

Lampiran 4. Perhitungan Pembuatan Larutan Pereaksi

2.1 Pembuatan Larutan H_3PO_4 2.5% dari H_3PO_4 85%

$V_1 \times M_1 = V_2 \times M_2$

$V_1 \times 85\% = 250\ mL \times 2.5\%$

$V_1 = 7.35\ mL$

2.2 Pembuatan Larutan Na_2CO_3 0,05 N

gram = L × N × BE

gram = 0,25 L × 0,05 N × 106 g/eq

gram = 1,3250 gram

2.3 Pembuatan Larutan $NaHCO_3$ 0,05 N

gram = L × N × BE

gram = 0,25 L × 0,05 N × 84 g/eq

gram = 1,0500 gram

2.4 Pembuatan Larutan NaOH 0,05 N

gram = L × N × BE

gram = 0,25 L × 0,05 N × 40 g/eq

gram = 0,5000 gram

2.5 Pembuatan Larutan HCl 0,05 N

$$N = \frac{\% \times bj \times 10}{BE}$$

$$\frac{37 \times 1{,}19\ g/mL \times 10}{36{,}5\ g/eq}$$

2,06 N

$V_1 \times N_1 = V_2 \times N_2$

$V_1 \times 12{,}06\ N = 250\ mL \times 0{,}05\ N$

$V_1 = 1{,}03\ mL$

2.6 Pembuatan Larutan $Na_2B_4O_7$ 0,05 N

gram = L × N × BE

gram = 0,1 L × 0,05 N × 190,6 g/eq

gram = 0,9530 gram

2.7 Pembuatan Larutan $H_2C_2O_4$ 0,05 N

gram = L × N × BE

gram = 0,1 L × 0,05 N × 63 g/eq

gram = 0,3150 gram

2.8 Pembuatan Larutan Li_2SO_4 0.5 M

gram = L × M × BM

gram = 0.05 L × 0.5 M × 109.94 g/mol

gram = 2.7485 gram

2.9 Pembuatan Larutan Na_2SO_4 0. 5 M

gram = L × M × BM

gram = 0.05 L × 0.5 M × 142.04 g/mol

gram = 3.551 gram

2.10Pembuatan Larutan K_2SO_4 0. 5 M

gram = L × M × BM

gram = 0.05 L × 0.5 M × 174.27 g/mol

gram = 4.3567 gram

nbuatan Larutan Metilen Biru 5000 ppm

metilen biru = 5000 ppm x 0,25 L

mg metilen biru = 1250 mg

2.12 Pembuatan Larutan Metilen Biru 50 ppm

$V_1 \times C_1 = V_2 \times C_2$

$V_1 \times 500$ ppm = 100 mL × 50 ppm

V_1 = 10 mL

2.13 Pembuatan Larutan Standar Metilen Biru 0,5; 1; 2; 4 dan 8 ppm

$V_1 \times C_1 = V_2 \times C_2$

$V_1 \times 50$ ppm = 25 mL × 0,5 ppm

V_1 = 0,25 mL

$V_1 \times C_1 = V_2 \times C_2$

$V_1 \times 50$ ppm = 25 mL × 1 ppm

V_1 = 0,5 mL

$V_1 \times C_1 = V_2 \times C_2$

$V_1 \times 50$ ppm = 25 mL × 2 ppm

V_1 = 1 mL

$V_1 \times C_1 = V_2 \times C_2$

$V_1 \times 50$ ppm = 25 mL × 4 ppm

V_1 = 2 mL

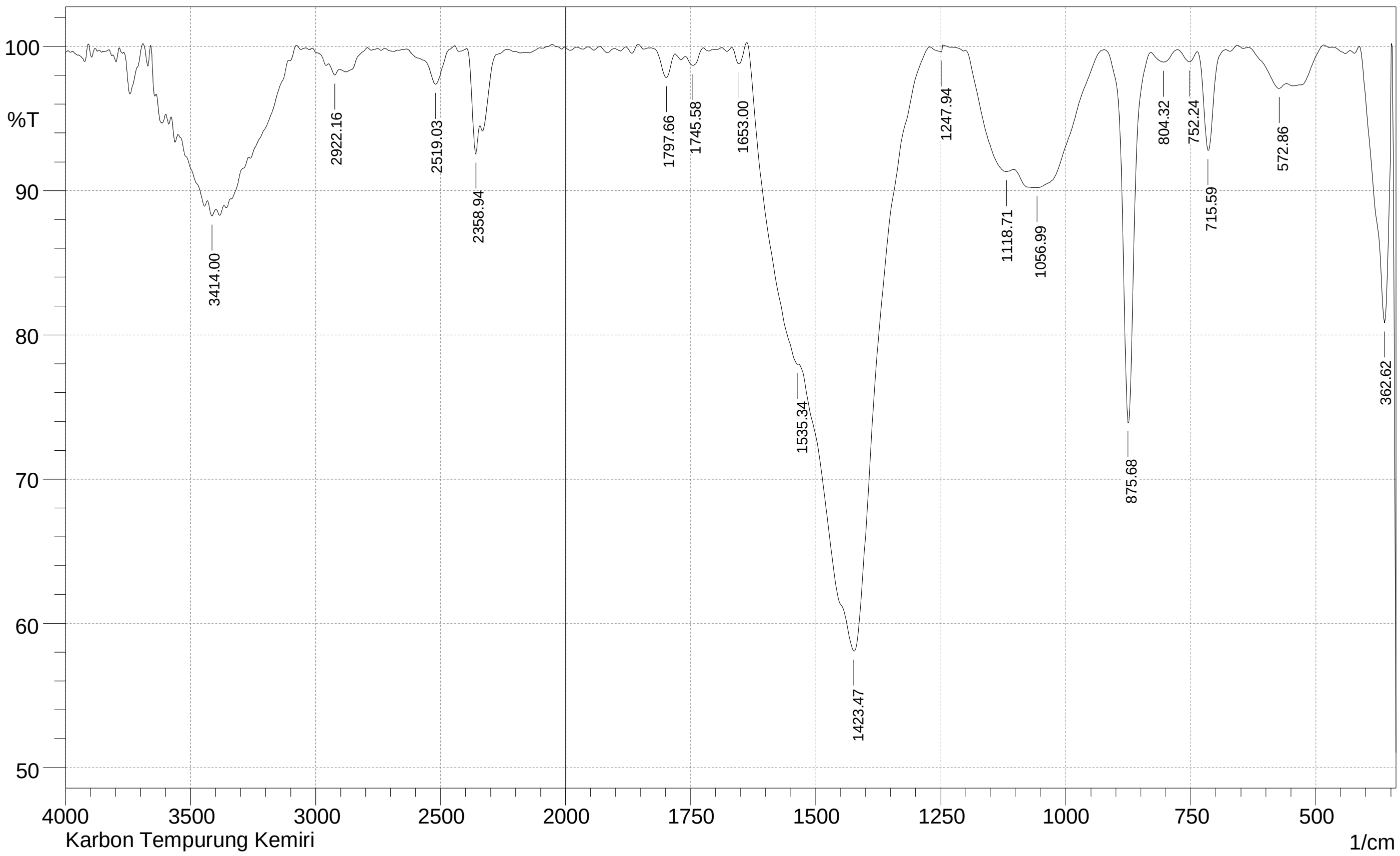
$V_1 \times C_1 = V_2 \times C_2$

× 50 ppm = 25 mL × 8 ppm

V_1 = 4 mL

Lampiran 5. Data Spektrum FTIR

1. Karbon Tempurung Kemiri



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	362.62	80.847	19.317	410.84	349.12	2.877	2.9
2	572.86	97.095	0.781	634.58	559.36	0.538	0.101
3	715.59	92.788	6.914	736.81	680.87	0.722	0.653
4	752.24	98.938	0.762	777.31	736.81	0.119	0.068
5	804.32	98.92	0.766	829.39	777.31	0.169	0.099
6	875.68	73.919	25.754	921.97	831.32	3.331	3.203
7	1056.99	90.21	3.403	1103.28	923.9	5.304	1.793
8	1118.71	91.321	1.328	1199.72	1105.21	2.496	0.581
9	1247.94	99.629	0.476	1273.02	1246.02	0.026	0.031
10	1423.47	58.079	29.186	1533.41	1273.02	30.504	16.575
11	1535.34	77.96	0.429	1637.56	1533.41	6.716	1.154
12	1653	98.796	1.306	1666.5	1637.56	0.073	0.088
13	1745.58	98.682	0.878	1761.01	1724.36	0.138	0.076
14	1797.66	97.854	1.78	1828.52	1780.3	0.221	0.157
15	2358.94	92.554	3.594	2393.66	2343.51	0.997	0.354
16	2519.03	97.387	2.574	2636.69	2443.81	0.889	0.836
17	2922.16	98.02	0.561	2947.23	2904.8	0.309	0.052
18	3259.7	88.255	0.721	3431.36	3398.57	1.725	0.062

Comm

Karb

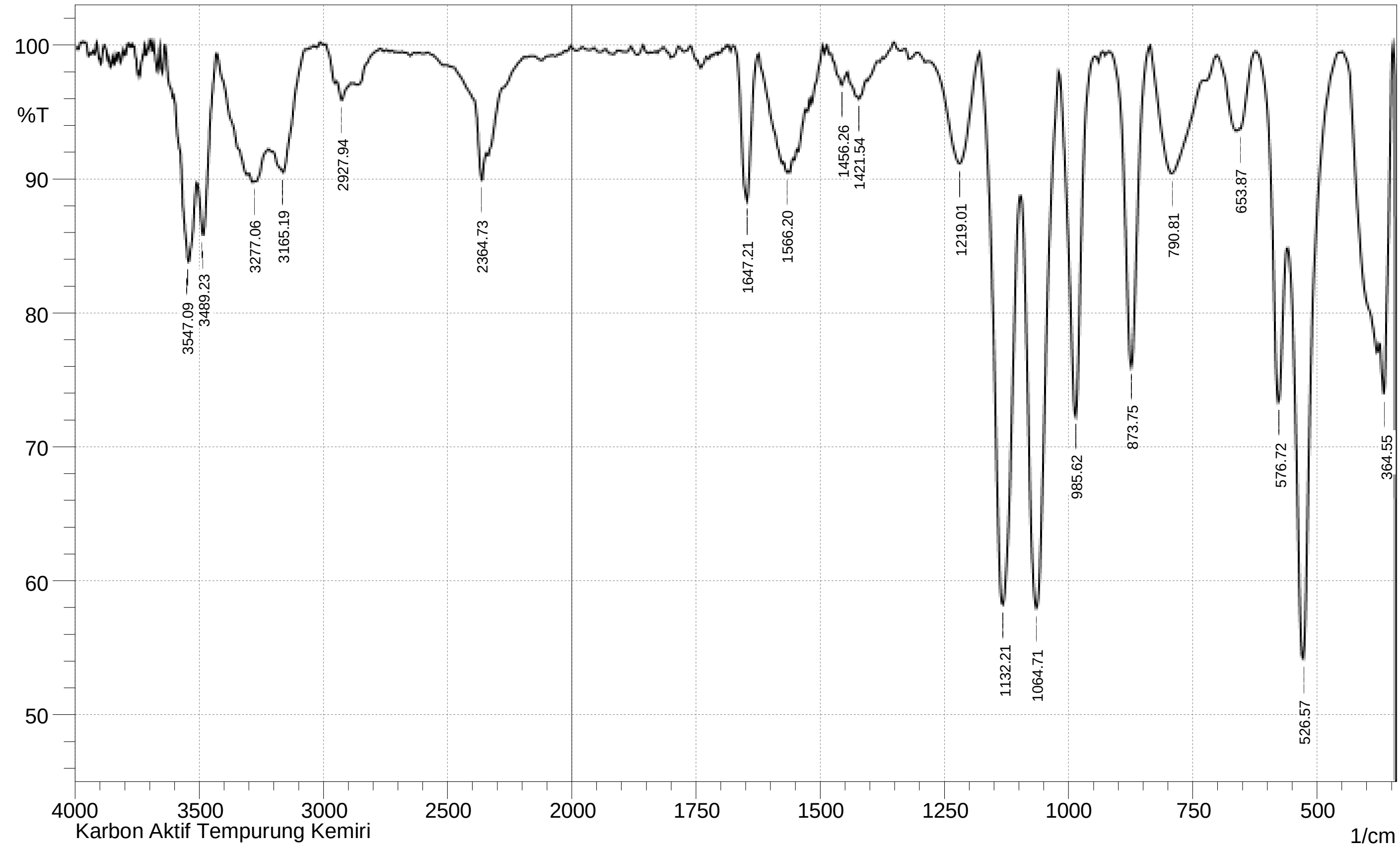
Date/Time; 5/16/2019 11:29:51 AM

No. of Scans;

Resolution;

Apodization;

2. Karbon Aktif Tempurung Kemiri



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	364.55	73.973	10.455	372.26	347.19	2.069	0.772
2	526.57	54.185	35.157	557.43	455.2	9.669	6.056
3	576.72	73.37	15.641	621.08	559.36	3.665	1.501
4	653.87	93.786	0.405	655.8	623.01	0.479	0
5	790.81	90.475	8.515	835.18	727.16	2.916	2.315
6	873.75	76.075	23.755	918.12	837.11	3.317	3.253
7	985.62	72.344	26.197	1018.41	947.05	4.045	3.612
8	1064.71	57.964	34.657	1095.57	1020.34	9.43	7.22
9	1132.21	58.215	35.204	1178.51	1097.5	9.589	7.377
10	1219.01	91.225	7.992	1280.73	1180.44	2.101	1.734
11	1421.54	96.063	1.684	1444.68	1406.11	0.543	0.171
12	1456.26	97.105	1.454	1479.4	1444.68	0.292	0.108
13	1566.2	90.57	0.216	1573.91	1564.27	0.401	0.006
14	1647.21	88.422	11.236	1674.21	1625.99	1.124	1.058
15	2364.73	89.999	2.673	2507.46	2347.37	2.834	0.213
16	2927.94	95.992	1.353	2949.16	2891.3	0.833	0.152
17	3165.19	90.555	4.005	3207.62	3074.53	3.473	1.082
18	3277.06	89.896	0.092	3278.99	3228.84	2.031	0.029
19	3489.23	85.895	6.786	3512.37	3435.22	2.995	1.145
20	3547.09	83.883	8.232	3606.89	3514.3	4.825	1.882

Comm

Karbo

Date/Time; 5/16/2019 11:23:38 AM

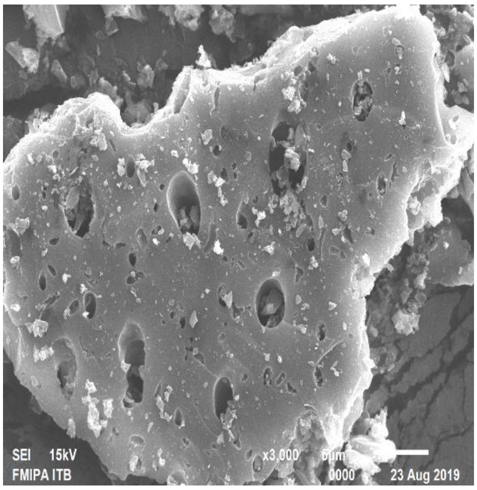
No. of Scans;

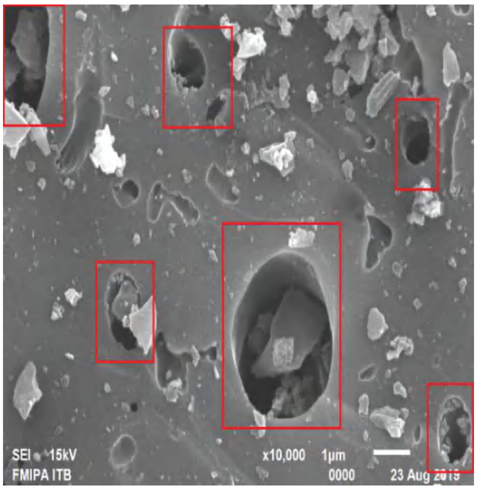
Resolution;

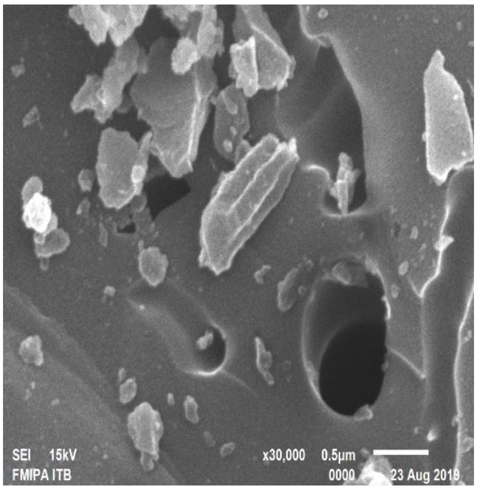
Apodization;

Lampiran 6. Hasil SEM

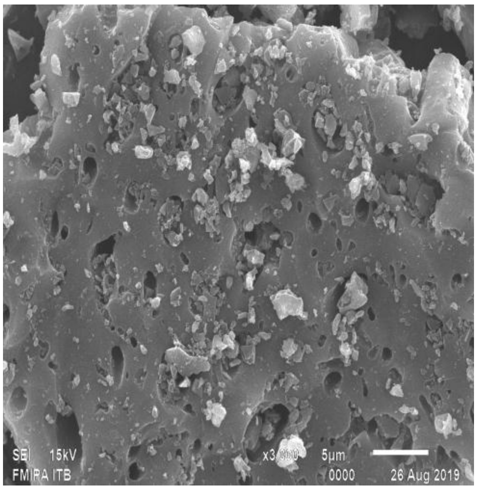
1. Karbon Tempurung Kemiri

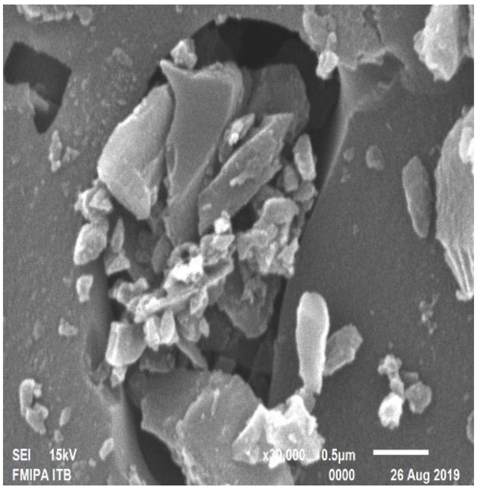






2. Karbon Aktif Tempurung Kemiri





Lampiran 7. Hasil Analisis XRD

1. Karbon Tempurung Kemiri

Group : Standard
Data : C#kemiri

Strongest 3 peaks

no.	peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	10	30.0221	2.97407	100	0.74980	1400	56507
2	9	27.0324	3.29582	30	0.86750	418	23768
3	6	23.5266	3.77841	24	2.05330	341	28215

Peak Data List

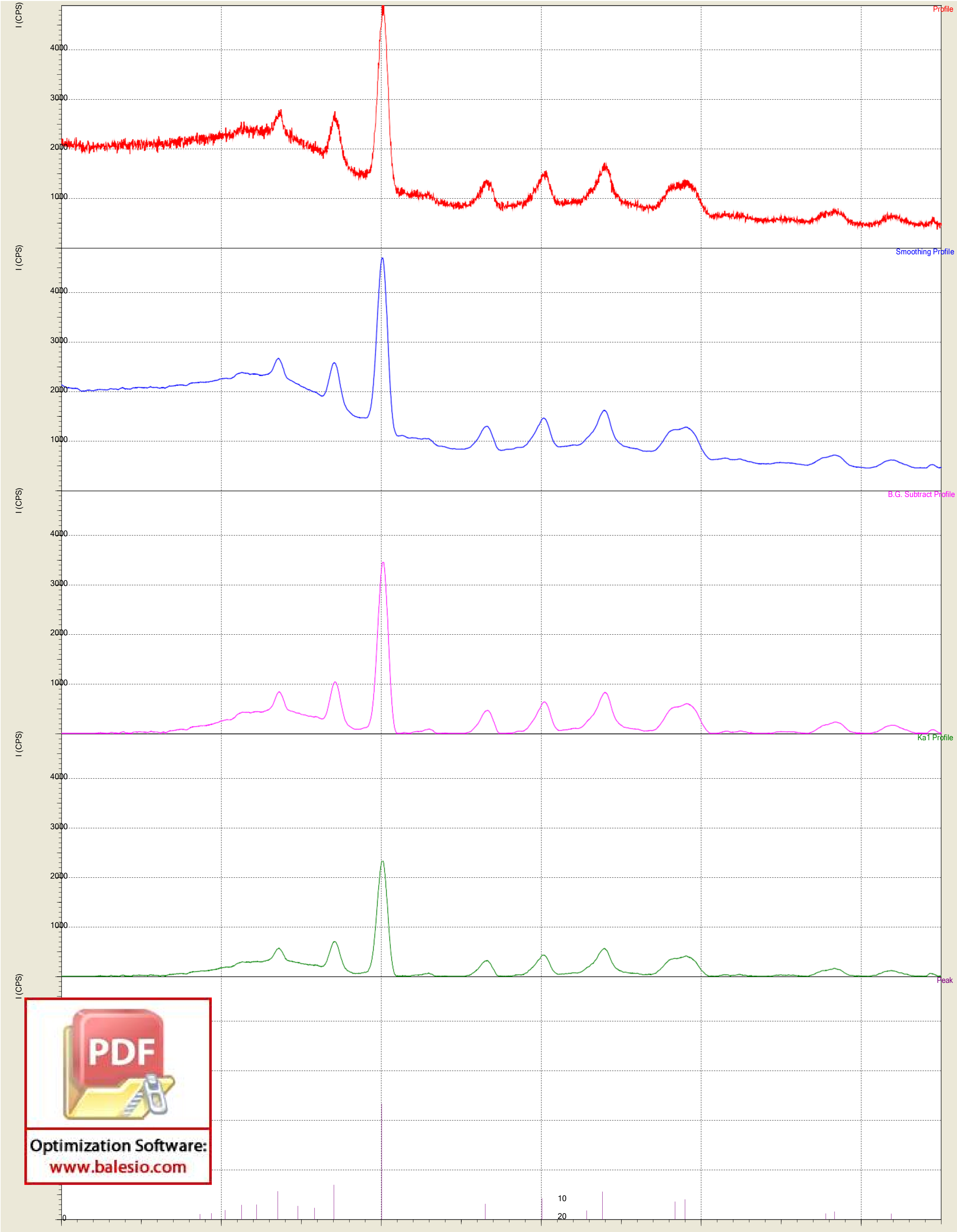
peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	18.6600	4.75140	5	1.58660	64	7040
2	19.3800	4.57647	5	0.00000	73	0
3	20.2400	4.38392	8	0.00000	111	0
4	21.2600	4.17584	12	0.00000	174	0
5	22.2000	4.00110	13	0.00000	180	0
6	23.5266	3.77841	24	2.05330	341	28215
7	24.7800	3.59006	12	0.00000	161	0
8	25.8200	3.44776	10	0.00000	140	0
9	27.0324	3.29582	30	0.86750	418	23768
10	30.0221	2.97407	100	0.74980	1400	56507
11	36.4900	2.46039	13	0.90000	188	9061
12	40.0379	2.25016	18	1.02240	256	15375
13	42.8400	2.10925	8	0.73340	106	5473
14	43.8221	2.06422	24	1.13080	335	19702
15	48.3600	1.88059	15	1.64000	215	14053
16	48.9800	1.85823	17	1.65140	243	14677
17	57.7800	1.59440	5	1.28000	71	4223
18	58.3200	1.58091	7	1.11000	95	3907
19	61.8800	1.49823	5	1.36000	69	5582

```
# Data Infomation
          Group                  :  Standard
          Data                   :  C#kemiri
          Sample Nmae            :  serbuk
          Comment                :
          Date & Time            :  05-22-19 11:41:51

# Measurement Condition
    X-ray tube
          target                 :  Cu
          voltage                :  40.0  (kV)
          current                :  30.0  (mA)
    Slits
          Auto Slit              :  Used
          divergence   slit   :   1.00000   (deg)
          scatter   slit   :      1.00000   (deg)
          receiving slit :  0.30000(mm)
    Scanning
          drive axis             :  Theta-2Theta
          scan range             :    10.0000 - 65.0000  (deg)
          scan mode              :  Continuous Scan
          scan speed             :     2.0000  (deg/min)
          sampling pitch         :     0.0200  (deg)
          preset time            :     0.60  (sec)

# Data Process Condition
    Smoothing                    [ AUTO ]
          smoothing points       :  43
    B.G.Subtruction              [ AUTO ]
          sampling points        :  45
          repeat times           :  30
    Ka1-a2  Separate             [ MANUAL ]
          Ka1 a2 ratio           :  50  (%)
    Peak Search                  [ AUTO ]
          differential points :  39
          FWHM threhold          :  0.050  (deg)
          intensity threhold     :  30  (par mil)
          FWHM ratio   (n-1)/n :  2
    System error Correction      [ NO ]
    Precise peak Correction      [ NO ]
```

< Group: Standard   Data: C#kemiri >



2. Karbon Aktif Tempurung Kemiri

```
Group      : Standard
Data       : C#Aktif3Kemiri
```

\# Strongest 3 peaks

no.	peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	7	20.8399	4.25906	100	0.44810	686	19395
2	2	11.5921	7.62766	84	0.37570	576	11500
3	17	29.1790	3.05806	83	0.40660	570	14333

\# Peak Data List

peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	10.4444	8.46312	16	0.35550	109	2074
2	11.5921	7.62766	84	0.37570	576	11500
3	18.0565	4.90883	4	0.38300	27	622
4	18.7626	4.72565	24	0.47180	163	4469
5	19.4000	4.57180	8	0.00000	56	0
6	19.8000	4.48034	8	0.00000	54	0
7	20.8399	4.25906	100	0.44810	686	19395
8	21.6000	4.11087	12	0.00000	84	0
9	22.1200	4.01539	11	0.00000	78	0
10	22.5800	3.93462	14	0.00000	96	0
11	23.3000	3.81464	23	0.00000	155	0
12	23.8400	3.72944	17	0.00000	116	0
13	24.3600	3.65099	15	0.00000	103	0
14	25.1400	3.53946	12	0.00000	79	0
15	26.3284	3.38233	36	0.62680	249	10633
16	27.3000	3.26412	18	0.46660	121	3863
17	29.1790	3.05806	83	0.40660	570	14333
18	29.8200	2.99376	23	0.00000	158	0
19	30.3807	2.93978	66	0.54860	455	13472
20	31.1400	2.86980	7	0.38660	47	1355
21	34.1246	2.62532	69	0.45770	470	11907
22	36.9640	2.42992	17	0.60000	118	4064
23	38.9166	2.31237	3	0.35330	22	354
24	39.5400	2.27734	10	0.36000	66	1033
25	39.9200	2.25654	8	0.56000	52	1576
26	41.4400	2.17721	26	0.41660	181	3869
27	41.9400	2.15240	19	0.42000	128	2922
28	43.1980	2.09259	20	0.72400	134	5118
29	44.0043	2.05610	17	0.40860	118	2286
30	44.7000	2.02570	8	0.76000	52	1537
31	45.0846	2.00931	17	0.65730	115	2679
32	45.7800	1.98039	6	0.36000	42	863
33	47.6000	1.90883	3	0.42660	24	850
34	48.3053	1.88260	19	0.44270	133	3097
35	48.9200	1.86037	9	0.36500	65	1490
[illegible]	[illegible]154	1.81876	23	0.45420	158	3742
[illegible]	[illegible]600	1.80048	7	0.39340	49	1322
[illegible]	[illegible]200	1.72879	3	0.46000	22	535
[illegible]	[illegible]325	1.71638	9	0.36910	60	1119
[illegible]	[illegible]616	1.66372	3	0.30330	22	411
[illegible]	[illegible]400	1.61331	5	0.38000	35	963
[illegible]	[illegible]325	1.60321	12	0.34000	80	1362

43	58.6100	1.57378	4	0.38000	28	620
44	59.3750	1.55532	9	0.37660	63	1216
45	60.3000	1.53365	5	0.32000	31	588
46	60.7600	1.52314	4	0.36000	27	692
47	63.9200	1.45524	6	0.64000	41	1324
48	64.3994	1.44556	28	0.34630	195	3384

```
# Data Infomation
          Group                 : Standard
          Data                  : C#Aktif3Kemiri
          Sample Nmae           : serbuk
          Comment               :
          Date & Time           : 05-22-19 12:13:04

# Measurement Condition
    X-ray tube
          target                : Cu
          voltage               : 40.0  (kV)
          current               : 30.0  (mA)
    Slits
          Auto Slit             : Used
          divergence   slit   :   1.00000   (deg)
          scatter  slit   :      1.00000   (deg)
          receiving slit :  0.30000(mm)
    Scanning
          drive axis            : Theta-2Theta
          scan range            :   10.0000 - 65.0000  (deg)
          scan mode             : Continuous Scan
          scan speed            :    2.0000  (deg/min)
          sampling pitch        :    0.0200  (deg)
          preset time           :    0.60  (sec)

# Data Process Condition
    Smoothing                   [ AUTO ]
          smoothing points      : 29
    B.G.Subtruction             [ AUTO ]
          sampling points       : 39
          repeat times          : 30
    Ka1-a2  Separate            [ MANUAL ]
          Ka1 a2 ratio          : 50  (%)
    Peak  Search                [ AUTO ]
          differential points : 25
          FWHM threhold         : 0.050 (deg)
          intensity threhold   : 30 (par mil)
          FWHM ratio   (n-1)/n : 2
    System error Correction     [ NO ]
    Precise peak Correction     [ NO ]
```

< Group: Standard   Data: C#Aktif3Kemiri >

Lampiran 8. ***Database*** **JCPDS Karbon**

PDF # 200258, Wavelength = 1.5418 (A)

20-0258 (Deleted)

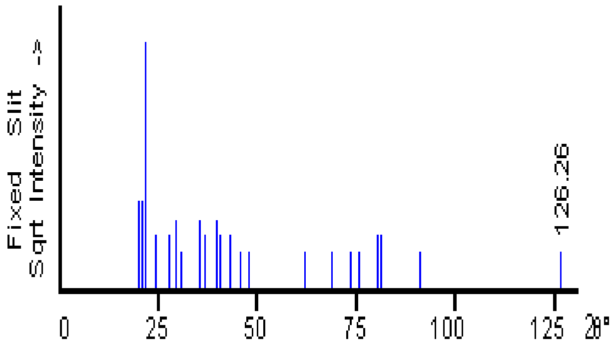
CAS Number:

Molecular Weight: 12.01
Volume[CD]: 976.17
Dx: Dm:

S.G.:
Cell Parameters:
a 8.948 b c 14.07
α β γ

SS/FOM: F20= (0.127,367)
I/Icor:
Rad: CuKa
Lambda: 1.5418
Filter: Ni
d-sp:

C
Carbon
Ref: Goresy, Donnay, Science, 161, 363 (1968)



2θ	int-f	h	k	l	2θ	int-f	h	k	l	2θ	int-f	h	k	l
19.862	100	1	1	0	36.525	40	2	1	3	73.462	20	6	0	0
20.852	100	1	1	1	39.524	60	2	0	5	75.443	20	3	3	6
21.569	80				40.260	40	2	2	0	80.186	40	5	1	6
23.986	40	2	0	1	43.073	40	3	0	4	81.249	40	4	2	7
27.703	40	1	0	4	45.754	20				91.089	20	3	3	9
29.479	60	2	0	3	47.608	20	3	0	5	126.26	20	5	4	8
30.403	20	2	1	0	62.036	20	2	2	7					
35.193	60	3	0	1	68.486	20	4	1	6					

Lampiran 9. Perhitungan Kadar Air

a. Karbon Tempurung Kemiri

No.	Berat Kosong Cawan (A)	Berat Cawan + Sampel (B)	Berat Akhir Penimbangan I	Berat Akhir Penimbangan II	Berat Akhir Penimbangan III	Rata-rata Berat Akhir (C)	Berat Uap Air (B-C)	Berat Awal Sampel (B-A)	Kadar Air (%)
1.	43,2797	43,8388	43,8148	43,8011	43,7967	43,8042	0,0346	0,5591	6,1885
2.	39,6263	40,1885	40,1658	40,1529	40,1521	40,1569	0,0316	0,5622	5,6207
3.	44,2113	44,8095	44,7897	44,7874	44,7703	44,7824	0,0271	0,5982	4,5302
Rata-rata Kadar Air									5,4464

$$\text{Kadar air (\%)} = \frac{\text{berat uap air}}{\text{berat awal sampel}} \times 100\% = \frac{0{,}0346}{0{,}5591} \times 100\% = 6{,}1885\%$$

b. Karbon Aktif Tempurung Kemiri

No.	Berat Kosong Cawan (A)	Berat Cawan + Sampel (B)	Berat Akhir Penimbangan I	Berat Akhir Penimbangan II	Berat Akhir Penimbangan III	Rata-rata Berat Akhir (C)	Berat Uap Air (B-C)	Berat Awal Sampel (B-A)	Kadar Air (%)
1.	38,6113	39,2005	39,1787	39,1696	39,1640	39,1707	0,0298	0,5892	5,0577
2.	36,3282	36,9016	36,8781	36,8766	36,8701	36,8749	0,0267	0,5734	4,6564
3.	48,5117	49,0788	49,0525	49,0410	49,0321	49,0418	0,037	0,5671	6,5244
Rata-rata Kadar Air									5,4128

$$\text{Kadar air (\%)} = \frac{\text{berat uap air}}{\text{berat awal sampel}} \times 100\% = \frac{0{,}0298}{0{,}5892} \times 100\% = 5{,}0577\%$$

Lampiran 10. Perhitungan Kadar Abu

a. Karbon Tempurung Kemiri

No.	Berat Kosong Cawan (A)	Berat Cawan + Sampel (B)	Berat Akhir Penimbangan I	Berat Akhir Penimbangan II	Berat Akhir Penimbangan III	Rata-rata Berat Akhir (C)	Berat Abu (C-A)	Berat Awal Sampel (B-A)	Kadar Abu (%)
1.	20,9305	21,4644	20,9569	20,9539	20,9516	20,9541	0,0236	0,5339	4,4203
2.	27,2698	27,8148	27,3000	27,2979	27,2905	27,2961	0,0263	0,5450	4,8256
3.	25,4046	25,9847	25,4457	25,4422	25,4416	25,4431	0,0385	0,5801	6,6367
Rata-rata Kadar Abu									5,2942

$$\text{Kadar air (\%)} = \frac{\text{berat abu}}{\text{berat awal sampel}} \times 100\% = \frac{0{,}0236}{0{,}5339} \times 100\% = 4{,}4203\%$$

b. Karbon Aktif Tempurung Kemiri

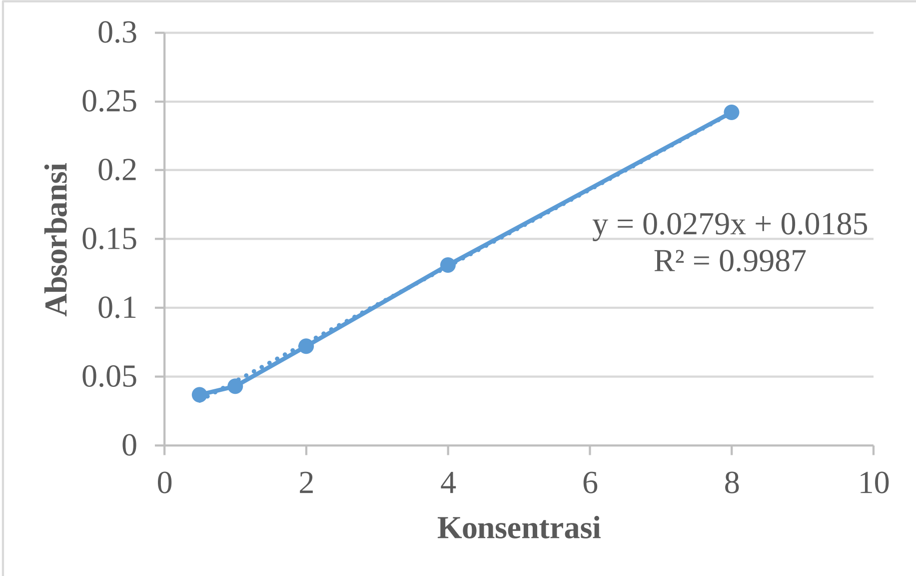
No.	Berat Kosong Cawan (A)	Berat Cawan + Sampel (B)	Berat Akhir Penimbangan I	Berat Akhir Penimbangan II	Berat Akhir Penimbangan III	Rata-rata Berat Akhir (C)	Berat Abu (C-A)	Berat Awal Sampel (B-A)	Kadar Abu (%)
1.	25,2517	25,8274	25,2841	25,2824	25,2818	25,2827	0,0310	0,5757	5,3847
2.	26,0541	26,6015	26,0832	26,0824	26,0813	26,0823	0,0282	0,5474	5,1516
3.	24,6194	25,1518	24,6464	24,6448	24,6445	24,6452	0,0258	0,5324	4,8459
Rata-rata Kadar Abu									5,1274

$$\text{Kadar abu (\%)} = \frac{\text{berat abu}}{\text{berat awal sampel}} \times 100\% = \frac{0{,}0310}{0{,}5757} \times 100\% = 5{,}1274\%$$

Lampiran 11. Perhitungan Luas Permukaan dengan Metode Metilen Biru

Penentuan Persamaan Regresi

Konsentrasi	Absorbansi
0,5	0,037
1	0,043
2	0,072
4	0,131
8	0,242



Penentuan konsentrasi awal metilen biru (C_o)

y = 0,0279 x + 0,0185

1,6 = 0,0279 x + 0,0185

x = 5668,4587 ppm

a. Karbon Tempurung Kemiri

Absorbansi	Faktor Pengenceran	Ce (mg/L)	C_o (mg/L)	Volume Larutan (L)	Massa Karbon (g)	Xm (mg/g)	S (m^2/g)
1,07	100	3768,8172	5668,4587	0,025	0,3115	152,4592	564,1419
0,634	100	2206,0932	5668,4587	0,025	0,3409	253,9136	939,5515
0,588	100	2041,2186	5668,4587	0,025	0,3304	274,4582	1015,5724
Rata-rata Luas Permukaan							839,7553

$$X_m = \frac{(C_o - C_e) \text{x Volume Larutan}}{\text{massa karbon}} = \frac{(5668,4587 - 3768,8172)\text{ppm x } 0,025 \text{ L}}{0,3115 \text{ gram}} = 152,4592 \text{ mg/g}$$

$$X_m . N . a = \frac{152,4592 \text{ mg/g} . 6,02 \text{ x } 10^{23} \text{ mol}^{-1} . 197 \text{ x } 10^{-20} \text{ m}^2}{320,5 \text{ g/mol}} = 564,1419 \text{ m}^2/\text{g}$$

b. Karbon Aktif Tempurung Kemiri

Absorbansi	Faktor Pengenceran	Ce (mg/L)	C_o (mg/L)	Volume Larutan (L)	Massa Karbon (g)	Xm (mg/g)	S (m^2/g)
0,594	100	2062,7240	5668,4587	0,025	0,3083	292,3885	1081,9195
0,598	100	2077,0609	5668,4587	0,025	0,3058	294,7788	1090,7645
0,586	100	2034,0502	5668,4587	0,025	0,3105	292,6255	1082,7965
Rata-rata Luas Permukaan							1085,1602

$$X_m = \frac{(C_o - C_e) \text{x Volume Larutan}}{\text{massa karbon}} = \frac{(5668,4587 - 2062,7240)\text{ppm x } 0,025 \text{ L}}{0,3083 \text{ gram}} = 292,3885 \text{ mg/g}$$

$$S = \frac{X_m \,.\, N \,.\, a}{Mr} = \frac{292,3885 \text{ mg/g} \,.\, 6,02 \text{ x } 10^{23} \text{ mol}^{-1} \cdot 197 \text{ x } 10^{-20} \text{ m}^2}{320,5 \text{ g/mol}} = 1081,9195 \text{ m}^2/\text{g}$$

Lampiran 12. Perhitungan Kadar Gugus Fungsi dengan Titrasi Boehm

a. Karbon Tempurung Kemiri

Penentuan Kadar Karboksilat

No	V. Sampel (Vs) (mL)	V. Titran $NaHCO_3$ (Vp) (mL)	N. $NaHCO_3$	N. HCl	V. HCl (mL)	N. NaOH	V. NaOH (mL)	Massa Karbon (g)	n Carboxyl (meq/g)
1	25	10	0,05	0,0279	12	0,0481	5	0,1169	8,6762
2	25	10	0,05	0,0279	12	0,0481	4,7	0,1169	8,3676
Rata-rata									8,5219

$$n_{carboxylic} = \frac{[V_{NaHCO_3} N_{NaHCO_3} - (N_{HCl} V_{HCl} - N_{NaOH} V_{NaOH})] \frac{V_p}{V_s}}{w}$$

$$n_{carboxylic} = \frac{[10 \text{ mL x } 0{,}05 \text{ N} - (0{,}0279 \text{ N x } 12 \text{ mL} - 0{,}0481 \text{ N x } 5 \text{ mL})] \frac{25 \text{ mL}}{10 \text{ mL}}}{0{,}1169 \text{ gram}}$$

$$n_{carboxylic} = \frac{[0{,}5 \text{ meq} - (0{,}3348 \text{ meq} - 0{,}2405 \text{ meq})] \frac{25 \text{ mL}}{10 \text{ mL}}}{0{,}1169 \text{ gram}}$$

$$\frac{[0{,}5 \text{ meq} - 0{,}0943 \text{ meq}] \frac{25 \text{ mL}}{10 \text{ mL}}}{0{,}1169 \text{ gram}} = 8{,}6762 \ \frac{\text{meq}}{\text{gram}}$$

Penentuan Kadar Lakton

No	V. Sampel (Vs) (mL)	V. Titran Na_2CO_3 (Vp) (mL)	N. Na_2CO_3	N. HCl	V. HCl (mL)	N. NaOH	V. NaOH (mL)	Massa Karbon (g)	n Lactone (meq/g)
1	25	10	0,05	0,0279	12	0,0481	3,2	0,1040	-1,0050
2	25	10	0,05	0,0279	12	0,0481	3,2	0,1040	-1,0050
Rata-rata									-1,0050

$$n_{lactonic} = \frac{\left[V_{Na_2CO_3} N_{Na_2CO_3} - (N_{HCl} V_{HCl} - N_{NaOH} V_{NaOH})\right] \frac{V_p}{V_s}}{w} - n_{carboxylic}$$

$$n_{lactonic} = \frac{[10\ mL\ x\ 0{,}05\ N - (0{,}0279\ N\ x\ 12\ mL - 0{,}0481\ N\ x\ 3{,}2\ mL)] \frac{25\ mL}{10\ mL}}{0{,}1040\ gram} - 8{,}6762\ \frac{meq}{gram}$$

$$n_{lactonic} = \frac{[0{,}5\ meq - (0{,}3348\ meq - 0{,}15392\ meq)] \frac{25\ mL}{10\ mL}}{0{,}1040\ gram} - 8{,}6762\ \frac{meq}{gram}$$

$$n_{lactonic} = 7{,}6711\ \frac{meq}{gram} - 8{,}6762\ \frac{meq}{gram} = -1{,}0050\ \frac{meq}{gram}$$

Penentuan Kadar Fenol

No	V. Sampel (Vs) (mL)	V. Titran NaOH (Vp) (mL)	N. NaOH	N. HCl	V. HCl (mL)	N. NaOH	V. NaOH (mL)	Massa Karbon (g)	n Phenolic (meq/g)
1	25	10	0,0481	0,0279	12	0,0481	5,4	0,1006	5,4505
2	25	10	0,0481	0,0279	12	0,0481	5,7	0,1006	5,8091
Rata-rata									5,6298

$$n_{phenolic} = \frac{[V_{NaOH}N_{NaOH} - (N_{HCl}V_{HCl} - N_{NaOH}V_{NaOH})]\frac{V_p}{V_s}}{w} - n_{carboxylic} - n_{lactonic}$$

$$n_{phenolic} = \frac{[10 \text{ mL x } 0{,}0481 \text{ N} - (0{,}0279 \text{ N x } 12 \text{ mL} - 0{,}0481 \text{ N x } 5{,}4 \text{ mL})]\frac{25 \text{ mL}}{10 \text{ mL}}}{0{,}1006 \text{ gram}} - 8{,}6762\ \frac{\text{meq}}{\text{gram}} - (-4{,}0388\ \frac{\text{meq}}{\text{gram}})$$

$$n_{phenolic} = \frac{[0{,}481 \text{ meq} - (0{,}3348 \text{ meq} - 0{,}25974 \text{ meq})]\frac{25 \text{ mL}}{10 \text{ mL}}}{0.1006 \text{ gram}} - 8{,}6762\ \frac{\text{meq}}{\text{gram}} - (-4{,}0388\ \frac{\text{meq}}{\text{gram}})$$

$$n_{phenolic} = 10{,}0879\ \frac{\text{meq}}{\text{gram}} - 8{,}6762\ \frac{\text{meq}}{\text{gram}} - \left(-4{,}0388\ \frac{\text{meq}}{\text{gram}}\right) = 5{,}4505\ \frac{\text{meq}}{\text{gram}}$$

Penentuan Kadar Basa Total

No	V. Sampel (Vs) (mL)	V. Titran HCl (Vp) (mL)	N. HCl	N. NaOH	V. NaOH (mL)	N. HCl	V. HCl (mL)	Massa Karbon (g)	n total base (meq/g)
1	25	10	0,0279	0,0481	12	0,0279	9	0,1551	-0,7591
2	25	10	0,0279	0,0481	12	0,0279	10	0,1551	-0,3094
Rata-rata									-0,5342

$$n_{phenolic} = \frac{[V_{HCl}N_{HCl} - (N_{NaOH}V_{NaOH} - N_{HCl}V_{HCl})]\frac{V_p}{V_s}}{w}$$

$$n_{phenolic} = \frac{[10\ mL \times 0{,}0279\ N - (0{,}0481\ N \times 12\ mL - 0{,}0279\ N \times 9\ mL)]\frac{25\ mL}{10\ mL}}{0{,}1551\ gram}$$

$$n_{phenolic} = \frac{[0{,}279\ meq - (0{,}5772\ meq - 0{,}2511\ meq)]\frac{25\ mL}{10\ mL}}{0.1551\ gram}$$

$$n_{phenolic} = \frac{[0{,}279\ meq - 0{,}3261\ meq]\frac{25\ mL}{10\ mL}}{0.1551\ gram} = -0{,}7591\ \frac{meq}{gram}$$

b. Karbon Aktif Tempurung Kemiri

Penentuan Kadar Karboksilat

No	V. Sampel (Vs) (mL)	V. Titran $NaHCO_3$ (Vp) (mL)	N. $NaHCO_3$	N. HCl	V. HCl (mL)	N. NaOH	V. NaOH (mL)	Massa Karbon (g)	n Carboxyl (meq/g)
1	25	10	0,05	0,0279	12	0,0481	5	0,1066	9,5145
2	25	10	0,05	0,0279	12	0,0481	6	0,1066	10,6425
Rata-rata									10,0785

Penentuan Kadar Lakton

No	V. Sampel (Vs) (mL)	V. Titran Na_2CO_3 (Vp) (mL)	N. Na_2CO_3	N. HCl	V. HCl (mL)	N. NaOH	V. NaOH (mL)	Massa Karbon (g)	n Lactone (meq/g)
1	25	10	0,05	0,0279	12	0,0481	1,9	0,1487	-5,7646
2	25	10	0,05	0,0279	12	0,0481	2,7	0,1487	-5,1176
Rata-rata									-5,4411

Penentuan Kadar Fenol

No	V. Sampel (Vs) (mL)	V. Titran NaOH (Vp) (mL)	N. NaOH	N. HCl	V. HCl (mL)	N. NaOH	V. NaOH (mL)	Massa Karbon (g)	n Phenolic (meq/g)
1	25	10	0,0481	0,0279	12	0,0481	6,4	0,1025	6,4367
2	25	10	0,0481	0,0279	12	0,0481	6,6	0,1025	6,6713
Rata-rata									6,5540

Penentuan Kadar Basa Total

No	V. Sampel (Vs) (mL)	V. Titran HCl (Vp) (mL)	N. HCl	N. NaOH	V. NaOH (mL)	N. HCl	V. HCl (mL)	Massa Karbon (g)	n total base (meq/g)
1	25	10	0,0279	0,0481	12	0,0279	7,7	0,1202	-1,7339
2	25	10	0,0279	0,0481	12	0,0279	7	0,1202	-2,1401
Rata-rata									-1,9370

Lampiran 13. Perhitungan Kapasitansi Spesifik

a. Elektrolit Li_2SO_4 0,5 M

Sampel	Scanrate (V/s)	Ic (A)	Id (A)	Massa karbon (gram)	Kapasitansi spesifik (F/g)
KTK	0.05	3.74E-05	-1.18E-05	0.106	0.009281
	0.02	4.11E-05	-1.75E-05	0.106	0.027624
	0.01	4.21E-05	9.44E-06	0.106	0.030837
KATK	0.05	5.19E-05	-1.75E-05	0.1079	0.012859
	0.02	5.21E-05	-1.43E-05	0.1079	0.030758
	0.01	4.56E-05	-1.20E-05	0.1079	0.053383

1. Penentuan Kapasitansi Spesifik KTK

1.1 Scan rate 50 mV/s

$$C_s = \frac{\left(3.74 \text{ x } 10^{-5} - (-1.18 \text{ x } 10^{-5}\right) \text{ A}}{0.05 \ ^{V}/_{s} \text{ x } 0.106 \text{ gram}} = \frac{\left(4.77 \text{ x } 10^{-5}\right) \text{ A}}{0.05 \ ^{V}/_{s} \text{ x } 0.106 \text{ gram}} = 0.009281 \ ^{F}/_{g}$$

1.2 Scan rate 20 mV/s

$$C_s = \frac{\left(4.11 \text{ x } 10^{-5} - (-1.75 \text{ x } 10^{-5}\right) \text{ A}}{0.02 \ ^{V}/_{s} \text{ x } 0.106 \text{ gram}} = \frac{\left(5.86 \text{ x } 10^{-5}\right) \text{ A}}{0.02 \ ^{V}/_{s} \text{ x } 0.106 \text{ gram}} = 0.027624 \ ^{F}/_{g}$$

1.3 Scan rate 10 mV/s

$$C_s = \frac{\left(4.21 \text{ x } 10^{-5} - 9.44 \text{ x } 10^{-6}\right) \text{ A}}{0.01 \ ^{V}/_{s} \text{ x } 0.106 \text{ gram}} = \frac{\left(3.266 \text{ x } 10^{-5}\right) \text{ A}}{0.01 \ ^{V}/_{s} \text{ x } 0.106 \text{ gram}} = 0.030837 \ ^{F}/_{g}$$

2. Penentuan Kapasitansi Spesifik KATK

2.1 Scan rate 50 mV/s

$$C_s = \frac{\left(5.19 \text{ x } 10^{-5} - (-1.75 \text{ x } 10^{-5}\right) \text{ A}}{0.05 \ ^{V}/_{s} \text{ x } 0.1079 \text{ gram}} = \frac{\left(6.94 \text{ x } 10^{-5}\right) \text{ A}}{0.05 \ ^{V}/_{s} \text{ x } 0.1079 \text{ gram}} = 0.012859 \ ^{F}/_{g}$$

1.4 Scan rate 20 mV/s

$$C_s = \frac{(5.21 \text{ x } 10^{-5} - (-1.43 \text{ x } 10^{-5})) \text{ A}}{0.02 \ ^V/_s \text{ x } 0.1079 \text{ gram}} = \frac{(6.64 \text{ x } 10^{-5}) \text{ A}}{0.02 \ ^V/_s \text{ x } 0.1079 \text{ gram}} = 0.030758 \ ^F/_g$$

1.5 Scan rate 10 mV/s

$$C_s = \frac{(4.56 \text{ x } 10^{-5} - (-1.20 \text{ x } 10^{-5})) \text{ A}}{0.01 \ ^V/_s \text{ x } 0.1079 \text{ gram}} = \frac{(5.76 \text{ x } 10^{-5}) \text{ A}}{0.01 \ ^V/_s \text{ x } 0.1079 \text{ gram}} = 0.053383 \ ^F/_g$$

b. Elektrolit Na_2SO_4 0,5 M

Sampel	Scanrate (V/s)	Ic (A)	Id (A)	Massa karbon (gram)	Kapasitansi spesifik (F/g)
KTK	0.05	2.51E-05	3.13E-06	0.1212	0.003624
	0.02	3.01E-05	2.50E-07	0.1212	0.012315
	0.01	2.67E-05	1.75E-06	0.1212	0.020575
KATK	0.05	5.19E-05	-1.25E-05	0.1112	0.011589
	0.02	4.89E-05	-1.24E-05	0.1112	0.027597
	0.01	4.54E-05	-7.81E-05	0.1112	0.047851

1. Penentuan Kapasitansi Spesifik KTK

1.1 Scan rate 50 mV/s

$$C_s = \frac{(2.51 \text{ x } 10^{-5} - 3.13 \text{ x } 10^{-6}) \text{ A}}{0.05 \ ^V/_s \text{ x } 0.1212 \text{ gram}} = \frac{(2.197 \text{ x } 10^{-5}) \text{ A}}{0.05 \ ^V/_s \text{ x } 0.1212 \text{ gram}} = 0.003624 \ ^F/_g$$

1.2 Scan rate 20 mV/s

$$C_s = \frac{(3.01 \text{ x } 10^{-5} - 2.50 \text{ x } 10^{-7}) \text{ A}}{0.02 \ ^V/_s \text{ x } 0.1212 \text{ gram}} = \frac{(2.985 \text{ x } 10^{-5}) \text{ A}}{0.02 \ ^V/_s \text{ x } 0.1212 \text{ gram}} = 0.012315 \ ^F/_g$$

1.3 Scan rate 10 mV/s

$$C_s = \frac{(2.67 \text{ x } 10^{-5} - 1.75 \text{ x } 10^{-6}) \text{ A}}{0.01 \ ^V/_s \text{ x } 0.1212 \text{ gram}} = \frac{(2.495 \text{ x } 10^{-5}) \text{ A}}{0.01 \ ^V/_s \text{ x } 0.1212 \text{ gram}} = 0.020575 \ ^F/_g$$

2. **Penentuan Kapasitansi Spesifik KATK**

1.4 Scan rate 50 mV/s

$$C_s = \frac{(5.19 \text{ x } 10^{-5} - (-1.25 \text{ x } 10^{-5})\text{ A}}{0.05 \text{ V/s x } 0.1112 \text{ gram}} = \frac{(6.44 \text{ x } 10^{-5})\text{ A}}{0.05 \text{ V/s x } 0.1112 \text{ gram}} = 0.011589 \text{ F/g}$$

1.5 Scan rate 20 mV/s

$$C_s = \frac{(4.89 \text{ x } 10^{-5} - (-1.24 \text{ x } 10^{-5})\text{ A}}{0.02 \text{ V/s x } 0.1112 \text{ gram}} = \frac{(6.13 \text{ x } 10^{-5})\text{ A}}{0.02 \text{ V/s x } 0.1112 \text{ gram}} = 0.027597 \text{ F/g}$$

1.6 Scan rate 10 mV/s

$$C_s = \frac{(4.54 \text{ x } 10^{-5} - (-7.81 \text{ x } 10^{-6})\text{ A}}{0.01 \text{ V/s x } 0.1112 \text{ gram}} = \frac{(5.32 \text{ x } 10^{-5})\text{ A}}{0.01 \text{ V/s x } 0.1112 \text{ gram}} = 0.047851 \text{ F/g}$$

c. **Elektrolit K_2SO_4 0,5 M**

Sampel	Scanrate (V/s)	Ic (A)	Id (A)	Massa karbon (gram)	Kapasitansi spesifik (F/g)
KTK	0.05	2.29E-05	1.22E-05	0.1046	0.002043
	0.02	2.24E-05	1.52E-05	0.1046	0.003436
	0.01	2.21E-05	1.42E-05	0.1046	0.007588
KATK	0.05	3.56E-05	2.87E-06	0.1108	0.0059
	0.02	3.55E-05	-3.13E-06	0.1108	0.01743
	0.01	3.44E-05	-2.81E-06	0.1108	0.033619

1. **Penentuan Kapasitansi Spesifik KTK**

1.1 Scan rate 50 mV/s

$$C_s = \frac{(2.29 \text{ x } 10^{-5} - 1.22 \text{ x } 10^{-5})\text{ A}}{0.05 \text{ V/s x } 0.1046 \text{ gram}} = \frac{(1.07 \text{ x } 10^{-5})\text{ A}}{0.05 \text{ V/s x } 0.1046 \text{ gram}} = 0.002043 \text{ F/g}$$

1.2 Scan rate 20 mV/s

$$C_s = \frac{\left(2.24 \times 10^{-5} - 1.52 \times 10^{-5}\right) A}{0.02\ {}^{V}/_{s}\ \times\ 0.1046\ \text{gram}} = \frac{\left(7.2 \times 10^{-6}\right) A}{0.02\ {}^{V}/_{s}\ \times\ 0.1046\ \text{gram}} = 0.003436\ {}^{F}/_{g}$$

1.3 Scan rate 10 mV/s

$$C_s = \frac{\left(2.21 \times 10^{-5} - 1.42 \times 10^{-5}\right) A}{0.01\ {}^{V}/_{s}\ \times\ 0.1046\ \text{gram}} = \frac{\left(7.9 \times 10^{-6}\right) A}{0.01\ {}^{V}/_{s}\ \times\ 0.1046\ \text{gram}} = 0.007588\ {}^{F}/_{g}$$

2. Penentuan Kapasitansi Spesifik KATK

2.1 Scan rate 50 mV/s

$$C_s = \frac{\left(3.56 \times 10^{-5} - 2.87 \times 10^{-6}\right) A}{0.05\ {}^{V}/_{s}\ \times\ 0.1108\ \text{gram}} = \frac{\left(3.273 \times 10^{-5}\right) A}{0.05\ {}^{V}/_{s}\ \times\ 0.1108\ \text{gram}} = 0.0059\ {}^{F}/_{g}$$

2.2 Scan rate 20 mV/s

$$C_s = \frac{\left(3.55 \times 10^{-5} - (-3.13 \times 10^{-6}\right) A}{0.02\ {}^{V}/_{s}\ \times\ 0.1108\ \text{gram}} = \frac{\left(3.863 \times 10^{-5}\right) A}{0.02\ {}^{V}/_{s}\ \times\ 0.1108\ \text{gram}} = 0.01743\ {}^{F}/_{g}$$

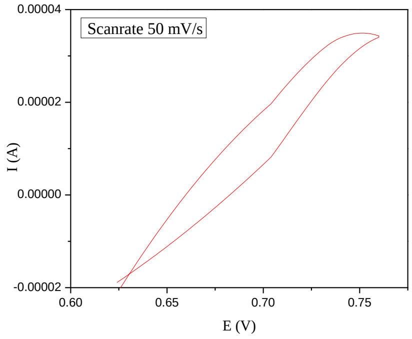
2.3 Scan rate 10 mV/s

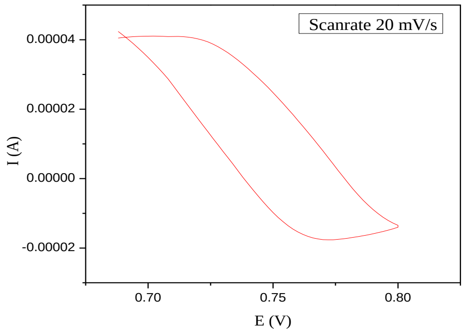
$$C_s = \frac{\left(3.44 \times 10^{-5} - (-2.81 \times 10^{-6}\right) A}{0.01\ {}^{V}/_{s}\ \times\ 0.1108\ \text{gram}} = \frac{\left(3.721 \times 10^{-5}\right) A}{0.01\ {}^{V}/_{s}\ \times\ 0.1108\ \text{gram}} = 0.033619\ {}^{F}/_{g}$$

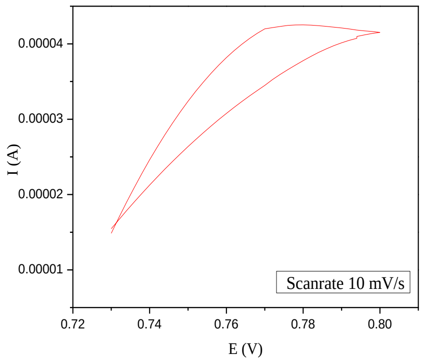
Lampiran 14. Grafik Voltammogram Kapasitansi Spesifik KTK dan KATK

1. Grafik voltammogram kapasitansi spesifik dalam elektrolit Li_2SO_4 0,5 M

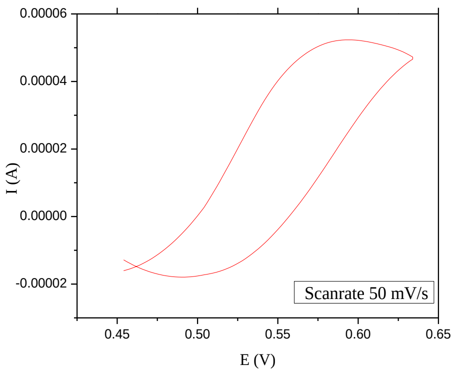
   a. KTK

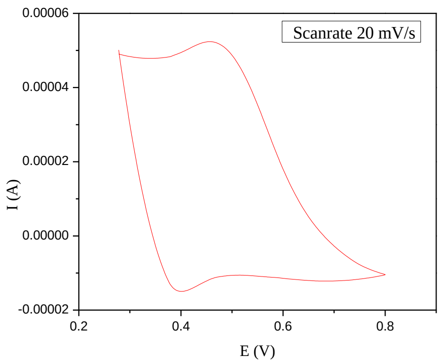


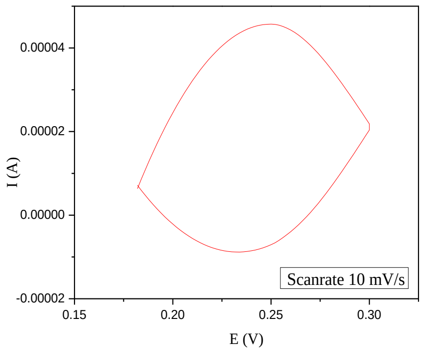




   b. KATK

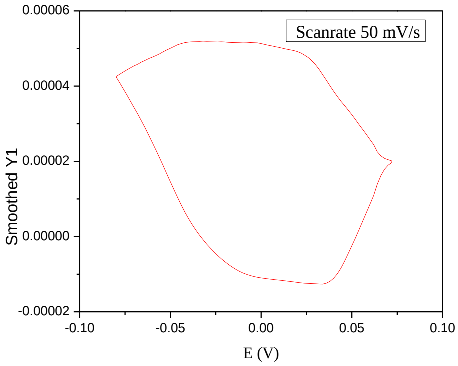


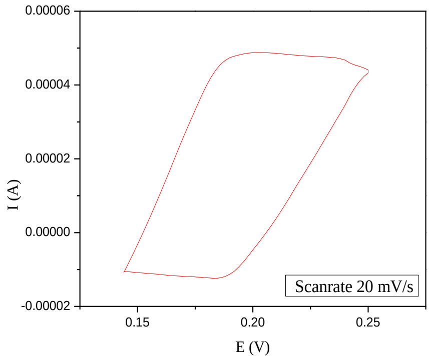


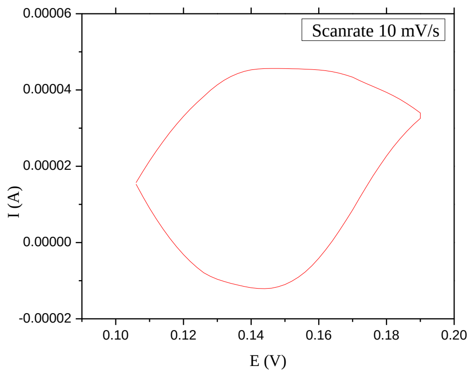


2. Grafik voltammogram kapasitansi spesifik dalam elektrolit Na_2SO_4 0,5 M

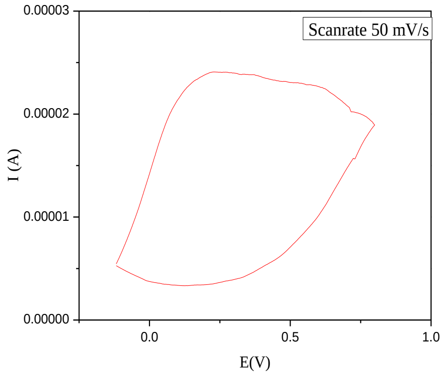
   a. KTK

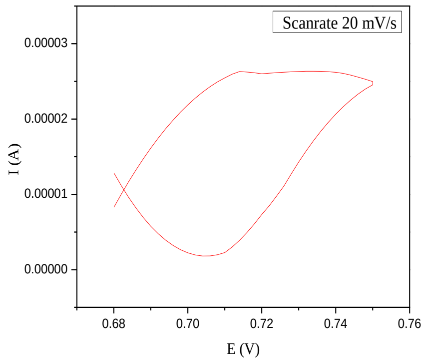


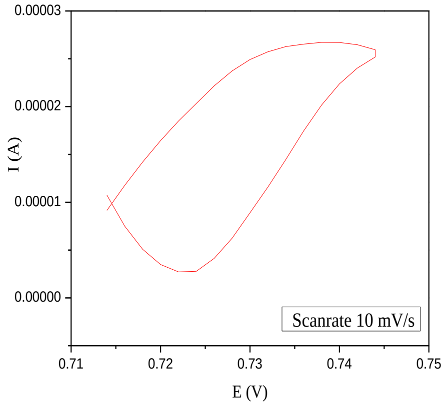




b. KATK







3. Grafik voltammogram kapasitansi spesifik dalam elektrolit K_2SO_4 0,5 M

a. KTK