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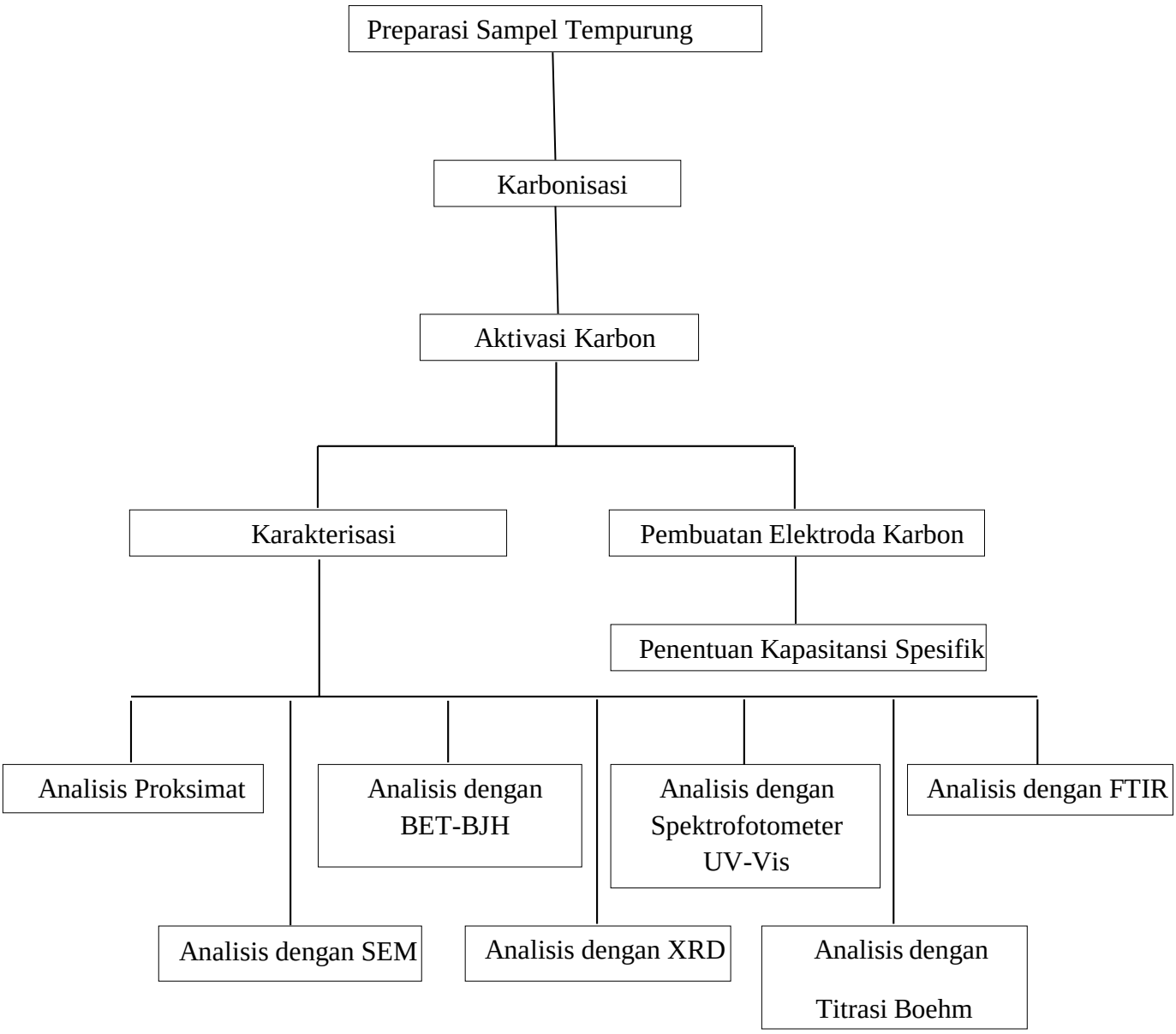
LAMPIRAN

Lampiran 1. Diagram Alir Penelitian



Lampiran 2. Bagan Kerja

1.1 Prosedur Umum

Tempurung Kemiri

- dibersihkan kotoran yang menempel pada tempurung
- dikeringkan dalam oven pada suhu 110°C selama 2 jam
- dikarbonisasi pada suhu 600°C, 650°C, 700°C, 750°C, 800°C dan 900 ^{o}C selama 3 jam
- dihaluskan dan diayak dengan ukuran 150 mesh

Karbon Tempurung Kemiri

- diaktivasi dengan larutan KOH 25 % dengan perbandingan 5:1 (volume KOH : massa karbon)
- dicuci dengan HCl 3 M dan akuades hingga pH netral
- dipirolisis dalam tanur pada suhu 800°C, 850°C dan 900°C
- dibilas dengan akuades
- dikeringkan dalam oven pada suhu 110°C selama 24 jam

Karbon Aktif Tempurung Kemiri

1.2 Analisis Kadar Air

Tempurung Kemiri

- ditimbang sebanyak 0.5 gram kedalam cawan petri yang telah diketahui beratnya
- dikeringkan dalam oven pada suhu 105°C selama 3 jam
- didinginkan dalam desikator, dan timbang bobotnya
- dimasukkan kembali ke dalam oven selama 15 menit dan dinginkan kembali dalam desikator hingga bobot konstan

Hasil

Catatan: diulangi prosedur yang sama dengan sampel lain seperti KTK, dan KATK.

1.3 Analisis Kadar Abu

Tempurung Kemiri

- ditimbang sebanyak 0.5 gram kedalam cawan porselin yang telah diketahui beratnya
- dikeringkan dalam oven pada suhu 600°C selama 6 jam
- didinginkan dalam desikator, dan timbang bobotnya
- dimasukkan kembali ke dalam oven selama 30 menit dan dinginkan kembali dalam desikator hingga bobot konstan

Hasil

Catatan: diulangi prosedur yang sama dengan sampel lain seperti KTK, dan KATK.

1.4 Analisis Kadar Senyawa Volatil

Tempurung Kemiri

- ditimbang sebanyak 1 gram kedalam cawan porselin yang telah diketahui beratnya
- dikeringkan dalam tanur pada suhu 950 ^{o}C selama 6 menit
- didinginkan dalam desikator, dan timbang bobotnya
- dimasukkan kembali ke dalam tanur selama 2 menit dan dinginkan kembali dalam desikator hingga bobot konstan

Hasil

Catatan: diulangi prosedur yang sama dengan sampel lain seperti KTK, dan KATK.

1.5 Analisis Luas Permukaan, Volume dan Diameter Pori

Tempurung Kemiri

- Dianalisis dengan BET-BJH

Hasil

Catatan: diulangi prosedur yang sama dengan sampel lain seperti KTK, dan KATK.

1.6 Analisis Morologi dengan SEM EDX

Tempurung Kemiri

- Dianalisis dengan SEM EDX

Hasil

Catatan: diulangi prosedur yang sama dengan sampel lain seperti KTK, dan KATK.

1.7 Analisis Gugus Fungsi dengan FTIR

Tempurung Kemiri

- ditimbang sebanyak 1-10 mg sampel dan dihaluskan
- dicampur dengan 100 mg KBr dan dicetak menjadi cakram tipis atau pelet lalu dianalisis.

Hasil

Catatan: diulangi prosedur yang sama dengan sampel lain seperti KTK, dan KATK.

1.8 Analisis Gugus Fungsi dengan Titrasi Boehm

Tempurung Kemiri

- ditimbang sebanyak 0,1 gram 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 5 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 5 mL dari larutan HCl dan ditambahkan NaOH 0.05 N berlebih, kemudian dititrasi balik dengan menggunakan HCl 0,05 N.

Hasil

Catatan: diulangi prosedur yang sama dengan sampel lain seperti KTK, dan KATK.

1.9 Analisis Kapasitansi Spesifik

Karbon Tempurung Kemiri

- dicampur dengan karbon tempurung kemiri dan lilin paraffin dengan perbandingan 1:1
- dipanaskan diatas *hotplate* dan diaduk hingga homogen
- dicetak dalam badan elektroda dan dikeringkan

Elektroda Karbon

Elektroda Karbon | Elektroda Pt | Elektroda Ag/AgCl

- dirangkai dalam alat Potensiostat
- dilakukan pengukuran dengan nilai *scanrate* 10, 20, 50 dan 100 mV/s menggunakan larutan Li_2SO_4 1 M dan $NaSO_4$ 1 sehingga diperoleh data voltammogram
- dihitung nilai kapasitansi spesifik

Hasil

Catatan: diulangi prosedur yang sama dengan sampel KATK

Lampiran 3. Perhitungan Pembuatan Larutan Pereaksi

3.1 Pembuatan Larutan KOH 25%

$$\% \frac{b}{v} = \frac{b}{v} \times 100\ \%$$

$$25\ \% = \frac{b}{500\ mL} \times 100\ \%$$

$$b = \frac{12500\%}{100}$$

$$b = 125\ gram$$

3.2 Pembuatan Larutan Na_2CO_3 0,05 N

gram = L × N × BE

gram = 0,25 L × 0,05 N × 53 g/eq = 0,6625 gram

3.3 Pembuatan Larutan $NaHCO_3$ 0,05 N

gram = L × N × BE

gram = 0,25 L × 0,05 N × 84 g/eq = 1,0500 gram

3.4 Pembuatan Larutan NaOH 0,05 N

gram = L × N × BE

gram = 0,25 L × 0,05 N × 40 g/eq = 0,5000 gram

3.5 Pembuatan Larutan HCl 0,05 N

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

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

$$N = 12{,}06\ N$$

$$V_1 \times N_1 = V_2 \times N_2$$

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

$V_1 = 1{,}03\ mL$

3.6 Pembuatan Larutan $Na_2B_4O_7$ 0,05 N

gram = L × N × BE

gram = 0,1 L × 0,05 N × 99 g/eq = 0,4950 gram

3.7 Pembuatan Larutan $H_2C_2O_4$ 0,05 N

gram = L × N × BE

gram = 0,1 L × 0,05 N × 63 g/eq = 0,3150 gram

3.8 Pembuatan Larutan Li_2SO_4 1 M

gram = L × M × BM

gram = 0,05 L × 1 M × 109,94 g/mol

gram = 5,4970 gram

3.9 Pembuatan Larutan Na_2SO_4 1 M

gram = L × M × BM

gram = 0.05 L × 0.5 M × 142.04 g/mol

gram = 7,1020 gram

Lampiran 4. Dokumentasi Penelitian

Tempurung Kemiri

Karbon Tempurung Kemiri

Karbon Tempurung Kemiri ukuran 50 mesh, 100 mesh dan 150 mesh

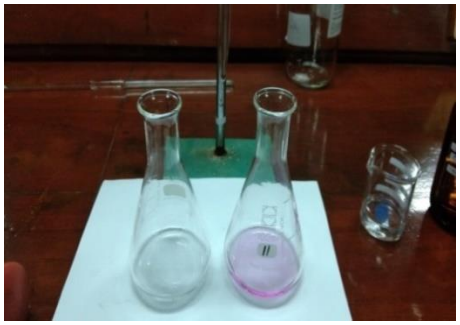
Aktivasi Karbon Tempurung Kemiri dengan KOH

Analisis Kadar Air

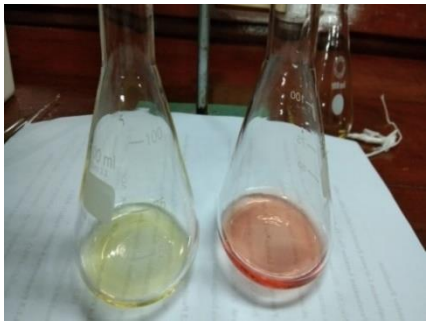
Karbon Aktif yang telah dikeringkan pada suhu 110°C

Analisis Kadar Abu

Analisis Kadar Senyawa Volatil



Standarisasi NaOH dengan $H_2C_2O_4$



Standarisasi HCl dengan $Na_2B_4O_7$

Perendaman sampel pada Titrasi Boehm

Hasil Titrasi Boehm

Elektroda karbon

Penentuan kapasitansi spesifik

Lampiran 5. Penentuan Kadar Air

$$\text{Kadar air (\%)} = \frac{\text{berat uap air}}{\text{berat awal sampel}} \times 100\ \%$$

$$\text{Kadar air (\%)} = \frac{B - C}{B - A} \times 100\ \%$$

1. Tempurung Kemiri

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Sampel (B-C)	Bobot awal (B-A)	Kadar Air (%)
1.	39.8126	40.3128	40.2835	0.0293	0.5002	5.8643
2.	45.5554	46.0562	46.0281	0.0281	0.5008	5.6110
3.	48.0456	48.5465	48.5179	0.0286	0.5009	5.7097
Rata-rata						5.7284

$$\text{Kadar air (\%)} = \frac{40.3128 - 40.2835}{40.3128 - 39.8126} \times 100\ \% = \frac{0.0293\ \text{gram}}{0.5002\ \text{gram}} \times 100\ \% = 5{,}8643\ \%$$

2. Karbon Tempurung Kemiri Suhu 600°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Sampel (B-C)	Bobot awal (B-A)	Kadar Air (%)
1	48.8334	49.3339	49.3051	0.0288	0.5005	5.7542
2	48.8396	49.3396	49.3079	0.0317	0.5000	6.3400
3	39.8395	40.3442	40.3159	0.0283	0.5047	5.6007
Rata-rata						5.8983

3. Karbon Tempurung Kemiri Suhu 650°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Sampel (B-C)	Bobot awal (B-A)	Kadar Air (%)
1	48.0455	48.5480	48.5343	0.0137	0.5025	2.7330
2	39.8130	40.3138	40.2999	0.0139	0.5008	2.7822
3	45.5560	46.0571	46.0460	0.0111	0.5011	2.2151
Rata-rata						2.5768

4. Karbon Tempurung Kemiri Suhu 700°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Sampel (B-C)	Bobot awal (B-A)	Kadar Air (%)
1	36.2956	36.7983	36.7752	0.0231	0.5027	4.6018
2	45.5804	46.0823	46.0596	0.0227	0.5019	4.5241
3	48.0624	48.5664	48.5521	0.0143	0.5040	2.8439
Rata-rata						3.9900

5. Karbon Tempurung Kemiri Suhu 750°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Sampel (B-C)	Bobot awal (B-A)	Kadar Air (%)
1	48.0454	48.5465	48.5320	0.0145	0.5011	2.8870
2	45.5555	46.0555	46.0418	0.0137	0.5000	2.7467
3	39.8128	40.3149	40.3026	0.0123	0.5021	2.4497
Rata-rata						2.6945

6. Karbon Tempurung Kemiri Suhu 800°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Sampel (B-C)	Bobot awal (B-A)	Kadar Air (%)
1	48.0586	48.5597	48.5085	0.0512	0.5011	10.2109
2	39.8295	40.3298	40.2764	0.0534	0.5003	10.6803
3	48.0456	48.5478	48.4952	0.0526	0.5022	10.4673
Rata-rata						10.4528

7. Karbon Tempurung Kemiri Suhu 900°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Sampel (B-C)	Bobot awal (B-A)	Kadar Air (%)
1	45.5687	46.0689	46.0128	0.0561	0.5002	11.2155
2	36.3137	36.8141	36.7569	0.0572	0.5004	11.4375
3	39.8127	40.3137	40.2542	0.0595	0.5010	11.8762
Rata-rata						11.5098

8. Karbon Aktif Tempurung Kemiri Suhu 800°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Sampel (B-C)	Bobot awal (B-A)	Kadar Air (%)
1	35.5797	36.0798	36.0779	0.0019	0.5001	0.3866
2	47.6024	48.1029	48.1003	0.0026	0.5005	0.5261
3	45.5549	46.0550	46.0529	0.0021	0.5001	0.4133
Rata-rata						0.4420

9. Karbon Aktif Tempurung Kemiri Suhu 850°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Sampel (B-C)	Bobot awal (B-A)	Kadar Air (%)
1	39.8470	40.3480	40.3465	0.0015	0.5010	0.2994
2	47.6026	48.1037	48.1003	0.0034	0.5011	0.6785
3	48.9893	49.4909	49.4882	0.0027	0.5016	0.5316
Rata-rata						0.5032

10. Karbon Aktif Tempurung Kemiri Suhu 900°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Sampel (B-C)	Bobot awal (B-A)	Kadar Air (%)
1	50.1062	50.6065	50.6040	0.0025	0.5003	0.4997
2	38.6238	39.1249	39.1238	0.0011	0.5011	0.2195
3	39.5440	40.0453	40.0438	0.0015	0.5013	0.3059
Rata-rata						0.3417

Lampiran 6. Penentuan Kadar Abu

$$\text{Kadar abu (\%)} = \frac{\text{berat abu}}{\text{berat awal sampel}} \times 100\ \%$$

$$\text{Kadar abu (\%)} = \frac{C - A}{B - A} \times 100\ \%$$

1. Tempurung Kemiri

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Abu (C-A)	Bobot Awal Sampel (B-A)	Kadar Abu (%)
1	50.4229	50.9235	50.4335	0.0106	0.5006	2.1241
2	43.5748	44.0756	43.5859	0.0111	0.5008	2.2165
3	45.8492	46.3490	45.8640	0.0148	0.4998	2.9545
Rata-rata						2.4317

$$\text{Kadar abu (\%)} = \frac{50.4335 - 50.4229}{50.9235 - 50.4229} \times 100\ \% = \frac{0.0106\ \text{gram}}{0.5006\ \text{gram}} \times 100\ \% = 2.1241\ \%$$

2. Karbon Tempurung Kemiri Suhu 600°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Abu (C-A)	Bobot Awal Sampel (B-A)	Kadar Abu (%)
1	49.0786	49.5788	49.1141	0.0355	0.5002	7.0972
2	54.8987	55.3988	54.9399	0.0412	0.5001	8.2384
3	45.3809	45.8860	45.4164	0.0355	0.5051	7.0283
Rata-rata						7.4546

3. Karbon Tempurung Kemiri Suhu 650°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Abu (C-A)	Bobot Awal Sampel (B-A)	Kadar Abu (%)
1	31.5137	32.0140	31.5409	0.0272	0.5003	5.4367
2	29.5475	30.0478	29.5751	0.0276	0.5003	5.5100
3	32.3045	32.8048	32.3252	0.0207	0.5003	4.1309
Rata-rata						5.0259

4. Karbon Tempurung Kemiri Suhu 700°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Abu (C-A)	Bobot Awal Sampel (B-A)	Kadar Abu (%)
1	32.2977	32.7989	32.3204	0.0227	0.5012	4.5358
2	31.4968	31.9978	31.5179	0.0211	0.5010	4.2049
3	29.5328	30.0332	29.5525	0.0197	0.5004	3.9369
Rata-rata						4.2259

5. Karbon Tempurung Kemiri Suhu 750°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Abu (C-A)	Bobot Awal Sampel (B-A)	Kadar Abu (%)
1	31.5012	32.0014	31.5403	0.0391	0.5002	7.8169
2	29.5413	30.0420	29.5817	0.0404	0.5007	8.0754
3	32.2992	32.7999	32.3506	0.0514	0.5007	10.2590
Rata-rata						8.7171

6. Karbon Tempurung Kemiri Suhu 800°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Abu (C-A)	Bobot Awal Sampel (B-A)	Kadar Abu (%)
1	54.8704	55.3713	54.8873	0.0169	0.5009	3.3806
2	45.3848	45.8852	45.4022	0.0174	0.5004	3.4839
3	32.3472	32.8478	32.3642	0.0170	0.5006	3.4026
Rata-rata						3.4223

7. Karbon Tempurung Kemiri Suhu 900°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Abu (C-A)	Bobot Awal Sampel (B-A)	Kadar Abu (%)
1	29.5358	30.0358	29.5662	0.0304	0.5000	6.0733
2	31.5495	32.0520	31.5796	0.0301	0.5025	5.9900
3	32.3448	32.8449	32.3739	0.0291	0.5001	5.8122
Rata-rata						5.9585

8. Karbon Aktif Tempurung Kemiri Suhu 800°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Abu (C-A)	Bobot Awal Sampel (B-A)	Kadar Abu (%)
1	45.8836	46.3839	45.8882	0.0046	0.5003	0.9128
2	26.9522	27.4526	26.9567	0.0045	0.5004	0.8926
3	43.6672	44.1678	43.6713	0.0041	0.5006	0.8124
Rata-rata						0.8726

9. Karbon Aktif Tempurung Kemiri Suhu 850°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Abu (C-A)	Bobot Awal Sampel (B-A)	Kadar Abu (%)
1	26.8271	27.3275	26.831	0.0039	0.5004	0.7794
2	26.9523	27.4546	26.956	0.0037	0.5023	0.7366
3	45.8595	46.3598	45.86277	0.003267	0.5003	0.6529
Rata-rata						0.7230

10. Karbon Aktif Tempurung Kemiri Suhu 900°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampe (B)	Bobot Konstan (C)	Bobot Abu (C-A)	Bobot Awal Sampel (B-A)	Kadar Abu (%)
1	24.9645	25.4648	24.96947	0.004967	0.5003	0.9927
2	43.5894	44.0901	43.5946	0.0052	0.5007	1.0385
3	32.2567	32.7579	32.2634	0.0067	0.5012	1.3368
Rata-rata						1.1227

Lampiran 7. Penentuan Kadar Zat Volatil

$$\text{Kadar Zat Volatil (\%)} = \left(\frac{\text{berat volatil}}{\text{berat awal sampel}} \text{ x } 100\ \% \right)$$

$$\text{Kadar Zat Volatil (\%)} = \frac{\text{B -C}}{\text{B - A}} \text{ x } 100\ \%$$

1. Tempurung Kemiri

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Senyawa Volatil (B-C)	Bobot Awal Sampel (B-A)	Kadar Zat Volatil (%)
1	21.1457	21.6457	21.2209	0.4248	0.5000	84.9600
1	26.7595	27.2598	26.8415	0.4183	0.5003	83.6098
3	22.3651	22.8656	22.4459	0.4197	0.5005	83.8561
Rata-rata						84.1420

$$\text{Kadar Zat Volatil (\%)} = \left(\frac{21.6457 - 21.2209}{21.6457 - 21.1457}\text{x}100\ \%\right) = \left(\frac{0.4248}{0.5000}\text{x}100\ \%\right) = 84.96\ \%$$

2. Karbon Tempurung Kemiri Suhu 600°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Senyawa Volatil (B-C)	Bobot Awal Sampel (B-A)	Kadar Zat Volatil (%)
1	22.3614	22.8614	22.5416	0.3198	0.5000	63.9600
2	21.5416	22.0418	21.7216	0.3202	0.5002	64.0144
3	26.7595	27.2596	26.9389	0.3207	0.5001	64.1272
Rata-rata						64.0339

3. Karbon Tempurung Kemiri Suhu 650°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Senyawa Volatil (B-C)	Bobot Awal Sampel (B-A)	Kadar Zat Volatil (%)
1	29.5465	30.0481	29.7443	0.3038	0.5016	60.5662
2	31.5298	32.0308	31.7255	0.3053	0.5010	60.9381
3	32.3056	32.8060	32.5006	0.3054	0.5004	61.0312
Rata-rata						60.8452

4. Karbon Tempurung Kemiri Suhu 700°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Senyawa Volatil (B-C)	Bobot Awal Sampel (B-A)	Kadar Zat Volatil (%)
1	31.5460	32.0462	31.7853	0.2609	0.5002	52.1591
2	45.8480	46.3484	46.0825	0.2659	0.5004	53.1375
3	32.3086	32.8094	32.5570	0.2524	0.5008	50.3994
Rata-rata						51.8987

5. Karbon Tempurung Kemiri Suhu 750°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Senyawa Volatil (B-C)	Bobot Awal Sampel (B-A)	Kadar Zat Volatil (%)
1	31.5306	32.0132	31.7324	0.2808	0.4826	58.1848
2	32.3050	32.8053	32.5018	0.3035	0.5003	60.6636
3	29.5462	30.0484	29.7577	0.2907	0.5022	57.8853
Rata-rata						58.9112

6. Karbon Tempurung Kemiri Suhu 800°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Senyawa Volatil (B-C)	Bobot Awal Sampel (B-A)	Kadar Zat Volatil (%)
1	29.5421	30.0428	29.7378	0.3050	0.5007	60.9147
2	29.5432	30.0442	29.7528	0.2914	0.5010	58.1637
3	29.5451	30.0455	29.7679	0.2776	0.5004	55.4756
Rata-rata						58.1847

7. Karbon Tempurung Kemiri Suhu 900°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Senyawa Volatil (B-C)	Bobot Awal Sampel (B-A)	Kadar Zat Volatil (%)
1	32.3024	32.8030	32.5441	0.2589	0.5006	51.7179
2	31.5003	32.0065	31.7509	0.2556	0.5062	50.4939
3	29.5434	30.0440	29.7781	0.2659	0.5006	53.1163
Rata-rata						51.7760

8. Karbon Aktif Tempurung Kemiri Suhu 800°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Senyawa Volatil (B-C)	Bobot Awal Sampel (B-A)	Kadar Zat Volatil (%)
1	26.9500	27.9507	27.5317	0.2664	1.0007	26.6214
2	16.9059	17.9060	17.3743	0.2602	1.0001	26.0174
3	26.8252	27.8257	27.4030	0.2460	1.0005	24.5877
Rata-rata						25.7422

9. Karbon Aktif Tempurung Kemiri Suhu 850°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Senyawa Volatil (B-C)	Bobot Awal Sampel (B-A)	Kadar Zat Volatil (%)
1	26.8276	27.8298	27.5858	0.2440	1.0022	24.3464
2	16.8985	17.8990	27.5612	0.2672	1.0009	26.6960
3	26.9540	27.9557	27.7220	0.2337	1.0017	23.3303
Rata-rata						24.7909

10. Karbon Aktif Tempurung Kemiri Suhu 900°C

No.	Bobot Kosong Cawan (A)	Bobot Cawan + Sampel (B)	Bobot Konstan (C)	Bobot Senyawa Volatil (B-C)	Bobot Awal Sampel (B-A)	Kadar Zat Volatil (%)
1	24.9656	25.9680	25.7282	0.2398	1.0024	23.9226
2	26.8288	27.8316	27.5941	0.2375	1.0028	23.6837
3	16.8969	17.8980	17.6603	0.2377	1.0011	23.7439
Rata-rata						23.7834

Lampiran 8. Perhitungan Kadar Karbon Tetap

Sampel	Kadar Air (%)	Kadar Abu (%)	Kadar Zat Volatil (%)	Kadar Karbon Tetap (%)
TK	5,7284	2,,4317	84,1420	7,6979
KTK 600˚C	5,8983	7,4546	64,0339	22,6132
KTK 650˚C	2,5768	5,0259	60,8452	31,5522
KTK 700˚C	3,9900	4,2259	51,8987	39,8855
KTK 750˚C	2,6945	8,7171	58,9112	29,6772
KTK 800˚C	10,4528	3,4223	58,1847	27,9402
KTK 900˚C	11,5098	5,9585	51,7760	30,7557
KATK 800˚C	0,4420	0,8726	25,7422	72,9433
KATK 850˚C	0,5032	0,7230	24,7909	73,9829
KATK 900˚C	0,3417	1,1227	23,7834	74,7522

a. Tempurung Kemiri

Karbon tetap (%) = 100 % - (kadar air + kadar abu + zat volatil) %

Karbon tetap (%) = 100 % - (5.7284 + 2.4317 + 84.1420) %

Karbon tetap (%) = 7.6979 %

b. Karbon Tempurung Kemiri suhu 600°C

Karbon tetap (%) = 100 % - (kadar air + kadar abu + zat volatil) %

Karbon tetap (%) = 100 % - (5.8983 + 7.4546 + 64.0339) %

Karbon tetap (%) = 22.6132 %

c. Karbon Tempurung Kemiri suhu 650°C

Karbon tetap (%) = 100 % - (kadar air + kadar abu + zat volatil) %

Karbon tetap (%) = 100 % - (2.5768 + 5.0259 + 0.8452) %

Karbon tetap (%) = 31.5522 %

d. Karbon Tempurung Kemiri suhu 700°C

Karbon tetap (%) = 100 % - (kadar air + kadar abu + zat volatil) %

Karbon tetap (%) = 100 % - (3.9900 + 4.2259 + 51.8987) %

Karbon tetap (%) = 39.8855 %

e. Karbon Tempurung Kemiri suhu 750°C

Karbon tetap (%) = 100 % - (kadar air + kadar abu + zat volatil) %

Karbon tetap (%) = 100 % - (2.6945 + 8.7171 + 58.9112) %

Karbon tetap (%) = 29.772 %

f. Karbon Tempurung Kemiri suhu 800°C

Karbon tetap (%) = 100 % - (kadar air + kadar abu + zat volatil) %

Karbon tetap (%) = 100 % - (10.4528 + 3.4223 + 58.1847) %

Karbon tetap (%) = 27.9402 %

g. Karbon Tempurung Kemiri suhu 900°C

Karbon tetap (%) = 100 % - (kadar air + kadar abu + zat volatil) %

Karbon tetap (%) = 100 % - (11.5098 + 5.9585 + 51.7760) %

Karbon tetap (%) = 30.7557 %

h. Karbon Tempurung Kemiri suhu 800°C

Karbon tetap (%) = 100 % - (kadar air + kadar abu + zat volatil) %

Karbon tetap (%) = 100 % - (0.4420 + 0.8726 + 25.7422) %

Karbon tetap (%) = 72.9433 %

i. Karbon Tempurung Kemiri suhu 850°C

Karbon tetap (%) = 100 % - (kadar air + kadar abu + zat volatil) %

Karbon tetap (%) = 100 % - (0.5032 + 0.7230 + 24.7909) %

Karbon tetap (%) = 73.9829 %

j. Karbon Tempurung Kemiri suhu 900°C

Karbon tetap (%) = 100 % - (kadar air + kadar abu + zat volatil) %

Karbon tetap (%) = 100 % - (0.3417 + 1.1227 + 23.7834) %

Karbon tetap (%) = 74.7522 %

Lampiran 9. Data Hasil Analisis XRD

1. Karbon Tempurung Kemiri 600°C

*** Basic Data Process ***

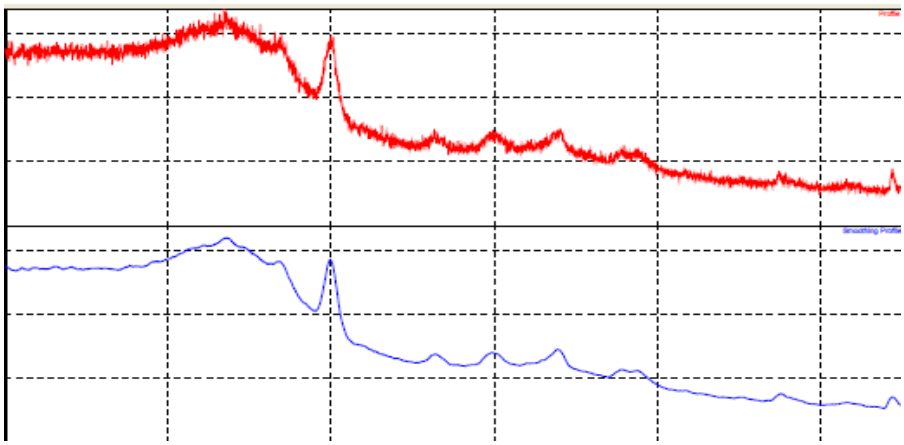
Group : Standard
Data : Carbon#600C#6jam

Strongest 3 peaks

no.	peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	13	29.9271	2.98329	100	0.95020	460	24322
2	9	23.6000	3.76682	72	0.00000	331	0
3	10	24.7200	3.59863	67	0.00000	310	0

Peak Data List

peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	13.0900	6.75799	3	0.40000	14	374
2	17.6200	5.02944	9	0.66000	40	1968
3	19.2600	4.60472	18	1.38000	83	7056
4	20.0800	4.41849	25	0.00000	115	0
5	20.5000	4.32890	30	0.00000	136	0
6	20.6000	4.30811	32	0.00000	148	0
7	21.4800	4.13356	46	0.00000	210	0
8	22.2000	4.00110	53	0.00000	246	0
9	23.6000	3.76682	72	0.00000	331	0
10	24.7200	3.59863	67	0.00000	310	0
11	25.3000	3.51744	62	0.00000	286	0
12	26.8000	3.32387	67	2.05000	306	38881
13	29.9271	2.98329	100	0.95020	460	24322
14	36.3817	2.46746	13	0.83000	61	2751
15	39.9433	2.25527	21	1.35330	98	7312
16	42.0000	2.14947	11	0.84000	51	4245
17	42.9800	2.10270	17	0.00000	76	0
18	43.7620	2.06692	35	1.36400	159	11407
19	45.6200	1.98697	8	0.00000	39	0
20	46.2800	1.96015	6	0.00000	27	0
21	46.4800	1.95219	6	0.00000	29	0
22	47.7800	1.90206	18	1.00000	82	4142
23	48.7600	1.86610	19	1.38660	89	5867
24	57.7241	1.59581	12	1.01830	54	2273
25	58.6400	1.57305	3	0.80000	15	853
26	61.6700	1.50283	5	0.86000	23	934
27	62.1600	1.49215	3	0.80000	14	463
28	64.4433	1.44468	14	0.52670	66	1691



2. Karbon Tempurung Kemiri 650°C

*** Basic Data Process ***

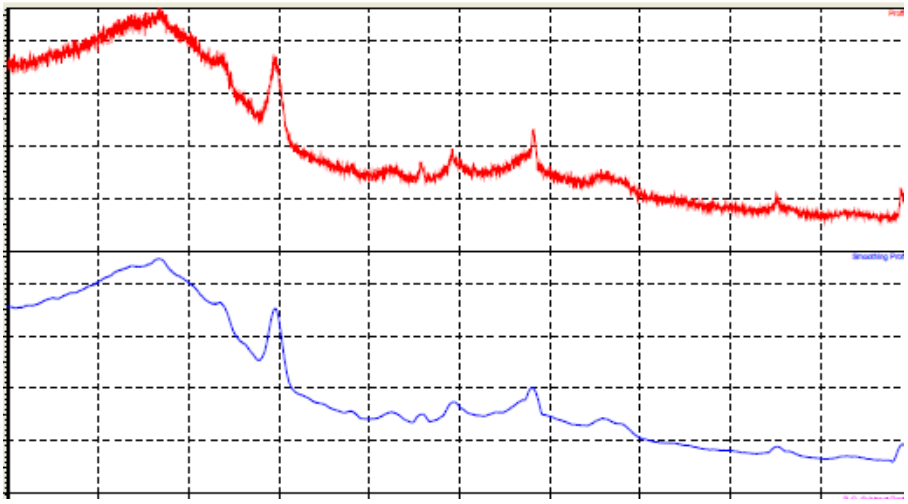
Group : Standard
Data : AC#650#2020

Strongest 3 peaks

no.	peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	11	29.7597	2.99969	100	0.86950	556	29945
2	7	23.3800	3.80177	97	0.00000	541	0
3	8	24.5400	3.62462	82	0.00000	458	0

Peak Data List

peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	17.4600	5.07516	14	1.20000	80	7485
2	18.4400	4.80759	24	0.00000	134	0
3	19.4200	4.56714	36	0.00000	198	0
4	20.4800	4.33308	53	0.00000	297	0
5	21.0800	4.21109	64	0.00000	358	0
6	21.7800	4.07730	76	0.00000	420	0
7	23.3800	3.80177	97	0.00000	541	0
8	24.5400	3.62462	82	0.00000	458	0
9	26.7400	3.33119	71	1.64580	396	62059
10	28.1800	3.16415	28	0.00000	155	0
11	29.7597	2.99969	100	0.86950	556	29945
12	33.9900	2.63541	5	0.42000	27	553
13	36.2508	2.47607	11	0.98830	61	2942
14	37.8610	2.37438	12	0.57800	64	1771
15	38.7400	2.32251	4	0.65340	24	1155
16	39.8100	2.26252	30	1.26000	165	14283
17	41.9800	2.15044	19	0.00000	103	0
18	43.2600	2.08973	35	0.00000	194	0
19	44.0000	2.05629	56	0.85140	313	17459
20	44.9600	2.01459	19	0.00000	105	0
21	45.2800	2.00109	15	0.00000	86	0
22	45.7400	1.98203	13	0.00000	71	0
23	46.6200	1.94665	11	0.00000	62	0
24	47.9000	1.89757	24	1.52000	133	8706
25	48.8400	1.86323	19	1.32000	108	6715
26	57.5783	1.59950	12	0.73670	65	2717
27	58.4800	1.57697	5	0.26000	26	638
28	61.4000	1.50879	5	0.96000	27	924
29	61.9200	1.49736	5	1.05000	28	1316
30	64.4585	1.44438	25	0.60700	138	4255



3. Karbon Tempurung Kemiri 700°C

*** Basic Data Process ***

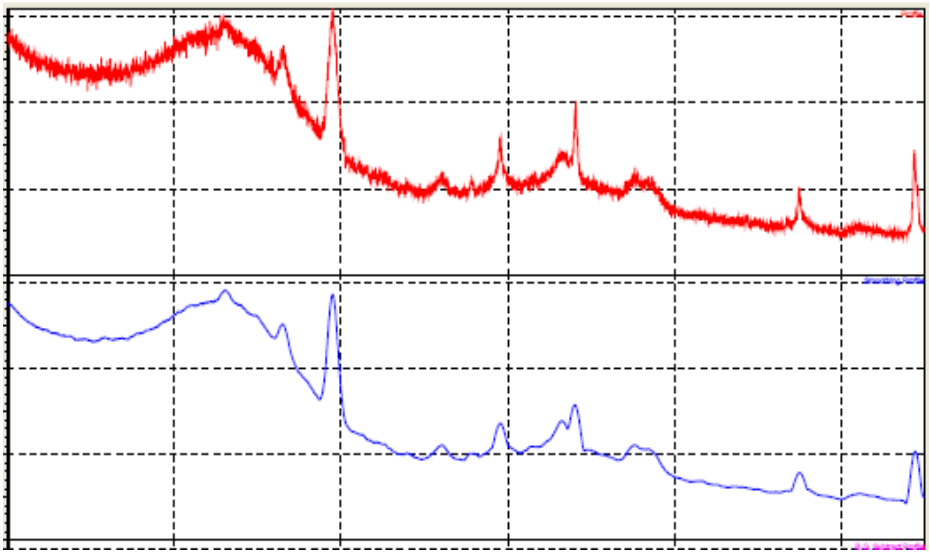
Group : Standard
Data : Carbon#700#3

Strongest 3 peaks

no.	peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	15	29.4716	3.02836	100	0.73370	584	21527
2	10	23.0400	3.85709	60	0.00000	353	0
3	13	26.4600	3.36580	54	1.38660	318	27786

Peak Data List

peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	15.9050	5.56768	4	0.65000	23	937
2	16.8600	5.25440	5	1.02000	27	1121
3	17.8600	4.96239	9	1.08000	55	2647
4	18.3400	4.83358	13	0.00000	75	0
5	19.4400	4.56248	22	0.00000	130	0
6	20.2000	4.39251	32	0.00000	185	0
7	21.0800	4.21109	41	0.00000	237	0
8	21.5800	4.11463	43	0.00000	252	0
9	22.0600	4.02618	47	0.00000	275	0
10	23.0400	3.85709	60	0.00000	353	0
11	23.9600	3.71103	54	0.00000	313	0
12	24.9200	3.57020	51	0.00000	295	0
13	26.4600	3.36580	54	1.38660	318	27786
14	27.7800	3.20880	20	1.61340	114	9642
15	29.4716	3.02836	100	0.73370	584	21527
16	35.9733	2.49453	10	0.78670	60	2451
17	37.8466	2.37525	4	0.54670	22	595
18	38.7400	2.32251	5	0.52000	29	949
19	39.5310	2.27784	29	0.75400	168	6620
20	40.3200	2.23507	8	0.00000	44	0
21	41.5200	2.17320	11	1.38660	65	5351
22	42.2600	2.13684	16	0.00000	92	0
23	43.2000	2.09250	34	1.46660	199	10888
24	43.9800	2.05718	48	0.80580	280	10375
25	44.9200	2.01629	13	0.00000	77	0
26	45.6800	1.98450	10	0.00000	61	0
27	47.6000	1.90883	22	1.25000	131	8878
28	48.4000	1.87913	21	1.45340	121	6604
29	49.6600	1.83436	3	0.48000	20	812
30	57.4991	1.60152	19	0.65170	109	4453
31	61.0900	1.51570	5	1.22000	32	1973
32	62.0200	1.49518	3	0.36000	19	460
33	64.4268	1.44501	41	0.55890	238	6428



4. Karbon Tempurung Kemiri 800°C

*** Basic Data Process ***

Group : Standard
Data : Carbon#800#3

Strongest 3 peaks

no.	peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	9	29.4431	3.03122	100	0.55380	1020	31363
2	7	26.5133	3.35916	32	0.77780	326	18730
3	4	23.1400	3.84065	21	1.25600	219	15709

Peak Data List

peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	20.6800	4.29163	8	0.75420	85	5614
2	21.3000	4.16809	9	0.00000	88	0
3	22.1400	4.01181	11	0.00000	116	0
4	23.1400	3.84065	21	1.25600	219	15709
5	24.2200	3.67178	14	0.00000	145	0
6	25.2000	3.53117	15	0.00000	154	0
7	26.5133	3.35916	32	0.77780	326	18730
8	28.0189	3.18198	15	0.47490	152	4695
9	29.4431	3.03122	100	0.55380	1020	31363
10	35.3600	2.53638	3	0.32000	33	634
11	36.0160	2.49167	13	0.63200	128	4084
12	39.4642	2.28154	20	0.62570	203	7879
13	41.7400	2.16225	3	0.76800	33	2106
14	43.1500	2.09481	21	1.11000	218	11071
15	44.1000	2.05186	13	0.49720	137	3220
16	44.7400	2.02398	4	0.59000	39	1903
17	47.5089	1.91228	18	0.78220	186	7659
18	48.5275	1.87449	17	0.76500	175	6856
19	56.6600	1.62322	3	0.42000	32	940
20	57.5164	1.60108	11	0.53290	113	3889
21	60.9500	1.51884	5	0.90000	47	2727
22	64.4885	1.44378	19	0.39800	196	4193

5. Karbon Tempurung Kemiri 900°C

*** Basic Data Process ***

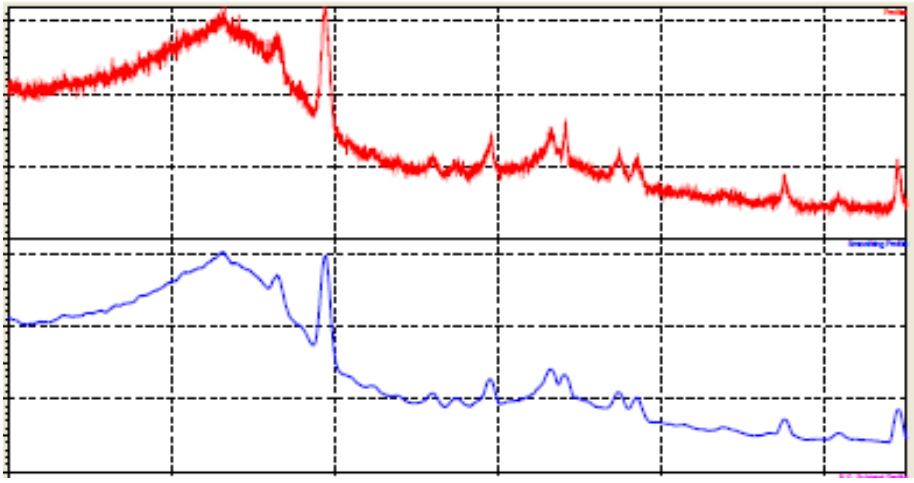
Group : Standard
Data : Carbon#900#3jam

Strongest 3 peaks

no.	peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	17	29.3508	3.04055	100	0.71010	620	22190
2	11	23.1600	3.83738	65	0.00000	400	0
3	15	26.4200	3.37081	62	1.38500	383	28644

Peak Data List

peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	13.3800	6.61217	4	0.60000	22	827
2	15.5260	5.70273	4	0.61200	23	1066
3	16.6000	5.33611	8	0.86000	47	1900
4	17.0200	5.20536	9	0.00000	54	0
5	18.2000	4.87044	16	2.08000	97	7199
6	18.8200	4.71137	19	0.00000	117	0
7	19.9600	4.44478	29	0.00000	181	0
8	20.8600	4.25500	40	0.00000	245	0
9	21.5000	4.12976	44	0.00000	273	0
10	22.2800	3.98692	52	0.00000	325	0
11	23.1600	3.83738	65	0.00000	400	0
12	23.8400	3.72944	58	0.00000	361	0
13	24.6400	3.61014	57	0.00000	351	0
14	25.2000	3.53117	53	0.00000	329	0
15	26.4200	3.37081	62	1.38500	383	28644
16	27.7400	3.21334	27	1.69340	165	13365
17	29.3508	3.04055	100	0.71010	620	22190
18	30.8166	2.89918	3	0.64670	20	802
19	32.3000	2.76934	4	0.52000	24	571
20	35.9133	2.49856	10	0.66670	64	2210
21	37.3875	2.40336	6	0.65500	38	1280
22	38.7600	2.32136	5	0.54000	31	1022
23	39.4376	2.28302	24	0.65810	151	4706
24	40.7200	2.21403	5	1.16000	33	1260
25	40.9000	2.20470	5	0.00000	34	0
26	41.5400	2.17220	8	0.00000	52	0
27	41.8400	2.15732	10	0.00000	65	0
28	42.3800	2.13107	18	0.00000	110	0
29	43.1200	2.09619	36	1.44000	226	11042
30	43.9800	2.05718	33	0.94400	204	8945
31	44.8800	2.01799	12	0.00000	74	0
32	45.3400	1.99858	12	0.00000	72	0
33	47.3265	1.91922	23	0.83700	143	9220
34	48.3967	1.87925	21	0.74000	128	4699
35	53.8900	1.69993	5	1.02000	30	1762
36	56.5200	1.62691	3	0.48000	21	635
37	57.4819	1.60195	17	0.64960	106	3710
38	60.7950	1.52234	6	0.71000	40	1698
39	64.4365	1.44482	29	0.57060	180	5037



6. Karbon Aktif Tempurung Kemiri 850°C

*** Basic Data Process ***

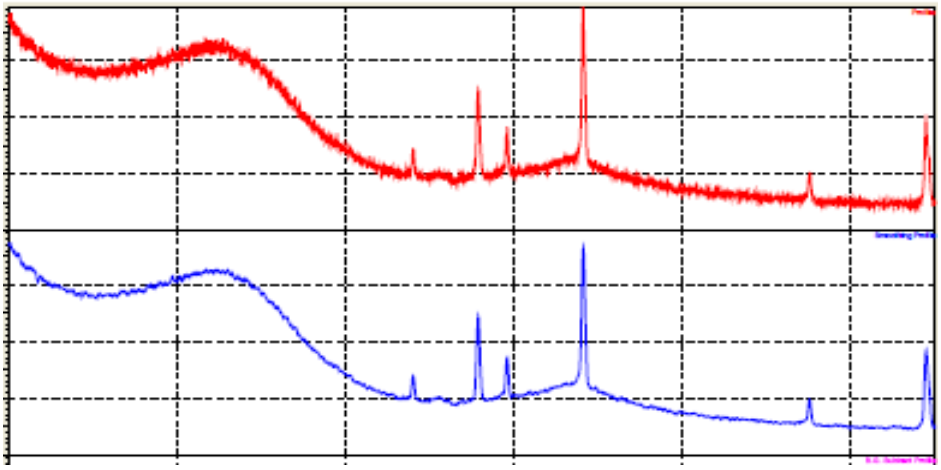
Group : Standard
Data : KOH#850C

Strongest 3 peaks

no.	peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	68	44.0744	2.05299	100	0.20960	1333	17651
2	85	64.4453	1.44464	57	0.20680	759	8916
3	48	37.8331	2.37607	53	0.20380	705	8042

Peak Data List

peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	16.2959	5.43499	3	0.18590	42	699
2	16.6400	5.32337	5	0.28620	63	1131
3	16.8600	5.25440	5	0.00000	64	0
4	17.2000	5.15129	5	0.00000	73	0
5	17.2800	5.12762	6	0.00000	85	0
6	17.6400	5.02378	7	0.00000	91	0
7	17.8000	4.97898	6	0.00000	80	0
8	18.2200	4.86514	10	0.00000	127	0
9	18.4600	4.80243	11	0.00000	145	0
10	18.7000	4.74133	11	0.00000	142	0
11	18.9200	4.68669	13	0.00000	177	0
12	19.2200	4.61421	12	0.00000	158	0
13	19.7000	4.50285	17	0.00000	229	0
14	20.1200	4.40979	19	0.00000	250	0
15	20.4000	4.34989	19	0.00000	250	0
16	20.8400	4.25904	22	0.00000	290	0
17	20.9800	4.23093	22	0.00000	296	0
18	21.2400	4.17972	23	0.00000	311	0
19	21.4200	4.14501	23	0.00000	309	0
20	21.6400	4.10336	26	0.00000	341	0
21	22.0200	4.03340	26	0.00000	351	0
22	22.3000	3.98339	27	0.00000	361	0
23	22.7000	3.91409	28	0.00000	367	0
24	23.0000	3.86371	29	0.00000	390	0
25	23.2200	3.82760	28	0.00000	377	0
26	23.6000	3.76682	28	0.00000	373	0
27	23.7600	3.74182	27	0.00000	365	0
28	24.0400	3.69886	29	0.00000	383	0
29	24.2400	3.66880	26	0.00000	352	0
30	24.8000	3.58721	26	0.00000	347	0
31	25.0600	3.55058	25	0.00000	332	0
32	25.6800	3.46624	21	0.00000	284	0
33	25.9200	3.43469	21	0.00000	274	0
34	26.1600	3.40372	17	0.00000	226	0
35	26.4600	3.36580	17	0.00000	225	0
36	27.0000	3.29970	13	0.00000	176	0
37	27.2200	3.27353	11	0.00000	145	0
38	27.5400	3.23622	9	0.00000	117	0
39	27.8000	3.20654	7	0.00000	96	0
40	28.0400	3.17963	7	0.00000	90	0
41	28.3200	3.14883	6	0.00000	79	0
42	28.6200	3.11650	5	0.24000	61	1507
43	28.9000	3.08694	3	0.00000	46	0
44	29.1200	3.06412	4	0.14860	47	562
45	29.4243	3.03312	4	0.33530	49	1349
46	33.9775	2.63635	15	0.15650	203	1895
47	35.5426	2.52377	3	0.38130	45	1333
48	37.8331	2.37607	53	0.20380	705	8042
49	38.4800	2.33760	3	0.40000	40	964



7. Karbon Aktif Tempurung Kemiri 900°C

*** Basic Data Process ***

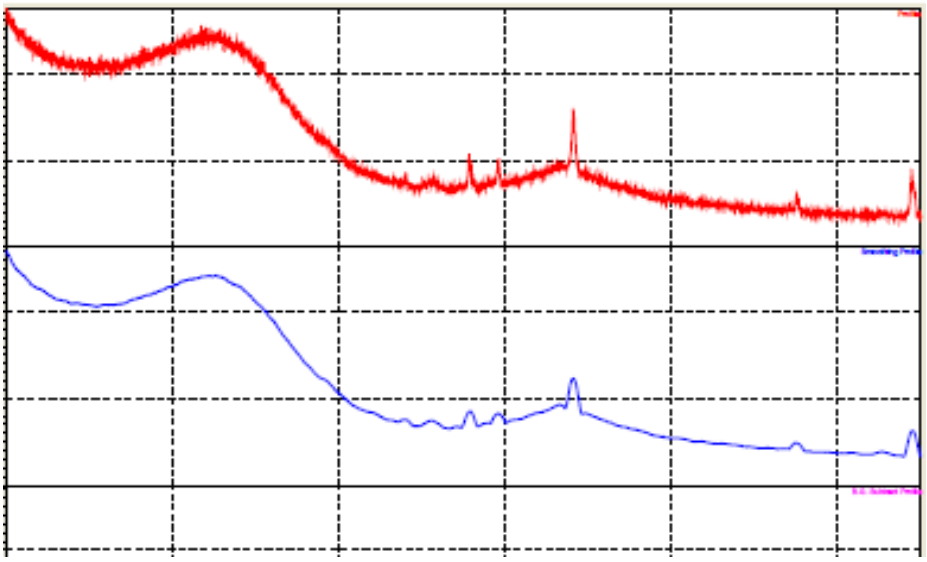
Group : Standard
Data : KOH#900C

Strongest 3 peaks

no.	peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	7	22.8800	3.88370	100	0.00000	551	0
2	8	24.2400	3.66880	94	0.00000	516	0
3	22	44.0475	2.05418	88	0.74900	485	28168

Peak Data List

peak no.	2Theta (deg)	d (A)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated Int (Counts)
1	16.0000	5.53483	5	0.60660	26	1110
2	17.5400	5.05220	19	1.21600	102	8327
3	18.3200	4.83881	30	0.00000	166	0
4	19.0200	4.66228	40	0.00000	220	0
5	19.6600	4.51192	52	0.00000	289	0
6	21.1600	4.19535	78	0.00000	430	0
7	22.8800	3.88370	100	0.00000	551	0
8	24.2400	3.66880	94	0.00000	516	0
9	25.7800	3.45302	70	0.00000	383	0
10	27.2000	3.27589	38	0.00000	210	0
11	28.0200	3.18186	23	0.00000	128	0
12	28.9800	3.07860	14	1.48000	79	7861
13	33.9633	2.63742	7	0.55330	40	1053
14	35.5816	2.52109	11	0.86330	63	2705
15	37.0500	2.42447	3	0.38000	17	316
16	37.8373	2.37582	28	0.57680	157	4416
17	38.7200	2.32366	9	0.43200	48	1215
18	39.5540	2.27657	24	0.73200	134	4671
19	40.6000	2.22030	15	1.12000	80	10036
20	42.0200	2.14849	27	0.00000	149	0
21	42.9800	2.10270	38	0.00000	212	0
22	44.0475	2.05418	88	0.74900	485	28168
23	45.1000	2.00866	27	0.00000	148	0
24	45.4800	1.99276	24	0.00000	130	0
25	45.6200	1.98697	22	0.00000	119	0
26	46.0000	1.97143	19	0.00000	107	0
27	47.1000	1.92792	12	0.00000	65	0
28	48.1800	1.88720	7	0.92000	38	4272
29	57.4775	1.60207	13	0.58500	71	2216
30	62.6000	1.48272	5	0.70000	29	1095
31	64.4452	1.44465	42	0.54300	229	6024



***Database* JCPDS Karbon**

PDF # 200258, Wavelength = 1.5418 (A)

20-0258 (Deleted)

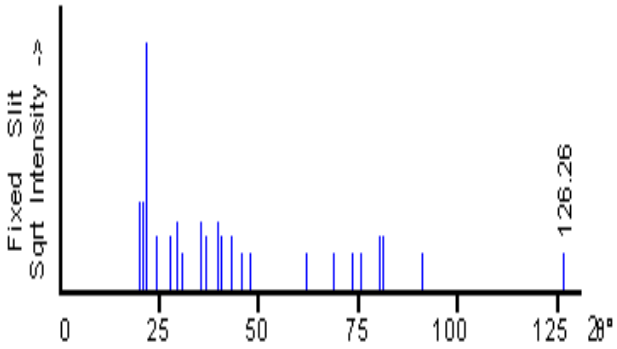
CAS Number:

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:

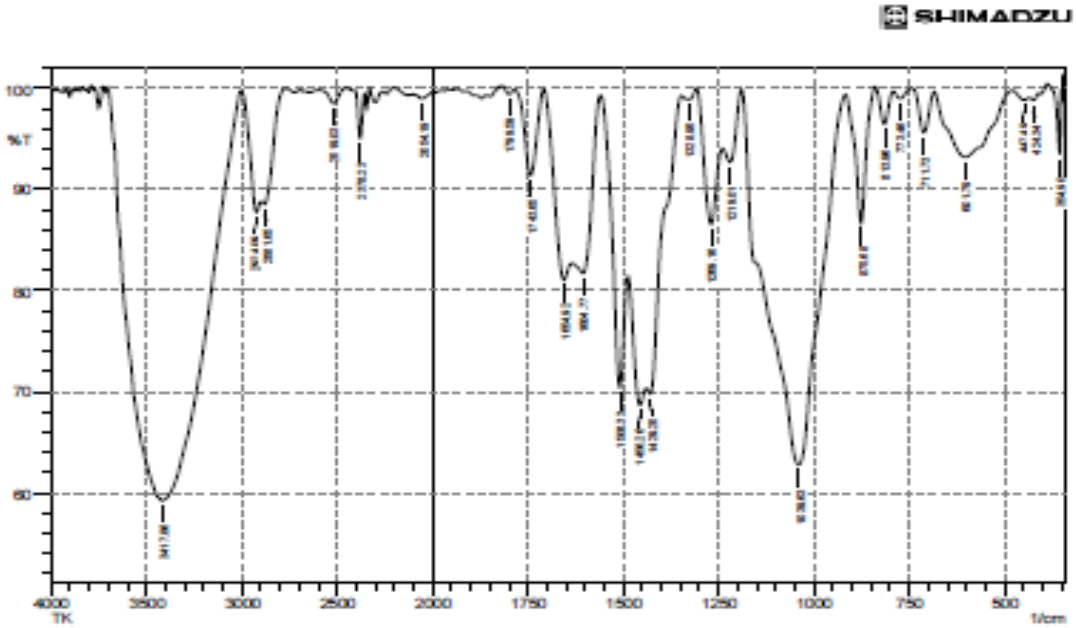
C
Carbon
Ref: Goresy, Donnay, Science, 161, 363 (1968)



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 11. Data Spektrum FTIR

1. Tempurung Kemiri



	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	354.9	93.466	6.443	387.69	351.04	0.242	0.267
2	424.34	98.832	0.432	435.91	406.91	0.108	0.025
3	447.49	98.858	0.398	480.28	435.91	0.152	0.042
4	601.79	93.206	6.493	682.8	482.2	3.756	3.507
5	711.73	95.628	4.179	742.59	684.73	0.544	0.499
6	773.46	98.968	0.82	790.81	742.59	0.114	0.083
7	813.96	96.473	3.446	839.03	790.81	0.361	0.346
8	875.68	86.657	13.135	916.19	839.03	1.91	1.838
9	1039.63	62.782	36.81	1188.15	916.12	28.488	28.036
10	1219.01	92.693	3.684	1238.3	1190.08	1.081	0.451
11	1269.16	86.549	10.117	1305.81	1240.23	2.473	1.571
12	1328.96	98.898	0.716	1346.31	1307.74	0.14	0.081
13	1429.25	89.779	3.632	1438.9	1348.24	8.69	0.408
14	1456.26	68.689	5.439	1485.19	1440.83	5.294	0.837
15	1508.33	70.404	16.445	1556.56	1487.12	5.734	2.45
16	1604.77	81.706	7.098	1631.78	1558.48	4.389	1.344
17	1654.92	81.058	8.628	1707	1633.71	4.292	1.196
18	1743.66	91.39	8.51	1782.23	1708.93	1.337	1.305
19	1799.59	99.401	0.655	1816.94	1784.15	0.037	0.047
20	2054.19	99.008	0.494	2102.41	2004.04	0.325	0.112
21	2378.23	95.078	4.536	2406.23	2357.01	0.541	0.464
22	2519.03	98.52	1.461	2600.04	2453.45	0.39	0.372
23	2881.66	88.532	1.601	2897.08	2767.86	3.227	0.376
24	2924.09	87.73	3.705	3003.17	2899.01	3.443	0.728
25	3417.86	59.196	40.763	3705.26	3005.1	92.869	92.641

Comment;

TK

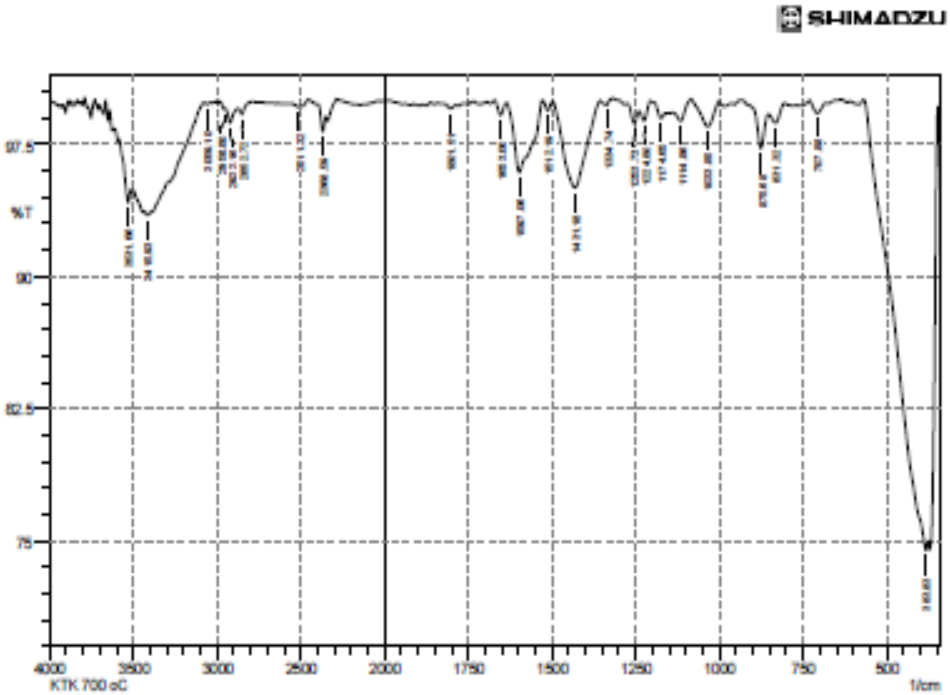
Date/Time; 11/16/2020 9:17:13 AM

No. of Scans;

Resolution;

Apodization;

2. Karbon Tempurung Kemiri 700°C



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	383.83	74.476	1.228	567.07	378.05	12.478	0.644
2	707.88	99.286	0.641	731.02	680.87	0.091	0.074
3	831.32	98.713	0.787	852.54	806.25	0.178	0.082
4	875.68	97.276	2.135	916.19	852.54	0.339	0.197
5	1033.85	98.522	1.457	1083.99	1002.98	0.269	0.269
6	1114.86	98.837	0.812	1139.93	1083.99	0.161	0.085
7	1174.65	98.988	0.574	1195.87	1157.29	0.112	0.043
8	1224.8	98.847	0.789	1240.23	1205.51	0.108	0.058
9	1253.73	98.71	0.842	1274.95	1240.23	0.122	0.062
10	1334.74	99.747	0.076	1338.6	1317.38	0.004	-0.002
11	1431.18	95.061	4.902	1496.78	1355.96	1.63	1.609
12	1512.19	99.435	0.534	1527.62	1496.78	0.039	0.035
13	1597.06	95.916	3.976	1633.71	1529.55	1.073	1.034
14	1653	99.184	0.764	1670.35	1635.64	0.066	0.055
15	1801.51	99.535	0.223	1824.86	1788.01	0.053	0.017
16	2368.59	98.249	1.083	2395.59	2351.23	0.208	0.094
17	2511.32	99.633	0.295	2555.68	2457.31	0.107	0.081
18	2852.72	99.227	0.406	2875.86	2789.07	0.143	0.041
19	2922.16	98.736	0.797	2949.16	2875.86	0.257	0.107
20	2958.8	99.508	0.13	2985.81	2949.16	0.05	0.006
21	3069.1	99.772	0.102	3078.39	3039.81	0.029	0.008
22	3415.93	93.509	0.555	3437.15	3080.32	6.046	0.938
23	3531.86	94.177	1.467	3583.74	3514.3	1.348	0.211

Comment;

KTK 700 oC

Date/Time; 11/10/2020 12:05:48 PM

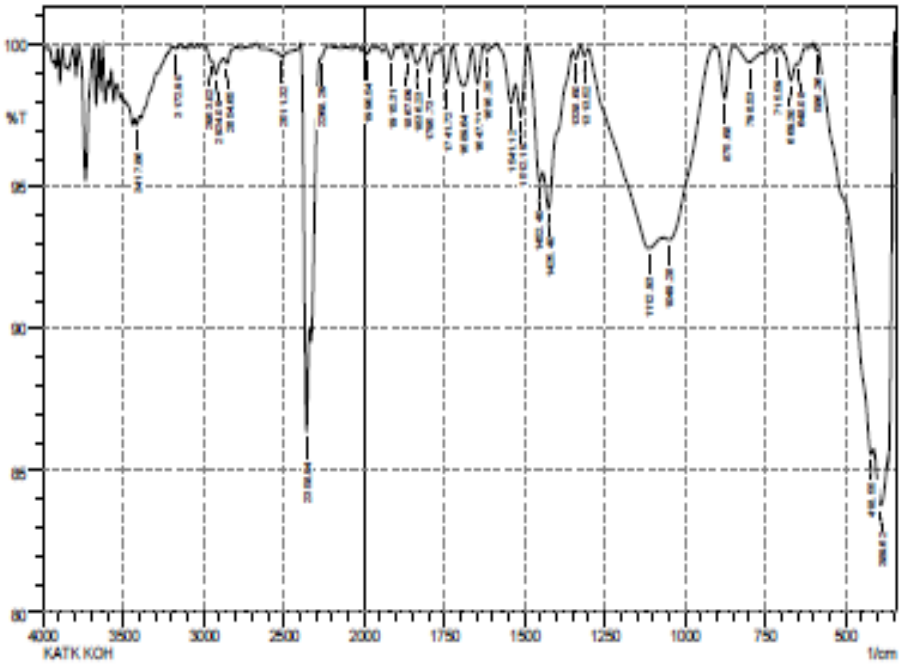
No. of Scans;

Resolution;

Apodization;

3. Karbon Aktif Tempurung Kemiri 800°C

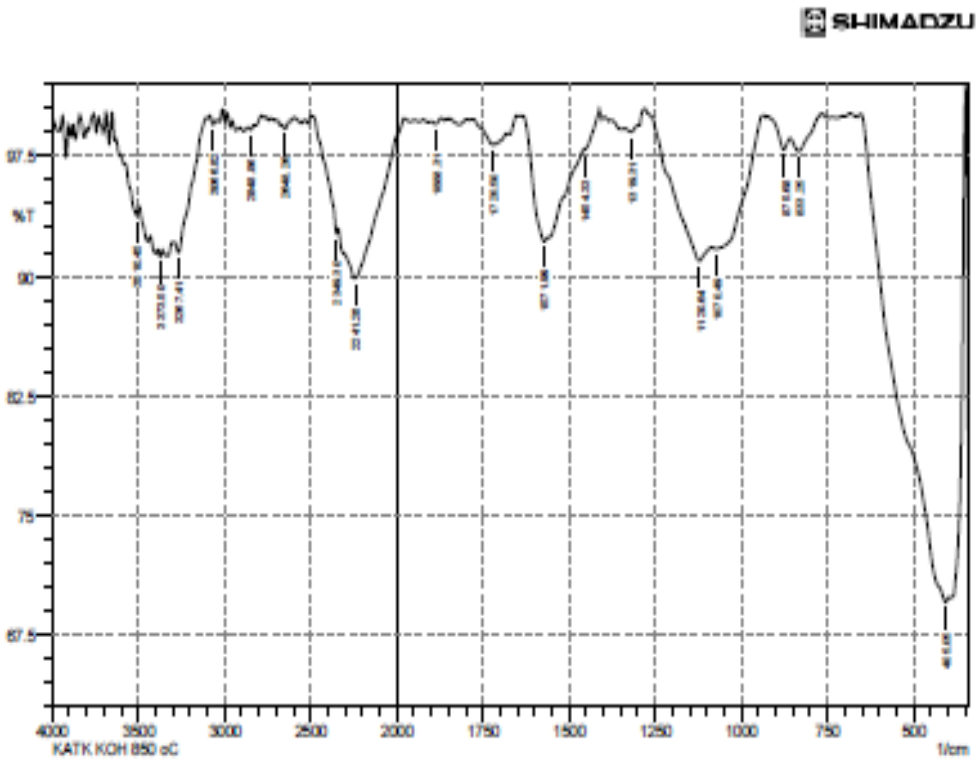
SHIMADZU



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	389.62	83.788	1.786	410.84	388.4	3.1	0.227
2	418.55	85.577	0.882	582.5	412.77	5.354	0.068
3	586.36	99.81	0.108	599.86	582.5	0.008	0.005
4	648.08	99.335	0.084	651.94	624.94	0.049	0.004
5	669.3	98.764	0.783	704.02	651.94	0.146	0.067
6	715.59	99.733	0.236	727.16	704.02	0.016	0.013
7	798.53	99.394	0.572	844.82	727.16	0.162	0.146
8	875.68	98.12	1.824	904.61	844.82	0.189	0.175
9	1049.28	93.139	0.794	1068.64	904.61	2.809	0.419
10	1112.93	92.838	1.851	1300.02	1068.56	4.696	1.071
11	1313.52	99.617	0.326	1325.1	1300.02	0.025	0.018
12	1338.6	99.517	0.377	1350.17	1325.1	0.031	0.021
13	1425.4	94.236	1.972	1440.83	1350.17	1.2	0.269
14	1452.4	95.171	1.223	1490.97	1442.75	0.579	0.091
15	1512.19	97.488	1.677	1527.62	1490.97	0.249	0.133
16	1541.12	97.967	0.957	1587.42	1527.62	0.248	0.07
17	1616.35	99.764	0.27	1627.92	1587.42	0.015	0.022
18	1647.21	98.642	1.316	1662.64	1627.92	0.103	0.098
19	1689.64	98.557	1.382	1724.36	1662.64	0.235	0.22
20	1741.72	98.681	1.273	1761.01	1724.36	0.11	0.102
21	1795.73	99.037	0.825	1813.09	1778.37	0.079	0.058
22	1838.23	99.35	0.631	1853.59	1813.09	0.067	0.063
23	1867.09	99.521	0.506	1880.8	1853.59	0.027	0.031
24	1915.31	99.525	0.399	1930.74	1899.88	0.037	0.026
25	1990.54	99.689	0.268	2004.04	1975.11	0.022	0.017
26	2268.29	99.543	0.038	2272.15	2220.07	0.049	-0.005
27	2358.94	86.361	6.798	2395.59	2341.58	1.954	0.707
28	2511.32	99.603	0.261	2630.91	2416.81	0.211	0.087
29	2854.65	99.363	0.26	2875.86	2794.85	0.116	0.019
30	2924.09	98.964	0.483	2949.16	2875.86	0.228	0.062
31	2953.02	99.441	0.049	2993.52	2949.16	0.057	0
32	3172.9	99.885	0.09	3192.19	3143.97	0.013	0.01
33	3417.86	97.194	0.224	3429.43	3400.5	0.342	0.015

Date/Time; 9/8/2020 3:16:55 PM
No. of Scans;

4. Karbon Aktif Tempurung Kemiri 850°C



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	405.06	69.5624	1.2352	651.94	397.34	23.0885	3.2093
2	833.25	97.8155	1.2288	858.32	757.67	0.5052	0.2632
3	875.68	97.9169	1.0572	923.9	858.32	0.3021	0.0993
4	1070.49	91.6990	0.8384	1083.99	935.48	3.6186	0.9215
5	1120.64	90.9501	2.4991	1255.66	1085.92	4.515	1.2852
6	1319.31	99.0148	0.2986	1336.67	1298.09	0.1377	0.0238
7	1454.33	97.9026	0.1165	1456.26	1411.89	0.2152	0.0522
8	1571.99	92.1612	1.4456	1635.64	1560.41	1.6014	0.3296
9	1720.5	98.2283	0.1173	1778.37	1716.65	0.2746	0.0113
10	1888.31	99.5089	0.2315	1899.88	1869.02	0.0458	0.0149
11	2241.28	89.8443	4.99	2339.65	1980.89	10.7249	4.9218
12	2349.3	92.6812	0.6211	2495.89	2341.58	2.1945	0.0373
13	2848.26	99.2127	0.3497	2867.56	2819.33	0.1203	0.0332
14	2848.86	99.1299	0.2263	2862.36	2829.57	0.1073	0.0171
15	3066.82	99.4565	0.4412	3084.18	3047.53	0.0521	0.0346
16	3267.41	91.46	1.5592	3288.63	3109.25	3.7328	0.5517
17	3373.5	91.1941	0.4421	3387	3361.93	0.9797	0.0286
18	3510.46	93.8004	0.9735	3577.96	3496.94	1.7957	0.2282

Comment;

KATK KOH 850 oC

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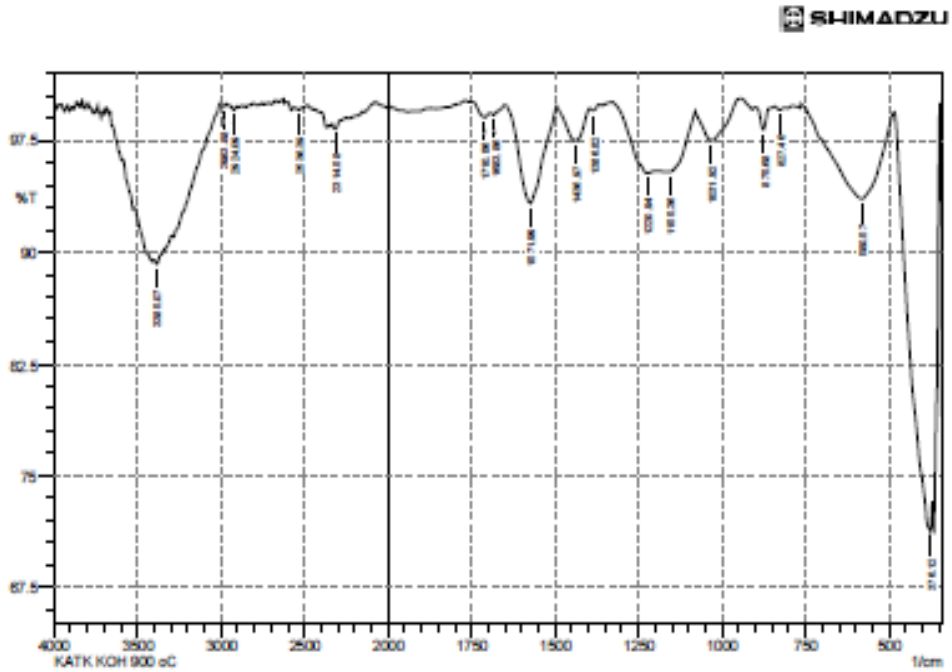
No. of Scans;

Resolution;

Apodization;

5. Karbon Aktif Tempurung Kemiri 900°C



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	375.12	71.247	3.337	484.13	370.33	9.992	2.051
2	580.57	93.581	5.98	761.88	486.06	4.565	4.137
3	827.46	99.542	0.206	840.96	810.1	0.049	0.014
4	875.88	98.225	1.464	898.83	858.32	0.187	0.113
5	1031.92	97.521	2.237	1080.14	941.26	0.623	0.756
6	1155.36	95.393	0.219	1159.22	1080.14	1.087	0.205
7	1220.94	95.298	0.97	1328.95	1197.79	1.62	0.328
8	1386.62	99.512	0.223	1396.46	1367.53	0.043	0.015
9	1436.97	97.495	0.205	1440.83	1396.46	0.33	0.053
10	1571.99	93.277	6.565	1651.07	1494.83	2.387	2.26
11	1683.86	99.197	0.159	1693.5	1676.14	0.055	0.006
12	1710.86	99.045	0.525	1749.44	1693.5	0.131	0.06
13	2314.58	98.283	0.416	2333.87	2279.86	0.345	0.047
14	2536.39	99.538	0.144	2546.04	2511.32	0.059	0.012
15	2924.09	99.535	0.297	2947.23	2904.8	0.069	0.029
16	2983.88	99.792	0.053	2987.74	2970.38	0.01	0.002
17	3385.07	89.202	0.453	3400.5	3340.71	2.844	0.063

Comment;

KATK KOH 900 oC

Date/Time; 11/10/2020 12:21:09 PM

No. of Scans;

Resolution;

Apodization;

Lampiran 12. Perhitungan Kadar Gugus Fungsi dengan Titrasi Boehm

a. Tempurung Kemiri

Penentuan Kadar Karboksilat

No	V. Sampel (Vs) (mL)	V. Titran NaHCO3 (Vp) (mL)	N. NaHCO3	N. HCl	V. HCl (mL)	N. NaOH	V. NaOH (mL)	Massa Karbon (g)	n Karboksilat (meq/g)
1	25	5	0.05	0.036	10	0.0446	8.5	0.1008	13.3482
2	25	5	0.05	0.036	10	0.0446	8.2	0.1008	12.6845
3	25	5	0.05	0.036	10	0.0446	8	0.1008	12.2421
Rata – rata									**12.7583**

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

$$n_{karboksilat} = \frac{[5\ mL \times 0.05\ N - (0.036\ N \times 10\ mL - 0.0446\ N \times 8.5\ mL)] \frac{25\ mL}{5\ mL}}{0.1008\ gram}$$

$$n_{karboksilat} = \frac{[0.2500\ meq - (0.360\ meq - 0.3791\ meq)] \frac{25\ mL}{5\ mL}}{0.1008\ gram}$$

$$n_{karboksilat} = \frac{[0.2500\ meq - (-\ 0.0191 meq] \frac{25\ mL}{5\ mL}}{0.1008\ gram} = 13.3482\ \frac{meq}{gram}$$

Penentuan Kadar Lakton

No	V. Sampel (Vs) (mL)	V. Titran Na2CO3 (Vp) (mL)	N. Na2CO3	N. HCl	V. HCl (mL)	N. NaOH	V. NaOH (mL)	Massa Karbon (g)	n Lakton (meq/g)
1	25	5	0.05014	0.0466	10	0.0573	4.8	0.1026	-9.8469
2	25	5	0.05014	0.0466	10	0.0573	4.8	0.1012	-9.8066
3	25	5	0.05014	0.0466	10	0.0573	4.8	0.1013	-9.8095
Rata – rata									**-9.8210**

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

$$n_{lakton} = \frac{[5\text{ mL x } 0.0501\text{ N} - (0.0466\text{ N x } 10\text{ mL} - 0.0573\text{ N x } 4.8\text{ mL})]\frac{25\text{ mL}}{5\text{ mL}}}{0.1026} - 12.7583\ \frac{\text{meq}}{\text{gram}}$$

$$n_{lakton} = \frac{[0.2505\text{ meq} - (0.4660\text{ meq} - 0.2750\text{ meq})]\frac{25\text{ mL}}{5\text{ mL}}}{0.1026\text{ gram}} - 12.0238\frac{\text{meq}}{\text{gram}}$$

$$n_{lakton} = 5.8145\ \frac{\text{meq}}{\text{gram}} - 12.7583\ \frac{\text{meq}}{\text{gram}} = -9.8469\frac{\text{meq}}{\text{gram}}$$

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 Fenol (meq/g)
1	25	5	0.0573	0.0466	10	0.0573	4.1	0.1017	-0.2120
2	25	5	0.0573	0.0466	10	0.0573	4.2	0.1009	0.0935
3	25	5	0.0573	0.0466	10	0.0573	4.4	0.1011	0.6543
Rata – rata									**0.1786**

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

$$n_{fenol} = \frac{[5\text{ mL x } 0.0573\text{ N} - (0.0466\text{ N x } 10\text{ mL} - 0.0573\text{ N x } 4.1\text{ mL})]\frac{25\text{ mL}}{5\text{ mL}}}{0.1017\text{ gram}} - 12.7583\ \frac{meq}{gram} - (-9.8210\frac{meq}{gram})$$

$$n_{fenol} = \frac{[0.2865\text{ meq} - (0.4660\text{ meq} - 0.2349\text{ meq})]\frac{25\text{ mL}}{5\text{ mL}}}{0.1017\text{ gram}} - 12.7583\ \frac{meq}{gram} - (-9.8210\frac{meq}{gram})$$

$$n_{fenol} = 2.7237\frac{meq}{gram} - 12.7583\ \frac{meq}{gram} - (-9.8210\frac{meq}{gram}) = -0.2120\ \frac{meq}{gram}$$

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 Basa Total (meq/g)
1	25	5	0.0466	0.0573	7.5	0.0466	4.3	0.1055	0.1720
2	25	5	0.0466	0.0573	7.5	0.0466	4.2	0.1045	-0.0493
3	25	5	0.0466	0.0573	7.5	0.0466	4.2	0.1049	-0.0491
Rata - rata									**0.0246**

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

$$n_{tbasa\ total} = \frac{[5\ mL\ x\ \ 0.0466\ N\ \ -\ (0.0573\ N\ x\ 7.5\ mL - 0.0466\ N\ \ x\ 4.3\ mL)\ ]\ \frac{25\ mL}{5\ mL}}{0.1055\ gram}$$

$$n_{basa\ total} = \frac{[0.2330\ meq - (0.4298\ meq - 0.2004\ meq)\ ]\ \frac{25\ mL}{5\ mL}}{0.1055\ gram}$$

$$n_{basa\ total} = \frac{[0.2330\ meq - 0.2294\ meq\ ]\ \frac{25\ mL}{5\ mL}}{0.1055\ gram} = 0.1720\ \frac{meq}{gram}$$

b. Karbon Tempurung Kemiri 700°C

Penentuan Kadar Karboksilat

No	V. Sampel (Vs) (mL)	V. Titran NaHCO3 (Vp) (mL)	N. NaHCO3	N. HCl	V. HCl (mL)	N. NaOH	V. NaOH (mL)	Massa Karbon (g)	n Karboksilat (meq/g)
1	25	5	0.05	0.0442	10	0.0452	8.2	0.101	8.8121
2	25	5	0.05	0.0442	10	0.0452	9.8	0.101	12.3908
3	25	5	0.05	0.0442	10	0.0452	8.4	0.101	9.2594
Rata - rata									**10.1541**

Penentuan Kadar Lakton

No	V. Sampel (Vs) (mL)	V. Titran Na2CO3 (Vp) (mL)	N. Na2CO3	N. HCl	V. HCl (mL)	N. NaOH	V. NaOH (mL)	Massa Karbon (g)	n Lakton (meq/g)
1	25	5	0.05	0.0442	10	0.0452	8.6	0.1003	0.9624
2	25	5	0.05	0.0442	10	0.0452	8.4	0.1003	-3.0667
3	25	5	0.05	0.0442	10	0.0452	9.2	0.1003	1.8664
Rata – rata									**-0.0793**

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 Fenol (meq/g)
1	25	5	0.0452	0.0442	10	0.0452	7.8	0.1005	-3.0165
2	25	5	0.0452	0.0442	10	0.0452	7.8	0.1005	-2.5661
3	25	5	0.0452	0.0442	10.2	0.0452	7.3	0.1005	-5.9321
Rata - rata									**-3.8382**

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 Basa Total (meq/g)
1	25	5	0.0442	0.0452	7.5	0.0442	2	0.1	-1.4560
2	25	5	0.0442	0.0452	7.5	0.0442	2.7	0.1	0.0926
3	25	5	0.0442	0.0452	7.5	0.0442	2	0.1	-1.4560
Rata - rata									**-0.9398**

c. Karbon Aktif Tempurung Kemiri 850°C

Penentuan Kadar Karboksilat

No	V. Sampel (Vs) (mL)	V. Titran NaHCO3 (Vp) (mL)	N. NaHCO3	N. HCl	V. HCl (mL)	N. NaOH	V. NaOH (mL)	Massa Karbon (g)	n Karboksilat (meq/g)
1	25	5	0.05	0.0442	10	0.0452	8.4	0.1001	9.3427
2	25	5	0.05	0.0442	10	0.0452	8.3	0.1001	9.1170
3	25	5	0.05	0.0442	10	0.0452	8.1	0.1001	8.6656
Rata - rata									**9.0418**

Penentuan Kadar Lakton

No	V. Sampel (Vs) (mL)	V. Titran Na2CO3 (Vp) (mL)	N. Na2CO3	N. HCl	V. HCl (mL)	N. NaOH	V. NaOH (mL)	Massa Karbon (g)	n Lakton (meq/g)
1	25	5	0.05	0.0442	10	0.0452	10	0.1004	3.8730
2	25	5	0.05	0.0442	10	0.0452	9.5	0.1004	2.7480
3	25	5	0.05	0.0442	10	0.0452	9.9	0.1004	3.6480
Rata - rata									**3.4230**

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 Fenol (meq/g)
1	25	5	0.0452	0.0442	10	0.0452	7.3	0.1	-7.5535
2	25	5	0.0452	0.0442	10	0.0452	7.2	0.1	-6.4287
3	25	5	0.0452	0.0442	10.2	0.0452	8.2	0.1	-5.0608
Rata - rata									**-6.3476**

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 Basa Total (meq/g)
1	25	5	0.0442	0.0452	7.5	0.0442	2.1	0.1005	-1.2287
2	25	5	0.0442	0.0452	7.5	0.0442	2	0.1005	-1.4488
3	25	5	0.0442	0.0452	7.5	0.0442	1.9	0.1005	-1.6689
Rata - rata									**-1.4488**

d. Karbon Aktif Tempurung Kemiri 900°C

Penentuan Kadar Karboksilat

No	V. Sampel (Vs) (mL)	V. Titran NaHCO3 (Vp) (mL)	N. NaHCO3	N. HCl	V. HCl (mL)	N. NaOH	V. NaOH (mL)	Massa Karbon (g)	n Karboksilat (meq/g)
1	25	5	0.05	0.0442	10.1	0.0452	7.9	0.1002	7.9853
2	25	5	0.05	0.0442	10.3	0.0452	8.6	0.1002	9.1219
3	25	5	0.05	0.0442	10	0.0452	7.1	0.1002	6.4025
Rata - rata									**7.8365**

Penentuan Kadar Lakton

No	V. Sampel (Vs) (mL)	V. Titran Na2CO3 (Vp) (mL)	N. Na2CO3	N. HCl	V. HCl (mL)	N. NaOH	V. NaOH (mL)	Massa Karbon (g)	n Lakton (meq/g)
1	25	5	0.05	0.0442	10	0.0452	9	0.101	2.7649
2	25	5	0.05	0.0442	10	0.0452	9.3	0.101	3.4359
3	25	5	0.05	0.0442	10	0.0452	9.2	0.101	3.2122
Rata - rata									**3.1377**

Penentuan Kadar Fenol

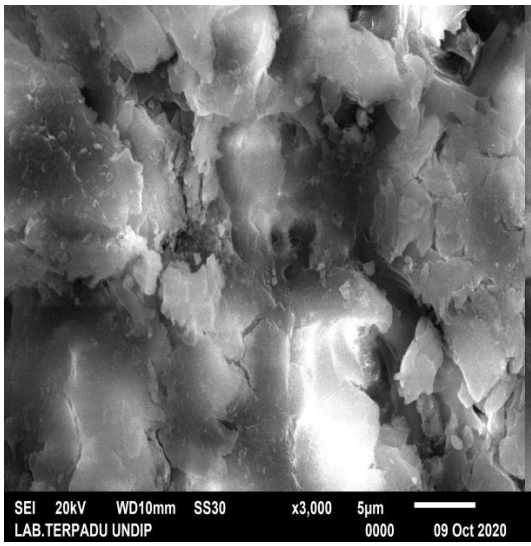
No	V. Sampel (Vs) (mL)	V. Titran NaOH (Vp) (mL)	N. NaOH	N. HCl	V. HCl (mL)	N. NaOH	V. NaOH (mL)	Massa Karbon (g)	n Fenol (meq/g)
1	25	5	0.0452	0.0442	10	0.0452	6.6	0.101	-7.0824
2	25	5	0.0452	0.0442	10	0.0452	7	0.101	-7.3243
3	25	5	0.0452	0.0442	10	0.0452	6.8	0.101	-5.0523
Rata - rata									**-6.4863**

Penentuan Kadar Basa Total

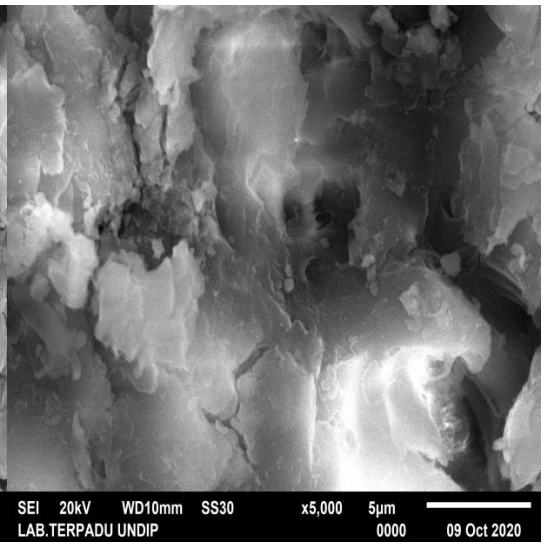
No	V. Sampel (Vs) (mL)	V. Titran HCl (Vp) (mL)	N. HCl	N. NaOH	V. NaOH (mL)	N. HCl	V. HCl (mL)	Massa Karbon (g)	n Basa Total (meq/g)
1	25	5	0.0442	0.0452	7.5	0.0442	2.2	0.1006	-1.0075
2	25	5	0.0442	0.0452	7.5	0.0442	2.2	0.1006	-1.0075
3	25	5	0.0442	0.0452	7.5	0.0442	2.1	0.1006	-1.2274
Rata - rata									**-1.0808**

Lampiran 13. Hasil Analisis SEM

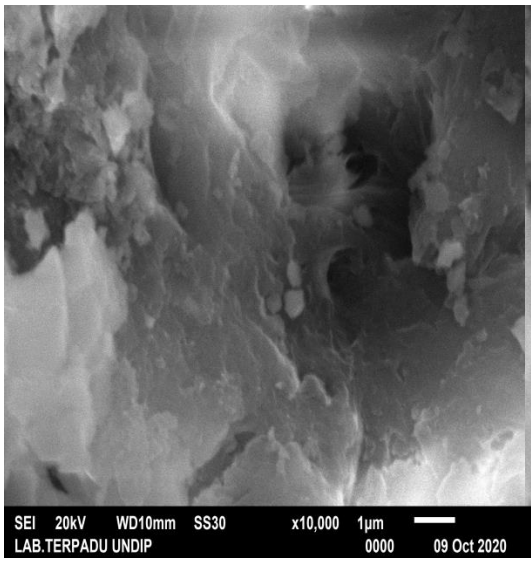
1. Tempurung Kemiri



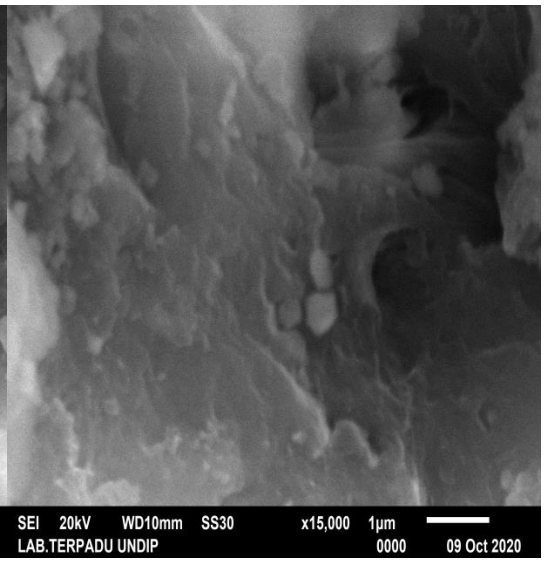
3.000x



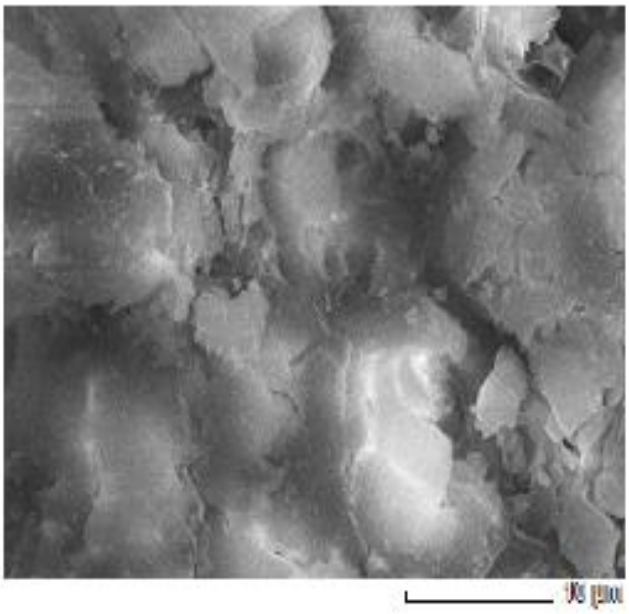
5.000x



10.000x

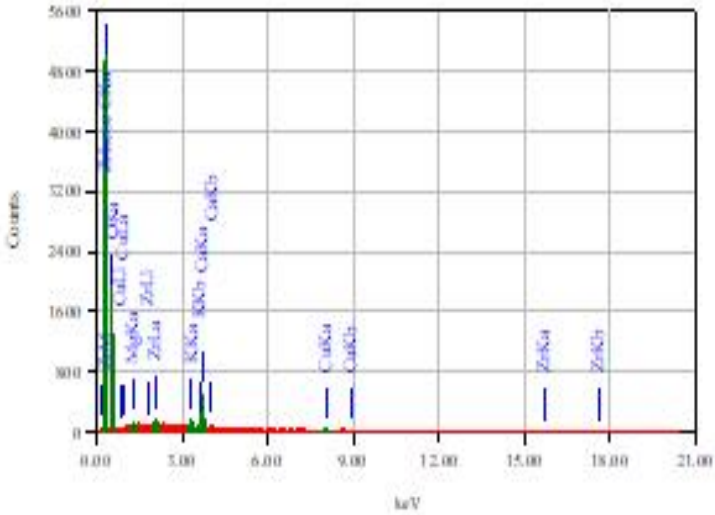


15.000x



Title : IMG1

Instrument : 6510(LA)
Volt : 20.00 kV
Mag : x 3,000
Date : 2020/10/09
Pixel : 512 x 384

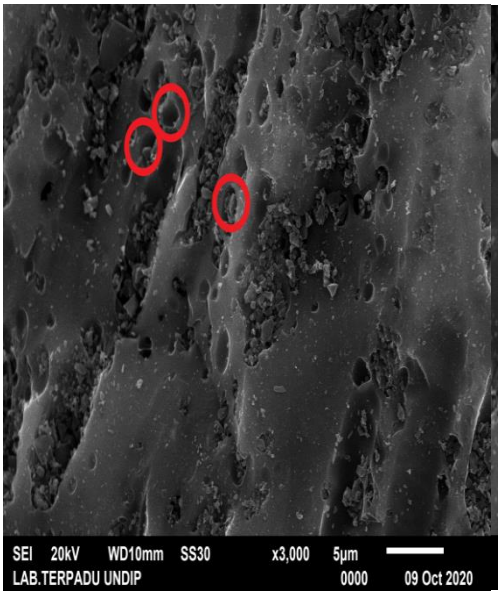


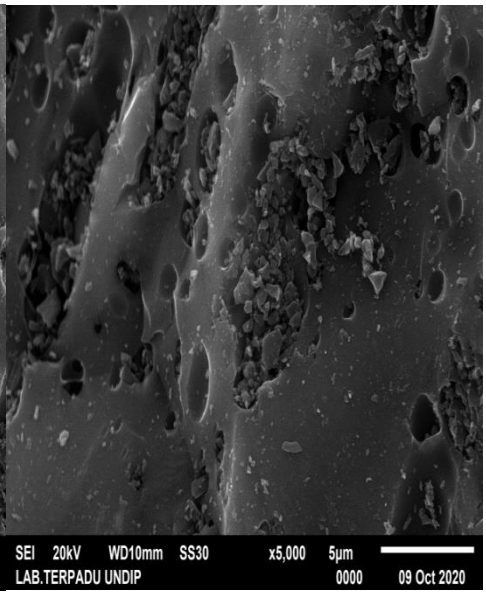
Acquisition Parameter
Instrument : 6510(LA)
Acc. Voltage : 20.0 kV
Probe Current: 1.00000 nA
PHA mode : T3
Real Time : 50.86 sec
Live Time : 50.00 sec
Dead Time : 1 %
Counting Rate: 1935 cps
Energy Range : 0 - 20 keV

ZAF Method Standardless Quantitative Analysis(Oxide)
Fitting Coefficient : 0.0389
Total Oxide : 24.0

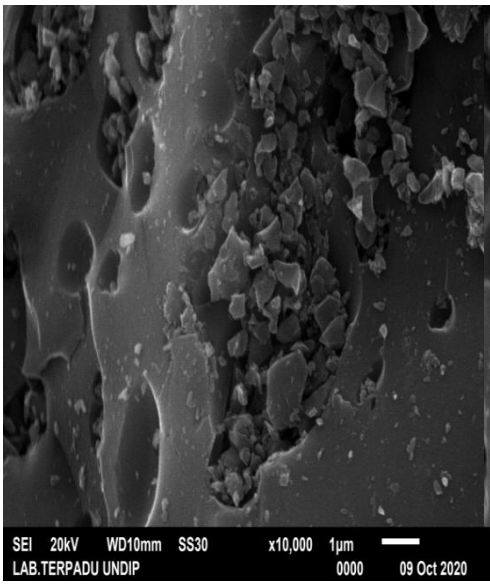
Element	(keV)	Mass%	Sigma	Mole%	Compound	Mass%	Cation	K
C K	0.277	91.98	0.05	98.63	C	91.98	0.00	92.8169
O		2.11						
Mg K	1.253	0.28	0.03	0.16	MgO	0.46	2.09	0.2460
K K	3.312	0.52	0.03	0.09	K_2O	0.62	2.41	0.6696
Ca K	3.690	3.02	0.05	0.93	CaO	4.23	13.70	3.9287
Cu K	8.040	1.15	0.07	0.43	CuO	1.45	3.30	1.2351
Se L	2.042	0.93	0.07	0.13	SeO	1.26	1.85	1.1037
Total		100.00		100.00		100.00	23.35	

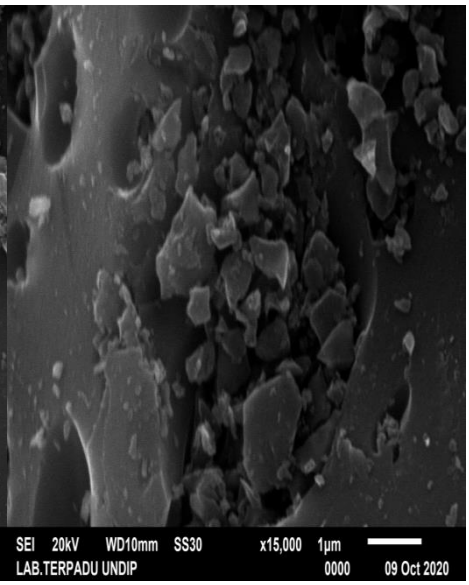
2. Karbon Tempurung Kemiri 700°C



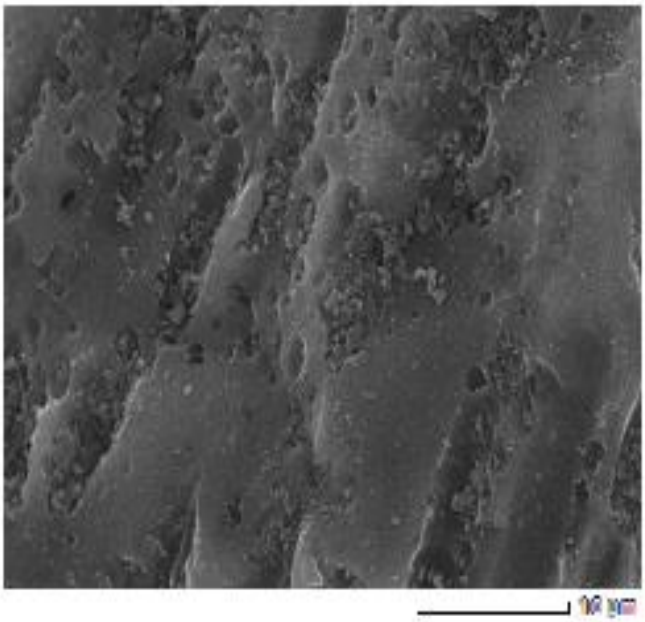


3.000x 5.000x



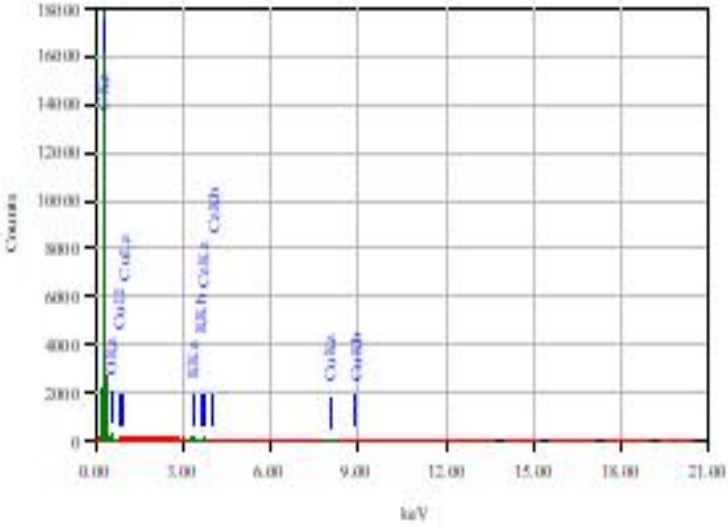


10.000x 15.000x



Title : IMG1

Instrument : 6510(LA)
Volt : 20.00 kV
[illegible] : x 3,000
Date : 2020/10/09
Pixel : 512 x 384

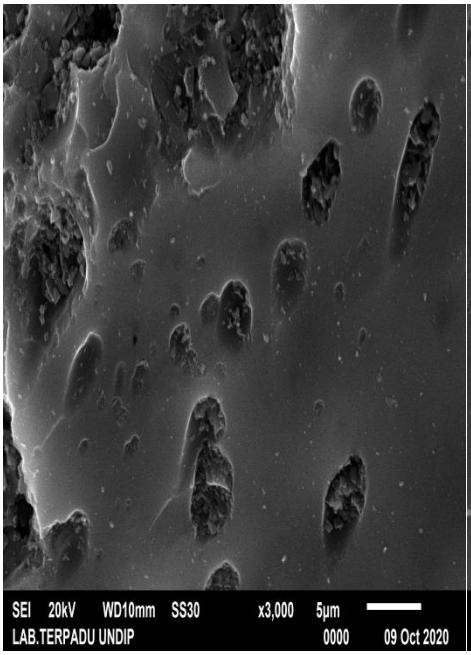


Acquisition Parameter
Instrument : 6510(LA)
Acc. [illegible] 20.0 kV
Probe Current: 1.00000 [illegible]
PSA mode : P1
Real Time : 51.14 sec
Live Time : 50.00 sec
Dead Time : 2 %
Counting Rate: 2960 cps
Energy [illegible] 0 - 20 [illegible]

ZAF Method [illegible] Quantitative [illegible](Oxide)
Fitting [illegible] 0.0151
Total [illegible] 24.0

Element	[illegible]	Mass%	Sigma	Mol[illegible]	Mass%	[illegible]	K
C K	0.277	99.26	0.03	[illegible]	99.26	0.00	99.4616
O		0.16					
K [illegible]	1.312	0.12	0.01	[illegible]	0.15	7.61	0.1259
Ca K	1.690	0.11	0.01	[illegible]	0.16	6.99	0.1202
Cu K	8.040	0.14	0.02	[illegible]	0.43	11.19	0.2921
Total		100.00		[illegible]	[illegible]	27.02	

3. Karbon Aktif Tempurung Kemiri 850°C



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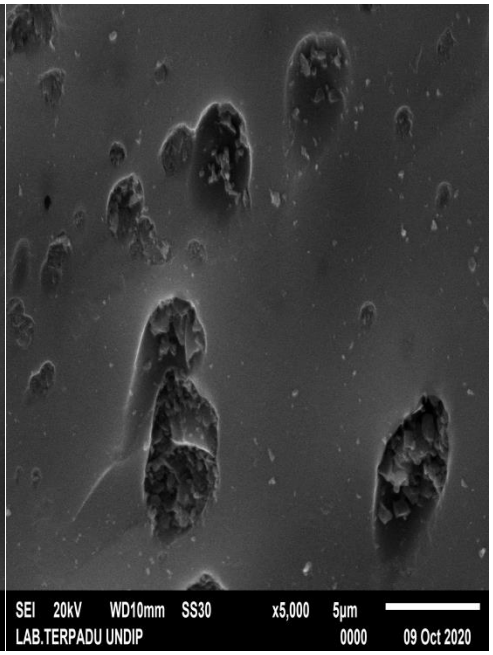
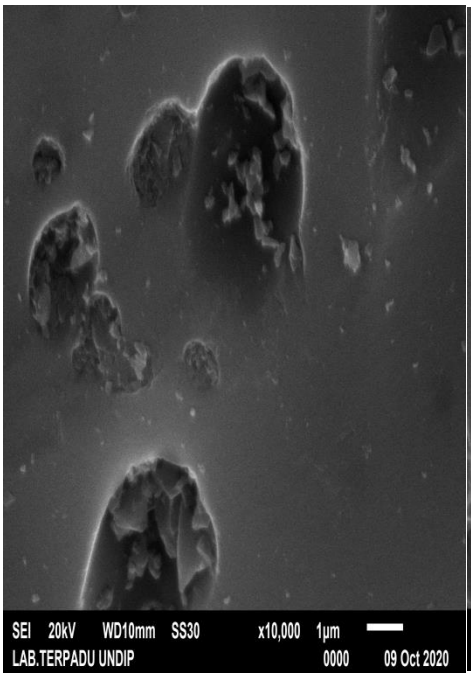
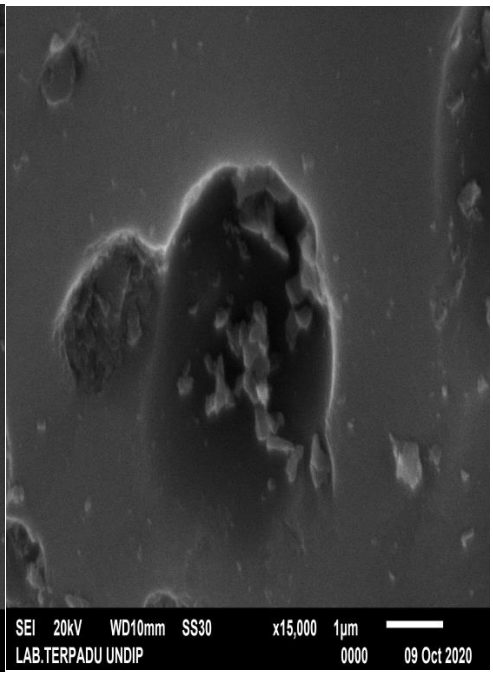


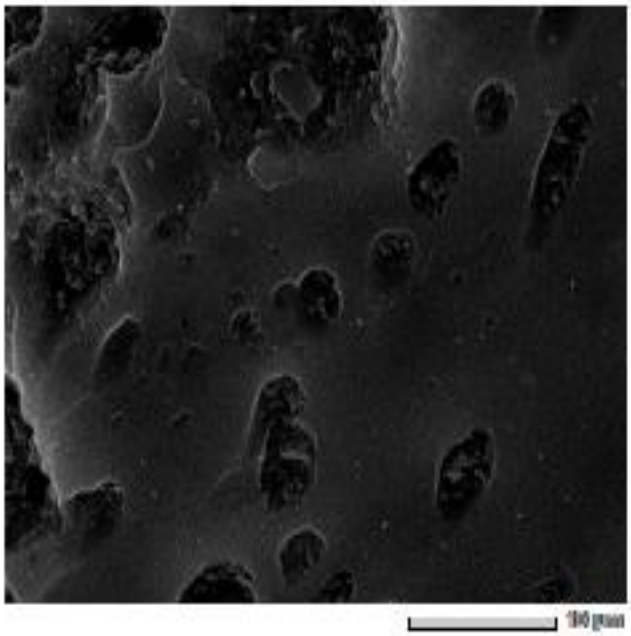
5.000x



10.000x

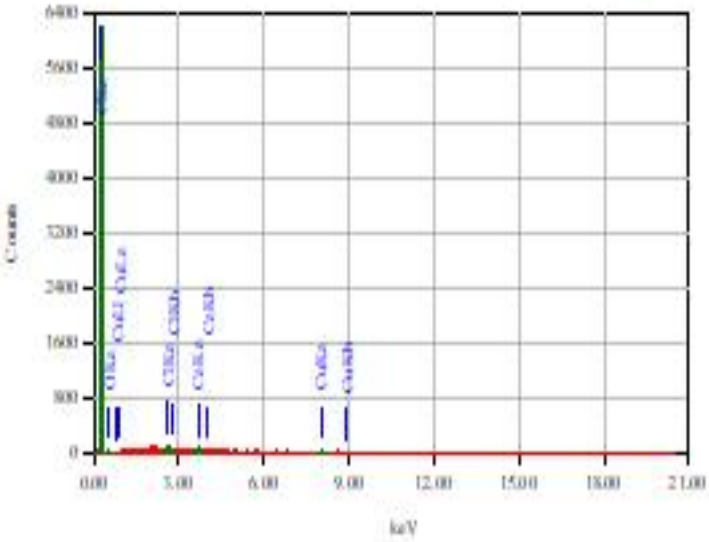


15.000x



Title : [illegible]

Instrument : 6510(LA)
Volt : 20.00 kV
[illegible] : [illegible] 1,000
Date : 2020/10/04
Pixel : 512 x 384

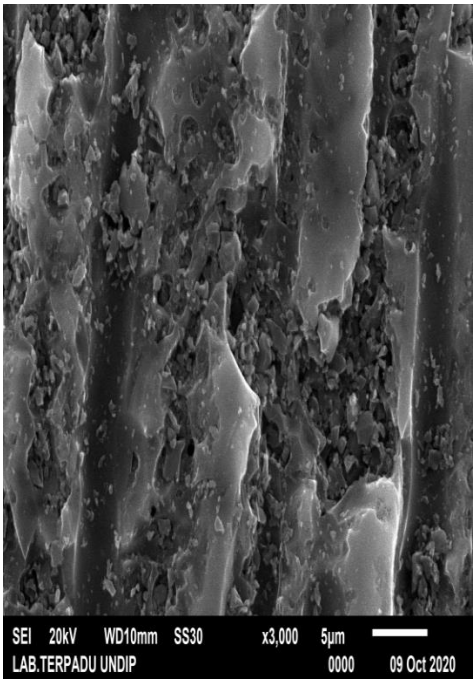


Acquisition Parameter
Instrument : 6510(LA)
Acc. [illegible] 20.0 kV
Probe Current: 1.00000 [illegible]
PKA mode : [illegible]
Real Time : 50.67 sec
Live Time : 50.00 sec
Dead Time : 1 %
Counting Rate: 1444 cps
Energy [illegible] 0 - 20 [illegible]

EAF Method [illegible] Quantitative [illegible]
Fitting [illegible] 0.0256
Total [illegible] 24.0

Element	[illegible]	Mass%	Sigma	Mol[illegible]	Mass%	[illegible]	K
C K	0.277	98.16	0.13	[illegible]	98.16	0.00	98.6612
O		0.31					
[illegible] K	2.621	0.21	0.02	[illegible]	0.21	0.00	0.2705
Ca K	1.698	0.19	0.03	[illegible]	0.26	5.07	0.2141
Cu K	0.040	0.93	0.11	[illegible]	1.16	18.13	0.8542
Total		100.00		100.00	100.00	24.00	

4. Karbon Aktif Tempurung Kemiri 900°C



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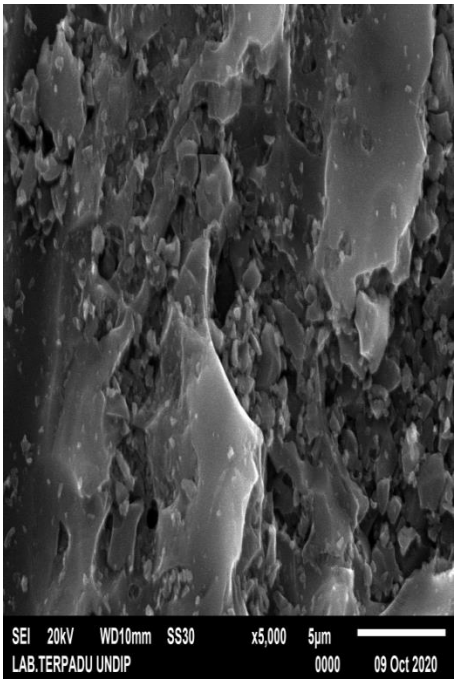
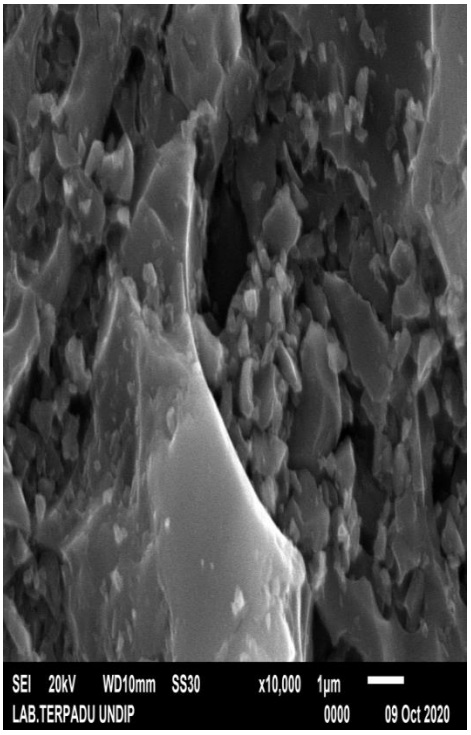
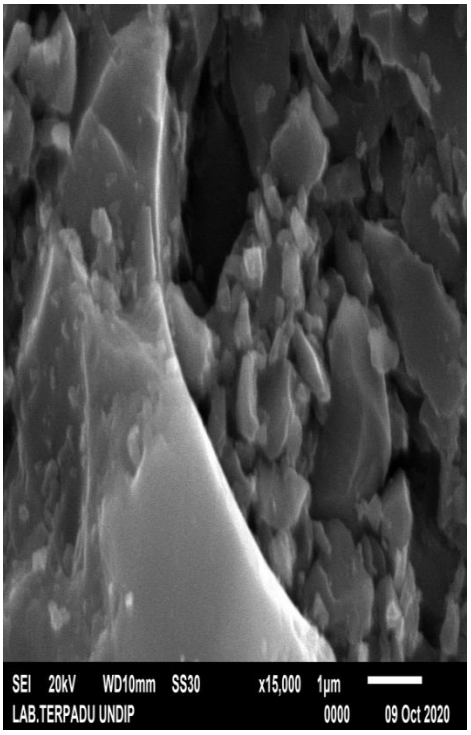


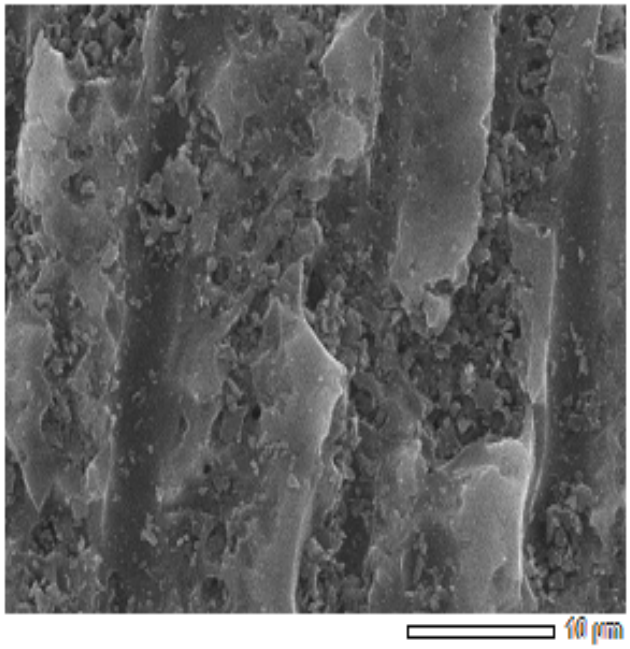
5.000x



10.000x

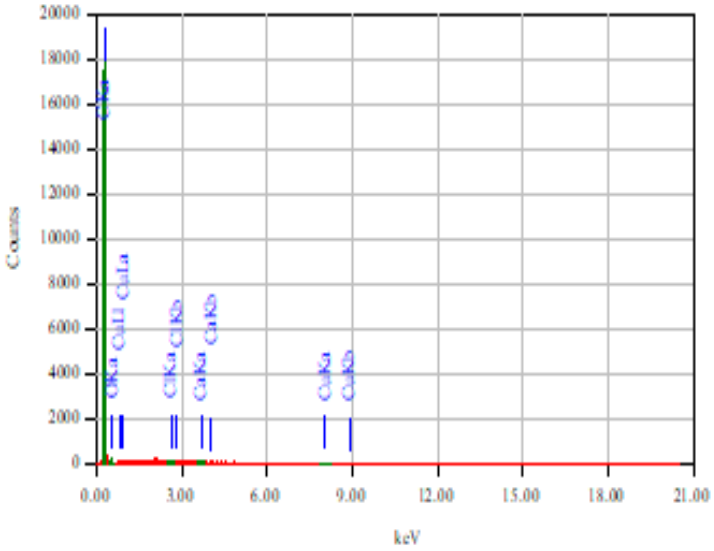


15.000x



Title : IMG1

-
Instrument : 6510 (LA)
Volt : 20.00 kV
Mag. : x 3,000
Date : 2020/10/09
Pixel : 512 x 384



Acquisition Parameter
Instrument : 6510 (LA)
Acc. Voltage : 20.0 kV
Probe Current: 1.00000 nA
PHA mode : T3
Real Time : 51.23 sec
Live Time : 50.00 sec
Dead Time : 2 %
Counting Rate: 3160 cps
Energy Range : 0 - 20 keV

ZAF Method Standardless Quantitative Analysis (Oxide)
Fitting Coefficient : 0.0160
Total Oxide : 24.0

Element	(keV)	Mass%	Sigma	Mol%	Compound	Mass%	Cation	K
C K	0.277	99.22	0.18	99.85	C	99.22	0.00	99.3695
O		0.14						
Cl K	2.621	0.14	0.01	0.05	Cl	0.14	0.00	0.1706
Ca K	3.690	0.10	0.01	0.03	CaO	0.13	6.56	0.1039
Cu K	8.040	0.41	0.04	0.08	CuO	0.51	17.44	0.3560
Total		100.00		100.00		100.00	24.00	

Lampiran 14. Hasil Luas Permukaan BET-BJH

1. Tempurung Kemiri

Quantachrome® ASiQwin™- Automated Gas Sorption Data Acquisition and Reduction
© 1994-2013, Quantachrome Instruments
version 3.01

Analysis			Report		
Operator:	UNDIP	Date:2021/01/04	Operator:	UNDIP	Date:2021/01/22
Sample ID:	01158	Filename:	20210104 TK.qps		
Sample Desc:		Comment:			
Sample Weight:	0.0559 g	Instrument:	Autosorb iQ Station 1		
Outgas Time:	3.0 hrs	Outgas Temp.:	300 °C		
Analysis gas:	Nitrogen	Non-ideality:	6.58e-05 1/Torr	CellType:	9mm w/o rod
Analysis Time:	1:43 hr:min	Bath temp.:	77.35 K		
Analysis Mode:	Standard			VoidVol Remeasure:	off
VoidVol. Mode:	He Measure	Cold Zone V:	2.05531 cc	Warm Zone V:	17.5265 cc

Total Pore Volume

Data Reduction Parameters Data

Adsorbate	Thermal Transpiration: on	Eff. mol. diameter (D): 3.54 Å		Eff. cell stem diam. (d): 4.0000 mm	
	Nitrogen	Temperature	77.350K		
	Molec. Wt.: 28.013	Cross Section:	16.200 Å²	Liquid Density:	0.808 g/cc

Total Pore Volume summary
Total Pore Volume

Total pore volume = 1.492e-02 cc/g for
pores smaller than 1792.7 Å (Radius)
at P/Po = 0.99463

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Analysis			Report		
Operator:	UNDIP	Date:2021/01/04	Operator:	UNDIP	Date:2021/01/06
Sample ID:	01158	Filename:	20210104 TK.qps		
Sample Desc:		Comment:			
Sample Weight:	0.0559 g	Instrument:	Autosorb iQ Station 1		
Outgas Time:	3.0 hrs	Outgas Temp.:	300 °C		
Analysis gas:	Nitrogen	Non-ideality:	6.58e-05 1/Torr	CellType:	9mm w/o rod
Analysis Time:	1:43 hr:min	Bath temp.:	77.35 K		
Analysis Mode:	Standard			VoidVol Remeasure:	off
VoidVol. Mode:	He Measure	Cold Zone V:	2.05531 cc	Warm Zone V:	17.5265 cc

Multi-Point BET

Data Reduction Parameters Data

Adsorbate	Thermal Transpiration: on	Eff. mol. diameter (D): 3.54 Å		Eff. cell stem diam. (d): 4.0000 mm	
	Nitrogen	Temperature	77.350K		
	Molec. Wt.: 28.013	Cross Section:	16.200 Å²	Liquid Density:	0.808 g/cc

Multi-Point BET Data

Relative Pressure [P/Po]	Volume @ STP [cc/g]	1 / [W((Po/P) - 1)]	Relative Pressure [P/Po]	Volume @ STP [cc/g]	1 / [W((Po/P) - 1)]
1.00357e-01	1.0203	8.7476e+01	2.50485e-01	2.6583	1.0059e+02
1.50418e-01	1.5992	8.8581e+01	3.00495e-01	3.1251	1.0999e+02
2.00418e-01	2.1461	9.3449e+01			

BET summary

Slope =	113.987
Intercept =	7.317e+01
Correlation coefficient, r =	0.962724
C constant=	2.558
Surface Area =	18.608 m²/g

Analysis			Report		
Operator:	UNDIP	Date:2021/01/04	Operator:	UNDIP	Date:2021/01/06
Sample ID:	01158	Filename:	20210104 TK.qps		
Sample Desc:		Comment:			
Sample Weight:	0.0559 g	Instrument:	Autosorb iQ Station 1		
Outgas Time:	3.0 hrs	Outgas Temp.:	300 °C		
Analysis gas:	Nitrogen	Non-ideality:	6.58e-05 1/Torr	CellType:	9mm w/o rod
Analysis Time:	1:43 hr:min	Bath temp.:	77.35 K		
Analysis Mode:	Standard			VoidVol Remeasure:	off
VoidVol. Mode:	He Measure	Cold Zone V:	2.05531 cc	Warm Zone V:	17.5265 cc

Raw Analysis Data

Raw Analysis Data

Press [Torr]	P0 [Torr]	Volume @ STP [cc]	Time [min]	Tol	Equ
38.6372	760.00	0.0227798	3.0	0	1
76.2711	760.00	0.0570368	4.6	0	1
114.318	760.00	0.0893971	6.2	0	1
152.318	760.00	0.119969	7.8	0	1
190.368	760.00	0.148597	9.4	0	1
228.376	760.00	0.17469	12.5	0	1
266.394	760.00	0.199549	15.7	0	1
304.43	760.00	0.221448	18.8	0	1
341.805	760.00	0.274578	21.3	0	1
380.239	760.00	0.303975	23.8	0	1
418.325	760.00	0.328661	26.5	0	1
456.32	760.00	0.352118	29.2	0	1
494.353	760.00	0.373056	32.2	0	1
532.329	760.00	0.393728	35.3	0	1
570.356	760.00	0.412236	38.4	0	1
608.3	760.00	0.432602	40.9	0	1
646.314	760.00	0.451234	43.5	0	1
684.27	760.00	0.469313	46.3	0	1
722.268	760.00	0.488375	49.3	0	1
755.921	760.00	0.539375	52.4	0	1
754.833	760.00	0.543866	55.1	0	1
722.255	760.00	0.485389	57.7	0	1
683.658	760.00	0.458607	60.8	0	1
645.568	760.00	0.436423	63.6	0	1
607.506	760.00	0.416458	66.4	0	1
569.538	760.00	0.392137	69.1	0	1
530.917	760.00	0.400959	71.7	0	1
493.447	760.00	0.379571	74.3	0	1
455.463	760.00	0.353861	77.5	0	1
417.553	760.00	0.326668	80.3	0	1
379.532	760.00	0.299601	82.9	0	1
341.46	760.00	0.272149	86.1	0	1
303.448	760.00	0.242989	89.1	0	1
265.609	760.00	0.213177	90.8	0	1
227.569	760.00	0.183432	92.5	0	1
189.566	760.00	0.152072	94.3	0	1
151.761	760.00	0.119661	96.1	0	1
113.749	760.00	0.0857206	98.0	0	1
75.7246	760.00	0.0508533	100.3	0	1
37.369	760.00	0.0127031	103.2	0	1

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Analysis			Report		
Operator:	UNDIP	Date:2021/01/04	Operator:	UNDIP	Date:2021/01/22
Sample ID:	01158	Filename:	20210104 TK.qps		
Sample Desc:		Comment:			
Sample Weight:	0.0559 g	Instrument:	Autosorb iQ Station 1		
Outgas Time:	3.0 hrs	Outgas Temp.:	300 °C		
Analysis gas:	Nitrogen	Non-ideality:	6.58e-05 1/Torr	CellType:	9mm w/o rod
Analysis Time:	1:43 hr:min	Bath temp.:	77.35 K		
Analysis Mode:	Standard			VoidVol Remeasure:	off
VoidVol. Mode:	He Measure	Cold Zone V:	2.05531 cc	Warm Zone V:	17.5265 cc

Average Pore Size

Data Reduction Parameters Data

Adsorbate	Thermal Transpiration: on	Eff. mol. diameter (D):	3.54 Å	Eff. cell stem diam. (d):	4.0000 mm
	Nitrogen	Temperature	77.350K		
	Molec. Wt.: 28.013	Cross Section:	16.200 Å²	Liquid Density:	0.808 g/cc

Average Pore Size summary

Average pore Radius = 1.60416e+01 Å

2. Karbon Tempurung Kemiri 700°C

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Analysis			Report		
Operator:	UNDIP	Date:2020/12/30	Operator:	UNDIP	Date:2021/01/06
Sample ID:	01157	Filename:	20201230 KATK.qps		
Sample Desc:		Comment:			
Sample Weight:	0.1267 g	Instrument:	Autosorb iQ Station 1		
Outgas Time:	3.0 hrs	Outgas Temp.:	300 °C		
Analysis gas:	Nitrogen	Non-ideality:	6.58e-05 1/Torr	CellType:	9mm w/o rod
Analysis Time:	8:37 hr:min	Bath temp.:	77.35 K		
Analysis Mode:	Standard			VoidVol Remeasure:	off
VoidVol. Mode:	He Measure	Cold Zone V:	0 cc	Warm Zone V:	0 cc

Total Pore Volume

Data Reduction Parameters Data

Adsorbate	Thermal Transpiration: on	Eff. mol. diameter (D): 3.54 Å		Eff. cell stem diam. (d): 4.0000 mm	
	Nitrogen	Temperature	77.350K		
	Molec. Wt.: 28.013	Cross Section:	16.200 Å²	Liquid Density:	0.808 g/cc

Total Pore Volume summary
Total Pore Volume

Total pore volume = 2.685e-01 cc/g for
pores smaller than 1843.7 Å (Radius)
at P/Po = 0.99478

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Analysis			Report		
Operator:	UNDIP	Date:2020/12/30	Operator:	UNDIP	Date:2021/01/06
Sample ID:	01157	Filename:	20201230 KATK.qps		
Sample Desc:		Comment:			
Sample Weight:	0.1267 g	Instrument:	Autosorb iQ Station 1		
Outgas Time:	3.0 hrs	Outgas Temp.:	300 °C		
Analysis gas:	Nitrogen	Non-ideality:	6.58e-05 1/Torr	CellType:	9mm w/o rod
Analysis Time:	8:37 hr:min	Bath temp.:	77.35 K		
Analysis Mode:	Standard			VoidVol Remeasure:	off
VoidVol. Mode:	He Measure	Cold Zone V:	0 cc	Warm Zone V:	0 cc

Multi-Point BET

Data Reduction Parameters Data

Adsorbate	Thermal Transpiration: on	Eff. mol. diameter (D): 3.54 Å		Eff. cell stem diam. (d): 4.0000 mm	
	Nitrogen	Temperature	77.350K		
	Molec. Wt.: 28.013	Cross Section:	16.200 Å²	Liquid Density:	0.808 g/cc

Multi-Point BET Data

Relative Pressure [P/Po]	Volume @ STP [cc/g]	1 / [W((Po/P) - 1)]	Relative Pressure [P/Po]	Volume @ STP [cc/g]	1 / [W((Po/P) - 1)]
1.03875e-01	130.3953	7.1127e-01	2.50367e-01	137.5935	1.9422e+00
1.49815e-01	132.9931	1.0602e+00	3.00305e-01	139.8401	2.4557e+00
2.00085e-01	135.3542	1.4786e+00			

BET summary

Slope =	8.865
Intercept =	-2.513e-01
Correlation coefficient, r =	0.998273
C constant=	-34.271
Surface Area =	404.297 m²/g

Analysis			Report			
Operator:	UNDIP	Date:2020/12/30	Operator:	UNDIP	Date:2021/01/06	
Sample ID:	01157	Filename:	20201230 KATK.qps			
Sample Desc:		Comment:				
Sample Weight:	0.1267 g	Instrument:	Autosorb iQ Station 1			
Outgas Time:	3.0 hrs	Outgas Temp.:	300 °C			
Analysis gas:	Nitrogen	Non-ideality:	6.58e-05 1/Torr	CellType:	9mm w/o rod	
Analysis Time:	8:37 hr:min	Bath temp.:	77.35 K			
Analysis Mode:	Standard			VoidVol Remeasure:	off	
VoidVol. Mode:	He Measure	Cold Zone V:	0 cc	Warm Zone V:	0 cc	

Raw Analysis Data

Raw Analysis Data

Press [Torr]	P0 [Torr]	Volume @ STP [cc]	Time [min]	Tol	Equ
40.0126	760.00	15.6766	79.7	0	1
78.9451	760.00	16.5211	132.7	0	1
113.859	760.00	16.8502	137.5	0	1
152.065	760.00	17.1494	140.8	0	1
190.279	760.00	17.4331	145.1	0	1
228.232	760.00	17.7177	151.6	0	1
265.832	760.00	18.0166	160.2	0	1
304.421	760.00	18.3351	169.3	0	1
342.085	760.00	18.6529	177.8	0	1
380.063	760.00	18.9598	185.0	0	1
418.371	760.00	19.253	194.8	0	1
456.073	760.00	19.5246	206.2	0	1
493.448	760.00	19.7258	212.7	0	1
531.489	760.00	19.9356	220.0	0	1
569.464	760.00	20.1434	227.3	0	1
608.018	760.00	20.3872	239.7	0	1
645.379	760.00	20.6123	250.1	0	1
683.699	760.00	20.9143	266.4	0	1
721.968	760.00	21.3276	289.2	0	1
756.035	760.00	21.9898	320.4	0	1
754.443	760.00	22.0078	326.7	0	1
720.905	760.00	21.6716	344.7	0	1
683.317	760.00	21.4963	358.2	0	1
645.698	760.00	21.3076	366.6	0	1
607.498	760.00	21.1706	377.7	0	1
569.132	760.00	21.0267	388.2	0	1
531.138	760.00	20.8753	398.7	0	1
493.301	760.00	20.7185	408.3	0	1
455.395	760.00	20.5494	417.6	0	1
417.436	760.00	20.3692	426.8	0	1
379.905	760.00	20.1624	433.9	0	1
342.308	760.00	19.7541	442.9	0	1
303.353	760.00	19.2042	456.3	0	1
265.884	760.00	18.8206	463.1	0	1
227.472	760.00	18.4748	466.9	0	1
190.722	760.00	18.1688	469.4	0	1
151.322	760.00	17.8142	474.0	0	1
113.317	760.00	17.4358	493.2	0	1
75.684	760.00	17.0079	504.6	0	1
37.8456	760.00	16.4167	517.5	0	1

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Analysis			Report			
Operator:	UNDIP	Date:2020/12/30	Operator:	UNDIP	Date:2021/01/06	
Sample ID:	01157	Filename:	20201230 KATK.qps			
Sample Desc:		Comment:				
Sample Weight:	0.1267 g	Instrument:	Autosorb iQ Station 1			
Outgas Time:	3.0 hrs	Outgas Temp.:	300 °C			
Analysis gas:	Nitrogen	Non-ideality:	6.58e-05 1/Torr	CellType:	9mm w/o rod	
Analysis Time:	8:37 hr:min	Bath temp.:	77.35 K			
Analysis Mode:	Standard			VoidVol Remeasure:	off	
VoidVol. Mode:	He Measure	Cold Zone V:	0 cc	Warm Zone V:	0 cc	

Average Pore Size

Data Reduction Parameters Data

	Thermal Transpiration: on	Eff. mol. diameter (D): 3.54 Å		Eff. cell stem diam. (d): 4.0000 mm	
Adsorbate	Nitrogen	Temperature	77.350K		
	Molec. Wt.: 28.013	Cross Section:	16.200 Å²	Liquid Density:	0.808 g/cc

Average Pore Size summary

Average pore Radius = 1.32803e+01 Å

3. Karbon Aktif Tempurung Kemiri 850°C

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Analysis				Report			
Operator:	UNDIP	Date:2021/01/05		Operator:	UNDIP	Date:2021/01/22	
Sample ID:	01159	Filename:		20210105 KATK KOH 850C.qps			
Sample Desc:		Comment:					
Sample Weight:	0.1657 g	Instrument:		Autosorb iQ Station 1			
Outgas Time:	3.0 hrs	Outgas Temp.:		300 °C			
Analysis gas:	Nitrogen	Non-ideality:		6.58e-05 1/Torr		CellType:	9mm w/o rod
Analysis Time:	3:56 hr:min	Bath temp.:		77.35 K			
Analysis Mode:	Standard					VoidVol Remeasure:	off
VoidVol. Mode:	He Measure	Cold Zone V:		0 cc		Warm Zone V:	0 cc

Total Pore Volume

Data Reduction Parameters Data

Adsorbate	Thermal Transpiration: on	Eff. mol. diameter (D):	3.54 Å	Eff. cell stem diam. (d):	4.0000 mm
	Nitrogen	Temperature	77.350K		
	Molec. Wt.: 28.013	Cross Section:	16.200 Å²	Liquid Density:	0.808 g/cc

Total Pore Volume summary
Total Pore Volume

Total pore volume = 3.084e-01 cc/g for
pores smaller than 1708.5 Å (Radius)
at P/Po = 0.99437

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Analysis				Report			
Operator:	UNDIP	Date:2021/01/05		Operator:	UNDIP	Date:2021/01/06	
Sample ID:	01159	Filename:		20210105 KATK KOH 850C.qps			
Sample Desc:		Comment:					
Sample Weight:	0.1657 g	Instrument:		Autosorb iQ Station 1			
Outgas Time:	3.0 hrs	Outgas Temp.:		300 °C			
Analysis gas:	Nitrogen	Non-ideality:		6.58e-05 1/Torr		CellType:	9mm w/o rod
Analysis Time:	3:56 hr:min	Bath temp.:		77.35 K			
Analysis Mode:	Standard					VoidVol Remeasure:	off
VoidVol. Mode:	He Measure	Cold Zone V:		0 cc		Warm Zone V:	0 cc

Multi-Point BET

Data Reduction Parameters Data

Adsorbate	Thermal Transpiration: on	Eff. mol. diameter (D):	3.54 Å	Eff. cell stem diam. (d):	4.0000 mm
	Nitrogen	Temperature	77.350K		
	Molec. Wt.: 28.013	Cross Section:	16.200 Å²	Liquid Density:	0.808 g/cc

Multi-Point BET Data

Relative Pressure [P/Po]	Volume @ STP [cc/g]	1 / [W((Po/P) - 1)]	Relative Pressure [P/Po]	Volume @ STP [cc/g]	1 / [W((Po/P) - 1)]
9.96914e-02	155.0571	5.7139e-01	2.51356e-01	164.0590	1.6375e+00
1.51701e-01	159.1066	8.9931e-01	2.99976e-01	167.3999	2.0482e+00
1.99454e-01	162.1802	1.2292e+00			

BET summary

Slope =	7.379
Intercept =	-2.018e-01
Correlation coefficient, r =	0.998177
C constant=	-35.559
Surface Area =	485.255 m²/g

Analysis				Report			
Operator:	UNDIP	Date:2021/01/05		Operator:	UNDIP	Date:2021/01/06	
Sample ID:	01159	Filename:		20210105 KATK KOH 850C.qps			
Sample Desc:		Comment:					
Sample Weight:	0.1657 g	Instrument:		Autosorb IQ Station 1			
Outgas Time:	3.0 hrs	Outgas Temp.:		300 °C			
Analysis gas:	Nitrogen	Non-ideality:		6.58e-05 1/Torr		CellType:	9mm w/o rod
Analysis Time:	3:56 hr:min	Bath temp.:		77.35 K			
Analysis Mode:	Standard					VoidVol Remeasure:	off
VoidVol. Mode:	He Measure	Cold Zone V:		0 cc		Warm Zone V:	0 cc

Raw Analysis Data

Raw Analysis Data

Press [Torr]	P0 [Torr]	Volume @ STP [cc]	Time [min]	Tol	Equ
38.034	760.00	24.6584	26.7	0	1
75.7655	760.00	25.693	32.3	0	1
115.293	760.00	26.364	37.4	0	1
151.585	760.00	26.8733	40.5	0	1
191.031	760.00	27.1846	43.2	0	1
227.982	760.00	27.7382	47.5	0	1
266.052	760.00	28.2324	55.3	0	1
304.504	760.00	28.673	63.5	0	1
342.233	760.00	29.0965	69.5	0	1
380.195	760.00	29.5534	76.4	0	1
418.133	760.00	29.963	83.5	0	1
455.6	760.00	30.3016	87.8	0	1
494.102	760.00	30.5937	93.2	0	1
531.916	760.00	30.8681	99.1	0	1
569.799	760.00	31.1119	105.0	0	1
608.276	760.00	31.3559	109.8	0	1
646.34	760.00	31.6328	115.2	0	1
683.422	760.00	31.9348	120.5	0	1
721.929	760.00	32.3501	127.8	0	1
755.718	760.00	33.0361	137.5	0	1
754.807	760.00	33.0335	139.9	0	1
722.306	760.00	32.6064	145.6	0	1
682.559	760.00	32.3916	151.4	0	1
646.014	760.00	32.236	154.6	0	1
607.479	760.00	32.099	158.9	0	1
569.095	760.00	31.9833	163.4	0	1
531.134	760.00	31.8605	167.6	0	1
493.723	760.00	31.703	172.1	0	1
455.107	760.00	31.5807	176.4	0	1
418.247	760.00	31.4009	180.7	0	1
379.383	760.00	31.1409	187.3	0	1
339.89	760.00	30.0852	199.6	0	1
302.146	760.00	29.3252	208.6	0	1
266.567	760.00	28.8794	213.8	0	1
228.381	760.00	28.4413	216.7	0	1
190.507	760.00	27.9933	219.6	0	1
152.537	760.00	27.53	222.4	0	1
113.501	760.00	26.9839	226.4	0	1
76.057	760.00	26.3337	230.8	0	1
37.5235	760.00	25.3654	237.0	0	1

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Analysis				Report			
Operator:	UNDIP	Date:2021/01/05		Operator:	UNDIP	Date:2021/01/22	
Sample ID:	01159	Filename:		20210105 KATK KOH 850C.qps			
Sample Desc:		Comment:					
Sample Weight:	0.1657 g	Instrument:		Autosorb iQ Station 1			
Outgas Time:	3.0 hrs	Outgas Temp.:		300 °C			
Analysis gas:	Nitrogen	Non-ideality:		6.58e-05 1/Torr		CellType:	9mm w/o rod
Analysis Time:	3:56 hr:min	Bath temp.:		77.35 K			
Analysis Mode:	Standard					VoidVol Remeasure:	off
VoidVol. Mode:	He Measure	Cold Zone V:		0 cc		Warm Zone V:	0 cc

Average Pore Size

Data Reduction Parameters Data

Adsorbate	Thermal Transpiration: on	Eff. mol. diameter (D):	3.54 Å	Eff. cell stem diam. (d):	4.0000 mm
	Nitrogen	Temperature	77.350K		
	Molec. Wt.: 28.013	Cross Section:	16.200 Å²	Liquid Density:	0.808 g/cc

Average Pore Size summary

Average pore Radius = 1.27104e+01 Å

4. Karbon Aktif Tempurung Kemiri 900°C

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Analysis			**Report**		
Operator:	UNDIP	**Date:**2020/12/29	**Operator:**	UNDIP	**Date:**2021/01/06
Sample ID:	01156	**Filename:**	20201229 KATK KOH 900C.qps		
Sample Desc:		**Comment:**			
Sample Weight:	0.1607 g	**Instrument:**	Autosorb iQ Station 1		
Outgas Time:	3.0 hrs	**Outgas Temp.:**	300 °C		
Analysis gas:	Nitrogen	**Non-ideality:**	6.58e-05 1/Torr	**CellType:**	9mm w/o rod
Analysis Time:	6:31 hr:min	**Bath temp.:**	77.35 K		
Analysis Mode:	Standard			**VoidVol Remeasure:**	off
VoidVol. Mode:	He Measure	**Cold Zone V:**	0.953743 cc	**Warm Zone V:**	18.6378 cc

Total Pore Volume

Data Reduction Parameters Data

	Thermal Transpiration: on	**Eff. mol. diameter (D):** 3.54 Å		**Eff. cell stem diam. (d):** 4.0000 mm	
Adsorbate	Nitrogen	**Temperature**	77.350K		
	Molec. Wt.: 28.013	**Cross Section:**	16.200 Å²	**Liquid Density:**	0.808 g/cc

Total Pore Volume summary
Total Pore Volume

Total pore volume = 3.152e-01 cc/g for
pores smaller than 3227.2 Å (Radius)
at P/Po = 0.99703

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Analysis			**Report**		
Operator:	UNDIP	**Date:**2020/12/29	**Operator:**	UNDIP	**Date:**2021/01/06
Sample ID:	01156	**Filename:**	20201229 KATK KOH 900C.qps		
Sample Desc:		**Comment:**			
Sample Weight:	0.1607 g	**Instrument:**	Autosorb iQ Station 1		
Outgas Time:	3.0 hrs	**Outgas Temp.:**	300 °C		
Analysis gas:	Nitrogen	**Non-ideality:**	6.58e-05 1/Torr	**CellType:**	9mm w/o rod
Analysis Time:	6:31 hr:min	**Bath temp.:**	77.35 K		
Analysis Mode:	Standard			**VoidVol Remeasure:**	off
VoidVol. Mode:	He Measure	**Cold Zone V:**	0.953743 cc	**Warm Zone V:**	18.6378 cc

Multi-Point BET

Data Reduction Parameters Data

	Thermal Transpiration: on	**Eff. mol. diameter (D):** 3.54 Å		**Eff. cell stem diam. (d):** 4.0000 mm	
Adsorbate	Nitrogen	**Temperature**	77.350K		
	Molec. Wt.: 28.013	**Cross Section:**	16.200 Å²	**Liquid Density:**	0.808 g/cc

Multi-Point BET Data

Relative Pressure [P/Po]	Volume @ STP [cc/g]	1 / [W((Po/P) - 1)]	Relative Pressure [P/Po]	Volume @ STP [cc/g]	1 / [W((Po/P) - 1)]
1.00509e-01	155.2694	5.7581e-01	2.50109e-01	164.9217	1.6181e+00
1.49711e-01	158.9689	8.8620e-01	2.99039e-01	167.4297	2.0387e+00
2.00109e-01	162.1203	1.2347e+00			

BET summary

Slope =	7.352
Intercept =	-1.989e-01
Correlation coefficient, r =	0.998159
C constant=	-35.958
Surface Area =	486.863 m²/g

Analysis			Report		
Operator:	UNDIP	Date:2020/12/29	Operator:	UNDIP	Date:2021/01/06
Sample ID:	01156	Filename:	20201229 KATK KOH 900C.qps		
Sample Desc:		Comment:			
Sample Weight:	0.1607 g	Instrument:	Autosorb iQ Station 1		
Outgas Time:	3.0 hrs	Outgas Temp.:	300 °C		
Analysis gas:	Nitrogen	Non-ideality:	6.58e-05 1/Torr	CellType:	9mm w/o rod
Analysis Time:	6:31 hr:min	Bath temp.:	77.35 K		
Analysis Mode:	Standard			VoidVol Remeasure:	off
VoidVol. Mode:	He Measure	Cold Zone V:	0.953743 cc	Warm Zone V:	18.6378 cc

Raw Analysis Data

Raw Analysis Data

Press [Torr]	P0 [Torr]	Volume @ STP [cc]	Time [min]	Tol	Equ
39.3747	760.00	23.9556	89.0	0	1
76.3871	760.00	24.9518	105.5	0	1
113.781	760.00	25.5463	109.0	0	1
152.083	760.00	26.0527	112.8	0	1
190.083	760.00	26.5029	116.6	0	1
227.27	760.00	26.906	120.9	0	1
265.337	760.00	27.3494	128.2	0	1
303.337	760.00	27.7832	135.8	0	1
342.189	760.00	28.2677	146.4	0	1
380.259	760.00	28.7242	157.2	0	1
417.584	760.00	29.1188	165.5	0	1
455.804	760.00	29.4782	172.9	0	1
493.778	760.00	29.8094	180.8	0	1
532.017	760.00	30.0655	186.5	0	1
570.02	760.00	30.3497	193.9	0	1
607.94	760.00	30.6358	201.0	0	1
645.861	760.00	30.9475	208.8	0	1
683.618	760.00	31.297	217.7	0	1
721.689	760.00	31.7906	230.0	0	1
757.742	760.00	32.7465	250.8	0	1
755.093	760.00	32.7406	254.6	0	1
722.437	760.00	32.1779	264.1	0	1
682.925	760.00	31.9068	274.0	0	1
646.165	760.00	31.7153	280.2	0	1
607.941	760.00	31.5336	286.1	0	1
569.775	760.00	31.366	291.7	0	1
531.776	760.00	31.1912	297.0	0	1
494.036	760.00	31.0201	302.3	0	1
455.924	760.00	30.837	306.2	0	1
418.02	760.00	30.6311	312.9	0	1
380.267	760.00	30.4105	319.3	0	1
341.665	760.00	29.4628	333.6	0	1
302.447	760.00	28.6047	347.7	0	1
266.526	760.00	28.1378	354.5	0	1
228.568	760.00	27.6901	357.5	0	1
190.288	760.00	27.2375	360.4	0	1
152.586	760.00	26.7585	363.1	0	1
113.952	760.00	26.2142	377.2	0	1
75.8265	760.00	25.5593	387.3	0	1
37.5371	760.00	24.6225	392.0	0	1

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version 3.01

Analysis			Report		
Operator:	UNDIP	Date:2020/12/29	Operator:	UNDIP	Date:2021/01/06
Sample ID:	01156	Filename:	20201229 KATK KOH 900C.qps		
Sample Desc:		Comment:			
Sample Weight:	0.1607 g	Instrument:	Autosorb iQ Station 1		
Outgas Time:	3.0 hrs	Outgas Temp.:	300 °C		
Analysis gas:	Nitrogen	Non-ideality:	6.58e-05 1/Torr	CellType:	9mm w/o rod
Analysis Time:	6:31 hr:min	Bath temp.:	77.35 K		
Analysis Mode:	Standard			VoidVol Remeasure:	off
VoidVol. Mode:	He Measure	Cold Zone V:	0.953743 cc	Warm Zone V:	18.6378 cc

Average Pore Size

Data Reduction Parameters Data

Adsorbate	Thermal Transpiration: on	Eff. mol. diameter (D):	3.54 Å	Eff. cell stem diam. (d):	4.0000 mm
	Nitrogen	Temperature	77.350K		
	Molec. Wt.: 28.013	Cross Section:	16.200 Å²	Liquid Density:	0.808 g/cc

Average Pore Size summary

Average pore Radius = 1.29481e+01 Å

Lampiran 15. Perhitungan Kapasitansi Spesifik

a. Elektrolit Li_2SO_4

Sampel	Scan rate (V/s)	I_c (A)	I_d (A)	Massa karbon (gram)	Kapasitansi spesifik (F/g)	Kapasitansi spesifik (mF/g)
TK	0.1	3.90×10^{-7}	3.85×10^{-7}	0.1011	4.95×10^{-7}	$4,95 \times 10^{-4}$
	0.05	3.91×10^{-7}	3.84×10^{-7}	0.1011	1.37×10^{-6}	1.37×10^{-3}
	0.02	3.94×10^{-7}	3.86×10^{-7}	0.1011	4.36×10^{-6}	4.36×10^{-3}
	0.01	3.91×10^{-7}	3.80×10^{-7}	0.1011	1.08×10^{-5}	1.08×10^{-2}
KTK	0.1	2.20×10^{-6}	-1.40×10^{-6}	0.102	0.00035	0.35
	0.05	2.78×10^{-6}	-1.94×10^{-6}	0.102	0.00093	0.93
	0.02	3.21×10^{-6}	-2.28×10^{-6}	0.102	0.00269	2.69
	0.01	3.54×10^{-6}	-2.52×10^{-6}	0.102	0.00594	5.94
KATK	0.1	7.06×10^{-6}	-8.48×10^{-6}	0.1002	0.00159	1.59
	0.05	4.85×10^{-6}	-1.06×10^{-6}	0.1002	0.00308	3.08
	0.02	4.26×10^{-6}	-8.68×10^{-6}	0.1002	0.00646	6.46
	0.01	3.46×10^{-6}	-8.69×10^{-6}	0.1002	0.01214	12.14

1. Penentuan Kapasitansi TK

1.1 Scan rate 100 mV/s

$$C_s = \frac{(3.90 \times 10^{-7} - (3.85 \times 10^{-7})\ A}{0.1\ V/s \times 0.1011\ gram} = 4.95 \times 10^{-7}\ F/g$$

1.2 Scan rate 50 mV/s

$$C_s = \frac{(3.91 \times 10^{-7} - (3.84 \times 10^{-7})\ A}{0.05\ V/s \times 0.1011\ gram} = 1.37 \times 10^{-6}\ F/g$$

1.3 Scan rate 20 mV/s

$$C_s = \frac{(3.94 \times 10^{-7} - (3.94 \times 10^{-7})\ A}{0.02\ V/s \times 0.1011\ gram} = 4.36 \times 10^{-6}\ F/g$$

1.4 Scan rate 10 mV/s

$$C_s = \frac{(3.90 \times 10^{-7} - (3.85 \times 10^{-7})\ A}{0.01\ {}^{V}/_{s} \times 0.1011\ gram} = 1.08 \times 10^{-5}\ {}^{F}/_{g}$$

2 Penentuan Kapasitansi Spesifik KTK

2.1 Scan rate 100 mV/s

$$C_s = \frac{(2.20 \times 10^{-6} - (-1.40 \times 10^{-6}))\ A}{0.1\ {}^{V}/_{s} \times 0.1020\ gram} = 0.00035\ {}^{F}/_{g}$$

2.2 Scan rate 50 mV/s

$$C_s = \frac{(2.78 \times 10^{-6} - (-1.94 \times 10^{-6}))\ A}{0.05\ {}^{V}/_{s} \times 0.1020\ gram} = 0.00093\ {}^{F}/_{g}$$

2.3 Scan rate 20 mV/s

$$C_s = \frac{(3.21 \times 10^{-6} - (-2.28 \times 10^{-6}))\ A}{0.05\ {}^{V}/_{s} \times 0.1020\ gram} = 0.00269\ {}^{F}/_{g}$$

2.4 Scan rate 10 mV/s

$$C_s = \frac{(3.54 \times 10^{-6} - (-2.52 \times 10^{-6}))\ A}{0.01\ {}^{V}/_{s} \times 0.1020\ gram} = 0.00594\ {}^{F}/_{g}$$

3.Penentuan Kapasitansi Spesifik KATK

3.1 Scan rate 100 mV/s

$$C_s = \frac{(7.06 \times 10^{-6} - (-8.48 \times 10^{-6}))\ A}{0.1\ {}^{V}/_{s} \times 0.1002\ gram} = 0.00159\ {}^{F}/_{g}$$

3.2 Scan rate 50 mV/s

$$C_s = \frac{(4.85 \times 10^{-6} - (-1.06 \times 10^{-6}))\ A}{0.05\ {}^{V}/_{s} \times 0.1002\ gram} = 0.00308\ {}^{F}/_{g}$$

3.3 Scan rate 20 mV/s

$$C_s = \frac{(4.26E \times 10^{-6} - (-8.68 \times 10^{-6}))\ A}{0.02\ {}^{V}/_{s} \times 0.1002\ gram} = 0.00646\ {}^{F}/_{g}$$

3.4 Scan rate 10 mV/s

$$C_s = \frac{(3.46 \times 10^{-6} - (-8.69 \times 10^{-6}))\ A}{0.01\ V/s \times 0.1002\ gram} = 0.01214\ F/g$$

b. Elektrolit Na_2SO_4

Sampel	Scan rate (V/s)	I_c (A)	I_d (A)	Massa karbon (gram)	Kapasitansi spesifik (F/g)	Kapasitansi spesifik (mF/g)
TK	0.1	3.96×10^{-7}	3.86×10^{-7}	0.1011	1.03×10^{-6}	1.03×10^{-3}
	0.05	3.96×10^{-7}	3.83×10^{-7}	0.1011	2.50×10^{-6}	2.50×10^{-3}
	0.02	4.04×10^{-7}	3.89×10^{-7}	0.1011	7.54×10^{-6}	7.54×10^{-3}
	0.01	3.95×10^{-7}	3.84×10^{-7}	0.1011	1.14×10^{-5}	1.14×10^{-2}
KTK 700	0.1	2.79×10^{-6}	-1.84×10^{-6}	0.102	0.00045	0.45
	0.05	2.33×10^{-6}	-1.44×10^{-6}	0.102	0.00074	0.74
	0.02	2.78×10^{-6}	-2.30×10^{-6}	0.102	0.00236	2.36
	0.01	2.77×10^{-6}	-2.02×10^{-6}	0.102	0.00469	4.69
KATK 900	0.1	7.27×10^{-6}	-1.03×10^{-5}	0.1002	0.00175	1.75
	0.05	7.22×10^{-6}	-8.49×10^{-6}	0.1002	0.00314	3.14
	0.02	7.19×10^{-6}	-8.27×10^{-6}	0.1002	0.00771	7.71
	0.01	7.26×10^{-6}	-8.91×10^{-6}	0.1002	0.01614	16.14

1. Penentuan Kapasitansi TK

1.1 Scan rate 100 mV/s

$$C_s = \frac{(3.96 \times 10^{-7} - (3.86 \times 10^{-7})\ A}{0.1\ V/s \times 0.1011\ gram} = 1.30 \times 10^{-6}\ F/g$$

1.2 Scan rate 50 mV/s

$$C_s = \frac{(3.96 \times 10^{-7} - (3.83 \times 10^{-7})\ A}{0.05\ V/s \times 0.1011\ gram} = 1.26 \times 10^{-6}\ F/g$$

1.3 Scan rate 20 mV/s

$$C_s = \frac{(4.04\ x\ 10^{-7} - (3.89\ x\ 10^{-7})\ A}{0.02\ {}^{V}/_{S}\ x\ 0.1011\ gram} = 7.54 \text{ x } 10^{-6}\ {}^{F}/_{g}$$

1.4 Scan rate 10 mV/s

$$C_s = \frac{(3.95 \text{ x } 10^{-7} - (3.84 \text{ x } 10^{-7})\ A}{0.01\ {}^{V}/_{S} \text{ x } 0.1011 \text{ gram}} = 1.14 \text{ x } 10^{-5}\ {}^{F}/_{g}$$

2 Penentuan Kapasitansi Spesifik KTK

2.1 Scan rate 100 mV/s

$$C_s = \frac{(2.79 \text{ x } 10^{-6} - (-1.84 \text{ x } 10^{-6}))\ A}{0.1\ {}^{V}/_{S} \text{ x } 0.1020 \text{ gram}} = 0.00045\ {}^{F}/_{g}$$

2.2 Scan rate 50 mV/s

$$C_s = \frac{(2.33 \text{ x } 10^{-6} - (-1.44 \text{ x } 10^{-6}))\ A}{0.05\ {}^{V}/_{S} \text{ x } 0.1020 \text{ gram}} = 0.00074\ {}^{F}/_{g}$$

2.3 Scan rate 20 mV/s

$$C_s = \frac{(2.78 \text{ x } 10^{-6} - (-2.30 \text{ x } 10^{-6}))\ A}{0.05\ {}^{V}/_{S} \text{ x } 0.1020 \text{ gram}} = 0.00236\ {}^{F}/_{g}$$

2.4 Scan rate 10 mV/s

$$C_s = \frac{(2.77 \text{ x } 10^{-6} - (-2.02 \text{ x } 10^{-6}))\ A}{0.01\ {}^{V}/_{S} \text{ x } 0.1020 \text{ gram}} = 0.00469\ {}^{F}/_{g}$$

3. Penentuan Kapasitansi Spesifik KATK

3.1 Scan rate 100 mV/s

$$C_s = \frac{(2.20 \text{ x } 10^{-6} - (-1.40 \text{ x } 10^{-6}))\ A}{0.1\ {}^{V}/_{S} \text{ x } 0.1020 \text{ gram}} = 0.00035\ {}^{F}/_{g}$$

3.2 Scan rate 50 mV/s

$$C_s = \frac{(2.78 \text{ x } 10^{-6} - (-1.94 \text{ x } 10^{-6}))\ A}{0.05\ {}^{V}/_{S} \text{ x } 0.1020 \text{ gram}} = 0.00093\ {}^{F}/_{g}$$

3.3 Scan rate 20 mV/s

$$C_s = \frac{\left(3.21 \times 10^{-6} - (-2.28 \times 10^{-6})\right) A}{0.05\ {}^{V}/_{s} \times 0.1020 \text{ gram}} = 0.00269\ {}^{F}/_{g}$$

3.4 Scan rate 10 mV/s

$$C_s = \frac{\left(3.54 \times 10^{-6} - (-2.52 \times 10^{-6})\right) A}{0.01\ {}^{V}/_{s} \times 0.1020 \text{ gram}} = 0.00594\ {}^{F}/_{g}$$

3 Penentuan Kapasitansi Spesifik KATK

3.1 Scan rate 100 mV/s

$$C_s = \frac{\left(7.27 \times 10^{-6} - (-1.038 \times 10^{-6})\right) A}{0.1\ {}^{V}/_{s} \times 0.1002 \text{ gram}} = 0.00175\ {}^{F}/_{g}$$

3.2 Scan rate 50 mV/s

$$C_s = \frac{\left(7.22 \times 10^{-6} - (-8.49 \times 10^{-6})\right) A}{0.05\ {}^{V}/_{s} \times 0.1002 \text{ gram}} = 0.00314\ {}^{F}/_{g}$$

3.3 Scan rate 20 mV/s

$$C_s = \frac{\left(7.19 \times 10^{-6} - (-8.27 \times 10^{-6})\right) A}{0.02\ {}^{V}/_{s} \times 0.1002 \text{ gram}} = 0.00771\ {}^{F}/_{g}$$

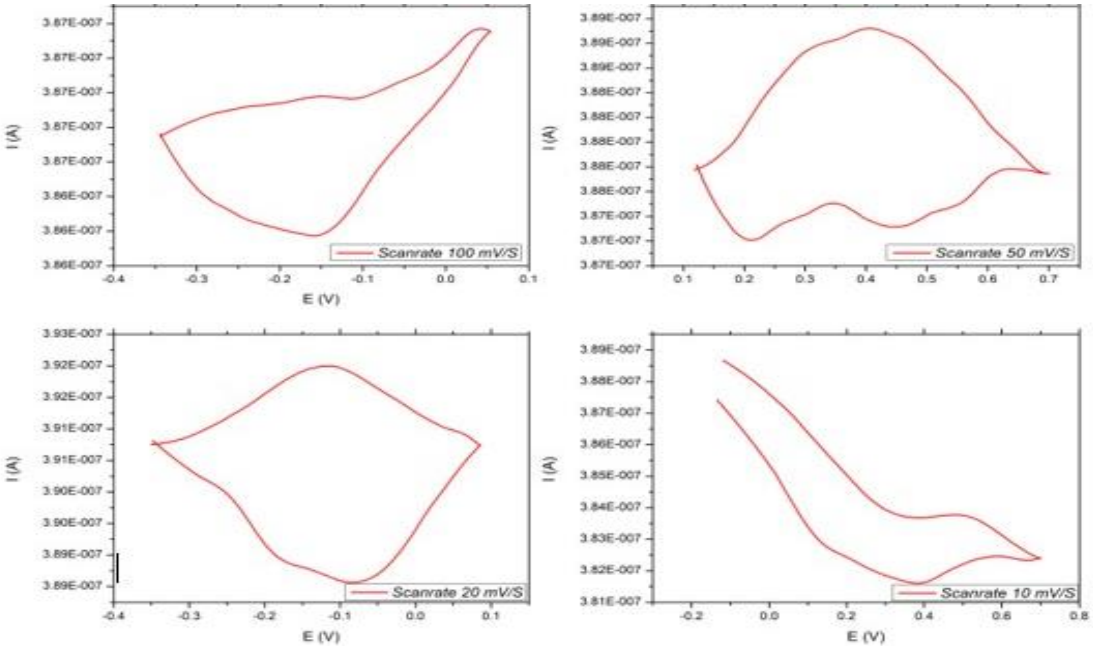
3.4 Scan rate 10 mV/s

$$C_s = \frac{\left(7.26 \times 10^{-6} - (-8.91 \times 10^{-6})\right) A}{0.01\ {}^{V}/_{s} \times 0.1002 \text{ gram}} = 0.01614\ {}^{F}/_{g}$$

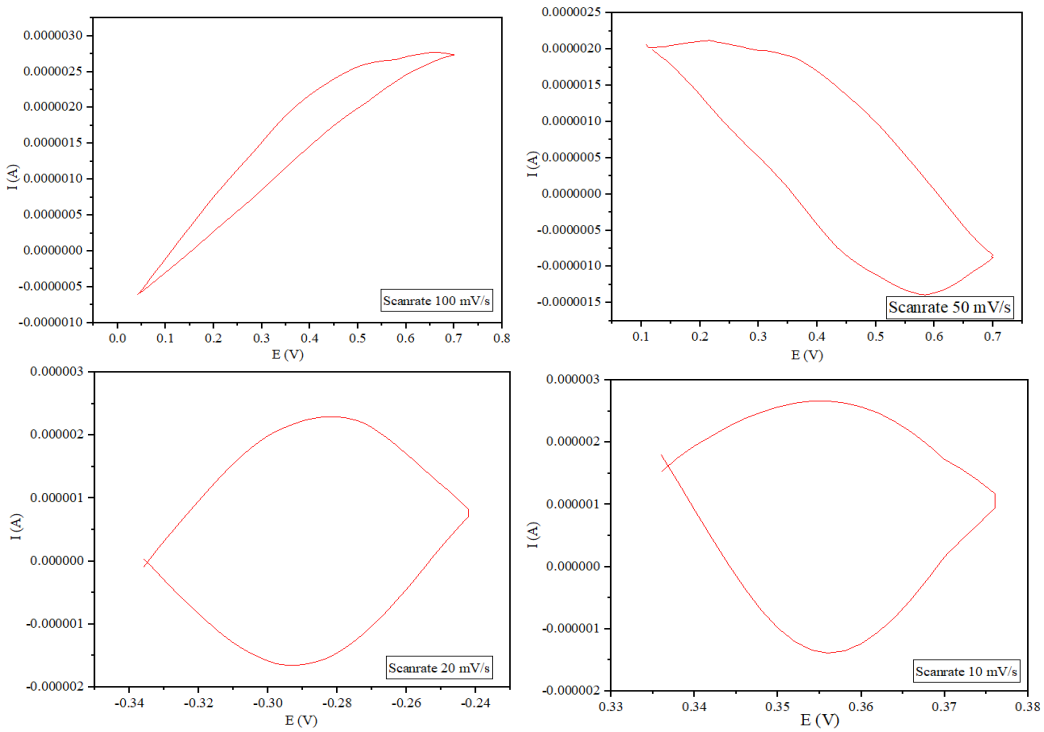
Lampiran 16. Grafik Kapasitansi Spesifik TK, KTK dan KATK

1. Grafik kapasitansi spesifik dalam elektrolit Li_2SO_4 1 M

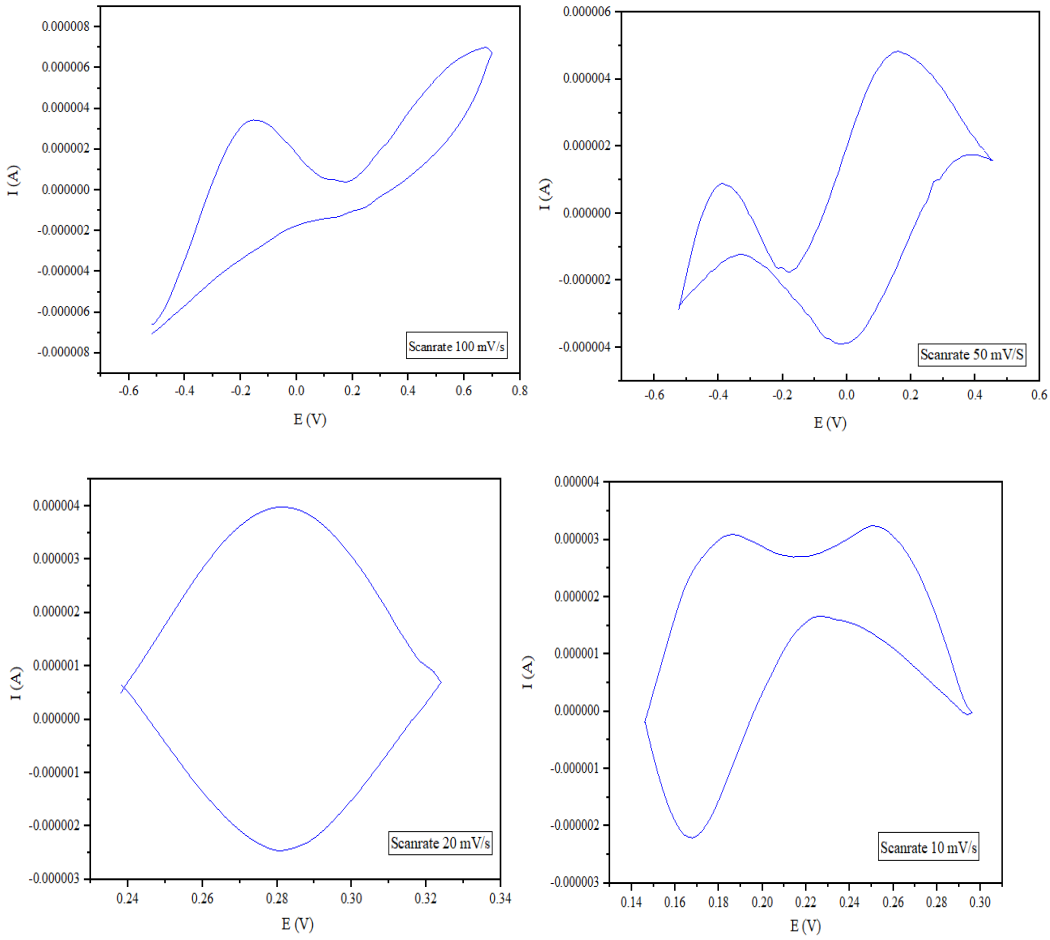
a. TK



b. KTK 700

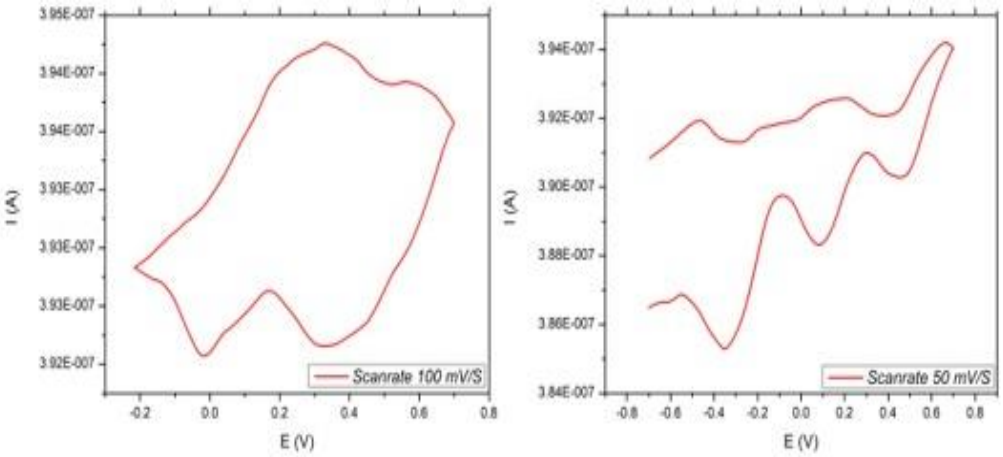


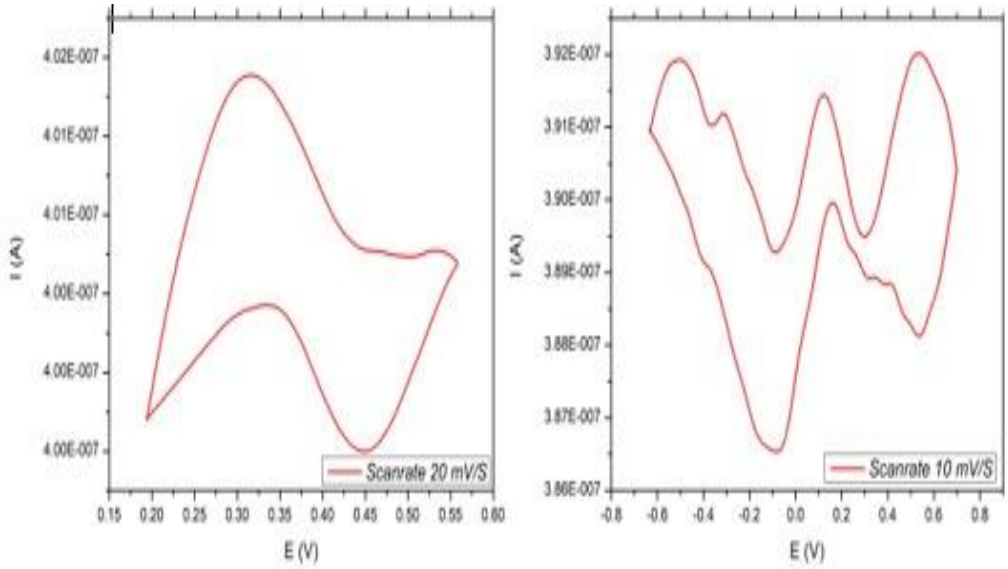
c. KATK 900



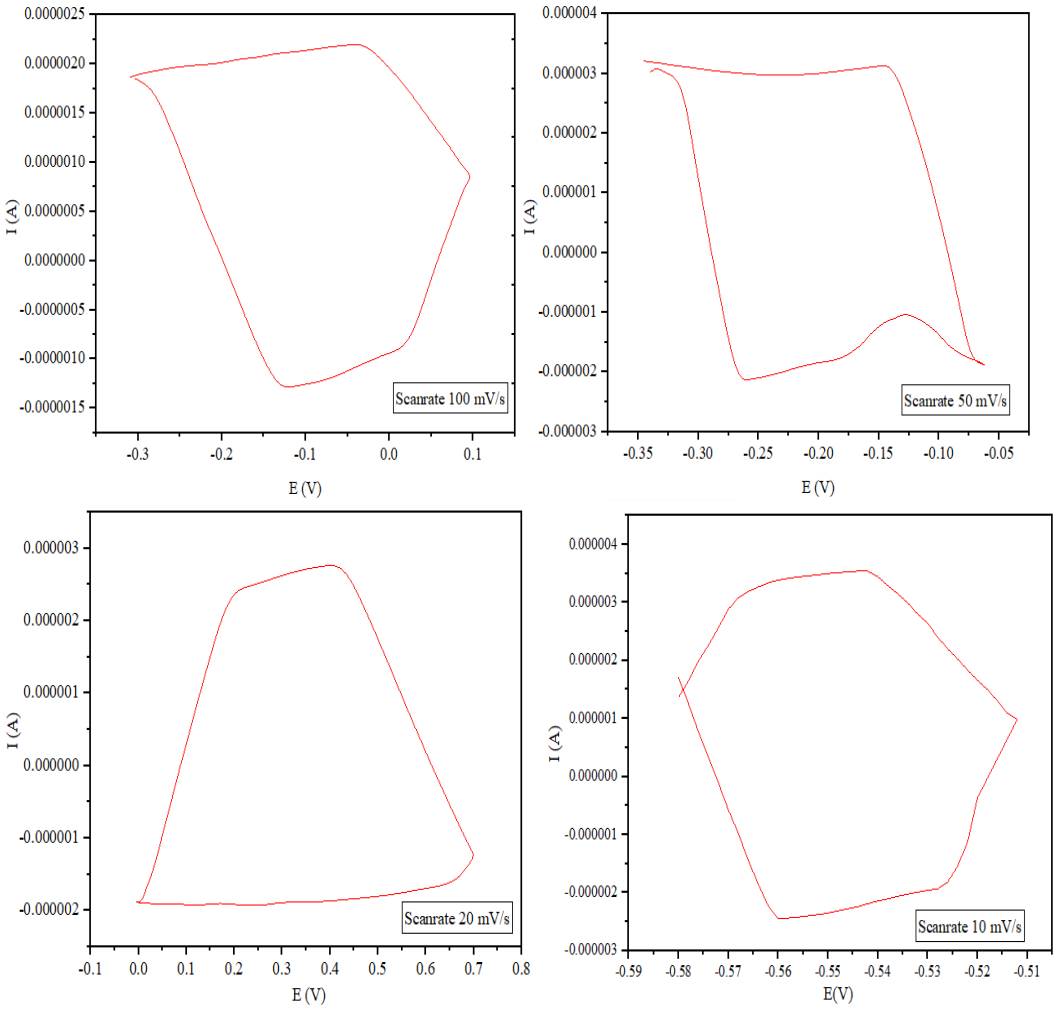
2. Grafik kapasitansi spesifik dalam elektrolit Na_2SO_4 1 M

a. TK

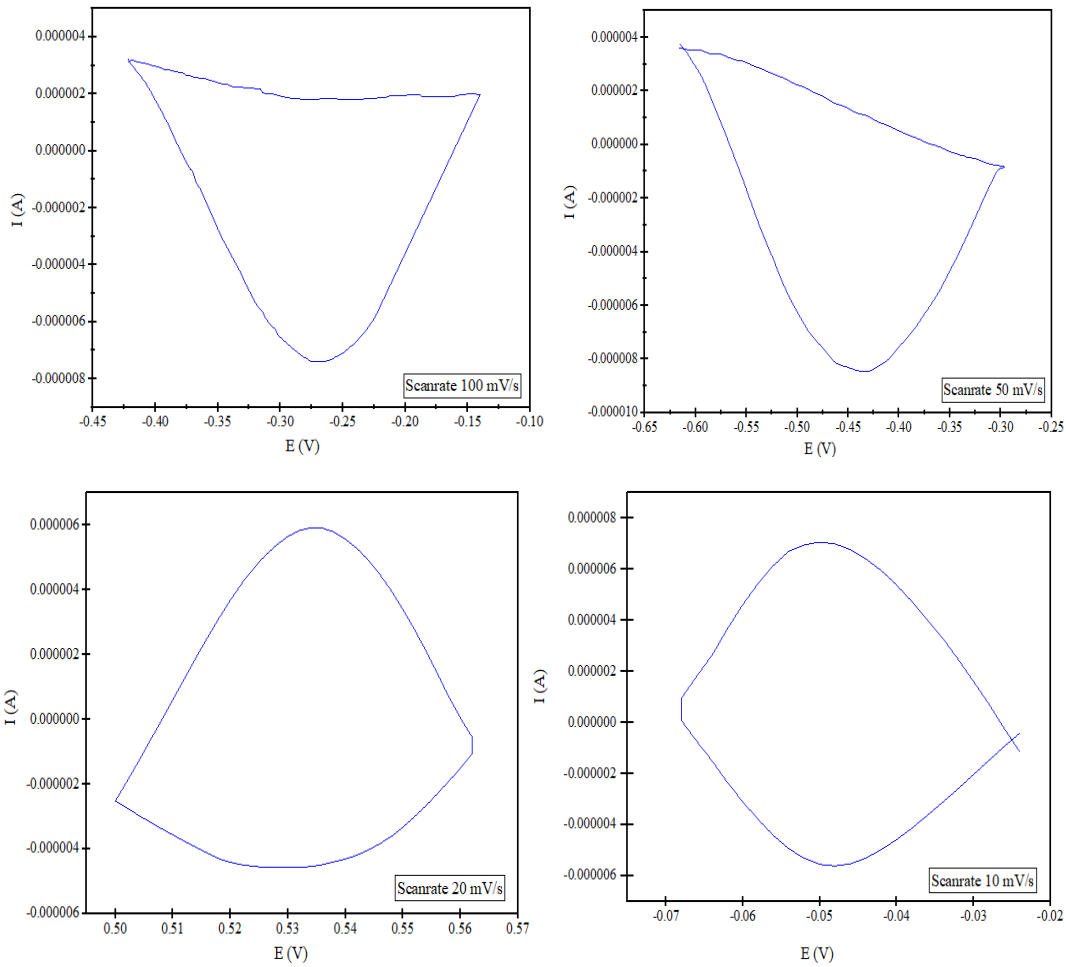



I (A)
E (V)
Scanrate 20 mV/S
Scanrate 10 mV/S

b. KTK 700


I (A)
E (V)
Scanrate 100 mV/s
Scanrate 50 mV/s
Scanrate 20 mV/s
Scanrate 10 mV/s

c. KATK 900


Scanrate 100 mV/s
Scanrate 50 mV/s
Scanrate 20 mV/s
Scanrate 10 mV/s
I (A)
E (V)