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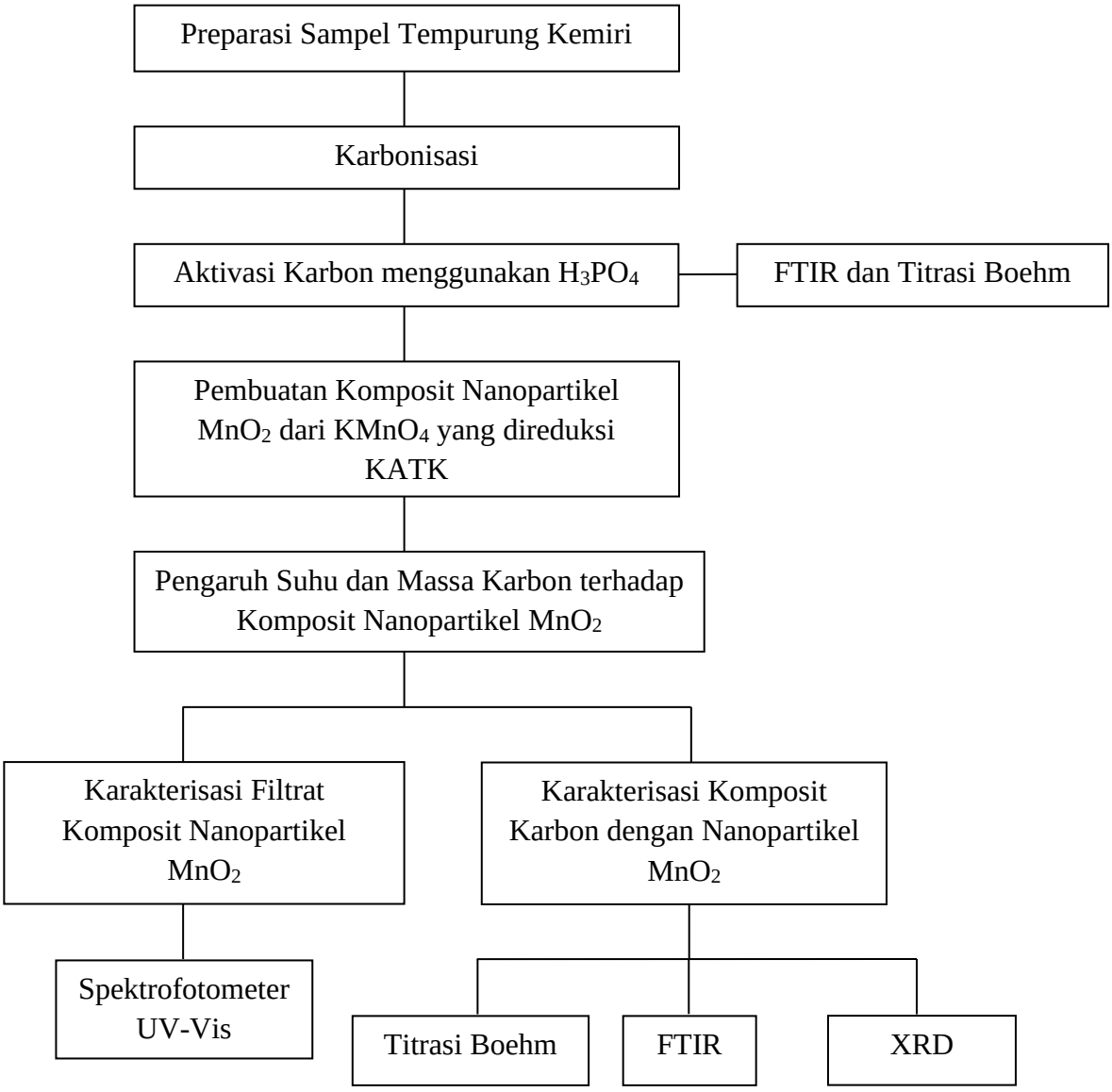
LAMPIRAN

Lampiran 1. Diagram Alir Penelitian



Lampiran 2. Bagan Kerja

2.1 Prosedur Umum

Tempurung Kemiri

- dibersihkan kotoran yang menempel pada tempurung dan dikeringkan dalam oven pada suhu 110 °C selama 2 jam
- dikarbonisasi pada suhu 700 °C selama 3 jam
- dihaluskan dan diayak dengan ukuran 150 mesh

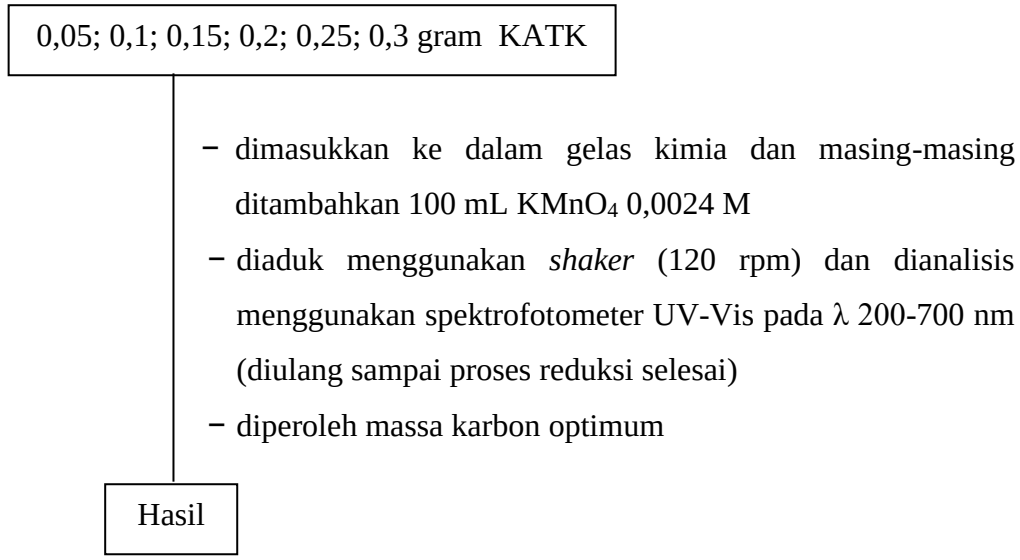
Karbon Tempurung Kemiri (KTK)

- diaktivasi dengan larutan H_3PO_4 10% dengan perbandingan 5:1 (volume H_3PO_4 : massa karbon)
- diaduk kemudian didiamkan selama 24 jam pada suhu kamar
- disaring menggunakan corong Buchner dengan kertas saring Whatman no. 42, hingga pH netral
- dipirolisis dalam tanur pada suhu 850 °C selama 30 menit
- dibilas dengan akuades
- dikeringkan dalam oven pada suhu 110 °C selama 3 jam

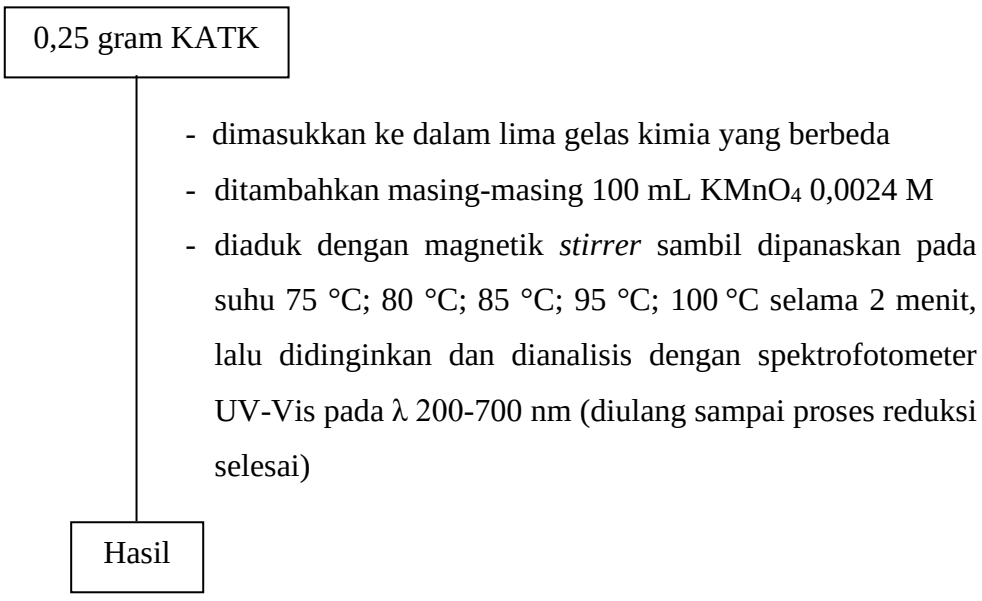
Karbon Aktif Tempurung Kemiri (KATK)

2.2 Optimasi Komposit Nanopartikel MnO_2 dari $KMnO_4$ yang Direduksi dengan KATK

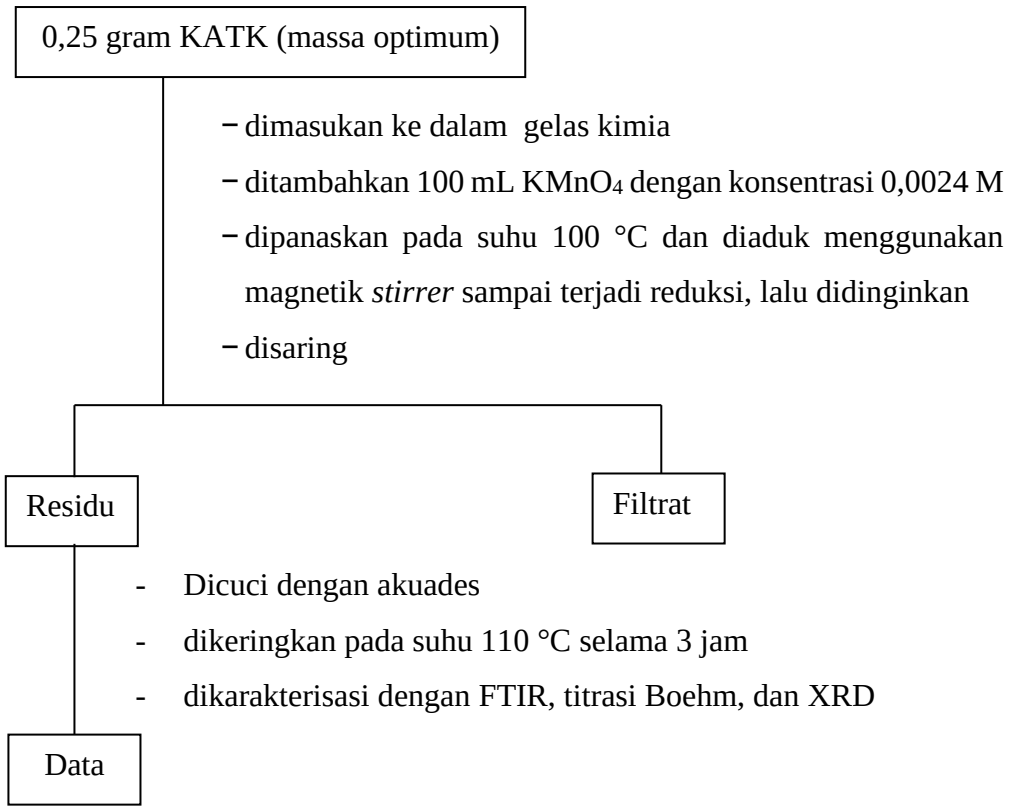
2.2.1 Pengaruh Massa $KMnO_4$



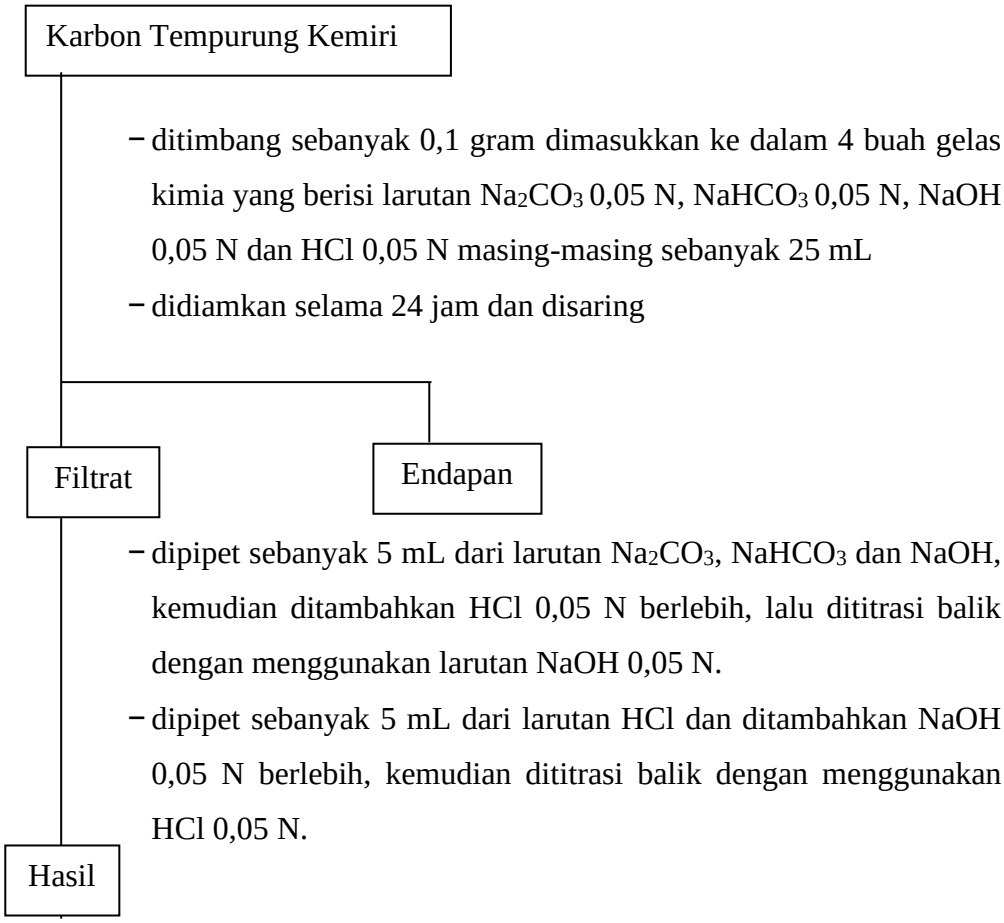
2.2.2 Pengaruh Suhu



2.3 Sintesis Nanopartikel MnO_2 pada Kondisi Optimum



2.4 Analisis Gugus Fungsi denganTitrasi Boehm



Catatan: diulangi prosedur yang sama dengan sampel KATK dan MnO_2/AC.

Lampiran 3. Dokumentasi Penelitian

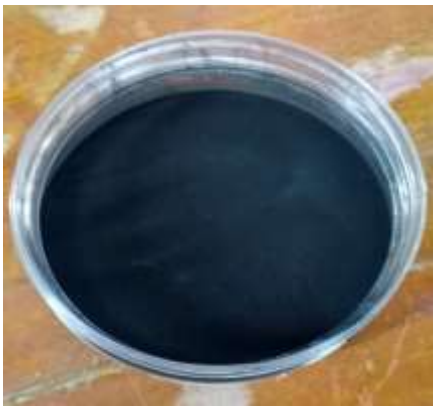
Tempurung Kemiri

Karbon Tempurung Kemiri

Karbon Tempurung Kemiri ukuran 150 mesh

Aktivasi Karbon Tempurung Kemiri dengan H_3PO_4

Proses Penyaringan KATK



Karbon Aktif setelah Pengeringan

Standarisasi NaOH dengan $H_2C_2O_4$

Standarisasi HCl dengan $Na_2B_4O_{7.\ 10}H_2O$

Perendaman Sampel pada Titrasi Boehm

Hasil Titrasi Boehm

Hasil Titrasi Boehm (Asam Total)

Hasil Titrasi Boehm (Basa Total)

Optimasi Massa

Optimasi Suhu

Pembentukan Nanopartikel MnO_2 pada Massa dan Suhu Optimum

AC/MnO_2

Lampiran 4. Perhitungan Pembuatan Larutan Pereaksi

1. Pembuatan Larutan H_3PO_4 10% dari H_3PO_4 85%

$V_1 \times M_1 = V_2 \times M_2$

$V_1 \times 85\% = 500\ mL \times 10\%$

$V_1 = 58{,}82\ mL$

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. Pembuatan Larutan $NaHCO_3$ 0,05 N

gram = L × N × BE

gram = 0,25 L × 0,05 N × 84,007 g/eq = 1,0500 gram

4. Pembuatan Larutan NaOH 0,05 N

gram = L × N × BE

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

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

$V_1 \times N_1 = V_2 \times N_2$

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

$V_1 = 1{,}03\ mL$

6. Pembuatan Larutan $Na_2B_4O_{7.\ 10}H_2O$ 0,05 N

gram = L × N × BE

gram = 0,1 L × 0,05 N × 191 g/eq = 0,9550 gram

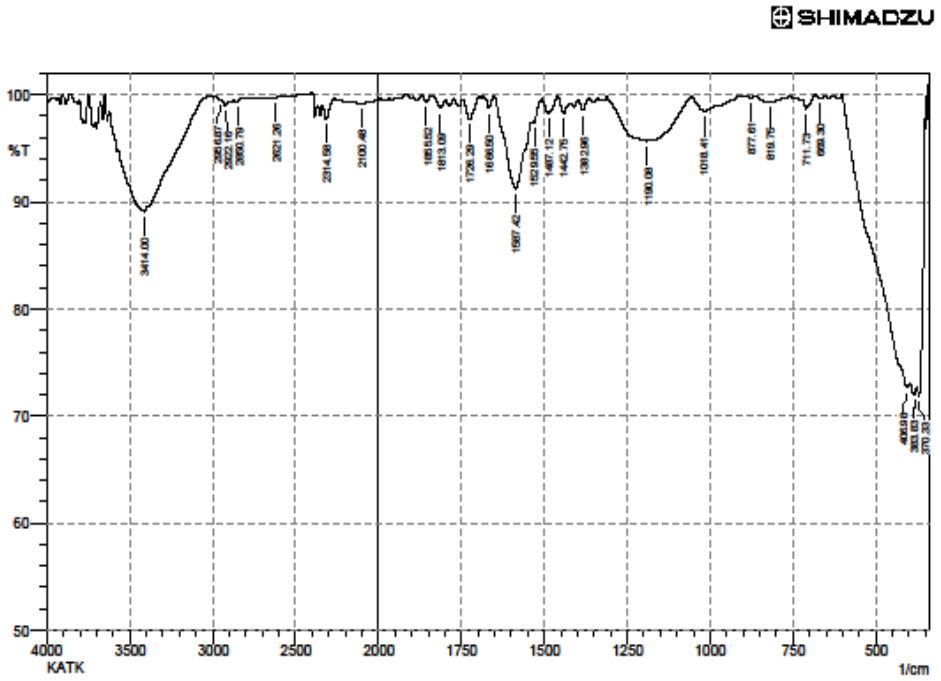
7. Pembuatan Larutan $H_2C_2O_4$ 0,05 N

gram = L × N × BE

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

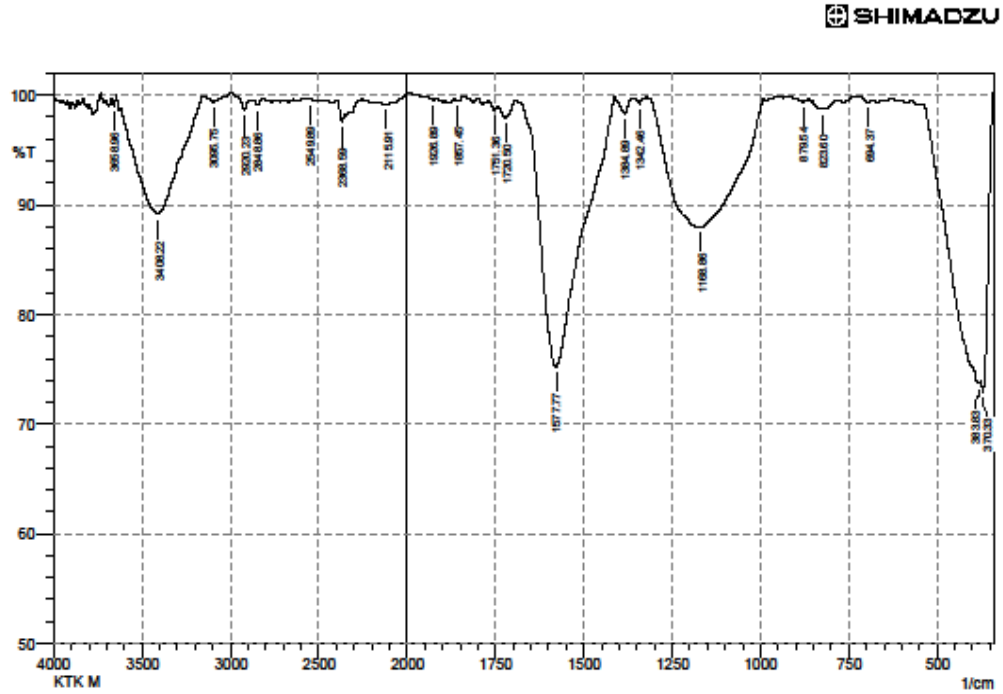
Lampiran 5. Hasil Karakterisasi FTIR KTK, KATK, dan AC/MnO_2

Hasil Karakterisasi FTIR KTK



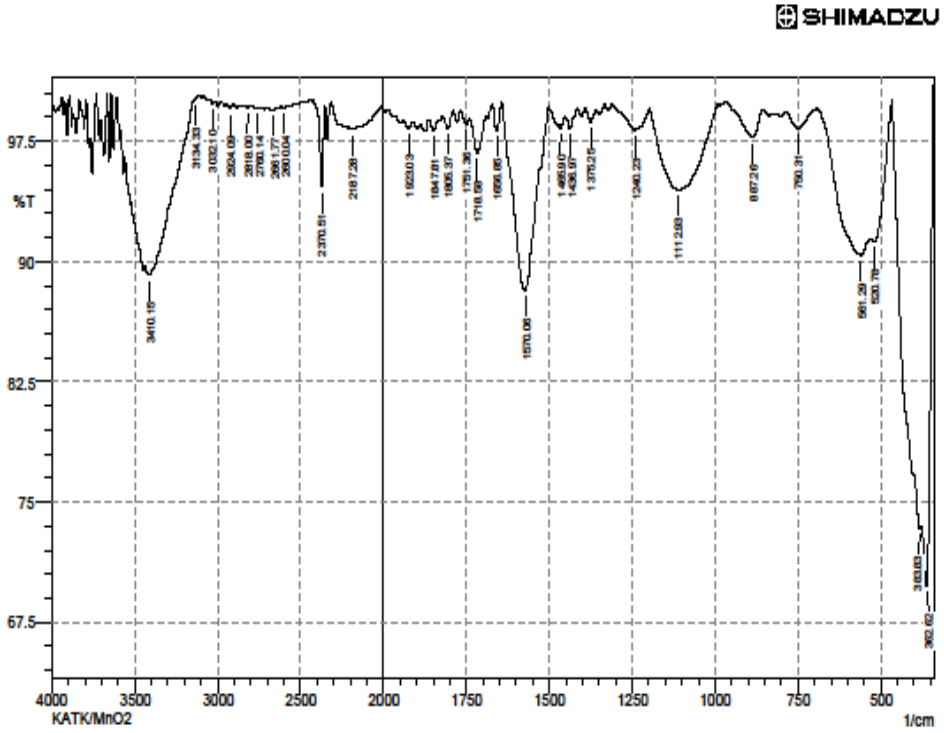
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	370.33	71.839	7.053	376.12	351.04	2.485	0.859
2	383.83	71.996	0.736	397.34	378.05	2.714	0.054
3	406.98	72.674	1.36	601.79	399.26	15.397	1.443
4	669.3	99.636	0.272	684.73	651.94	0.031	0.017
5	711.73	98.664	1.067	727.16	684.73	0.132	0.093
6	819.75	99.298	0.538	864.11	761.88	0.212	0.139
7	877.61	99.731	0.141	908.47	864.11	0.034	0.012
8	1018.41	98.481	1.423	1055.06	908.47	0.565	0.51
9	1190.08	95.689	4.134	1311.59	1056.99	3.226	3.029
10	1382.96	98.521	1.029	1398.39	1365.6	0.131	0.068
11	1442.75	98.253	1.332	1458.18	1421.54	0.18	0.106
12	1487.12	98.252	1.47	1508.33	1458.18	0.229	0.172
13	1529.55	97.373	0.418	1533.41	1508.33	0.166	0.005
14	1587.42	91.26	7.232	1653	1535.34	2.667	1.949
15	1666.5	98.723	1.126	1683.86	1653	0.087	0.067
16	1726.29	97.716	1.939	1745.58	1697.36	0.282	0.218
17	1813.09	98.739	0.903	1834.3	1797.66	0.122	0.07
18	1855.52	99.341	0.552	1869.02	1842.02	0.049	0.037
19	2100.48	99.225	0.03	2115.91	2065.76	0.165	0.005
20	2314.58	97.713	1.542	2337.72	2270.22	0.403	0.213
21	2621.26	99.759	0.024	2632.83	2563.4	0.059	0.003
22	2850.79	99.293	0.231	2870.08	2794.85	0.159	0.02
23	2922.16	99.023	0.484	2949.16	2870.08	0.24	0.068
24	2956.87	99.515	0.074	2983.88	2949.16	0.055	0.004
25	3414	89.114	1.05	3568.31	3392.79	7.239	1.001

Hasil Karakterisasi FTIR KATK



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	370.33	72.9229	5.4205	376.12	343.33	2.6658	0.6109
2	383.83	73.7166	1.096	536.21	378.05	12.0808	1.2944
3	694.37	99.3242	0.2672	715.59	682.8	0.0675	0.0165
4	823.6	98.7339	0.7695	852.54	783.1	0.2991	0.1523
5	879.54	99.3664	0.359	921.97	864.11	0.0936	0.038
6	1168.86	87.9488	11.7779	1321.24	993.34	11.7225	11.3254
7	1342.46	99.2245	0.5491	1361.74	1321.24	0.0758	0.0361
8	1384.89	98.3453	1.4621	1413.82	1361.74	0.2043	0.162
9	1577.77	75.2018	24.3616	1680	1413.82	15.2786	14.8411
10	1720.5	97.9015	1.2896	1741.72	1693.5	0.3111	0.1471
11	1751.36	98.5906	0.5598	1770.65	1741.72	0.1287	0.0326
12	1857.45	99.4718	0.2524	1867.09	1842.02	0.0445	0.0176
13	1926.89	99.5748	0.1795	1944.25	1915.31	0.0403	0.0127
14	2115.91	99.1567	0.1233	2137.13	2088.91	0.1643	0.0143
15	2368.59	97.5883	1.1381	2397.52	2351.23	0.3206	0.0972
16	2549.89	99.5927	0.0627	2571.11	2538.32	0.0521	0.0046
17	2848.86	99.0591	0.5181	2870.08	2819.93	0.1429	0.0541
18	2920.23	98.6553	0.9697	2956.87	2889.37	0.2191	0.1132
19	3095.75	99.382	0.2252	3120.82	3076.46	0.0978	0.0233
20	3408.22	89.1474	8.025	3562.52	3159.4	12.4542	8.3466
21	3658.96	98.9845	0.845	3670.54	3645.46	0.0672	0.0499

Hasil Karakterisasi FTIR AC/MnO_2

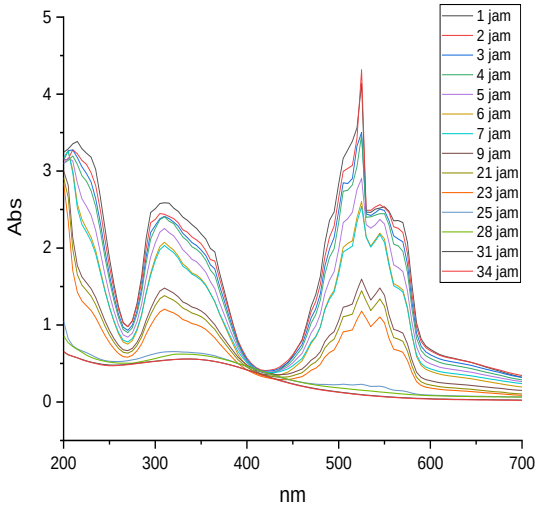


No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	362.62	69.75	13.931	376.12	343.33	3.696	1.499
2	383.83	73.363	1.891	466.77	378.05	7.773	1.742
3	520.78	91.234	1.432	530.42	468.7	1.627	0.427
4	561.29	90.415	2.425	690.52	532.35	4.625	1.332
5	750.31	98.321	1.103	785.03	692.44	0.453	0.229
6	887.26	97.738	1.684	945.12	854.47	0.568	0.337
7	1112.93	94.447	5.22	1197.79	991.41	3.329	3.048
8	1240.23	98.206	1.457	1309.67	1197.79	0.551	0.4
9	1375.25	98.687	0.8	1392.61	1357.89	0.138	0.06
10	1436.97	98.265	1.008	1454.33	1415.75	0.196	0.078
11	1465.9	98.31	0.357	1469.76	1454.33	0.099	0.017
12	1570.06	88.169	0.742	1573.91	1504.48	1.986	0.107
13	1656.85	98.149	1.698	1672.28	1645.28	0.129	0.11
14	1718.58	96.732	2.217	1739.79	1691.57	0.475	0.256
15	1751.36	98.538	0.568	1766.8	1739.79	0.134	0.033
16	1805.37	98.333	0.891	1822.73	1789.94	0.177	0.065
17	1847.81	98.166	0.764	1863.24	1822.73	0.247	0.062
18	1923.03	98.315	0.442	1940.39	1913.39	0.171	0.027
19	2187.28	98.227	0.152	2206.57	2156.42	0.373	0.018
20	2370.51	94.673	5.126	2420.66	2353.16	0.579	0.544
21	2600.04	99.581	0.109	2619.33	2576.9	0.067	0.01
22	2661.77	99.449	0.087	2671.41	2642.48	0.061	0.006
23	2760.14	99.553	0.098	2794.85	2744.71	0.083	0.011
24	2818	99.572	0.144	2835.36	2794.85	0.063	0.013
25	2924.09	99.539	0.316	2945.3	2904.8	0.053	0.027
26	3032.1	99.849	0.177	3049.46	3016.67	0.008	0.012
27	3134.33	100.133	0.038	3138.18	3111.18	-0.026	0.005
28	3410.15	89.178	0.278	3415.93	3143.97	7.34	0.741

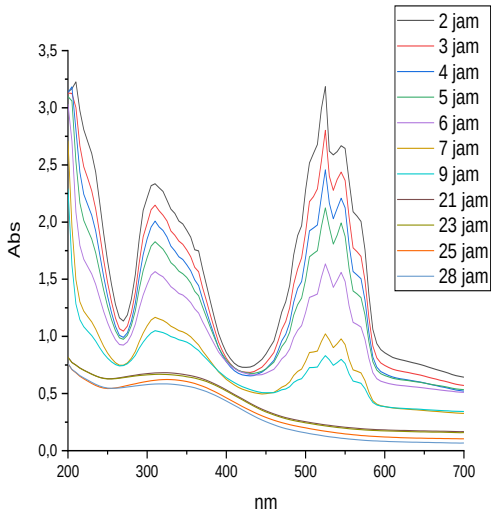
Lampiran 6. Hasil Karakterisasi UV-Vis

Data UV-Vis filtrat hasil reduksi larutan $KMnO_4$ oleh KATK pada variasi massa

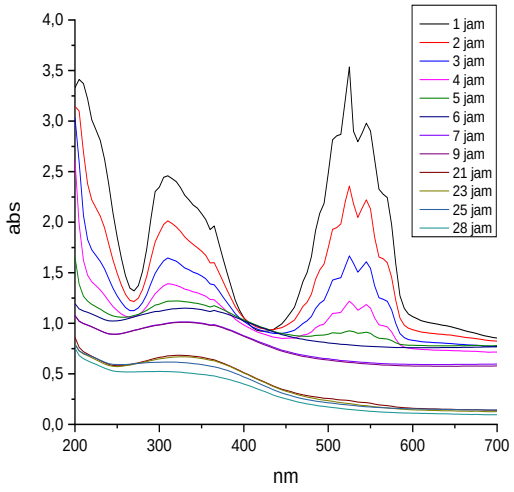
0,05 gram



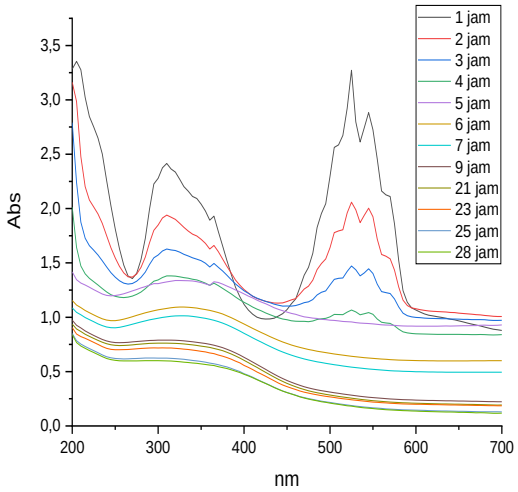
0,1 gram



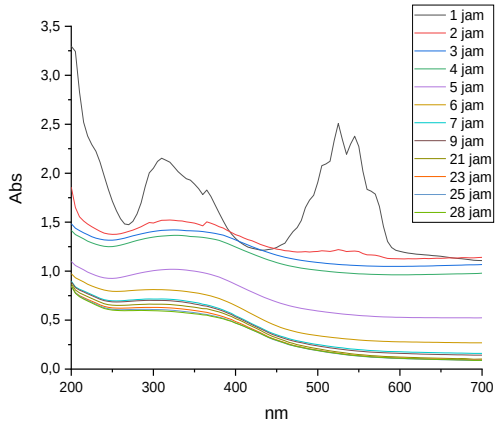
0,15 gram



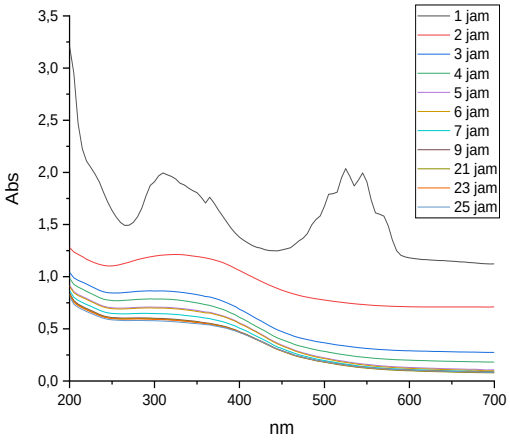
0,2 gram



0,25 gram



0,3 gram



1. Tabel 0,05 gram – 0,0024 M (0 menit-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	550	2,582
	525	4,100
	365	2,204
	310	2,716
	225	3.440
2	565	2,358
	550	2,537
	525	4,138
	310	2,587
	215	3,384
3	545	2,564
	525	4,315
	305	2,448
	210	3,277
4	545	2,507
	525	3,502
	310	2,412
	210	3,274
5	550	2,446
	525	2,469
	310	2,406
	210	3,197
6	545	2371
	525	2904
	310	2255
	205	3171
7	545	2193
	525	2603
	310	2074
	205	3261
8	545	2178
	525	2540
	310	2033
	205	2262
9	545	1481
	525	1597
	310	1480
10	545	1338
	525	1446
	310	1382
11	545	1105
	525	1181
	310	1206

12	545 523 505 320	0,205 0,230 0,231 0,655
13	**330**	**0,627**
14	335	0,564
15	335	0,561

2. Tabel 0,1 gram – 0,0024 M (0 menit-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	555 525 510 365 325 220	2,896 9,999 9,999 2,387 2,656 3,561
2	545 525 310 210	2,095 9,999 2,518 3,343
3	545 525 310 210	2,668 3,186 2,335 3,227
4	545 525 310	2,437 2,803 2,148
5	545 525 310 205	2,209 2,457 2,008 3,183
6	545 525 310	1,993 2,124 1,824
7	545 525 310	1,560 1,634 1,567
8	545 525 310	0,978 1,022 1,167
9	545 525 310	0,799 0,832 1,050
10	**320**	**0,684**
11	315	0,670

12	325	0,625
13	320	0,586

3. Tabel 0,15 gram – 0,0024 M (0 menit-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	550	3,254
	525	9,999
	365	2,570
	315	2,747
	305	2,789
	225	3,675
2	545	2,980
	525	3,536
	365	1,962
	310	2,459
	205	3,412
3	545	2,221
	525	2,358
	310	2,013
4	545	1,609
	525	1,666
	310	1,646
5	545	1,186
	525	1,420
	310	1,390
6	545	0,912
	525	1,220
	365	1,174
	320	1,221
7	**330**	**1,128**
8	365	0,986
	325	1,014
9	330	1,010
10	325	0,683
11	675	0,131
	325	0,668
12	310	0,617
13	300	0,524

4. Tabel 0,2 gram – 0,0024 M (0 menit-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	550	4,191
	365	2,780

	295 230	3022 3,673
2	545 525 365 310 205	2,883 3,273 1,930 2,415 3,354
3	545 525 365 310	2,003 2,616 1,667 1,940
4	545 525 365	1,446 1,872 1,495
5	545 525 365 310	1,043 1,660 1,314 1,380
6	**325**	**1,338**
7	325	1,096
8	325	1,016
9	675 310	0,227 0,791
10	675 310	0,198 0,763
11	295	0,718
12	295	0,625
13	290	0,601

5. Tabel 0,25 gram – 0,0024 M (0 menit-selesai)

Pengukuran ke-	**Panjang Gelombang**	**Absorbansi**
1	570 560 365 295 230 220	3,938 9,999 2,876 3,034 3,631 3,715
2	545 525 365 370	2,378 2,508 1,828 2,153
3	545 525 365 320	1,205 1,220 1,503 1,522
4	**325**	**1,429**

5	365 330	1,356 1,371
6	675 365 320	0,525 0,988 1,023
7	295	0,814
8	310	0,716
9	295	0,702
10	675 295	0,108 0,664
11	295	0,630
12	290	0,610
13	290	0,598

6. Tabel 0,3 gram – 0,0024 M (0 menit-selesai)

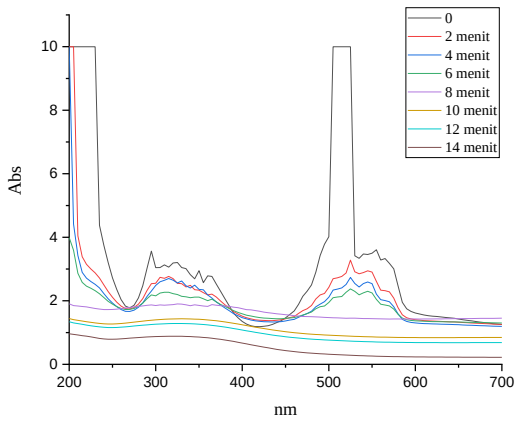
Pengukuran ke-	**Panjang Gelombang**	**Absorbansi**
1	495 365 305 295 235	9,999 3,015 2,787 3,128 3,665
2	545 525 365 310	1,995 2,036 1,762 1,995
3	550 530 370 325 295	1,458 1,461 1,802 1,764 1,764
4	**330**	**1,217**
5	295	0,865
6	295	1,787
7	675 295	0,113 0,709
8	295	0,701
9	290	0,649
10	280	0,605
11	280	0,599
12	280	0,595
13	300	0,549

7. Tabel Optimum setiap Variasi Massa

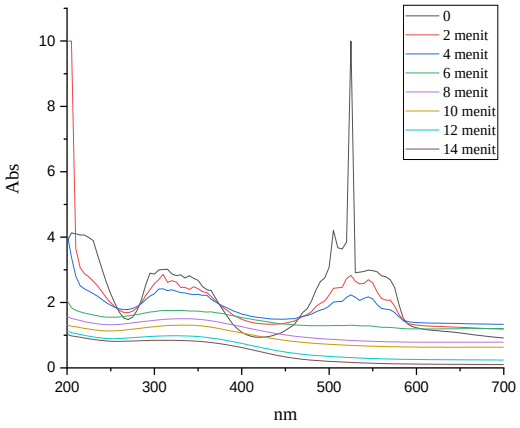
Konsentrasi (M)	Panjang Gelombang	Absorbansi
0,05	330	0,627
0,1	320	0,684
0,15	330	1,149
0,2	325	1,338
0,25	325	1,429
0,3	330	1,217

Data UV-Vis filtrat hasil reduksi larutan $KMnO_4$ oleh KATK pada variasi suhu

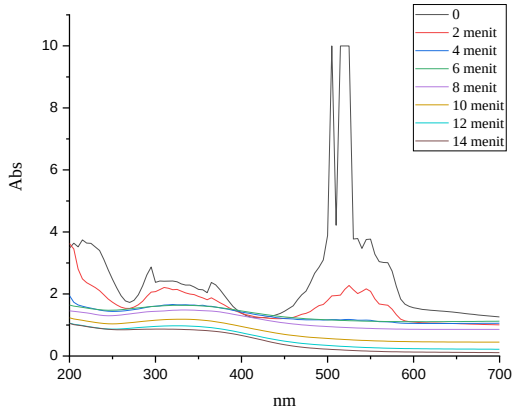
Suhu 75 °C



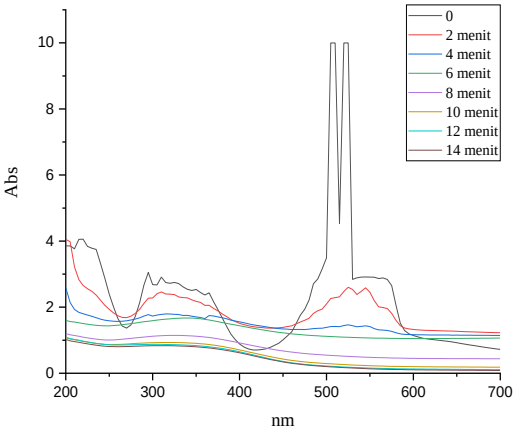
Suhu 80 °C



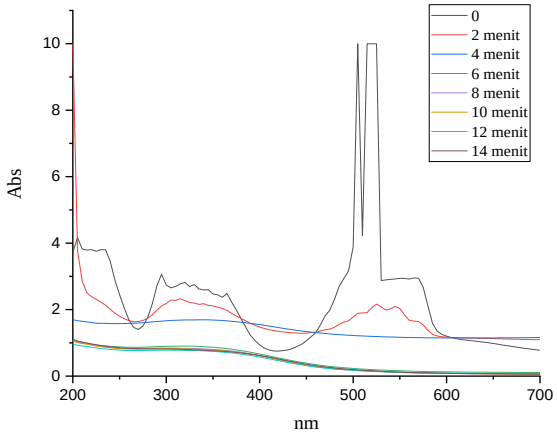
Suhu 85 °C



Suhu 95 °C



Suhu 100 °C



1. Tabel 75 °C - 0,25 gram – 0,0024 M (0 menit-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	565	3,330
	555	3,607
	505	9,999
	360	2,786
	350	2,948
	325	3,205
2	545	2,946
	525	3,282
	365	2,210
	340	2,487
	315	2,266
3	545	2,594
	525	2,735
	345	2,493
	330	2623
	315	2,702
4	545	2,300
	525	2,376
	365	2,050
	350	2,116
	310	2,269
5	530	1,454
	365	1,881
	345	1,874
	325	1,901
6	**340**	**1,438**
7	330	1,290
8	320	0,886

2. Tabel 80 °C - 0,25 gram – 0,0024 M (0 menit-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	545	2,990
	525	9,999
	340	2,821
	330	2,848
	315	3,017
	205	4,132
2	545	2,698
	525	2,878
	345	2,483
	320	2,668
	310	2,859
3	545	2,174

	525	2,234
	350	2,250
	320	2,391
	310	2,418
4	545	1,289
	525	1,608
	365	1,716
	330	1,759
5	**350**	**1,500**
6	345	1,312
7	320	0,985
8	310	0,874

3. Tabel 85 °C - 0,25 gram – 0,0024 M (0 menit-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	550	3,768
	535	3,788
	515	9,999
	365	2,373
	350	2,149
2	545	2,167
	525	2,876
	365	1,877
	325	2,148
	310	2,211
3	545	1,158
	525	1,780
	355	1,636
	335	1,663
	320	1,663
4	**350**	**1,626**
5	340	1,486
6	325	1,191
7	320	0,980
8	315	0,847

4. Tabel 95 °C - 0,25 gram – 0,0024 M (0 menit-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	565	2,884
	545	2,914
	520	9,999
	365	2,435
	350	2,338
	325	2,750
	320	4,060

2	545 525 310	2,586 2,601 2,463
3	545 525 365 340 315	1,935 2,465 1,746 1,753 1,986
4	**350**	**1,679**
5	325	1,152
6	320	0,935
7	305	0,877
8	305	0,839

5. Tabel 100 °C - 0,25 gram – 0,0024 M (0 menit-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	565 550 515 365 330 320 235 220	2,954 2,942 9,999 2,487 2754 2,817 3,804 3,808
2	545 525 340 315	2,097 2,766 2,178 2,315
3	**365**	**1,703**
4	315	0,916
5	300	0,848
6	300	0,827
7	310	0,785
8	310	0,618

6. Tabel Nilai Optimum setiap Variasi Suhu

Suhu (°C)	Panjang Gelombang	Absorbansi
75	340	1,438
80	350	1,500
85	350	1,626
95	350	1,679
100	365	1,703

Lampiran 7. Perhitungan MnO_4^- dalam Larutan dan Kadar MnO_2 Variasi Masa Karbon.

A = ε x B x C

A: Absorbansi

B : Tebal kuvet (1 cm)

C : Konsentrasi

ε : 526: 2,40 x 10^3

546 : 2,38 x 10^3

Konsentrasi awal: 0,0024 M

1. Massa 0,05 gram

- A = ε x B x C (1 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{4,138}{1 \text{ cm. } 2,40 \text{ x } 10^3 \text{ ml/mmol. cm}}$$

C = 0,00172 M

- A = ε x B x C (3 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{3,502}{1 \text{ cm. } 2,40 \text{ x } 10^3 \text{ ml/mmol. cm}}$$

C = **0,00145 M**

- A = ε x B x C (5 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2904}{1 \text{ cm. } 2,40 \text{ x } 10^3 \text{ ml/mmol. cm}}$$

C = **0,00121 M**

- A = ε x B x C (6 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2,603}{1 \text{ cm. } 2,40 \text{ x } 10^3 \text{ ml/mmol. cm}}$$

C = **0,00108 M**

- A = ε x B x C (7 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2,540}{1 \text{ cm. } 2,40 \text{ x } 10^3 \text{ ml/mmol. cm}}$$

C = **0,00105 M**

- A = ε x B x C (9 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{1,597}{1 \text{ cm. } 2,40 \text{ x } 10^3 \text{ ml/mmol. cm}}$$

C = **0,00066 M**

- A = ε x B x C (21 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{1,446}{1 \text{ cm. } 2,40 \text{ x } 10^3 \text{ ml/mmol. cm}}$$

C = **0,0006 M**

- A = ε x B x C (23 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{1,181}{1 \text{ cm. } 2,40 \text{ x } 10^3 \text{ ml/mmol. cm}}$$

C = **0,00049 M**

- A = ε x B x C (25 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{0,230}{1 \text{ cm. } 2,40 \text{ x } 10^3 \text{ ml/mmol. cm}}$$

C = **0,00009 M**

2. Massa 0,1 gram

- A = ε x B x C (2 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{3,186}{1 \text{ cm. } 2,38 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00132 M**

- A = ε x B x C (3 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2,803}{1 \text{ cm. } 2,40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00116 M**

- A = ε x B x C (4 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2,457}{1 \text{ cm. } 2,40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00102 M**

- A = ε x B x C (5 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2,124}{1 \text{ cm. } 2,40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00088 M**

- A = ε x B x C (6 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{1,634}{1 \text{ cm. } 2,40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00068 M**

- A = ε x B x C (7 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{1,022}{1 \text{ cm. } 2,40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00042 M**

- A = ε x B x C (9 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{0,832}{1 \text{ cm. } 2,40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00034 M**

3. Massa 0,15 gram

- A = ε x B x C (1 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{3,536}{1 \text{ cm. } 2,40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00147 M**

- A = ε x B x C (2 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2,358}{1 \text{ cm. } 2,40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00098 M**

- A = ε x B x C (3 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{1,666}{1 \text{ cm. } 2,40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00069 M**

- A = ε x B x C (4 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{1,420}{1 \text{ cm. } 2,40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00059 M**

- A = ε x B x C (5 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{1,220}{1 \text{ cm. } 2,40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,0005 M**

4. Massa 0,2 gram

- A = ε x B x C (1 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{3,273}{1 \text{ cm. } 2,40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00136 M**

- A = ε x B x C (2 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2,616}{1 \text{ cm. } 2,40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,000109 M**

- A = ε x B x C (3 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{1,872}{1 \text{ cm. } 2,40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00078 M**

- A = ε x B x C (4 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{1,660}{1 \text{ cm. } 2,40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00069 M**

5. Massa 0,25 gram

- A = ε x B x C (1 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2,508}{1 \text{ cm. } 2,40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00104 M**

- A = ε x B x C (2 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{1,220}{1 \text{ cm. } 2,40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00088 M**

6. Massa 0,3 gram

- A = ε x B x C (1 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2{,}036}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00084 M**

- A = ε x B x C (2 jam)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{1{,}461}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,0006 M**

Tabel Fraksi [MnO_4^-] dalam larutan % variasi massa

Massa karbon (gram)	Jam	Fraksi [MnO_4^-] dalam larutan %
0,05	1	71,66
	3	60,41
	5	50,41
	6	45
	7	43,75
	9	27,5
	21	25
	23	20,41
	25	3,75
0,1	2	55
	3	48,33
	4	42,5
	5	36,66
	6	28,33
	7	17,5
	9	14,16
0,15	1	61,25
	2	43,33
	3	28,75
	4	24,58
	5	20,83
0,2	1	56,66
	2	35,41
	3	25,41
	4	18,33
0,25	1	43,33
	2	36,66
0,3	1	35
	2	25

Kadar MnO_2

1. 0,05 gram

- **1 Jam**

MnO_4^- ⟶ MnO_2

A 0,0024 M

R 0,00068 M 0,00068 M

S 0,00172 M **0,00068 M**

- **3 Jam**

MnO_4^- ⟶ MnO_2

A 0,00172 M

R 0,00027 M 0,00027 M

S 0,00145 M **0,00027 M**

- **5 Jam**

MnO_4^- ⟶ MnO_2

A 0,00145 M

R 0,00024 M 0,00024 M

S 0,00021 M **0,00024 M**

- **6 Jam**

MnO_4^- ⟶ MnO_2

A 0,00121 M

R 0,00013 M 0,00013 M

S 0,00108 M **0,00013 M**

- **7 Jam**

MnO_4^- ⟶ MnO_2

A 0,00108 M

R 0,00015 M 0,00003 M

S 0,00105 M **0,00003 M**

- **9 Jam**

MnO_4^- ⟶ MnO_2

A 0,00105 M

R 0,00039 M 0,00039 M

S 0,00066 M **0,00039 M**

- **21 Jam**

MnO_4^- ⟶ MnO_2

A 0,00066 M

R 0,00006 M 0,00006 M

S 0,0006M **0,00006 M**

- **23 Jam**

MnO_4^- ⟶ MnO_2

A 0,0006 M

R 0,00011 M 0,00011 M

S 0,00049 M **0,00011 M**

- **25 Jam**

MnO_4^- ⟶ MnO_2

A 0,00049M

R 0,00004 M 0, 00004 M

S 0,00009 M **0,00004 M**

Jumlah MnO_4^- yang bereaksi:

0,00068 M + 0,00027 M + 0,00024 M + 0,00013 M + 0,00003 M + 0,00039 M + 0,00006 M + 0,00011 M + 0,0004 M = **0,00231 M.**

$$\frac{\text{C awal-C bereaksi}}{\text{C awal}} \times 100\ \%$$

$$\frac{0{,}0024\ \text{M}-0{,}00231\ \text{M}}{0{,}0024\ \text{M}} \times 100\ \% = \mathbf{3{,}75\%}$$

2. 0,1 gram

- **2 Jam**

MnO_4^- ⟶ MnO_2

A 0,0024 M

R 0,00108 M 0,00108 M

S 0,00132 M **0,00108 M**

- **3 Jam**

MnO_4^- ⟶ MnO_2

A 0,00132 M

R 0,00016 M 0,00016 M

S 0,00116 M **0,00016 M**

- **4 Jam**

MnO_4^- ⟶ MnO_2

A 0,00116 M

R 0,00014 M 0,00014 M

S 0,00102 M **0,00014 M**

- **5 Jam**

MnO_4^- ⟶ MnO_2

A 0,00102 M

R 0,00014 M 0,00014 M

S 0,00088 M **0,00014 M**

- **6 Jam**

MnO_4^- ⟶ MnO_2

A 0,00088 M

R 0,0002 M 0,0002 M

S 0,00068 M **0,0002 M**

- **7 Jam**

MnO_4^- ⟶ MnO_2

A 0,00068 M

R 0,00026 M 0,00026 M

S 0,00042 M **0,00026 M**

- **9 Jam**

MnO_4^- ⟶ MnO_2

A 0,00042 M

R 0,00008 M 0,00008 M

S 0,00034 M **0,00008 M**

Jumlah MnO_4^- yang bereaksi:

0,00108 M + 0,00016 M + 0,00014 M + 0,00014 M + 0,00002 + 0,00026 + 0,00008 = **0,00206 M**

$$\frac{\text{C awal-C bereaksi}}{\text{C awal}} \text{ x } 100\ \%$$

$$\frac{0{,}0024\text{ M}-0{,}00206\text{ M}}{0{,}0024\text{ M}} \text{ x } 100\ \% = \mathbf{14{,}16\%}$$

3. 0,15 gram

- **1 Jam**

MnO_4^- ⟶ MnO_2

A 0,0024 M

R 0,00093 M 0,00093 M

S 0,00147 M **0,00093 M**

- **2 Jam**

MnO_4^- ⟶ MnO_2

A 0,00147 M

R 0,00049 M 0,00049 M

S 0,00098 M **0,00049 M**

- **3 Jam**

MnO_4^- ⟶ MnO_2

A 0,00098 M

R 0,00029 M 0,00029 M

S 0,00069 M **0,00029 M**

- **4 Jam**

MnO_4^- ⟶ MnO_2

A 0,00069 M

R 0,0001 M 0,0001 M

S 0,00059 M **0,0001 M**

- **5 Jam**

MnO_4^- ⟶ MnO_2

A 0,00059 M

R 0,00009 M 0,00009 M

S 0,0005 M **0,00009 M**

Jumlah MnO_4^- yang bereaksi

0,00093 M + 0,00049 M + 0,00029 M + 0,0001 M + 0,0009 = **0,0019 M.**

$$\frac{\text{C awal-C bereaksi}}{\text{C awal}} \text{ x } 100\ \%$$

$$\frac{0{,}0024\text{ M}-0{,}0019\text{ M}}{0{,}0024\text{ M}} \text{ x } 100\ \% = \textbf{20,83\%}$$

4. 0,2 gram

- **1 Jam**

MnO_4^- ⟶ MnO_2

A 0,0024 M

R 0,00104 M 0,00104 M

S 0,00136 M **0,00104 M**

- **2 Jam**

MnO_4^- ⟶ MnO_2

A 0,00136 M

R 0,00027 M 0,00027 M

S 0,00109 M **0,00027 M**

- **3 Jam**

MnO_4^- ⟶ MnO_2

A 0,00109 M

R 0,00031 M 0,00031 M

S 0,00078 M **0,00031 M**

- **4 Jam**

MnO_4^- ⟶ MnO_2

A 0,00078 M

R 0,00009 M 0,00009 M

S 0,00069 M **0,00009 M**

Jumlah MnO_4^- yang bereaksi

0,00104 M + 0,00027 M + 0,00031 M + 0,00009 M = **0,00171 M.**

$$\frac{\text{C awal-C bereaksi}}{\text{C awal}} \text{ x } 100\ \%$$

$$\frac{0{,}0024\text{ M}-0{,}00171\text{ M}}{0{,}0024\text{ M}} \text{x} 100\ \% = \textbf{28,75\%}$$

5. 0,25 gram

- **1 Jam**

MnO_4^- ⟶ MnO_2

A 0,0024 M

R 0,00136 M 0,00136 M

S 0,00104 M **0,00136 M**

- **2 Jam**

MnO_4^- ⟶ MnO_2

A 0,00104 M

R 0,00016 M 0,00016 M

S 0,00088 M **0,00016 M**

Jumlah MnO_4^- yang bereaksi

0,00136 M + 0,00016 M = **0,00152 M**

$$\frac{\text{C awal-C bereaksi}}{\text{C awal}} \text{ x } 100\ \%$$

$$\frac{0{,}0024\text{ M}-0{,}00152\text{ M}}{0{,}0024\text{ M}} \text{ x } 100\ \% = 36{,}66\textbf{\%}$$

6. 0,3 gram

- **1 Jam**

MnO_4^- ⟶ MnO_2

A 0,0024 M

R 0,00156 M 0,00156 M

S 0,00084 M **0,00156 M**

- **2 Jam**

MnO_4^- ⟶ MnO_2

A 0,00084 M

R 0,00024 M 0,00024 M

S 0,0006 M **0,00024 M**

Jumlah MnO_4^- yang bereaksi

0,00156 M + 0,00024 M = **0,0018M.**

$$\frac{\text{C awal-C bereaksi}}{\text{C awal}} \text{ x } 100\ \%$$

$$\frac{0{,}0024\text{ M}-0{,}0018\text{ M}}{0{,}0024\text{ M}} \text{ x } 100\ \% = \mathbf{25\%}$$

Tabel kadar MnO_2 pada penggunaan variasi massa karbon

Massa (gram)	Kadar MnO_2 (%)
0,05	3,75
0,1	14,16
0,15	20,83
0,2	28,75
0,25	36,66
0,3	25

Lampiran 8. Perhitungan MnO_4^- dalam Larutan dan Kadar MnO_2 Variasi Suhu

1. Suhu 75 °C

- A = ε x B x C (2 menit)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{3{,}282}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00136 M**

- A = ε x B x C (4 menit)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2{,}735}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,000113 M**

- A = ε x B x C (6 menit)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2{,}376}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00099 M**

- A = ε x B x C (8 menit)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{1{,}454}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,0006 M**

2. Suhu 80 °C

- A = ε x B x C (2 menit)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2{,}878}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00119 M**

- A = ε x B x C (4 menit)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2{,}234}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00093 M**

- A = ε x B x C (6 menit)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{1{,}608}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00067 M**

3. Suhu 85 °C

- A = ε x B x C (2 menit)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2{,}876}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00119 M**

- A = ε x B x C (4 menit)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{1{,}780}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00074 M**

4. Suhu 95 °C

- A = ε x B x C (2 menit)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2{,}601}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00108 M**

- A = ε x B x C (4 menit)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2{,}465}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00102 M**

5. Suhu 100 °C

- A = ε x B x C (2 menit)

$$C = \frac{A}{B.\varepsilon}$$

$$C = \frac{2{,}766}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00115 M**

Tabel Fraksi [MnO_4^-] dalam larutan % variasi massa

Suhu (°C)	Waktu (menit)	Fraksi [MnO_4^-] dalam larutan %
75	2	56,66
	4	47,08
	6	41,25
	8	25
80	2	49,58
	4	38,75
	6	27,91
85	2	49,58
	4	30,83
95	2	45
	4	42,5
100	2	47,5

Kadar MnO_2

1. Suhu 75 °C

- **2 Menit**

MnO_4^- ⟶ MnO_2

A 0,0024 M

R 0,00104 M 0, ,00104 M

S 0,00136 M **0,00104 M**

- **4 Menit**

MnO_4^- ⟶ MnO_2

A 0,00136 M

R 0,00023 M 0,00023 M

S 0,00113 M **0,00023 M**

- **6 Menit**

MnO_4^- ⟶ MnO_2

A 0,00113 M

R 0,00014 M 0,00014 M

S 0,00099 M **0,00014 M**

- **8 Menit**

MnO_4^- ⟶ MnO_2

A 0,00099 M

R 0,00039 M 0, 00039 M

S 0,0006 M **0,00039 M**

Jumlah MnO_4^- yang bereaksi

0,00104 M + 0,00023 M + 0,00014 +

0,00039 M = **0,00018 M.**

$$\frac{\text{C awal-C bereaksi}}{\text{C awal}} \text{ x } 100\ \%$$

$$\frac{0{,}0024\text{ M}-0{,}00018\text{ M}}{0{,}0024\text{ M}} \text{ x } 100\ \% = \mathbf{25\%}$$

2. Suhu 80 °C

- **2 Menit**

MnO_4^- ⟶ MnO_2

A 0,0024 M

R 0,00121 M 0,00121 M

S 0,00119 M **0,00121 M**

- **4 Menit**

MnO_4^- ⟶ MnO_2

A 0,00119 M

R 0,00026 M 0,00026 M

S 0,00093 M **0,00026 M**

- **6 menit**

MnO_4^- ⟶ MnO_2

A 0,00093 M

R 0,00026 M 0,00026 M

S 0,00067 M **0,00039 M**

Jumlah MnO_4^- yang bereaksi

0,00121 M + 0,00026 M+ 0,00026 M = **0,00173 M.**

$$\frac{\text{C awal-C bereaksi}}{\text{C awal}} \text{ x } 100\ \%$$

$$\frac{0{,}0024\text{ M}-0{,}00173\text{ M}}{0{,}0024\text{ M}} \text{ x } 100\ \% = \mathbf{27{,}91\%}$$

3. Suhu 85 °C

- **2 Menit**

MnO_4^- ⟶ MnO_2

A 0,0024 M

R 0,00121 M 0,00121 M

S 0,00119 M **0,00121 M**

- **4 Menit**

MnO_4^- ⟶ MnO_2

A 0,00119 M

R 0,00045 M 0,00045 M

S 0,00074 M **0,00045 M**

Jumlah MnO_4^- yang bereaksi

0,00121 M + 0,00045 M=**0,00166 M**

$$\frac{\text{C awal-C bereaksi}}{\text{C awal}} \times 100\ \%$$

$$\frac{0{,}0024\text{ M}-0{,}00166\text{ M}}{0{,}0024\text{ M}} \times 100\ \% = \mathbf{30{,}83\%}$$

4. Suhu 95 °C

- **2 Menit**

MnO_4^- ⟶ MnO_2

A 0,0024 M

R 0,00132 M 0,00132 M

S 0,00108 M **0,00132 M**

- **4 Menit**

MnO_4^- ⟶ MnO_2

A 0,00108 M

R 0,00006 M 0,00006 M

S 0,00102 M **0,00006 M**

Total MnO_4^- yang bereaksi

0,00132 M + 0,00006 M
= **0,00138 M**

$$\frac{\text{C awal-C bereaksi}}{\text{C awal}} \times 100\ \%$$

$$\frac{0{,}0024\text{ M}-0{,}00138\text{ M}}{0{,}0024\text{ M}} \times 100\ \% = \mathbf{42{,}5\%}$$

5. Suhu 100 °C

- **2 Menit**

MnO_4^- ⟶ MnO_2

A 0,0024 M

R 0,00125 M 0,00125 M

S 0,00115 M **0,00125 M**

Jumlah MnO_4^- yang bereaksi

0,0015 M.

$$\frac{\text{C awal-C bereaksi}}{\text{C awal}} \times 100\ \%$$

$$\frac{0{,}0024\text{ M}-0{,}00125\text{ M}}{0{,}0024\text{ M}} \times 100\ \% = \mathbf{47{,}5\%}$$

Tabel kadar MnO_2 pada penggunaan variasi suhu

Suhu (°C)	Kadar MnO_2 (%)
75	25
80	27,91
85	30,83
95	42,5
100	47,5

Lampiran 9. Perhitungan Hasil 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	5	0,05	0,0480	10	0,0520	5,5	0,1004	2,7888
2	25	5	0,05	0,0480	10	0,0520	5,9	0,1004	3,8247
3	25	5	0,05	0,0480	10	0,0520	5,8	0,1004	3,5657
Rata – rata									**3,3930**

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

$$n_{carboxylic} = \frac{[5\ mL \times 0{,}0500\ N - (0{,}0480\ N \times 10\ mL - 0{,}0520\ N \times 5{,}5\ mL)] \frac{25\ mL}{5\ mL}}{0{,}1004\ gram}$$

$$n_{carboxylic} = \frac{[0{,}2500\ meq - (0{,}4800\ meq - 0{,}2860\ meq)] \frac{25\ mL}{5\ mL}}{0{,}1004\ gram}$$

$$n_{carboxylic} = \frac{[0{,}2500\ meq - 0{,}1940\ meq] \frac{25\ mL}{5\ mL}}{0{,}1004\ gram} = 2{,}7888\ \frac{meq}{gram}$$

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	5	0,05	0,0480	10	0,0520	6,5	0,1002	1,9962
2	25	5	0,05	0,0480	10	0,0520	6,5	0,1002	1,9962
3	25	5	0,05	0,0480	10	0,0520	6,3	0,1002	1,4772
Rata – rata									**1,8232**

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

$$n_{lactonic} = \frac{[5\ mL \times\ 0{,}0500\ N\ -(0{,}0480\ N \times 10\ mL - 0{,}0520\ N\ \times 6{,}5\ mL)] \frac{25\ mL}{5\ mL}}{0{,}1002} - 3{,}3930\ \frac{meq}{gram}$$

$$n_{lactonic} = \frac{[0{,}2500\ meq\ -(0{,}4800\ meq - 0{,}3380\ meq)] \frac{25\ mL}{5\ mL}}{0{,}1002\ gram} - 3{,}3930 \frac{meq}{gram}$$

$$n_{lactonic} = 5{,}3892\ \frac{meq}{gram} - 3{,}3930\ \frac{meq}{gram} = 1{,}9962\ \frac{meq}{gram}$$

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	5	0,0520	0,0480	10	0,0520	5	0,1004	-3,2241
2	25	5	0,0520	0,0480	10	0,0520	4,9	0,1004	-3,4832
3	25	5	0,0520	0,0480	10	0,0520	5	0,1004	-3,2241
Rata – rata									**-3,3104**

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

$$n_{phenolic} = \frac{[5\text{ mL x }0{,}0520\text{ N} - (0{,}0480\text{ N x }10\text{ mL} - 0{,}0520\text{ N x }5\text{ mL})]\frac{25\text{ mL}}{5\text{ mL}}}{0{,}1004\text{ gram}} - 3{,}3930\ \frac{meq}{gram} - 1{,}8232\ \frac{meq}{gram}$$

$$n_{phenolic} = \frac{[0{,}2600\text{ meq} - (0{,}4800\text{ meq} - 0{,}2600\text{ meq})]\frac{25\text{ mL}}{5\text{ mL}}}{0{,}1004\text{ gram}} - 3{,}3930\ \frac{meq}{gram} - 1{,}8232\ \frac{meq}{gram}$$

$$n_{phenolic} = 1{,}9920\ \frac{meq}{gram} - 3{,}3930\ \frac{meq}{gram} - 1{,}8232\ \frac{meq}{gram} = -3{,}2241\ \frac{meq}{gram}$$

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 total base (meq/g)
1	25	5	0,0480	0,0520	7,5	0,0476	3,4	0,1002	0,5888
2	25	5	0,0480	0,0520	7,5	0,0476	3,3	0,1002	0,3493
3	25	5	0,0480	0,0520	7,5	0,0476	3,2	0,1002	0,1147
Rata – rata									**0,3509**

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

$$n_{total\ base} = \frac{[5\ mL \times 0{,}0480\ N -(0{,}0520\ N \times 7{,}5\ mL- 0{,}0476\ N \times 3{,}4\ mL)]\frac{25\ mL}{5\ mL}}{0{,}1002\ gram}$$

$$n_{total\ base} = \frac{[0{,}2400\ meq -(0{,}3900\ meq- 0{,}1618\ meq)]\frac{25\ mL}{5\ mL}}{0{,}1002\ gram}$$

$$n_{total\ base} = \frac{[0{,}2400\ meq - 0{,}2282\ meq\ ]\frac{25\ mL}{5\ mL}}{0{,}1002\ gram} = 0{,}5888\frac{meq}{gram}$$

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	5	0,05	0,0476	10	0,0507	9,6	0,1002	13,0089
2	25	5	0,05	0,0476	10	0,0507	9,6	0,1002	13,0089
3	25	5	0,05	0,0476	10	0,0507	9,5	0,1002	12,7544
Rata – rata									**12,9240**

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

$$n_{carboxylic} = \frac{[5\ mL \times 0{,}0500\ N - (0{,}0476\ N \times 10\ mL - 0{,}0507\ N \times 9{,}6\ mL)] \frac{25\ mL}{5\ mL}}{0{,}1002\ gram}$$

$$n_{carboxylic} = \frac{[0{,}2500\ meq - (0{,}4760\ meq - 0{,}4867\ meq)] \frac{25\ mL}{5\ mL}}{0{,}1002\ gram}$$

$$n_{carboxylic} = \frac{[0{,}2500\ meq - (-0{,}0107\ meq)] \frac{25\ mL}{5\ mL}}{0{,}1002\ gram} = 13{,}0089\ \frac{meq}{gram}$$

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	5	0,05	0,0476	10	0,0507	9,4	0,1002	-0,4240
2	25	5	0,05	0,0476	10	0,0507	9,6	0,1002	0,0849
3	25	5	0,05	0,0476	10	0,0507	9,5	0,1002	-0,1695
Rata – rata									**-0,1695**

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

$$n_{lactonic} = \frac{[5\ mL \times 0{,}0500\ N - (0{,}0476\ N \times 10\ mL - 0{,}0507\ N \times 9{,}4\ mL)] \frac{25\ mL}{5\ mL}}{0{,}1002} - 12{,}9240\ \frac{meq}{gram}$$

$$n_{lactonic} = \frac{[0{,}2500\ meq - (0{,}4760\ meq - 0{,}4765\ meq)] \frac{25\ mL}{5\ mL}}{0{,}1002\ gram} - 12{,}9240 \frac{meq}{gram}$$

$$n_{lactonic} = 12{,}5\ \frac{meq}{gram} - 12{,}9240\ \frac{meq}{gram} = -0{,}4240\ \frac{meq}{gram}$$

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	5	0,0520	0,0476	10	0,0507	8	0,1001	-3,2840
2	25	5	0,0520	0,0476	10	0,0507	8,1	0,1001	-3,0342
3	25	5	0,0520	0,0476	10	0,0507	8	0,1001	-3,2840
Rata – rata									**-3,2007**

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

$$n_{phenolic} = \frac{[5\text{ mL x }0,0520\text{ N }-(0,0476\text{ N x }10\text{ mL} - 0,0507\text{ N x }8\text{ mL})]\frac{25\text{ mL}}{5\text{ mL}}}{0,1001\text{ gram}} - 12,9240\frac{meq}{gram} - (-0,1695\frac{meq}{gram})$$

$$n_{phenolic} = \frac{[0,2600\text{ meq} - (0,4760\text{ meq} - 0,4056\text{ meq})]\frac{25\text{ mL}}{5\text{ mL}}}{0,1001\text{ gram}} - 12,9240\ \frac{meq}{gram} - (-0,1695\ \frac{meq}{gram})$$

$$n_{phenolic} = 9,4705\ \frac{meq}{gram} - 12,9240\ \frac{meq}{gram} - (-0,1695\ \frac{meq}{gram}) = -3,2840\ \frac{meq}{gram}$$

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 total base (meq/g)
1	25	5	0,0480	0,0520	7,5	0,0476	2,8	0,1003	-0,8374
2	25	5	0,0480	0,0520	7,5	0,0476	2,8	0,1003	-0,8374
3	25	5	0,0480	0,0520	7,5	0,0476	2,8	0,1003	-0,8374
Rata – rata									**-0,8374**

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

$$n_{total\ base} = \frac{[5\ mL \times 0{,}0480\ N -(0{,}0520\ N \times 7{,}5\ mL- 0{,}0476\ N \times 2{,}8\ mL)]\frac{25\ mL}{5\ mL}}{0{,}1003\ gram}$$

$$n_{total\ base} = \frac{[0{,}2400\ meq -(0{,}3900\ meq- 0{,}1332\ meq)]\frac{25\ mL}{5\ mL}}{0{,}1003\ gram}$$

$$n_{total\ base} = \frac{[0{,}2400\ meq - 0{,}2568\ meq\ ]\frac{25\ mL}{5\ mL}}{0{,}1003\ gram} = -0{,}8374\frac{meq}{gram}$$

c. MnO_2/AC

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	5	0,05	0,0476	10	0,0507	9,6	0,1002	13,0089
2	25	5	0,05	0,0476	10	0,0507	9,6	0,1002	13,0089
3	25	5	0,05	0,0476	10	0,0507	9,7	0,1002	13,2629
Rata – rata									**13,0935**

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

$$n_{carboxylic} = \frac{[5\ mL \times 0.0500\ N - (0{,}0476\ N \times 10\ mL - 0{,}0507\ N \times 9{,}6\ mL)] \frac{25\ mL}{5\ mL}}{0{,}1002\ gram}$$

$$n_{carboxylic} = \frac{[0{,}2500\ meq - (0{,}4760\ meq - 0{,}4867\ meq)] \frac{25\ mL}{5\ mL}}{0{,}1002\ gram}$$

$$n_{carboxylic} = \frac{[0.2500\ meq - (-0{,}0107\ meq)] \frac{25\ mL}{5\ mL}}{0{,}1002\ gram} = 13{,}0089\ \frac{meq}{gram}$$

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	5	0,05	0,0476	10	0,0507	9,7	0,1002	0,1700
2	25	5	0,05	0,0476	10	0,0507	9,8	0,1002	0,4224
3	25	5	0,05	0,0476	10	0,0507	9,8	0,1002	0,4224
Rata – rata									**0,3382**

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

$$n_{lactonic} = \frac{[5\ mL \times 0{,}0500\ N - (0{,}0476\ N \times 10\ mL - 0{,}0507\ N \times 9{,}7\ mL)] \frac{25\ mL}{5\ mL}}{0{,}1002} - 13{,}0935\ \frac{meq}{gram}$$

$$n_{lactonic} = \frac{[0{,}2500\ meq - (0{,}4760\ meq - 0{,}4918\ meq)] \frac{25\ mL}{5\ mL}}{0{,}1002\ gram} - 13{,}0935\ \frac{meq}{gram}$$

$$n_{lactonic} = 13{,}2635\ \frac{meq}{gram} - 13{,}0935\ \frac{meq}{gram} = 0{,}1700 \frac{meq}{gram}$$

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	5	0,0520	0,0476	10	0,0507	8,3	0,1001	-3,2020
2	25	5	0,0520	0,0476	10	0,0507	8,4	0,1001	-2,9481
3	25	5	0,0520	0,0476	10	0,0507	8,4	0,1001	-2,9481
Rata – rata									**-3,0327**

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

$$n_{phenolic} = \frac{[5\text{ mL x }0{,}0520\text{ N }-(0{,}0476\text{ N x }10\text{ mL} - 0{,}0507\text{ N x }8{,}3\text{ mL})]\frac{25\text{ mL}}{5\text{ mL}}}{0.1001\text{ gram}} - 13{,}0935\ \frac{meq}{gram} - (0{,}3382\frac{meq}{gram})$$

$$n_{phenolic} = \frac{[0{,}2600\text{ meq} - (0{,}4760\text{ meq} - 0{,}4208\text{ meq})]\frac{25\text{ mL}}{5\text{ mL}}}{0{,}1001\text{ gram}} - 13{,}0935\ \frac{meq}{gram} - (0{,}3382\frac{meq}{gram})$$

$$n_{phenolic} = 10{,}2297\ \frac{meq}{gram} - 13{,}0935\ \frac{meq}{gram} - (0{,}3382\frac{meq}{gram}) = -2{,}9481\ \frac{meq}{gram}$$

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 total base (meq/g)
1	25	5	0,0480	0,0520	7,5	0,0476	2,9	0,1002	-0,5988
2	25	5	0,0480	0,0520	7,5	0,0476	2,8	0,1002	-0,8343
3	25	5	0,0480	0,0520	7,5	0,0476	2,9	0,1002	-0,5988
Rata – rata									**-0,6773**

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

$$n_{total\ base} = \frac{[5\ mL \times 0{,}0480\ N -(0{,}0520\ N \times 7{,}5\ mL- 0{,}0476\ N \times 2{,}9\ mL)]\frac{25\ mL}{5\ mL}}{0{,}1002\ gram}$$

$$n_{total\ base} = \frac{[0{,}2400\ meq -(0{,}3900\ meq- 0{,}1380\ meq)]\frac{25\ mL}{5\ mL}}{0{,}1002\ gram}$$

$$n_{total\ base} = \frac{[0{,}2400\ meq - 0{,}2520\ meq\ ]\frac{25\ mL}{5\ mL}}{0{,}1002\ gram} = -0{,}5988\frac{meq}{gram}$$

Lampiran 10. Hasil Karakterisasi XRD