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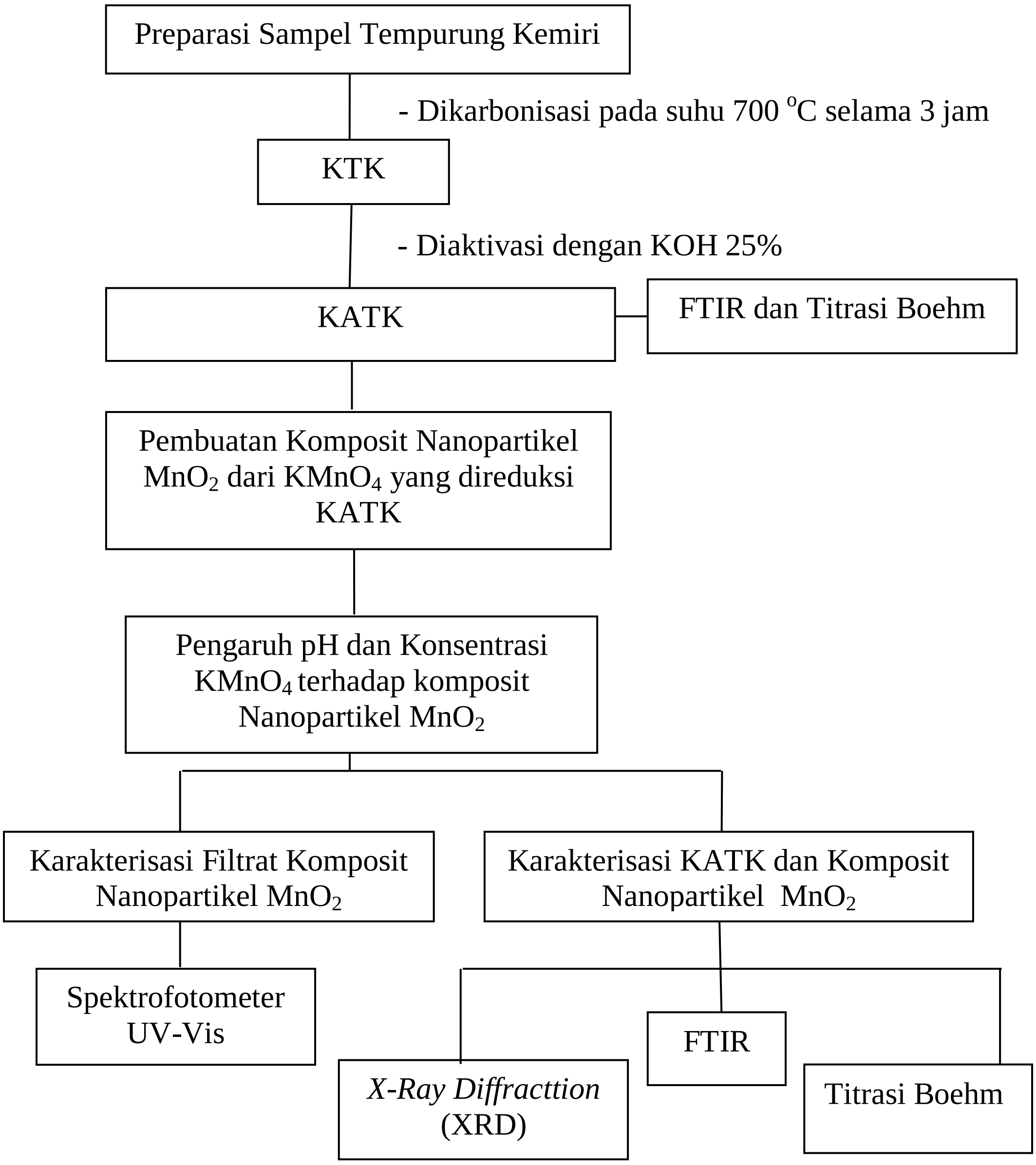
Lampiran 1. Diagram Alir Penelitian



Lampiran 2. Bagan Kerja

1.1 Prosedur Umum

Tempurung Kemiri

- dibersihkan kotoran yang menempel pada tempurung
- dikeringkan dalam oven pada suhu 110 ^{o}C selama 2 jam
- dikarbonisasi pada suhu 700 ^{o}C selama 3 jam

Karbon Tempurung Kemiri

- diaktivasi dengan larutan KOH 25 % dengan perbandingan 5:1 (volume KOH : massa karbon)
- direndam selam 24 jam
- disaring menggunakan corong Buchner dengan kertas saring Whatman no. 42
- dicuci dengan HCl 3 M dan akuades hingga pH netral
- dipirolisis dalam tanur pada suhu 900 ^{o}C selama 45 menit
- dibilas dengan akuades

Karbon Aktif Tempurung Kemiri

1.2 Analisis Gugus Fungsi dengan Titrasi Boehm

Karbon 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

1.3 Pembentukan MnO_2 Nanopartikel

1. Pengaruh Konsentrasi $KMnO_4$

Karbon Aktif Tempurung Kemiri

- Ditimbang sebanyak 0,1 gram
- Dimasukkan kedalam tiga gelas kimia yang berbeda masing-masing berisi 100 mL $KMnO_4$ 0,0008; 0,0016; 0,0024; 0,0032; 0,004 dan 0,0048 M
- Diaduk dengan *shaker*, lalu diukur menggunakan spektrofotometer UV-Vis (diulangi setiap satu jam hingga terjadi proses reduksi)
- Diperoleh konsentrasi optimum

Hasil

2. Pengaruh pH

Karbon Aktif Tempurung Kemiri

- Ditimbang sebanyak 0,1 gram
- Dimasukkan kedalam lima gelas kimia yang berbeda masing-masing berisi 100 mL $KMnO_4$ konsentrasi optimum 0,0032 M
- Diatur masing-masing pada pH 3, 4, 7, 9 dan 10 (dengan penambahan NaOH 0,5 N atau HCl 0,5 N)
- Diaduk dengan *shaker*, lalu diukur menggunakan spektrofotometer UV-Vis (diulangi setiap satu jam hingga terjadi proses reduksi)
- Diperoleh pH optimum

Hasil

3. Sintesis Nanopartikel MnO_2 pada Kondisi Optimum

0,1 gram KATK

- dimasukkan ke dalam gelas kimia
- ditambahkan 100 mL $KMnO_4$ dengan konsentrasi optimum (0,0032 M) dan pH dikontrol dengan penambahan NaOH 0,5 N atau HCl 0,5 N sampai pH optimum
- Diaduk dengan *shaker*, lalu diukur menggunakan spektrofotometer UV-Vis (diulangi setiap satu jam hingga terjadi proses reduksi)
- disaring

Filtrat

Residu

- Dicuci dengan akuades
- Dikeringkan pada suhu 70 ^oC selama 12 jam
- Dikarakterisasi dengan XRD

Data

Lampiran 3. Perhitungan Pembuatan Larutan Pereaksi

a) **Pembuatan Larutan KOH 25%**

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

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

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

$b = 125\ g$

b) **Pembuatan Larutan Na_2CO_3 0,05N**

$g = L \times N \times BE$

$g = 0{,}1\ L \times 0{,}05\ N \times 53\ g/eq$

$g = 0{,}265\ g$

c) **Pembuatan Larutan $NaHCO_3$ 0,05N**

$g = L \times N \times BE$

$g = 0{,}1\ L \times 0{,}05\ N \times 84\ g/eq$

$g = 0{,}42\ g$

d) **Pembuatan Larutan NaOH 0,05N**

$g = L \times N \times BE$

$g = 0{,}5\ L \times 0{,}05\ N \times 40\ g/eq$

$g = 1\ g$

e) **Pembuatan Larutan HCl 0,05 N**

$V_1 \times N_1 = V_2 \times N_2$

$V_1 \times 12{,}06\ N = 500\ mL \times 0{,}05\ N$

$V_1 = 2{,}07\ mL$

f) Pembuatan Larutan $H_2C_2O_4.2H_2O$ 0,05 N

g = L × N × BE

g = 0,05 L × 0,05 N × 63 g/eq

g = 0,1575 g

g) Pembuatan Larutan $Na_2B_4O_7.10H_2O$ 0,05 N

g = L × N × BE

g = 0,05 L × 0,05 N × 63 g/eq

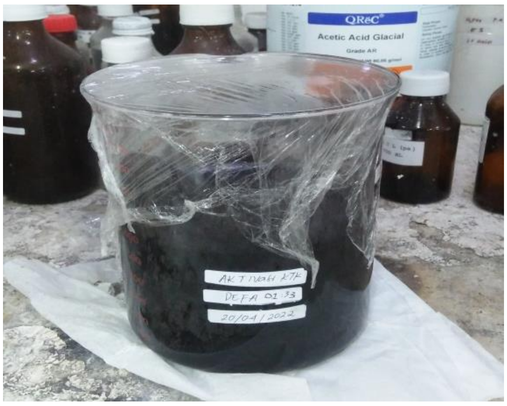
g = 0,1575 g

Lampiran 4. Dokumentasi Penelitian

Tempurung Kemiri

Karbon Tempurung Kemiri (KTK)

KTK 150 Mesh



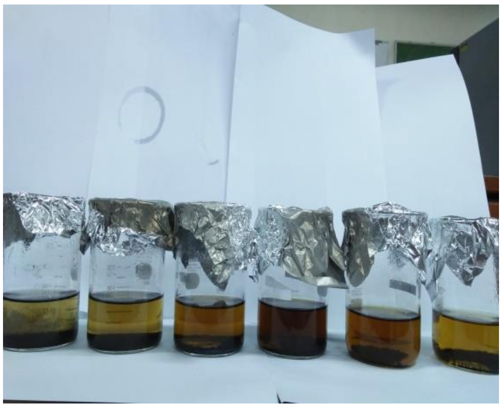
Aktivasi KTK dengan KOH

Proses penyaringan KATK

KATK

Standarisasi HCl dengan $Na_2B_4O_7.10H_2O$

Standarisasi NaOH dengan $H_2C_2O_4$



Optimasi nanopartikel MnO_2 variasi konsentrasi

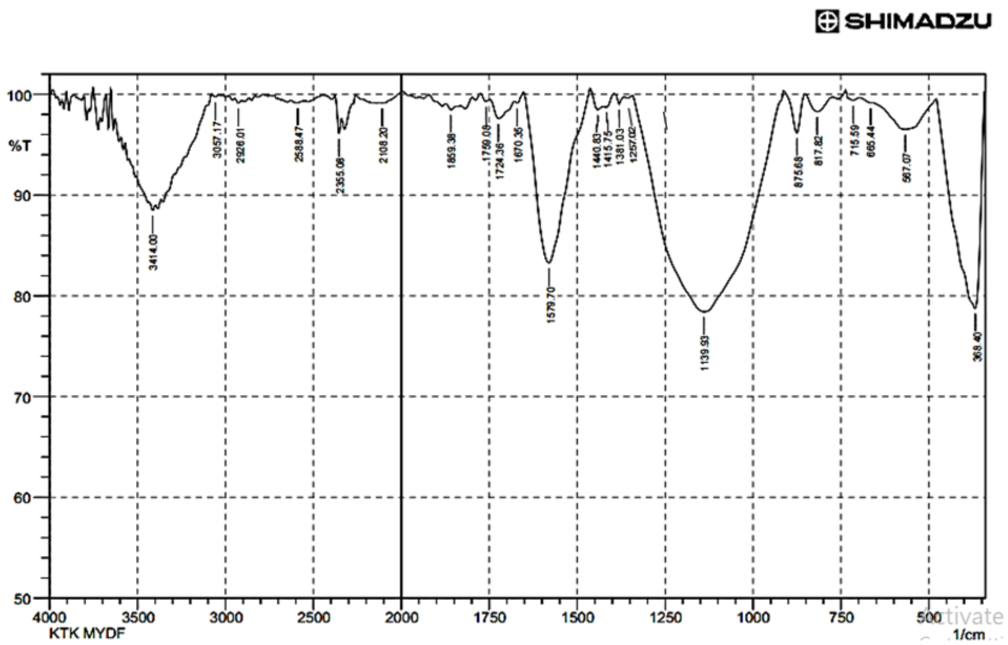
Optimasi nanopartikel MnO_2 variasi pH

Sintesis Nanopartikel MnO_2 pada konsentrasi dan pH optimum

Komposit nanopartikel MnO_2/AC

Lampiran 5. Data Spektrum FTIR

A. Karbon Tempurung Kemiri



No.	Peak	Intensity	Corr. intensity	Base (H)	Base (L)	Area	Corr.Area
1	368.4	78.767	20.647	478.35	343.33	8.392	8.074
2	567.07	96.526	2.803	661.58	480.28	1.76	1.225
3	665.44	99.158	0.053	698.23	661.58	0.098	0.004
4	715.59	99.398	0.591	736.81	698.23	0.069	0.073
5	817.82	98.279	1.618	852.54	773.46	0.348	0.306
6	875.68	96.173	3.975	914.26	852.54	0.403	0.452
7	1139.93	78.42	21.657	1342.46	914.26	27.615	27.784
8	1257.02	99.745	0.261	3056.42	3026.73	0.023	0.024
9	1381.03	99.016	0.868	1396.46	1367.53	0.053	0.04
10	1415.75	98.716	0.478	1425.4	1396.46	0.108	0.033
11	1440.83	98.466	1.03	1463.97	1425.4	0.149	0.095
12	1579.7	83.269	17.048	1651.07	1463.97	7.368	7.67
13	1670.35	99.116	0.454	1678.07	1653	0.057	0.029
14	1724.36	97.586	1.849	1747.51	1678.07	0.496	0.314
15	1759.08	99.294	0.448	1774.51	1747.51	0.055	0.03
16	1859.38	98.457	0.486	1872.88	1843.95	0.165	0.03
17	2108.2	99.125	0.182	2123.63	2000.18	0.259	0.131
18	2355.08	96.097	2.402	2378.23	2339.65	0.393	0.177
19	2588.47	99.165	0.208	2628.98	2546.04	0.27	0.044
20	2926.01	99.132	0.335	2947.23	2908.65	0.116	0.028
21	3057.17	99.734	0.272	3076.46	3037.89	0.025	0.026
22	3354.21	88.475	0.66	3433.29	3398.57	1.787	0.054

Comment;
KTK MYDF

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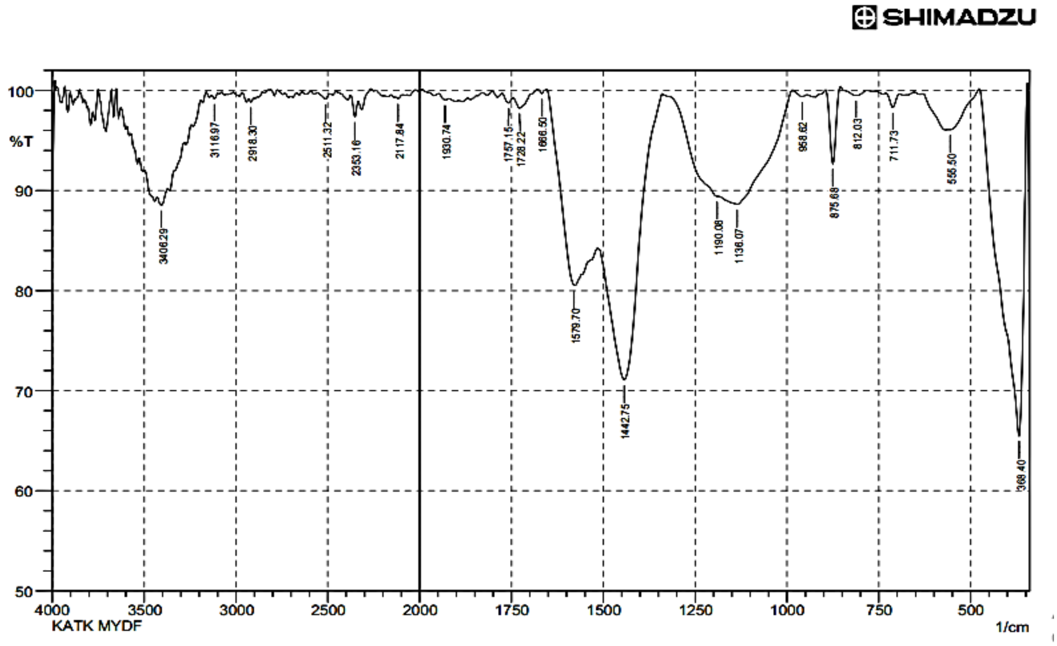
No. of Scans;
Resolution;
Apodization;

B. Karbon Aktif Tempurung Kemiri



No.	Peak	Intensity	Corr. intensity	Base (H)	Base (L)	Area	Corr.Area
1	368.4	5.5288	34.7356	476.42	347.19	11.9433	12.0639
2	555.5	6.0821	0.201	559.36	478.35	0.7647	0.0902
3	711.73	8.2875	1.4051	731.02	692.44	0.1558	0.1042
4	812.03	9.5009	0.6523	854.47	783.1	0.0678	0.1264
5	875.68	2.6958	7.5064	894.97	854.47	0.5715	0.6085
6	958.62	9.3796	0.3151	979.84	945.12	0.067	0.0269
7	1136.07	8.6307	3.4474	1186.22	985.62	7.223	2.4184
8	1190.08	9.4243	0.1342	1340.53	1188.15	3.78	0.0306
9	1442.75	1.0675	19.4951	1514.12	1340.53	14.4043	7.8678
10	1579.7	0.5274	4.9061	1653	1560.41	5.3632	1.2018
11	1666.5	9.6824	0.4355	1680	1654.92	0.0069	0.0196
12	1728.22	8.2346	1.1533	1745.58	1695.43	0.2577	0.1366
13	1757.15	8.7495	0.6889	1774.51	1745.58	0.1153	0.0502
14	1930.74	9.0544	0.3196	1948.1	1919.17	0.0953	0.0227
15	2117.84	9.193	0.2042	2129.41	2092.77	0.1049	0.0158
16	2353.16	7.357	1.8344	2376.3	2335.8	0.2856	0.1502
17	2511.32	9.1546	0.5371	2555.68	2490.1	0.1592	0.0772
18	2918.3	8.8249	0.3619	2931.8	2899.01	0.1364	0.0207
19	3116.97	9.1702	0.4314	3134.33	3099.61	0.0919	0.0317
20	3406.29	8.5369	1.1596	3429.43	3373.5	2.7968	0.1783

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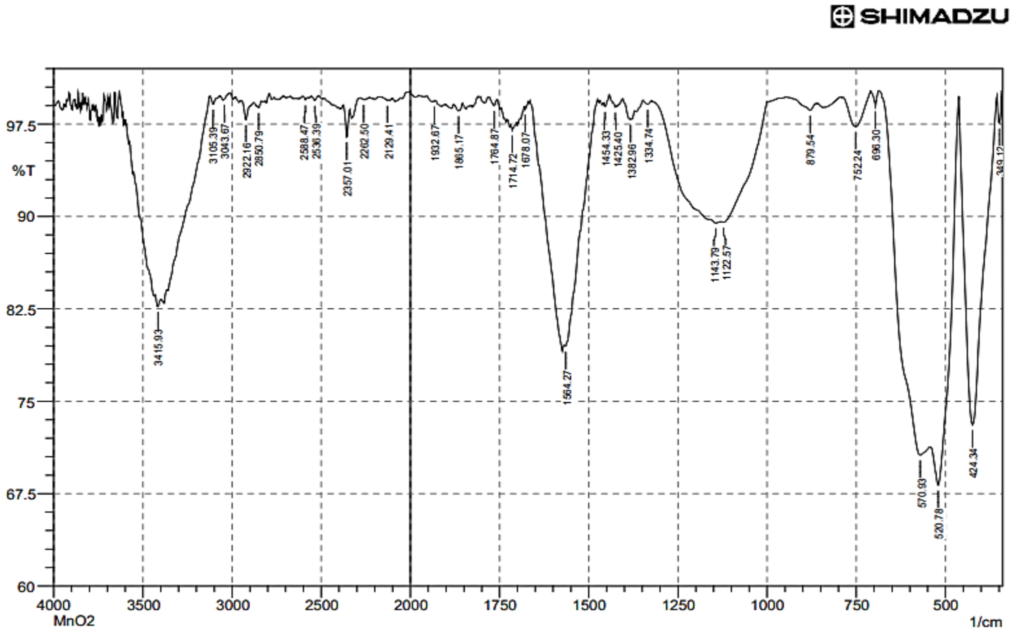
No. of Scans;

Resolution;
Apodization;

C. Komposit Nanopartikel MnO_2 (MnO_2/AC)



No.	Peak	Intensity	Corr. intensity	Base (H)	Base (L)	Area	Corr.Area
1	349.12	97.5746	2.4197	354.9	341.4	0.0895	0.0908
2	424.34	73.0876	26.6327	462.92	356.83	7.5228	7.384
3	520.78	68.1754	10.6856	542	464.84	8.9124	3.186
4	570.93	70.6386	6.183	684.73	543.93	13.3998	3.1642
5	696.3	98.9555	1.2414	709.8	686.66	0.0281	0.0476
6	752.24	97.2976	2.6015	786.96	709.8	0.5244	0.4989
7	879.54	98.6218	0.6435	947.05	864.11	0.292	0.0852
8	1122.57	89.5429	0.6128	1130.29	1001.06	4.0803	0.8341
9	1143.79	89.464	0.1793	1161.15	1132.21	1.3832	0.0115
10	1334.74	99.0917	0.3251	1348.24	1325.1	0.0776	0.0192
11	1382.96	97.8824	0.0321	1384.89	1381.03	0.0356	0.0003
12	1425.4	98.8718	0.2314	1431.18	1421.54	0.0417	0.005
13	1454.33	98.921	0.4745	1458.18	1442.75	0.0499	0.0203
14	1564.27	79.4615	0.8877	1568.13	1475.54	4.6463	0.1804
15	1678.07	98.7046	0.2867	1680	1670.35	0.0453	0.0074
16	1714.72	97.0037	0.4669	1718.58	1701.22	0.2056	0.0167
17	1764.87	98.9899	0.5885	1778.37	1757.15	0.067	0.0303
18	1865.17	98.5838	0.5595	1878.67	1853.59	0.1301	0.036
19	1932.67	99.3449	0.0386	1934.6	1928.82	0.0157	0.0004
20	2129.41	99.4213	0.0574	2158.35	2125.56	0.0651	0.0043
21	2262.5	99.494	0.0119	2283.72	2260.57	0.0438	0
22	2357.01	96.459	2.3938	2376.3	2339.65	0.3552	0.173
23	2536.39	99.4134	0.359	2555.68	2519.03	0.0642	0.0279
24	2588.47	99.4597	0.2398	2603.9	2576.9	0.0458	0.0115
25	2850.79	98.8427	0.3001	2862.36	2835.36	0.1155	0.0178
26	2922.16	97.8522	1.2799	2947.23	2902.87	0.2659	0.1036
27	3043.67	99.5073	0.0335	3045.6	3014.74	0.0289	0.0025
28	3105.39	99.1172	0.5693	3124.68	3089.96	0.09	0.0442
29	3415.93	82.6808	0.7752	3431.36	3400.5	2.4956	0.0699

Comment;
MnO2

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No. of Scans;
Resolution;
Apodization;

Lampiran 6. Data Absorbansi Spektrofotometer Uv-Vis

A. **Variasi Konsentrasi $KMnO_4$**

1. **Konsentrasi 0,0008 M**

Pengukuran ke	Waktu (Jam)	Panjang Gelombang (nm)	Absorbansi
1	0	545 525 310	1,784 1,835 1,470
2	1	545 525 310	0,552 0,562 0,527
3	2	545 525 505 365	0,126 0,133 0,233 0,271
4	**3**	**370**	**0,364**
5	4	675 370	0,167 0,181
6	5	675 665 365	0,172 0,170 0,187
7	6	675 665 365	0,089 0,088 0,120
8	8	480 460 380 365	0,053 0,053 0,056 0,056

2. **Konsentrasi 0,0016 M**

Pengukuran ke	Waktu (Jam)	Panjang Gelombang (nm)	Absorbansi
1	0	550 525 310 210	2,643 3,618 2,489 3,406
2	1	545 525 310 205	1,842 1,997 1,612 3,067
3	2	545 525 365 310	1,575 1,620 1,451 1,606

4	3	545 525 365 310	1,404 1,437 1,464 1,519
5	4	545 525 365 320	1,008 1,026 1,270 1,265
6	5	545 525 365 320	0,542 0,553 0,532 0,527
7	**6**	**370**	**0,687**
8	8	365	0,515
9	11	365	0,255
10	14	365	0,191
11	17	365	0,061

3. Konsentrasi 0,0024 M

Pengukuran ke	Waktu (Jam)	Panjang Gelombang (nm)	Absorbansi
1	0	555 525 365 315 225	2,999 9,999 2,456 2,784 3,538
2	1	545 525 365 305 210	2,900 3,715 2,102 2,523 3,408
3	2	545 525 365 310 205	2,775 3,100 2,088 2,464 3,265
4	3	545 525 365 310 205	2,639 2,878 2,095 2,383 3,284
5	4	545 525 365 310 205	2,409 2,546 1,982 2,217 3,234
6	5	545 525	2,125 2,229

		355 310	1,938 2,089
7	6	545 525 365 310	1,342 1,405 1,501 1593
8	8	545 525 365 325	0,874 0,899 1,321 1,309
9	**11**	**370**	**1,297**
10	14	370	1,281
11	17	370	0,996
12	23	365	0,961
13	26	365	0,847
14	29	365	0,686

4. Konsentrasi 0,0032 M

Pengukuran ke	Waktu (Jam)	Panjang Gelombang (nm)	Absorbansi
1	0	570 520 365 315 295 235 220	3,010 9,999 2,857 2,904 3,142 3,695 3,653
2	1	565 550 505 365 325 315 305 295 225	2,934 3,030 9,999 2,678 2,624 2,654 2,701 2,949 3,541
3	2	550 515 365 320 310 295 220	3,068 9,999 2,660 2,589 2,613 2,838 3,443
4	3	540 520 365 310 215	3,044 9,999 2,564 2,564 3,361

5	4	545 525 365 305 315	3,108 9,999 2,524 2,553 3,378
6	5	545 525 365 310 210	2,731 3,238 2,230 2,500 3,285
7	6	545 525 365 310 210	2,501 2,727 2,083 2,283 3,120
8	8	545 525 365 310	1,995 2,125 1,862 2,065
9	11	545 525 365 310	1,619 1,704 1,773 1,882
10	14	545 525 365 315	1,221 1,267 1,572 1,618
11	**17**	**370**	**1,388**
12	23	370	1,283
13	26	365	1,147

5. Konsentrasi 0,004 M

Pengukuran ke	Waktu (Jam)	Panjang Gelombang (nm)	Absorbansi
1	0	570 490 365 330 320 310 295 225	3,214 9,999 3,124 2,752 2,816 2,822 3,649 3,715
2	1	565 545 370 305 295 240	3,179 3,319 3,009 2,677 3,095 3,523

		220	3,501
3	2	565 550 535 500 370 330 310 295 235	3,425 3,456 3,497 9,999 3,001 2,520 2,598 2,978 3,491
4	3	555 535 495 370 320 295 230 220	3,547 3,594 9,999 2,939 2,607 2,037 3,520 3,516
5	4	555 500 370 315 295 225 215	3,325 9,999 2,861 2,572 2,946 3,428 2,435
6	5	550 500 370 335 315 295 220	3,757 9,999 2,832 2,459 2,574 2,969 3,489
7	6	545 520 510 365 310 295 220	3,000 9,999 4,279 2,564 2,505 2,757 3,327
8	8	545 525 365 310 210	2,896 3,837 2,340 2,503 3,303
9	11	545 525 365 305	2,635 2,882 2,289 2,464

		205	3,325
10	14	545	1,127
		525	1,233
		310	1,602
11	17	545	1,022
		525	1,102
		365	1,393
		320	1,442
12	**23**	**365**	**1,263**
13	26	370	1,168
14	29	370	1,088

6. Konsentraasi 0,0048 M

Pengukuran ke	**Waktu (Jam)**	**Panjang Gelombang (nm)**	**Absorbansi**
1	0	575	3,115
		555	3,090
		480	9,999
		365	3,225
		305	2,853
		295	3,256
		245	3,609
		235	3,684
2	1	575	3,276
		565	3,256
		540	3,240
		485	9,999
		370	3,228
		295	3,182
		245	3,650
3	2	575	3,224
		565	3,300
		540	3,307
		485	9,999
		370	3,094
		295	3,038
		235	3,535
4	3	560	3,338
		485	9,999
		370	3,080
		290	2,980
		240	3,479
		225	3,477
5	4	565	3,197
		370	3,059
		305	2,605
		295	3,024
		215	3,527

6	5	570 545 490 370 330 315 295 240	3,077 3,155 9,999 2,961 2,460 2,555 2,891 3,428
7	6	550 505 370 295 235	2,996 9,999 2,736 2,796 3,289
8	8	545 525 365 310 295 215	2,673 2,932 2,585 2,544 2,750 3,297
9	11	545 525 365 310 210	2,755 2,874 2,587 2,603 3,439
10	14	545 525 365 310 205	2,320 2,450 2,263 2,450 3,352
11	17	545 525 310	1,699 1,898 2,068
12	23	545 525 365 310	1,208 1,309 1,632 1,722
13	26	545 525 505 365 340	0,923 1,006 1,003 1,526 1,519
14	**29**	**360**	**1,212**
15	32	365	1,147

B. **Variasi pH**

1. pH 3

Pengukuran ke	Waktu (Jam)	Panjang Gelombang (nm)	Absorbansi
1	0	550 525 310 205	2,440 3,273 2,791 3,699
2	30	545 525 310	1,783 2,015 1,515
3	1,5	545 525 310	0,953 1,008 0,775
4	2,5	545 525 310	0,197 0,207 0,191
5	3,5	675 545 525 310	0,063 0,160 0,169 0,173
6	**4,5**	**675** **355** **335** **300**	**0,099** **0,148** **0,147** **0,146**

2. pH 4

Pengukuran ke	Waktu (Jam)	Panjang Gelombang (nm)	Absorbansi
1	0	545 525 315 205	2,622 3,616 2,866 3,624
2	1	545 525 310 205	2,130 2,616 2,057 3,337
3	2	545 525 310 205	1,957 2,295 1,713 3,090
4	4	545 525	1,592 1,777

		310	1,280
5	6	545 525 310	1,106 1,738 0,887
6	8	545 525 310	1,017 1,077 0,824
7	14	545 525 310	0,374 0,397 0,401
8	17	675 360	0,184 0,332
9	20	675 360	0,047 0,190
10	22	675 365	0,047 0,186

3. pH 7

Pengukuran ke	Waktu (Jam)	Panjang Gelombang (nm)	Absorbansi
1	0	550 525 350 305 230 215	2,618 4,615 2,533 2,872 3,587 3,582
2	1	545 525 310 210	2,335 3,314 2,663 3,495
3	2	545 525 310 210	2,337 3,024 2,422 3,357
4	4	545 525 310	2,114 2,467 2,100
5	6	545 525 310	1,233 1,330 1,288
6	8	545 525 310	0,936 1,006 1,750
7	14	545 525 310	0,688 0,741 0,897

8	17	545 525 310	0,533 0,579 0,809
9	**20**	**355**	**0,592**
10	22	355	0,583
11	24	355	0,560

4. pH 9

Pengukuran ke	Waktu (Jam)	Panjang Gelombang (nm)	Absorbansi
1	0	570 525 330 300 225	2,350 3,914 2,980 3,142 3,834
2	1	545 525 345 310 215	2,352 3,702 2,344 2,754 3,482
3	2	545 525 315 210	2,402 3,358 2,582 3,439
4	4	545 525 310	2,436 2,952 2,665
5	6	545 525 310 205	2,298 2,763 2,338 3,677
6	8	545 525 310	2,049 2,315 1,984
7	14	545 525 310	1,669 1,824 1,627
8	17	545 525 310	1,401 1,508 1,741
9	20	545 525 310	0,977 1,050 1,407
10	22	545 525 310	0,778 0,846 1,526

11	**24**	**350**	**1,138**
12	26	355	1,071
13	28	355	1,035

5. pH 10

Pengukuran ke	Waktu (Jam)	Panjang gelombang (nm)	Absorbansi
1	0	570	2,674
		525	9,999
		365	2,663
		320	2,764
		310	2,846
		295	3,149
		235	3,689
2	1	550	2,576
		520	9,999
		340	2,705
		310	2,858
		215	3,784
3	2	550	2,627
		525	4,136
		365	2,315
		345	2,446
		310	2,676
		210	3,609
4	4	545	2,675
		525	3,468
		310	3,012
		210	4,252
5	6	545	2,613
		525	3,083
		310	3,445
		205	4,703
6	8	545	2,426
		525	2,836
		310	2,910
7	14	545	2,113
		525	2,378
		310	2,375
8	17	545	1,666
		525	2,237
		350	2,850
9	20	545	1,378
		525	1,901
		365	2,311
		315	2,457

10	22	545 525 355 315	1,175 1,543 2,302 2,400
11	24	545 525 345 320	0,998 1,132 2,255 2,298
12	**26**	**365** **350**	**2,015** **1,996**
13	28	370	1,999

Lampiran 7. Perhitungan MnO_4^- dalam Larutan dan Kadar MnO_2 Variasi Konsentrasi $KMnO_4$.

A = ε x B x C

A: Absorbansi
B : tebal kuvet
C : konsentrasi
ε : 525: 2,40 x 10^3

1. **Konsentrasi 0,0008 M**

- A = ε x B x C (0 menit)

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

$$C = \frac{1{,}835}{1\ \text{cm}.\ 2{,}40 \times 10^3\ \text{ml/mmol. cm}}$$

C = **0,000764 M**

- A = ε x B x C (1 jam)

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

$$C = \frac{0{,}562}{1\ \text{cm}.\ 2{,}40 \times 10^3\ \text{ml/mmol. cm}}$$

C = **0,000234M**

- A = ε x B x C (2 jam)

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

$$C = \frac{0{,}133}{1\ \text{cm}.\ 2{,}40 \times 10^3\ \text{ml/mmol. cm}}$$

C = **0,000055 M**

2. **Konsentrasi 0,0016 M**

- A = ε x B x C (0 jam)

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

$$C = \frac{3{,}618}{1\ \text{cm}.\ 2{,}40 \times 10^3\ \text{ml/mmol. cm}}$$

C = **0,0015 M**

- A = ε x B x C (1 jam)

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

$$C = \frac{1{,}997}{1\ \text{cm}.\ 2{,}40 \times 10^3\ \text{ml/mmol. cm}}$$

C = **0,000832 M**

- A = ε x B x C (2 jam)

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

$$C = \frac{1{,}620}{1\ \text{cm}.\ 2{,}40 \times 10^3\ \text{ml/mmol. cm}}$$

C = **0,000675 M**

- A = ε x B x C (3 jam)

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

$$C = \frac{1{,}437}{1\ \text{cm}.\ 2{,}40 \times 10^3\ \text{ml/mmol. cm}}$$

C = **0,000598 M**

- A = ε x B x C (4 jam)

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

$$C = \frac{1,026}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,000427 M**

- A = ε x B x C (5 jam)

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

$$C = \frac{0,553}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00023 M**

3. Konsentrasi 0,0024 M

- A = ε x B x C (1 jam)

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

$$C = \frac{3,715}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00154 M**

- A = ε x B x C (2 jam)

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

$$C = \frac{3,100}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00129 M**

- A = ε x B x C (3 jam)

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

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

C = **0,00119 M**

- A = ε x B x C (4 jam)

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

$$C = \frac{2,546}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00106 M**

- A = ε x B x C (5 jam)

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

$$C = \frac{2,229}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,000928 M**

- A = ε x B x C (6 jam)

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

$$C = \frac{1,405}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,000585 M**

- A = ε x B x C (8 jam)

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

$$C = \frac{0,899}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,000374 M**

4. Konsentrasi 0,0032 M

- A = ε x B x C (5 jam)

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

$$C = \frac{3,238}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00134 M**

- A = ε x B x C (6 jam)

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

$$C = \frac{2,727}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00113 M**

- A = ε x B x C (8 jam)

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

$$C = \frac{2,125}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,000885 M**

- A = ε x B x C (11 jam)

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

$$C = \frac{1,704}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00071 M**

- A = ε x B x C (14 jam)

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

$$C = \frac{1,267}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,000527 M**

5. Konsentrasi 0,004 M

- A = ε x B x C (8 jam)

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

$$C = \frac{3,837}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00159 M**

- A = ε x B x C (11 jam)

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

$$C = \frac{2,882}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00120 M**

- A = ε x B x C (14 jam)

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

$$C = \frac{1,233}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,000514 M**

- A = ε x B x C (17 jam)

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

$$C = \frac{1,102}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,000459 M**

6. Konsentrasi 0,0048 M

- A = ε x B x C (8 jam)

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

$$C = \frac{2,932}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00122 M**

- A = ε x B x C (11 jam)

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

$$C = \frac{2,874}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00119 M**

- $A = \varepsilon \times B \times C$ (14 jam)

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

$$C = \frac{2{,}450}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,00102 M**

- $A = \varepsilon \times B \times C$ (17 jam)

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

$$C = \frac{1{,}898}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,000791 M**

- $A = \varepsilon \times B \times C$ (23 jam)

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

$$C = \frac{1{,}309}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,000545 M**

- $A = \varepsilon \times B \times C$ (26 jam)

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

$$C = \frac{1{,}006}{1 \text{ cm. } 2{,}40 \times 10^3 \text{ ml/mmol. cm}}$$

C = **0,000419 M**

Kadar MnO_2

1. **0,0008 M**

- **MnO_4^- ⟶ MnO_2**

M 0,0008 M

R 0,000036 M 0,000036 M

S 0,000764 M **0,00036 M**

- **MnO_4^- ⟶ MnO_2**

M 0,000764 M

R 0,00053 M 0,00053 M

S 0,000234 M **0,00053 M**

- **MnO_4^- ⟶ MnO_2**

M 0,000234 M

R 0,000179 M 0,000179 M

S 0,000055 M **0,000179 M**

Jumlah MnO_4^- yang bereaksi:

0,000036 M + 0,00053 M + 0,000179 M = **0,000745 M.**

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

$$\frac{0{,}0008 \text{ M} - 0{,}000745 \text{ M}}{0{,}0008 \text{ M}} \times 100\ \% = 6{,}87\ \%$$

2. **0,0016 M**

- **MnO_4^- ⟶ MnO_2**

M 0,0016 M

R 0,0001 M 0,0001 M

S 0,0015 M **0,0001 M**

- **MnO_4^- ⟶ MnO_2**

M 0,0015 M

R 0,000668 M 0,000668 M

S 0,000832 M **0,000668 M**

- **MnO_4^- ⟶ MnO_2**

M 0,000832 M

R 0,000157 M 0,000157 M

S 0,000675 M **0,000157 M**

- **MnO_4^- ⟶ MnO_2**

M 0,000675 M

R 0,000077 M 0,000077 M

S 0,000598 M **0,000077 M**

MnO_4^- ⟶ MnO_2

M 0,000598 M

R 0,000171 M 0,000171 M

S 0,000427 M **0,000171 M**

- **MnO_4^- ⟶ MnO_2**

M 0,000427 M

R 0,000197 M 0,000197 M

S 0,00023 M **0,000197 M**

Jumlah MnO_4^- yang bereaksi:

0,0001 M + 0,000668 M + 0,000157 M+ 0,000077 M + 0,000171 M + 0,000197 M = **0,00137 M.**

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

$$\frac{0{,}0016\text{ M}-0{,}00137\text{ M}}{0{,}0016\text{ M}} \text{x } 100\ \% = 14{,}37\ \%$$

Tabel kadar MnO_2 pada penggunaan variasi konsentrasi $KMnO_4$

Konsentrasi $KMnO_4$	**Kadar MnO_2**
0,0008 M	**6,87 %**
0,0016 M	**14,37%**
0,0024 M	**15,60%**
0,0032 M	**16,49%**
0,004 M	**11,47%**
0,0048 M	**8,73%**

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

1. **pH 3**

- A = ε x B x C (0 menit)

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

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

C = **0,001363 M**

- A = ε x B x C (0,5 jam)

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

$C = \frac{2{,}015}{1\ cm.\ 2{,}40 \times 10^3\ mL/mmol.\ cm}$

C = **0,000839M**

- A = ε x B x C (1,5 jam)

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

$C = \frac{1{,}008}{1\ cm.\ 2{,}40 \times 10^3\ mL/mmol.\ cm}$

C = **0,000420 M**

- A = ε x B x C (2,5 jam)

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

$C = \frac{0{,}207}{1\ cm.\ 2{,}40 \times 10^3\ mL/mmol.\ cm}$

C = **0,000086 M**

- A = ε x B x C (3,5 jam)

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

$C = \frac{0{,}160}{1\ cm.\ 2{,}40 \times 10^3\ mL/mmol.\ cm}$

C = **0,000066 M**

2. **pH 4**

- A = ε x B x C (0 jam)

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

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

C = **0,001506 M**

- A = ε x B x C (1 jam)

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

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

C = **0,00109 M**

- A = ε x B x C (2 jam)

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

$C = \frac{2{,}259}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$

C = **0,000956 M**

- A = ε x B x C (4 jam)

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

$C = \frac{1{,}777}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$

C = **0,000740 M**

- A = ε x B x C (6 jam)

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

$C = \frac{1{,}738}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$

C = **0,000724 M**

- $A = \varepsilon \times B \times C$ (8 jam)

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

$$C = \frac{1{,}077}{1\ \text{cm.}\ 2{,}40 \times 10^3\ \text{ml/mmol. cm}}$$

C = **0,000448 M**

- $A = \varepsilon \times B \times C$ (14 jam)

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

$$C = \frac{0{,}397}{1\ \text{cm.}\ 2{,}40 \times 10^3\ \text{ml/mmol. cm}}$$

C = **0,000165 M**

Kadar MnO_2

1. **pH 3**

- **MnO_4^- ⟶ MnO_2**

	MnO_4^-	MnO_2
M	0,0032 M	
R	0,001837 M	0,001837 M
S	0,001363 M	**0,001837 M**

- **MnO_4^- ⟶ MnO_2**

	MnO_4^-	MnO_2
M	0,001363 M	
R	0,000524 M	0,000524 M
S	0,000839 M	**0,000524 M**

- **MnO_4^- ⟶ MnO_2**

	MnO_4^-	MnO_2
M	0,000839 M	
R	0,000419 M	0,000419 M
S	0,00042 M	**0,000419 M**

- **MnO_4^- ⟶ MnO_2**

	MnO_4^-	MnO_2
M	0,00042 M	
R	0,000334 M	0,000334 M
S	0,000086 M	**0,000334 M**

- **MnO_4^- ⟶ MnO_2**

	MnO_4^-	MnO_2
M	0,000086 M	
R	0,00002 M	0,00002 M
S	0,000066 M	**0,00002 M**

Jumlah MnO_4^- yang bereaksi:

0,001837 M + 0,000524 M + 0,000419 M + 0,000334 M + 0,00002 M = **0,003134 M.**

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

$$\frac{0{,}0032\ \text{M}-0{,}003134\ \text{M}}{0{,}0032\ \text{M}} \times 100\ \% = 2{,}06\%$$

2. **pH 4**

- **MnO_4^- ⟶ MnO_2**

	MnO_4^-	MnO_2
M	0,0032 M	
R	0,001694 M	0,001694 M
S	0,001506 M	**0,001694 M**

- **MnO_4^- ⟶ MnO_2**

	MnO_4^-	MnO_2
M	0,001506 M	
R	0,000416 M	0,000416 M
S	0,00109 M	**0,000416 M**

- **MnO_4^- ⟶ MnO_2**

M 0,00109 M

R 0,000134 M 0,000134 M

S 0,000956 M **0,000134 M**

- **MnO_4^- ⟶ MnO_2**

M 0,000956 M

R 0,000216 M 0,000216 M

S 0,000740 M **0,000216 M**

- **MnO_4^- ⟶ MnO_2**

M 0,000740 M

R 0,000016 M 0,000016 M

S 0,000724 M **0,000016 M**

- **MnO_4^- ⟶ MnO_2**

M 0,000724 M

R 0,000276 M 0,000276 M

S 0,000448 M **0,000276 M**

- **MnO_4^- ⟶ MnO_2**

M 0,000448 M

R 0,000283 M 0,000283 M

S 0,000165 M **0,000283 M**

Jumlah MnO_4^- yang bereaksi:

0,001694 M + 0,000416 M + 0,000134 M + 0,000216 M + 0,000016 M + 0,000276 M + 0,000283 = **0,003035 M.**

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

$$\frac{0{,}0032\ \text{M}-0{,}003035\ \text{M}}{0{,}0032\ \text{M}} \times 100\ \% = 5{,}15\%$$

Tabel kadar MnO_2 variasi pH

pH	Kadar MnO_2
3	**2,06%**
4	**5,15%**
7	**7,5%**
9	**11,01%**
10	**17,18%**

Lampiran 9. Hasil Analisis dengan Titrasi Boehm

A. Data Hasil Titrasi Boehm KTK

Penentuan Kadar Karboksilat

No	V sampel (Vs) (mL)	V $NaHCO_3$ (Vp) (mL)	N $NaHCO_3$	N HCl	V HCl (mL)	N NaOH	V NaOH (mL)	m Karbon (g)	n Karboksilat
1	25	5	0.05	0.0479	10	0.0505	7.8	0.1004	8,8396
2	25	5	0.05	0.0479	10	0.0505	8	0.1004	8.3366
3	25	5	0.05	0.0479	10	0.0505	7.8	0.1004	8,8396
Rata-rata									**8.5042**

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

$$n_{karboksilat} = \frac{[5 \text{ mL x } 0{,}0505 \text{ N} - ((0{,}0479 \text{ N x } 10 \text{ mL}) - (0{,}0505 \text{ x } 7.8))] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1004 \text{ gram}}$$

$$n_{karboksilat} = \frac{[0{,}2525 \text{ meq} - (0{,}479 \text{ meq} - 0{,}404 \text{ meq})] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1004 \text{ gram}}$$

$$n_{karboksilat} = \frac{[0{,}2525 \text{ meq} - (0{,}075)] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1004 \text{ gram}} = 8{,}8396 \ \frac{\text{meq}}{\text{gram}}$$

Penentuan Kadar Lakton

No	V sampel (Vs) (mL)	V Na_2CO_3 (Vp) (mL)	N Na_2CO_3	N HCl	V HCl (mL)	N NaOH	V NaOH (mL)	m Karbon (g)	n Lakton
1	25	5	0,05	0.0479	10	0,0505	6,4	0.1001	-4,0094
2	25	5	0,05	0.0479	10	0,0505	6,4	0.1001	-4,0094
3	25	5	0,05	0.0479	10	0,0505	6,6	0.1001	-3,5049
Rata-rata									**-3,8412**

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

$$n_{lakton} = \frac{[5 \text{ mL x } 0,05 \text{ N} - ((0,0479 \text{ N x } 10 \text{ mL}) - (0,0505 \text{ N x } 6,4 \text{ mL}))]\frac{25 \text{ mL}}{10 \text{ mL}}}{0,1001 \text{ gram}} - 8,8396$$

$$n_{lakton} = \frac{[0,2525 \text{ meq} - (0,479 \text{ meq} - 0,3232 \text{ meq})]\frac{25 \text{ mL}}{5 \text{ mL}}}{0,1001 \text{ gram}} - 8,8396$$

$$n_{lakton} = \frac{[0,2525 \text{ meq} - (0,1558)]\frac{25 \text{ mL}}{5 \text{ mL}}}{0,1001 \text{ gram}} = -4,0094 \ \frac{\text{meq}}{\text{gram}}$$

Penentuan Kadar Fenol

No	V sampel (Vs) (mL)	V NaOH (Vp) (mL)	N NaOH	N HCl	V HCl (mL)	N NaOH	V NaOH (mL)	m Karbon (g)	n Fenol
1	25	5	0,05	0.0479	10	0,0505	6,5	0.1004	0,230
2	25	5	0,05	0.0479	10	0,0505	6,5	0.1004	0,230
3	25	5	0,05	0.0479	10	0,0505	6,6	0.1004	0,4885
Rata-rata									**0,3161**

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

$$n_{Fenol} = \frac{[5 \text{ mL x } 0{,}0505 \text{ N} - ((0{,}0479 \text{ N x } 10 \text{ mL}) - (0{,}0505 \text{ N x } 6{,}5 \text{ mL}))] \frac{25 \text{ mL}}{10 \text{ mL}}}{0{,}1004 \text{ gram}} - 8{,}8396 \frac{\text{meq}}{\text{gram}} - (-4{,}0094) \frac{\text{meq}}{\text{gram}}$$

$$n_{Fenol} = \frac{[0{,}2525 \text{ meq} - (0{,}479 \text{ meq} - 0{,}3282 \text{ meq})] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1004 \text{ gram}} - 8{,}8396 \frac{\text{meq}}{\text{gram}} + 4{,}0094 \frac{\text{meq}}{\text{gram}}$$

$$n_{lakton} = \frac{[0{,}2525 \text{ meq} - (0{,}1508)] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1004 \text{ gram}} = -8{,}8396 \frac{\text{meq}}{\text{gram}} + 4{,}0094 \frac{\text{meq}}{\text{gram}} = 0{,}2300 \frac{\text{meq}}{\text{gram}}$$

Penentuan Kadar Basa Total

No	V sampel (Vs) (mL)	V HCl (Vp) (mL)	N HCl (mL)	N NaOH	V NaOH (mL)	N HCl	V HCl (mL)	m Karbon (g)	n Basa Total
1	25	5	0,0479	0.0505	10	0,0479	5,7	0.1005	0,3731
2	25	5	0,0479	0.0505	10	0,0479	5,7	0.1005	0,3731
3	25	5	0,0479	0.0505	10	0,0479	5,6	0.1005	0,1344
Rata-rata									**0,2935**

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

$$n_{Basa\ total} = \frac{[5\ mL\ x\ 0{,}0479\ N - ((0{,}0505\ N\ x\ 10\ mL) - (0{,}0479\ N\ x\ 5{,}7\ mL))]\frac{25\ mL}{5\ mL}}{0{,}1005\ gram}$$

$$n_{Basa\ total} = \frac{[0{,}2395\ meq - (0{,}5050\ meq - 0{,}2730\ meq)]\frac{25\ mL}{5\ mL}}{0{,}1005\ gram}$$

$$n_{Basa\ total} = \frac{[0{,}2395\ meq - (0{,}232\ meq)]\frac{25\ mL}{5\ mL}}{0{,}1005\ gram} = 0{,}3731\ \frac{meq}{gram}$$

B. Data Hasil Titrasi Boehm KATK

Penentuan Kadar Kadar Karboksilat

No	V sampel (Vs) (mL)	V $NaHCO_3$ (Vp) (mL)	N $NaHCO_3$	N HCl	V HCl (mL)	N NaOH	V NaOH (mL)	m Karbon (g)	n Karboksilat
1	25	5	0,05	0,0479	10	0,0505	7,3	0.1005	7,0696
2	25	5	0,05	0,0479	10	0,0505	7,4	0.1005	7,3233
3	25	5	0,05	0,0479	10	0,0505	7,3	0.1005	7,0696
Rata-rata									**7,1541**

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

$$n_{karboksilat} = \frac{[5 \text{ mL x } 0{,}0505 \text{ N} - ((0{,}0479 \text{ N x } 10 \text{ mL}) - (0{,}0505 \text{ N x } 7{,}3 \text{ mL}))] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1005 \text{ gram}}$$

$$n_{karboksilat} = \frac{[0{,}2525 \text{ meq} - (0{,}479 \text{ meq} - 0{,}3686 \text{ meq})] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1005 \text{ gram}}$$

$$n_{karboksilat} = \frac{[0{,}2525 \text{ meq} - (0{,}1104)] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1005 \text{ gram}} = 7{,}0696 \ \frac{\text{meq}}{\text{gram}}$$

Penentuan Kadar Lakton

No	V sampel (Vs) (mL)	V Na_2CO_3 (Vp) (mL)	N Na_2CO_3	N HCl	V HCl (mL)	N NaOH	V NaOH (mL)	m Karbon (g)	n Lakton
1	25	5	0,05	0.0479	10	0,0505	6,3	0,1005	-2,4984
2	25	5	0,05	0.0479	10	0,0505	6,3	0,1005	-2,4984
3	25	5	0,05	0.0479	10	0,0505	6,2	0,1005	-2,7526
Rata-rata									**-2,5831**

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

$$n_{lakton} = \frac{[5 \text{ mL x } 0{,}05 \text{ N} - ((0{,}0479 \text{ N x } 10 \text{ mL}) - (0{,}0505 \text{ N x } 6{,}3 \text{ mL}))] \frac{25 \text{ mL}}{10 \text{ mL}}}{0{,}1003 \text{ gram}} - 7{,}0696$$

$$n_{lakton} = \frac{[0{,}2525 \text{ meq} - (0{,}479 \text{ meq} - 0{,}3181 \text{ meq})] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1003 \text{ gram}} - 7{,}0696$$

$$n_{lakton} = \frac{[0{,}2525 \text{ meq} - (0{,}1609)] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1003 \text{ gram}} = -2{,}4984 \ \frac{\text{meq}}{\text{gram}}$$

Penentuan Kadar Fenol

No	V sampel (Vs) (mL)	V NaOH (Vp) (mL)	N NaOH	N HCl	V HCl (mL)	N NaOH	V NaOH (mL)	m Karbon (g)	n Fenol
1	25	5	0,05	0.0479	10	0,0505	6,4	0.1002	0,2539
2	25	5	0,05	0.0479	10	0,0505	6,4	0.1002	0,2539
3	25	5	0,05	0.0479	10	0,0505	6,4	0.1002	0,2539
Rata-rata									0,2539

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

$$n_{Fenol} = \frac{[5 \text{ mL x } 0{,}0505 \text{ N} - ((0{,}0479 \text{ N x } 10 \text{ mL}) - (0{,}0505 \text{ N x } 6{,}4 \text{ mL}))]\frac{25 \text{ mL}}{10 \text{ mL}}}{0{,}1002 \text{ gram}} - 7{,}0696 \frac{\text{meq}}{\text{gram}} \text{ - (- } 2{,}4984) \frac{\text{meq}}{\text{gram}}$$

$$n_{Fenol} = \frac{[0{,}2525 \text{ meq} - (0{,}479 \text{ meq} - 0{,}3232 \text{ meq})]\frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1002 \text{ gram}} - 7{,}0696 \frac{\text{meq}}{\text{gram}} + 2{,}4984 \frac{\text{meq}}{\text{gram}}$$

$$n_{lakton} = \frac{[0{,}2525 \text{ meq} - (0{,}1558 \text{ meq})]\frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1002 \text{ gram}} = -7{,}0696 \frac{\text{meq}}{\text{gram}} + 2{,}4984 \frac{\text{meq}}{\text{gram}} = 0{,}2539 \frac{\text{meq}}{\text{gram}}$$

Penentuan Kadar Basa Total

No	V sampel (Vs) (mL)	V HCl (Vp) (mL)	N HCl (mL)	N NaOH	V NaOH (mL)	N HCl	V HCl (mL)	m Karbon (g)	n Basa Total
1	25	5	0,0479	0.0505	10	0,0479	5,9	0.1005	0,8512
2	25	5	0,0479	0.0505	10	0,0479	6,1	0.1005	1,3233
3	25	5	0,0479	0.0505	10	0,0479	6,1	0.1005	1,3233
Rata-rata									**1,1659**

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

$$n_{Basa\ total} = \frac{[5\ mL\ x\ 0{,}0479\ N - ((0{,}0505\ N\ x\ 10\ mL) - (0{,}0479\ N\ x\ 6{,}1\ mL))]\frac{25\ mL}{5\ mL}}{0{,}1005\ gram}$$

$$n_{Fenol} = \frac{[0{,}2395\ meq - (0{,}5050\ meq - 0{,}2921\ meq)]\frac{25\ mL}{5\ mL}}{0{,}1005\ gram}$$

$$n_{lakton} = \frac{[0{,}2395\ meq - (0{,}2129\ meq)]\frac{25\ mL}{5\ mL}}{0{,}1005\ gram} = 1{,}3233\ \frac{meq}{gram}$$

C. Data Hasil Titrasi Boehm MnO_2/AC

Penentuan Kadar Kadar Karboksilat

No	V sampel (Vs) (mL)	V $NaHCO_3$ (Vp) (mL)	N $NaHCO_3$	N HCl	V HCl (mL)	N NaOH	V NaOH (mL)	m Karbon (g)	n Karboksilat
1	25	5	0,05	0,0479	10	0,0505	8,2	0.1005	9,2089
2	25	5	0,05	0,0479	10	0,0505	8,2	0.1005	9,2089
3	25	5	0,05	0,0479	10	0,0505	8,3	0.1005	9,4601
Rata-rata									**9,2926**

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

$$n_{karboksilat} = \frac{[5 \text{ mL x } 0{,}0505 \text{ N} - ((0{,}0479 \text{ N x } 10 \text{ mL}) - (0{,}0505 \text{ N x } 8{,}2 \text{ mL}))] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1005 \text{ gram}}$$

$$n_{karboksilat} = \frac{[0{,}2525 \text{ meq} - (0{,}479 \text{ meq} - 0{,}4141 \text{ meq})] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1005 \text{ gram}}$$

$$n_{karboksilat} = \frac{[0{,}2525 \text{ meq} - (0{,}0649)] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1005 \text{ gram}} = 9{,}2089 \ \frac{\text{meq}}{\text{gram}}$$

Penentuan Kadar Lakton

No	V sampel (Vs) (mL)	V Na_2CO_3 (Vp) (mL)	N Na_2CO_3	N HCl	V HCl (mL)	N NaOH	V NaOH (mL)	m Karbon (g)	n Lakton
1	25	5	0,05	0.0479	10	0,0505	7,1	0,1005	-2,8474
2	25	5	0,05	0.0479	10	0,0505	7,3	0,1005	-2,3449
3	25	5	0,05	0.0479	10	0,0505	7,1	0,1005	-2,8474
Rata-rata									**-2,6799**

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

$$n_{lakton} = \frac{[5\ mL\ x\ 0,05\ N - ((0,0479\ N\ x\ 10\ mL) - (0,0505\ N\ x\ 7,1\ mL))] \frac{25\ mL}{10\ mL}}{0,1003\ gram} - 9,2926$$

$$n_{lakton} = \frac{[0,2525\ meq - (0,479\ meq - 0,3585\ meq)] \frac{25\ mL}{5\ mL}}{0,1003\ gram} - 9,2926$$

$$n_{lakton} = \frac{[0,2525\ meq - (0,1205)] \frac{25\ mL}{5\ mL}}{0,1003\ gram} - 9,2926 = -2,8474\ \frac{meq}{gram}$$

Penentuan Kadar Fenol

No	V sampel (Vs) (mL)	V NaOH (Vp) (mL)	N NaOH	N HCl	V HCl (mL)	N NaOH	V NaOH (mL)	m Karbon (g)	n Fenol
1	25	5	0,05	0.0479	10	0,0505	7,4	0.1002	0,6077
2	25	5	0,05	0.0479	10	0,0505	7,4	0.1002	0,6077
3	25	5	0,05	0.0479	10	0,0505	7,4	0.1002	0,6077
Rata-rata									0,6077

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

$$n_{Fenol} = \frac{[5\ mL\ x\ 0{,}0505\ N - ((0{,}0479\ N\ x\ 10\ mL) - (0{,}0505\ N\ x\ 7{,}4\ mL))]\frac{25\ mL}{10\ mL}}{0{,}1002\ gram} - 9{,}2926\frac{meq}{gram} - (-\ 2{,}6799)\ \frac{meq}{gram}$$

$$n_{Fenol} = \frac{[0{,}2525\ meq - (0{,}479\ meq - 0{,}3737\ meq)]\frac{25\ mL}{5\ mL}}{0{,}1002\ gram} - 9{,}2926\ \frac{meq}{gram} + 2{,}6799\ \frac{meq}{gram}$$

$$n_{lakton} = \frac{[0{,}2525\ meq - (0{,}1053\ meq)]\frac{25\ mL}{5\ mL}}{0{,}1002\ gram} = -9{,}2926\ \frac{meq}{gram} + 2{,}6799\ \frac{meq}{gram} = 0{,}6077\ \frac{meq}{gram}$$

Penentuan Kadar Basa Total

No	V sampel (Vs) (mL)	V HCl (Vp) (mL)	N HCl (mL)	N NaOH	V NaOH (mL)	N HCl	V HCl (mL)	m Karbon (g)	n Basa Total
1	25	5	0,0479	0.0505	10	0,0479	6,3	0.1005	1,8044
2	25	5	0,0479	0.0505	10	0,0479	6,4	0.1005	2,0427
3	25	5	0,0479	0.0505	10	0,0479	6,3	0.1005	1,8044
Rata-rata									**1,8839**

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

$$n_{Basa\ total} = \frac{[5\text{ mL x }0{,}0479\text{ N} - ((0{,}0505\text{ N x }10\text{ mL}) - (0{,}0479\text{ N x }6{,}3\text{ mL}))]\frac{25\text{ mL}}{5\text{ mL}}}{0{,}1005\text{ gram}}$$

$$n_{Basa\ total} = \frac{[0{,}2395\text{ meq} - (0{,}5050\text{ meq} - 0{,}3017\text{ meq})]\frac{25\text{ mL}}{5\text{ mL}}}{0{,}1005\text{ gram}}$$

$$n_{Basa\ total} = \frac{[0{,}2395\text{ meq} - (0{,}1979\text{ meq})]\frac{25\text{ mL}}{5\text{ mL}}}{0{,}1005\text{ gram}} = 1{,}8044\ \frac{\text{meq}}{\text{gram}}$$