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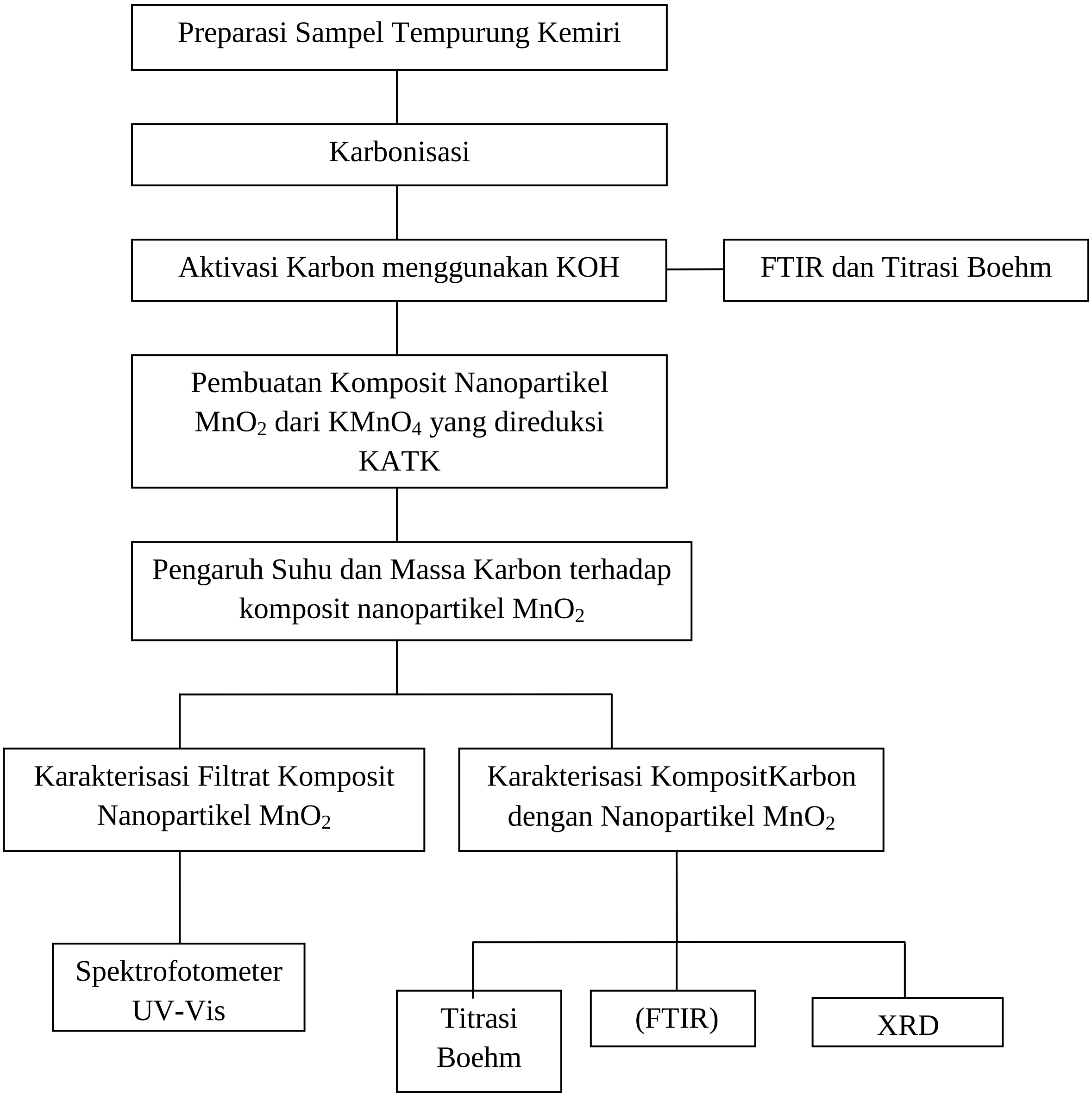
LAMPIRAN

Lampiran 1. Diagram Alir Penelitian



Lampiran 2. Bagan Kerja

2.1 Prosedur Umum

Tempurung Kemiri

–dibersihkan kotoran yang menempel pada tempurung

–dikeringkan dalam oven pada suhu 110 ^{o}C selama 2 jam

–dikarbonisasi pada suhu 700 ^{o}C selama 3 jam

–dihaluskan dan diayak dengan ukuran 150 mesh

Karbon Tempurung Kemiri (KTK)

–diaktivasi dengan larutan KOH 25 % dengan perbandingan 5:1 (volume KOH : massa karbon)

–dicuci dengan HCl 3 M dan akuades secara berulang hingga pH netral.

–dipirolisis dalam tanur pada suhu 900 ^{o}C selama 45 menit

–dibilas dengan akuades

–dikeringkan dalam oven pada suhu 110 ^{o}C selama 24 jam

Karbon Aktif Tempurung Kemiri (KATK)

2.2 Sintesis Komposit Nanopartikel MnO_2 dari $KMnO_4$ yang direduksi dengan KATK

2.2.1 Pengaruh Massa Karbon

0,05; 0,1; 0,15; 0,2; 0,25 g KATK

- dimasukkan ke dalam gelas kimia yang berisi 100 mL $KMnO_4$ 0,0016 M
- diaduk menggunakan shaker (120 rpm) dan dianalisis menggunakan spektrofotometer *UV-Vis* pada λ 200-700 nm (diulang sampai proses reduksi selesai)
- diperoleh massa karbon optimum

Hasil

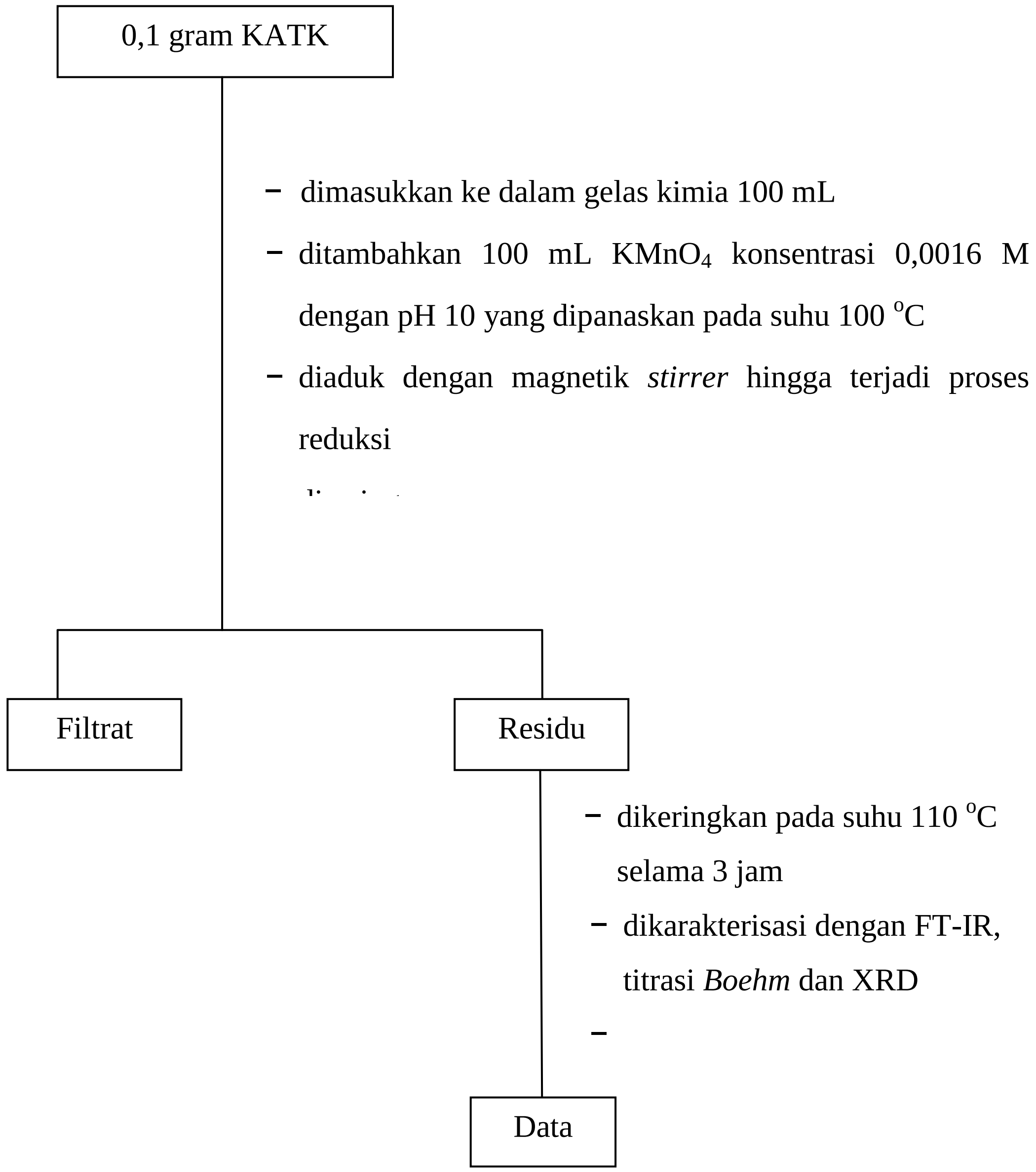
2.2.2 Pengaruh Suhu

0,1 g KATK

- dimasukkan ke dalam 5 gelas kimia yang berbeda
- ditambahkan masing-masing 100 mL $KMnO_4$ 0,0016 M
- diaduk dengan magnetik *stirrer* sambil dipanaskan pada suhu 75 ^oC; 80 ^oC; 85 ^oC; 95 ^oC; 100 ^oC selama 3 menit, lalu didinginkan dan dianalisis dengan Spektrofotometer *UV-Vis* pada λ 200-700 nm (diulang sampai proses reduksi selesai)

Hasil

2.3 Sintesis Nanopartikel MnO_2 pada Kondisi Optimum



2.4 Analisis Gugus Fungsi dengan Titrasi Boehm

Karbon Tempurung Kemiri (KTK)

- 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 dititrasi 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.

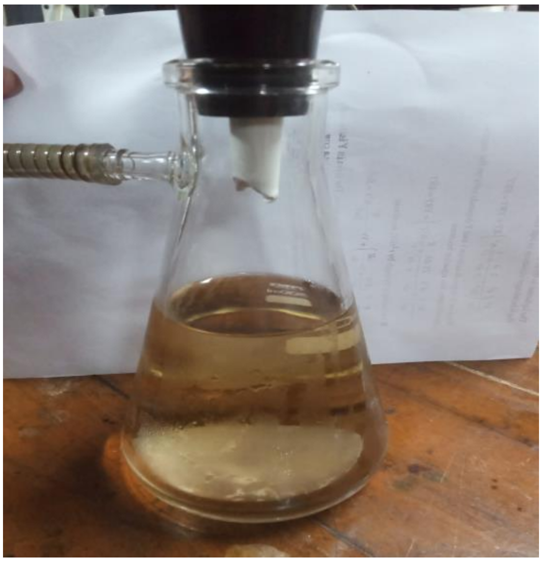
Hasil

Lampiran 3. Dokumentasi Penelitian

Tempurung Kemiri

Karbon Tempurung Kemiri (KTK)

Proses Aktivasi KTK



Proses Penyaringan KTK
Teraktivasi KOH

Karbon Aktif Tempurung Kemiri (KATK) hasil Penyaringan

Karbon Aktif Tempurung Kemiri (KATK) setelah Pengeringan

Karakterisasi dengan Titrasi *Boehm*

Sintesis untuk Karakterisasi menggunakan XRD

Pembentukan Nanopartikel MnO_2 dengan Variasi Massa Karbon

Pembentukan Nanopartikel MnO_2 dengan Variasi

Lampiran 4. Perhitungan Pembuatan Larutan Pereaksi

1. Pembuatan Larutan KOH 25%

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

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

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

b = 125 gram

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. PembuatanLarutan HCl 0,05 N

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

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

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 $Na_2B_4O_{7}.10H_2O$ 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. Perhitungan MnO_4^- dalam Larutan dan Kadar MnO_2 Variasi Massa 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: 0,0016 M

1. Massa Karbon 0,05 gr

- A = ε x B x C (1 jam)

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

$C = \frac{2,528}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$

C = **0,00105 M**

- A = ε x B x C (2 jam)

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

$C = \frac{2,278}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$

C = **0,00094 M**

- A = ε x B x C (3 jam)

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

$C = \frac{2,032}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$

C = **0,00084 M**

- A = ε x B x C (5 jam)

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

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

C = **0,00065 M**

- A = ε x B x C (7 jam)

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

$C = \frac{1,378}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$

C = **0,00057 M**

- A = ε x B x C (9 jam)

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

$C = \frac{1,189}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$

C = **0,00049 M**

- A = ε x B x C (11 jam)

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

$C = \frac{0,606}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$

C = **0,00025 M**

- A = ε x B x C (13 jam)

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

$C = \frac{0,540}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$

C = **0,00022 M**

- A = ε x B x C (15 jam)

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

$C = \frac{0,465}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$

C = **0,00019 M**

- $A = \varepsilon \times B \times C$ (18 jam)

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

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

C = **0,00016 M**

- $A = \varepsilon \times B \times C$ (21 jam)

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

$$C = \frac{0{,}345}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00014 M**

2. Massa Karbon 0,1 gr

- $A = \varepsilon \times B \times C$ (1 jam)

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

$$C = \frac{2{,}038}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00084 M**

- $A = \varepsilon \times B \times C$ (2 jam)

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

$$C = \frac{1{,}776}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00074 M**

- $A = \varepsilon \times B \times C$ (3 jam)

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

$$C = \frac{1{,}107}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00046 M**

- $A = \varepsilon \times B \times C$ (5 jam)

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

$$C = \frac{0{,}854}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00035 M**

3. Massa Karbon 0,15 gr

- $A = \varepsilon \times B \times C$ (1 jam)

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

$$C = \frac{1{,}107}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00046 M**

- $A = \varepsilon \times B \times C$ (2 jam)

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

$$C = \frac{0{,}807}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00033 M**

4. Massa Karbon 0,2 gr

- $A = \varepsilon \times B \times C$ (1 jam)

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

$$C = \frac{0{,}725}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = 0,00030 M

5. Massa Karbon 0,25 gr

- $A = \varepsilon \times B \times C$ (1 jam)

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

$$C = \frac{0{,}927}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00039 M**

- $A = \varepsilon \times B \times C$ (2 jam)

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

$$C = \frac{0,873}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00036 M**

- $A = \varepsilon \times B \times C$ (3 jam)

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

$$C = \frac{0,667}{1\ cm.\ 2,40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00027 M**

Tabel Fraksi [MnO_4^-] dalam Larutan (%) Variasi Massa Karbon (0,0016 M)

Massa Karbon (gr)	Jam	Fraksi [MnO_4^-] dalam Larutan (%)
0,05	1	65,62
	2	58,75
	3	52,5
	4	45
	5	40,62
	7	35,62
	9	30,62
	11	15,62
	13	13,75
	15	11,87
	18	10
	21	8,75
0,1	1	52,5
	2	46,25
	3	28,75
	4	21,87
0,15	1	28,75
	2	20,62
0,2	1	18,75
0,25	1	24,37
	2	22,5
	3	16,87

Kadar MnO_2

1. 0,05 gr

- **1 Jam**

MnO_4^- → MnO_2		
A	0,0016 M	
R	0,00055 M	0,00055 M
S	0,00105 M	**0,00055 M**

- **2 Jam**

MnO_4^- → MnO_2		
A	0,00105 M	
R	0,00011 M	0,00011 M
S	0,00094 M	**0,00011 M**

- **3 Jam**

MnO_4^- → MnO_2		
A	0,00094 M	
R	0,0001 M	0,0001 M
S	0,00084 M	**0,0001 M**

- **5 Jam**

MnO_4^- → MnO_2		
A	0,00084 M	
R	0,00019 M	0,00019 M
S	0,00065 M	**0,00019 M**

- **7 Jam**

MnO_4^- → MnO_2		
A	0,00065 M	
R	0,00008 M	0,00008 M
S	0,00057 M	**0,00008 M**

- **9 Jam**

MnO_4^- → MnO_2		
A	0,00057 M	
R	0,00008 M	0,00008 M
S	0,00049 M	**0,00008 M**

- **11 Jam**

MnO_4^- → MnO_2		
A	0,00049 M	
R	0,00024 M	0,00024 M
S	0,00025 M	**0,00024 M**

- **13 Jam**

MnO_4^- → MnO_2		
A	0,00025 M	
R	0,00003 M	0,00003 M
S	0,00022 M	**0,00003 M**

- **15 Jam**

MnO_4^- → MnO_2		
A	0,00022 M	
R	0,00003 M	0,00003 M
S	0,00019 M	**0,00003 M**

- **18 Jam**

MnO_4^- → MnO_2		
A	0,00019 M	
R	0,00003 M	0,00003 M
S	0,00016 M	**0,00003 M**

- **21 Jam**

MnO_4^- → MnO_2		
A	0,00016 M	
R	0,00002 M	0,00002 M
S	0,00014 M	**0,00002 M**

2. 0,15 gr

- **1 Jam**

MnO_4^- → MnO_2

A 0,0016 M

R 0,00114 M 0,00114 M

S 0,00046 M **0,00114 M**

- **2 Jam**

MnO_4^- ⟶ MnO_2

A 0,00046 M

R 0,00013 M 0,00013 M

S 0,00033 M **0,00013 M**

Total MnO_4^- yang bereaksi

0,00114 M + 0,00013 M = **0,00127 M.**

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

$$\frac{0{,}0016\ M - 0{,}00127\ M}{0{,}0016\ M} \times 100\ \% = \mathbf{20{,}62\%}$$

3. 0,2 gr

- **1 Jam**

MnO_4^- ⟶ MnO_2

A 0,0016 M

R 0,00130M 0,00130 M

S 0,00030 M **0,00130 M**

Total MnO_4^- yang bereaksi

0,00130 M

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

$$\frac{0{,}0016\ M - 0{,}00130\ M}{0{,}0016\ M} \times 100\ \% = \mathbf{18{,}75\%}$$

4. 0,25 gr

- **1 Jam**

MnO_4^- ⟶ MnO_2

A 0,0016 M

R 0,00121 M 0,00121 M

S 0,00039 M **0,00121 M**

- **2 Jam**

MnO_4^- ⟶ MnO_2

A 0,00039 M

R 0,00003 M 0,00003 M

S 0,00036 M **0,00003 M**

- **3 Jam**

MnO_4^- ⟶ MnO_2

A 0,00036 M

R 0,00009 M 0,00009 M

S 0,00027 M **0,00009 M**

Total MnO_4^- yang bereaksi

0,00122 M + 0,00003 M + 0,00009 = **0,00134 M.**

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

$$\frac{0{,}0016\ M - 0{,}00134\ M}{0{,}0016\ M} \times 100\ \% = \mathbf{16{,}25\%}$$

Lampiran 6. Perhitungan MnO_4^- dalam Larutan dan Kadar MnO_2 Variasi Suhu.

1. **Suhu 75 °C**

- A = ε x B x C (0 menit)

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

$$C = \frac{3{,}472}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00144 M**

- A = ε x B x C (3 menit)

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

$$C = \frac{1{,}740}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00072 M**

- A = ε x B x C (6 menit)

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

$$C = \frac{1{,}101}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00045 M**

- A = ε x B x C (9 menit)

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

$$C = \frac{0{,}767}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00032 M**

2. **Suhu 80 °C**

- A = ε x B x C (0 menit)

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

$$C = \frac{3{,}225}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00134M**

- A = ε x B x C (3 menit)

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

$$C = \frac{2{,}529}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00105 M**

- A = ε x B x C (6 menit)

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

$$C = \frac{1{,}951}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00081 M**

- A = ε x B x C (9 menit)

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

$$C = \frac{1{,}643}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00068 M**

3. **Suhu 85 °C**

- A = ε x B x C (0 menit)

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

$$C = \frac{3{,}544}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00147 M**

- A = ε x B x C (3 menit)

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

$$C = \frac{2{,}791}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00116 M**

- A = ε x B x C (6 menit)

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

$$C = \frac{1{,}732}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00072 M**

4. Suhu 95 °C

- A = ε x B x C (0 menit)

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

$$C = \frac{3{,}657}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00152 M**

- A = ε x B x C (3 menit)

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

$$C = \frac{2{,}721}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,000113 M**

- A = ε x B x C (6 menit)

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

$$C = \frac{1{,}896}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00079 M**

5. Suhu 100 °C

- A = ε x B x C (0 menit)

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

$$C = \frac{3{,}795}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00158 M**

- A = ε x B x C (3 menit)

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

$$C = \frac{2{,}984}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00124 M**

- A = ε x B x C (6 menit)

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

$$C = \frac{1{,}935}{1\ cm.\ 2{,}40 \times 10^3\ ml/mmol.\ cm}$$

C = **0,00080 M**

Suhu (^oC)	Waktu (menit)	Fraksi $[MnO_4^-]$ dalam larutan %
75	0	90
	3	45
	6	28,12
	9	20
80	0	83,75
	3	65,62
	6	50,62
	9	42,5
85	0	91,87
	3	72,5
	6	45
95	0	95
	3	70,62
	6	49,37
100	0	98,75
	3	77,5
	6	50

Kadar MnO_2

1. **Suhu 75 ^oC**

- **0 Menit**

MnO_4^- ⟶ MnO_2

A 0,0016 M

R 0,00016 M 0,00016 M

S 0,00144 M **0,00016 M**

- **3 Menit**

MnO_4^- ⟶ MnO_2

A 0,00144 M

R 0,00072 M 0,00072 M

S 0,00072 M **0,00072 M**

- **6 Menit**

MnO_4^- ⟶ MnO_2

A 0,00072 M

R 0,00027 M 0,00027 M

S 0,00045 M **0,00027 M**

- **9 Menit**

MnO_4^- ⟶ MnO_2

A 0,00045 M

R 0,00013 M 0,00013 M

S 0,00032 M **0,00013 M**

Total MnO_4^- yang bereaksi

0,00016 M + 0,00072 M + 0,00027 M + 0,00013= **0,00128 M.**

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

$$\frac{0{,}0016\ M - 0{,}00128\ M}{0{,}0016\ M} x\ 100\ \% = \mathbf{20\ \%}$$

2. **Suhu 80 °C**

- **0 Menit**

MnO_4^- ⟶ MnO_2

A 0,0016 M

R 0,00026 M 0,00017 M

S 0,00134 M **0,00017 M**

- **3 Menit**

MnO_4^- ⟶ MnO_2

A 0,00134 M

R 0,00029 M 0,00029 M

S 0,00105 M **0,00029 M**

- **6 Menit**

MnO_4^- ⟶ MnO_2

A 0,00105 M

R 0,00024 M 0,00024 M

S 0,00081 M **0,00024 M**

- **9 Menit**

MnO_4^- ⟶ MnO_2

A 0,00081 M

R 0,00013 M 0,00013 M

S 0,00068 M **0,00013 M**

Total MnO_4^- yang bereaksi

0,00026 M + 0,00029 M + 0,00024 M + 0,00013 M = **0,00092 M.**

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

$$\frac{0{,}0016\ M - 0{,}00092\ M}{0{,}0016\ M} x\ 100\ \% = \mathbf{42{,}5\ \%}$$

3. **Suhu 85 °C**

- **0 Menit**

MnO_4^- ⟶ MnO_2

A 0,0016 M

R 0,00013 M 0,00013 M

S 0,00147 M **0,00013 M**

- **3 Menit**

MnO_4^- ⟶ MnO_2

A 0,00147 M

R 0,00031 M 0,00031 M

S 0,00116 M **0,00031 M**

- **6 Menit**

MnO_4^- ⟶ MnO_2

A 0,00116 M

R 0,00044 M 0,00044 M

S 0,00072 M **0,00044 M**

Total MnO_4^- yang bereaksi

0,00013 M + 0,00031 M + 0,00044 M = **0,00088 M.**

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

$$\frac{0{,}0016\ M - 0{,}00088\ M}{0{,}0016\ M} x\ 100\ \% = \mathbf{45\ \%}$$

4. **Suhu 95 °C**

- **0 Menit**

MnO_4^- ⟶ MnO_2

A 0,0016 M

R 0,00008 M 0,00008 M

S 0,00152 M **0,00008 M**

- **3 Menit**

MnO_4^- ⟶ MnO_2

A 0,00152 M

R 0,00039 M 0,00039 M

S 0,00113 M **0,00039 M**

- **6 Menit**

MnO_4^- ⟶ MnO_2

A 0,00113 M

R 0,00034 M 0,00034 M

S 0,00079 M **0,00034 M**

Total MnO_4^- yang bereaksi

0,00008 M + 0,00039 M + 0,00034 M = **0,00081 M.**

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

$$\frac{0{,}0016\text{ M}-0{,}00081\text{ M}}{0{,}0016\text{ M}} \text{x } 100\ \% = \mathbf{49{,}37\ \%}$$

5. **Suhu 100 °C**

- **0 Menit**

MnO_4^- ⟶ MnO_2

A 0,0016 M

R 0,00002 M 0,00002 M

S 0,00158 M **0,00002 M**

- **3 Menit**

MnO_4^- ⟶ MnO_2

A 0,00158 M

R 0,00034 M 0,00034 M

S 0,00124 M **0,00034 M**

- **6 Menit**

MnO_4^- ⟶ MnO_2

A 0,00124 M

R 0,00044 M 0,00044 M

S 0,00080 M **0,00044 M**

Total MnO_4^- yang bereaksi

0,00002 M + 0,00034 M + 0,00044 = **0,00080 M.**

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

$$\frac{0{,}0016\text{ M}-0{,}00080\text{ M}}{0{,}0016\text{ M}} \text{x } 100\ \% = \mathbf{50\ \%}$$

Tabel kadar MnO_2 pada penggunaan variasi pH

Suhu (°C)	**Kadar MnO_2**
75	**20 %**
80	**42,5 %**
85	**45 %**
95	**49,37 %**
100	**50 %**

Lampiran 7. Perhitungan Titrasi Boehm

1. Hasil Analisis dengan Metode Titrasi Boehm

   a. Data Hasil Titrasi Boehm KTK

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	0,0479	10	0,0502	7,8	0,1004	8,09562
2	25	5	0,05	0,0479	10	0,0502	8,0	0,1004	8,59562
3	25	5	0,05	0,0479	10	0,0502	7,8	0,1004	8,09562
Rata-rata									**8,26228**

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

$$n_{carboxylic} = \frac{[5 \text{ mL x } 0{,}05 \text{ N} - (0{,}0479 \text{ N x } 10 \text{ mL} - 0{,}0502 \text{ N x } 7{,}8 \text{ mL})] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1004 \text{ gram}}$$

$$n_{carboxylic} = \frac{[0{,}2500 \text{ meq} - (0{,}4790 \text{ meq} - 0{,}39156 \text{ meq})] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1004 \text{ gram}}$$

$$n_{carboxylic} = \frac{[0{,}2500 \text{ meq} - 0{,}08744 \text{ meq}] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1004 \text{ gram}} = 8{,}09562 \frac{\text{meq}}{\text{gram}}$$

Penentuan Kadar Lakton

No	V, sampel (Vs) (mL)	V, Titran Na_2CO_3 (Vp) (mL)	N, Na_2CO_3	N, HCl	V, HCl (mL)	N, NaOH	V, NaOH (mL)	Massa Karbon (g)	n *Laktone* (meq/g)
1	25	5	0,05	0,0479	10	0,0502	6,4	0,1001	-3,48623
2	25	5	0,05	0,0479	10	0,0502	6,4	0,1001	-3,98623
3	25	5	0,05	0,0479	10	0,0502	6,6	0,1001	-2,98473
Rata-rata									-3,48573

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

$$n_{lactone} = \frac{[5 \text{ mL} \times 0,05 \text{ N} - (0,0479 \text{ N} \times 10 \text{ mL} - 0,0502 \text{ N} \times 6,4 \text{ mL})]\frac{25 \text{ mL}}{5 \text{ mL}}}{0,1001 \text{ gram}} - 8,09562 \frac{\text{meq}}{\text{gram}}$$

$$n_{lactone} = \frac{[0,2500 \text{ meq} - (0,4790 \text{ meq} - 0,32128 \text{ meq})]\frac{25 \text{ mL}}{5 \text{ mL}}}{0,1001 \text{ gram}} - 8,09562 \frac{\text{meq}}{\text{gram}}$$

$$n_{lactone} = \frac{[0,2500 \text{ meq} - 0,15772 \text{ meq}]\frac{25 \text{ mL}}{5 \text{ mL}}}{0,1001 \text{ gram}} - 14,0717 \frac{\text{meq}}{\text{gram}} = -3,48623 \frac{\text{meq}}{\text{gram}}$$

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 *Phenolic* (meq/g)
1	25	5	0,0502	0,0479	10	0,0502	6,5	0,1002	0,2958
2	25	5	0,0502	0,0479	10	0,0502	6,5	0,1002	0,2958
3	25	5	0,0502	0,0479	10	0,0502	6,6	0,1002	0,5463
Rata-rata									**0,3793**

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

$$n_{phenolic} = \frac{[5\text{ mL x }0{,}0502\text{ N} - (0{,}0479\text{ N x }10\text{ mL} - 0{,}0502\text{ N x }6{,}5\text{ mL})]\frac{25\text{ mL}}{5\text{ mL}}}{0{,}1002\text{ gram}} - 8{,}09562\frac{\text{meq}}{\text{gram}} - (-3{,}48623\frac{\text{meq}}{\text{gram}})$$

$$n_{phenolic} = \frac{[0{,}2685\text{ meq} - (0{,}4790\text{ meq} - 0{,}3263\text{ meq})]\frac{25\text{ mL}}{5\text{ mL}}}{0{,}1002\text{ gram}} - 8{,}09562\frac{\text{meq}}{\text{gram}} - (-3{,}48623\frac{\text{meq}}{\text{gram}})$$

$$n_{phenolic} = \frac{[0{,}2685\text{ meq} - 0{,}1527\text{ meq}]\frac{25\text{ mL}}{5\text{ mL}}}{0{,}1002\text{ gram}} - 8{,}09562\frac{\text{meq}}{\text{gram}} - (-3{,}48623\frac{\text{meq}}{\text{gram}}) = 0{,}2958\frac{\text{meq}}{\text{gram}}$$

Penentuan Kadar Basa Total

No	V, sampel (Vs) (mL)	V, Titran HCl (Vp) (mL)	N, HCl	N, NaOH	V, NaOH (mL)	N, HCl	V, HCl (mL)	Massa Karbon (g)	n Basa Total (meq/g)
1	25	5	0,0479	0,0502	10	0,0479	5,7	0,1002	0,52545
2	25	5	0,0479	0,0502	10	0,0479	5,7	0,1002	0,52545
3	25	5	0,0479	0,0502	10	0,0479	5,6	0,1002	0,28643
Rata-rata									0,44578

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

$$n_{basa\ total} = \frac{[5\ \text{mL x } 0{,}0479\ \text{N} - (0{,}0502\ \text{N x } 10\ \text{mL} - 0{,}0479\ \text{N x } 5{,}7\ \text{mL})]\frac{25\ \text{mL}}{5\ \text{mL}}}{0{,}1002\ \text{gram}}$$

$$n_{basa\ total} = \frac{[0{,}2395\ \text{meq} - (0{,}502\ \text{meq} - 0{,}27303\ \text{meq})]\frac{25\ \text{mL}}{5\ \text{mL}}}{0{,}1002\ \text{gram}}$$

$$n_{basa\ total} = \frac{[0{,}2200\ \text{meq} - 0{,}22897\ \text{meq}]\ \frac{25\ \text{mL}}{5\ \text{mL}}}{0{,}1002\ \text{gram}} = 0{,}52545\frac{\text{meq}}{\text{gram}}$$

b. Data Hasil Titrasi Boehm KATK

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	0,0473	10	0,0502	7,3	0,1005	6,8388
2	25	5	0,05	0,0473	10	0,0502	7,4	0,1005	7,0886
3	25	5	0,05	0,0473	10	0,0502	7,3	0,1005	6,8388
Rata-rata									**6,3221**

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

$$n_{carboxylic} = \frac{[5\ mL \times 0{,}05\ N - (0{,}0473\ N \times 10\ mL - 0{,}0502\ N \times 7{,}3\ mL)] \frac{25\ mL}{5\ mL}}{0{,}1005\ gram}$$

$$n_{carboxylic} = \frac{[0{,}2500\ meq - (0{,}4730\ meq - 0{,}36646\ meq)] \frac{25\ mL}{5\ mL}}{0{,}1005\ gram}$$

$$n_{carboxylic} = \frac{[0{,}2500\ meq - 0{,}10654\ meq] \frac{25\ mL}{5\ mL}}{0{,}1004\ gram} = 6{,}8388 \frac{meq}{gram}$$

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 *Laktone* (meq/g)
1	25	5	0,05	0,0473	10	0,0502	6,3	0,1003	-2,483
2	25	5	0,05	0,0473	10	0,0502	6,3	0,1003	-2,733
3	25	5	0,05	0,0473	10	0,0502	6,2	0,1003	-2,733
Rata-rata									-2,656

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

$$n_{lactone} = \frac{[5\ mL\ x\ 0{,}05\ N - (0{,}0473\ N\ x\ 10\ mL\ - 0{,}0502\ N\ \ x\ 6{,}3\ mL)] \frac{25\ mL}{5\ mL}}{0{,}1003\ gram} - 6{,}8388 \frac{meq}{gram}$$

$$n_{lactone} = \frac{[0{,}2500\ meq - (0{,}4730\ meq - 0{,}31626\ meq)] \frac{25\ mL}{5\ mL}}{0{,}1003\ gram} - 6{,}8388 \frac{meq}{gram}$$

$$n_{lactone} = \frac{[0{,}2500\ meq - 0{,}15674\ meq] \frac{25\ mL}{5\ mL}}{0{,}1003\ gram} - 6{,}8388 \frac{meq}{gram} = -\ 2{,}483 \frac{meq}{gram}$$

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	0,0502	0,0473	10	0,0467	6,4	0,1002	-0,813
2	25	5	0,0502	0,0473	10	0,0467	6,4	0,1002	-0,813
3	25	5	0,0502	0,0473	10	0,0467	6,4	0,1002	-0,813
Rata-rata									-0,813

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

$$n_{phenolic} = \frac{[5\ mL\ x\ 0{,}0502\ N - (0{,}0473\ N\ x\ 10\ mL\ - 0{,}0502\ N\ \ x\ 6{,}4\ mL)]\frac{25\ mL}{5\ mL}}{0{,}1002\ gram} - 6{,}8388\frac{meq}{gram} - (-2{,}483\ \frac{meq}{gram})$$

$$n_{phenolic} = \frac{[0{,}2685\ meq - (0{,}4730\ meq - 0{,}32128\ meq)]\frac{25\ mL}{5\ mL}}{0{,}1002\ gram} - 6{,}8388\frac{meq}{gram} - (\ -2{,}483\ \frac{meq}{gram})$$

$$n_{phenolic} = \frac{[0{,}2685\ meq - 0{,}15172\ meq]\ \frac{25\ mL}{5\ mL}}{0{,}1002\ gram} - 6{,}8388\frac{meq}{gram} - (\ -2{,}483\ \frac{meq}{gram}) = -0{,}813\ \frac{meq}{gram}$$

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	0,0473	0,0502	10	0,0473	5,9	0,1005	1,0005
2	25	5	0,0473	0,0502	10	0,0473	6,1	0,1005	1,4771
3	25	5	0,0473	0,0502	10	0,0473	6,1	0,1005	1,4771
Rata-rata									1,3182

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

$$n_{basa\ total} = \frac{[5\text{ mL x } 0{,}0473\text{ N} - (0{,}0502\text{ N x } 10\text{ mL} - 0{,}0473\text{ N x } 5{,}9\text{ mL})]\frac{25\text{ mL}}{5\text{ mL}}}{0{,}1005\text{ gram}}$$

$$n_{basa\ total} = \frac{[0{,}2365\text{ meq} - (0{,}502\text{ meq} - 0{,}27907\text{ meq})]\frac{25\text{ mL}}{5\text{ mL}}}{0{,}1005\text{ gram}}$$

$$n_{basa\ total} = \frac{[0{,}2365\text{ meq} - 0{,}22293\text{ meq}]\frac{25\text{ mL}}{5\text{ mL}}}{0{,}1005\text{ gram}} = 1{,}0005\frac{\text{meq}}{\text{gram}}$$

c. Data Hasil Titrasi Boehm AC/MnO_2

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	0,0479	10	0,0467	8,5	0,1005	7,310945
2	25	5	0,05	0,0479	10	0,0467	8,2	0,1005	6,61393
3	25	5	0,05	0,0479	10	0,0467	8,2	0,1005	6,61393
Rata-rata									**6,846269**

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

$$n_{carboxylic} = \frac{\left[5\text{ mL x } 0{,}05\text{ N} - (0{,}05\text{ N x } 10\text{ mL } - 0{,}0467\text{ N x } 8{,}5\text{ mL})\right] \frac{25\text{ mL}}{5\text{ mL}}}{0{,}1005\text{ gram}}$$

$$n_{carboxylic} = \frac{\left[0{,}2500\text{ meq} - (0{,}5\text{ meq} - 0{,}39695\text{ meq})\right] \frac{25\text{ mL}}{5\text{ mL}}}{0{,}1005\text{gram}}$$

$$n_{carboxylic} = \frac{\left[0{,}2500\text{ meq} - 0{,}10305\text{ meq}\right] \frac{25\text{ mL}}{5\text{ mL}}}{0{,}1005\text{ gram}} = 7{,}310945\ \frac{\text{meq}}{\text{gram}}$$

Penentuan Kadar Lakton

No	V, sampel (Vs) (mL)	V, Titran Na_2CO_3 (Vp) (mL)	N, Na_2CO_3	N, HCl	V, HCl (mL)	N, NaOH	V, NaOH (mL)	Massa Karbon (g)	n *Laktone* (meq/g)
1	25	5	0,05	0,0479	10	0,0467	8,1	0,1003	-0,91663
2	25	5	0,05	0,0479	10	0,0467	8,3	0,1003	-0,24599
3	25	5	0,05	0,0479	10	0,0467	7,9	0,1003	-0,68522
Rata-rata									**-0,45195**

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

$$n_{lactone} = \frac{[5 \text{ mL x } 0{,}05 \text{ N} - (0{,}05 \text{ N x } 10 \text{ mL } - 0{,}0467 \text{ N x } 8{,}1 \text{ mL})] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1003 \text{ gram}} - 7{,}310945 \frac{\text{meq}}{\text{gram}}$$

$$n_{lactone} = \frac{[0{,}2500 \text{ meq} - (0{,}5 \text{ meq} - 0{,}37827 \text{ meq})] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1003 \text{ gram}} - 7{,}310945 \frac{\text{meq}}{\text{gram}}$$

$$n_{lactone} = \frac{[0{,}2500 \text{ meq} - 0{,}12173 \text{ meq}] \frac{25 \text{ mL}}{5 \text{ mL}}}{0{,}1003 \text{ gram}} - 7{,}310945 \frac{\text{meq}}{\text{gram}} = -0{,}91663 \frac{\text{meq}}{\text{gram}}$$

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 *Phenolic* (meq/g)
1	25	5	0,0502	0,0479	10	0,0467	6,2	0,1002	-4,37136
2	25	5	0,0502	0,0479	10	0,0467	6,0	0,1002	-4,83743
3	25	5	0,0502	0,0479	10	0,0467	6,1	0,1002	-5,07
Rata-rata									**-4,7596**

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

$$n_{phenolic} = \frac{[5\ mL\ x\ 0{,}0502\ N - (0{,}05\ N\ x\ 10\ mL\ - 0{,}0467\ N\ \ x\ 6{,}2\ mL)]\frac{25\ mL}{5\ mL}}{0{,}1002gram}\ 7{,}310945\frac{meq}{gram} - (-0{,}91663\frac{meq}{gram})$$

$$n_{phenolic} = \frac{[0{,}2685\ meq - (0{,}5\ meq - 0{,}28954\ meq)]\frac{25\ mL}{5\ mL}}{0{,}1002\ gram} - 7{,}310945\frac{meq}{gram} - (-0{,}91663\frac{meq}{gram})$$

$$n_{phenolic} = \frac{[0{,}2685\ meq - 0{,}21046\ meq]\ \frac{25\ mL}{5\ mL}}{0{,}1002\ gram} - 7{,}310945\frac{meq}{gram} - (-0{,}91663\frac{meq}{gram}) = -4{,}37136\frac{meq}{gram}$$

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	0,0479	0,0467	10	0,0479	6,2	0,1005	4,104478
2	25	5	0,0479	0,0467	10	0,0479	5,8	0,1005	3,109453
3	25	5	0,0479	0,0467	10	0,0479	6,0	0,1005	3,606965
Rata-rata									**3,606965**

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

$$n_{basa\ total} = \frac{[5\ mL\ x\ 0{,}0479\ N - (0{,}0467\ N\ x\ 10\ mL\ - 0{,}0479\ N\ \ x\ 6{,}2\ mL)]\frac{25\ mL}{5\ mL}}{0{,}1005\ gram}$$

$$n_{basa\ total} = \frac{[0{,}2395\ meq - (0{,}467\ meq - 0{,}29698\ meq)]\frac{25\ mL}{5\ mL}}{0{,}1005\ gram}$$

$$n_{basa\ total} = \frac{[0{,}2200\ meq - 0{,}17002\ meq]\ \frac{25\ mL}{5\ mL}}{0{,}1005\ gram} = 4{,}104478\frac{meq}{gram}$$

Lampiran 8. Tabel Panjang Gelombang dan Adsorbansi Pengukuran dengan Spektrofotometer UV-Vis.

1. Pengaruh Variasi Massa Karbon

0,05 gr – 0,0016 M (1 jam-selesai)

Pengukuran ke-	**Panjang Gelombang**	**Absorbansi**
1	545 525 310 205	2,236 2,528 2,045 3,232
2	545 525 310 205	2,008 2,278 1,824 3,087
3	545 525 310 205	1,829 2,032 1,656 2,880
4	545 525 310	1,590 1,728 1,528
5	545 525 310	1,458 1,562 1,411
6	545 525 310	1,293 1,378 1,293
7	545 525 310	1,118 1,189 1,158
8	545 525 310	0,563 0,606 0,761
9	545 525 310	0,501 0,540 0,718
10	545 525 310	0,430 0,465 0,665
11	545 525 310	0,364 0,397 0,619

12	545 525 320	0,315 0,345 0,584
13	**325**	**0,518**
14	345	0,418

0,1 gr – 0,0016 M (1 jam-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	545 525 310	1,908 2,038 1,840
2	545 525 310	1,686 1,776 1,777
3	545 525 310	1,043 1,107 1,246
4	545 525 310	0,806 0,854 1,089
5	**365**	**0,874**
6	365	0,852
7	365	0,779
8	365	0,654
9	365	0,564
10	365	0,392
11	675 365	0,091 0,253
12	675 365	0,118 0,201
13	365	0,136
14	480 370	0,077 0,086

0,15 gr – 0,0016 M (1 jam-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	545 525 310	1,356 1,107 1,611
2	545	1,046

	525 365 320	0,807 1,396 1,435
3	**355**	**0,662**
4	365	0,169
5	675 495 450 370	0,042 0,041 0,042 0,048
6	675 420	0,066 0,065
7	675 365	0,071 0,073
8	675 365	0,068 0,072
9	370	0,157
10	480 460 450 360	0,044 0,044 0,044 0,049

0,2 gr – 0,0016 M (1 jam-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	545 525 365 320	1,138 0,725 1,519 1,545
2	**365**	**0,097**
3	370	0,070
4	370	0,071
5	370	0,065
6	370	0,047
7	675 665 450 370	0,039 0,039 0,040 0,045
8	675 420	0,069 0,068
9	675 665 365	0,045 0,044 0,049
10	657 665	0,059 0,058

	510 445 365	0,058 0,060 0,066
11	675 445 420	0,060 0,058 0,059
12	450 370	0,035 0,040
13	680 465 450 360	0,037 0,036 0,037 0,042
14	450 420 360	0,035 0,032 0,031

0,25 gr – 0,0016 M (1 jam-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	545 525 310	0,747 0,927 1,048,
2	370 340	1,462 1,446
3	530 370	0,873 1,166
4	675 510 370	0,969 0,667 0,894
5	675 400	0,024 0,023
6	**375**	**0,045**
7	370	0,043
8	365	0,040
9	365	0,044
10	365	0,375
11	675 365	0,054 0,057
12	675 365	0,043 0,047
13	675 365	0,083 0,088
14	675 420 365	0,060 0,059 0,063

15	480 460 450 365	0,034 0,034 0,035 0,040
16	540 480 460 450 365	0,037 0,037 0,037 0,037 0,037 0,043

Nilai Optimum setiap Variasi Massa

Variasi Massa	Panjang Gelombang	Absorbansi
0,05 gr	325	0,518
0,1 gr	365	0,874
0,15 gr	355	0,662
0,2 gr	365	0,097
0,25 gr	375	0,045

2. Pengaruh Variasi Suhu

0,1 gr – 75 ^{o}C (0 menit-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	550 525 365 310 210	2,649 3.472 1,531 2,075 3,258
2	545 525 310	1,610 1.740 1,462
3	545 525 310	1,045 1.101 1,152
4	545 525 310	0,733 0.767 0,987
5	**370**	**1,017**
6	675 365 340	0,484 0,898 0,889
7	675	0,443

	365 335	0,857 0,848

0,1 gr – 80 °C (0 menit-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	545 525 310 205	2,510 3.225 2,143 3,294
2	545 525 310 205	2,206 2.529 1,836 3,114
3	545 525 310	1,815 1.951 1,650
4	545 525 310	1,565 1.643 1,563
5	**365**	**1,053**
6	365 345	0,869 0,866
7	365 345	0,786 0,785

0,1 gr – 85 °C (0 menit-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	545 525 365 310 210	2,731 3.544 1,703 2,116 3,277
2	545 525 310 205	2,133 2.791 1,836 3,220
3	545 525 310	1,416 1.732 1,418
4	**370**	**1,104**
5	365 335	0,999 0,993

6	675 365 335	0,191 0,685 0,690
7	675 365 340	0,155 0,666 0,673

0,1 gr – 95 °C (0 menit-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	545 525 310 210	2,594 3,657 2,161 3,253
2	545 525 310	1,789 2,721 1,583
3	545 525 310	1,032 1,896 1,140
4	**370**	**1,165**
5	370 335	1,103 1,092
6	365 345	1,072 1,059
7	365 340	0,999 0,992

0,1 gr – 100 °C (0 menit-selesai)

Pengukuran ke-	Panjang Gelombang	Absorbansi
1	550 525 365 310 210	2,649 3.795 1,610 2,084 3,267
2	545 525 310	0,890 2,984 1,103
3	545 525 365 310	0,525 1,935 0,856 0,911
4	**370**	**1,193**

5	370 335	1,155 1,131
6	365 335	1,067 1,054
7	675 365 345	0,514 1,027 1,019

Nilai Optimum setiap Variasi Suhu

Variasi Massa	Panjang Gelombang	Absorbansi
75 ^oC	370	1,017
80 ^oC	365	1,053
85 ^oC	370	1,104
95 ^oC	370	1,165
100 ^oC	370	1,193

Lampiran 9. Karakterisasi dengan FTIR

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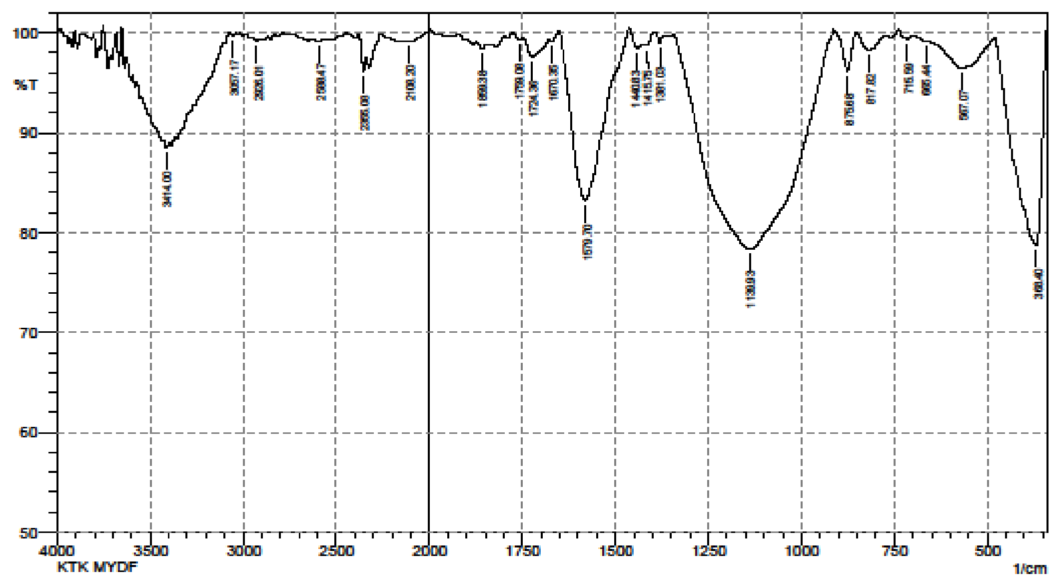

No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	368.4	78.767	20.647	478.35	343.33	8.392	8.074
2	567.07	96.526	2.803	661.58	480.28	1.76	1.225
3	665.44	99.158	0.053	698.23	661.58	0.098	0.004
4	715.59	99.398	0.591	736.81	698.23	0.069	0.073
5	817.82	98.279	1.618	852.54	773.46	0.348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

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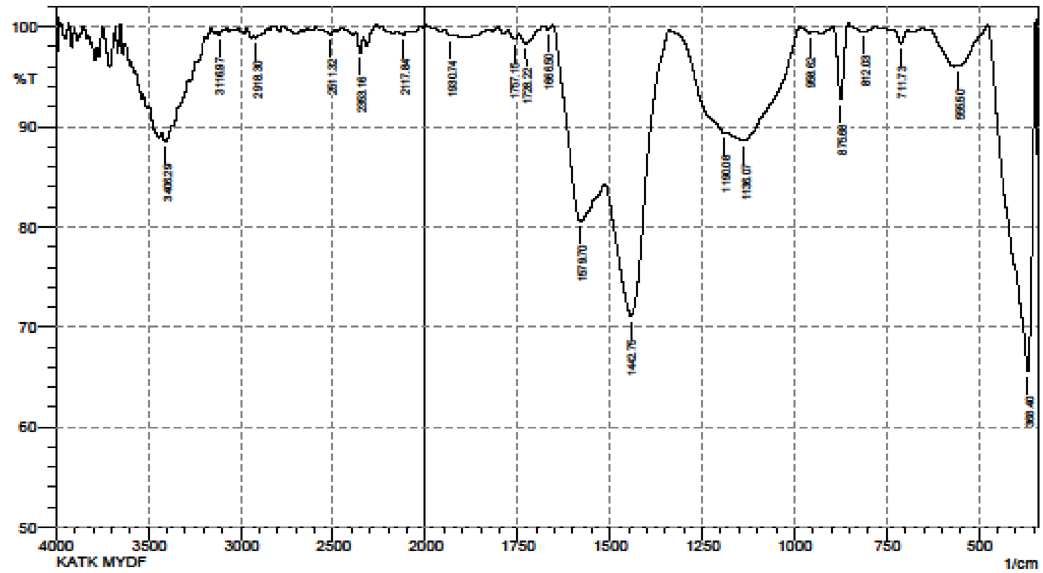

No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	368.4	65.5268	34.7356	476.42	347.19	11.9433	12.0639
2	555.5	96.0821	0.201	559.36	478.35	0.7647	0.0902
3	711.73	98.2875	1.4051	731.02	692.44	0.1558	0.1042
4	812.03	99.5009	0.6523	854.47	783.1	0.0678	0.1264
5	875.68	92.6958	7.5064	894.97	854.47	0.5715	0.6085
6	958.62	99.3796	0.3151	979.84	945.12	0.067	0.0269
7	1136.07	88.6307	3.4474	1186.22	985.62	7.223	2.4184
8	1190.08	89.4243	0.1342	1340.53	1188.15	3.78	-0.0306
9	1442.75	71.0675	19.4951	1514.12	1340.53	14.4034	7.8678
10	1579.7	80.5274	4.9061	1653	1560.41	5.3632	1.2081
11	1666.5	99.6824	0.4355	1680	1654.92	0.0069	0.0196
12	1728.22	98.2346	1.1533	1745.58	1695.43	0.2577	0.1366
13	1757.15	98.7495	0.6889	1774.51	1745.58	0.1153	0.0502
14	1930.74	99.0544	0.3196	1948.1	1919.17	0.0953	0.0227
15	2117.84	99.193	0.2042	2129.41	2092.77	0.1049	0.0158
16	2353.16	97.357	1.8344	2376.3	2335.8	0.2856	0.1502
17	2511.32	99.1564	0.5371	2555.68	2490.1	0.1592	0.0772
18	2918.3	98.8249	0.3619	2931.8	2899.01	0.1364	0.0207
19	3116.97	99.1702	0.4314	3134.33	3099.61	0.0919	0.0317
20	3406.29	88.5369	1.1596	3429.43	3373.5	2.7968	0.1783

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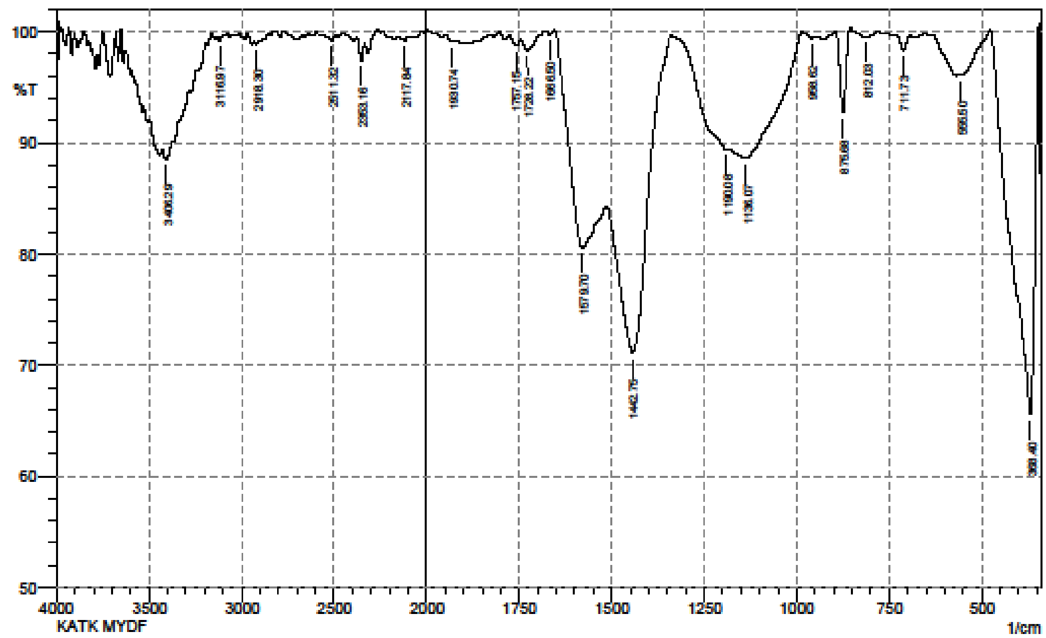

No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	368.4	65.5288	34.7356	476.42	347.19	11.9433	12.0639
2	555.5	96.0821	0.201	559.36	478.35	0.7647	0.0902
3	711.73	98.2875	1.4051	731.02	692.44	0.1558	0.1042
4	812.03	99.5009	0.6523	854.47	783.1	0.0678	0.1264
5	875.68	92.6958	7.5064	894.97	854.47	0.5715	0.6085
6	958.62	99.3796	0.3151	979.84	945.12	0.067	0.0269
7	1136.07	88.6307	3.4474	1186.22	985.62	7.223	2.4184
8	1190.08	89.4243	0.1342	1340.53	1188.15	3.78	-0.0306
9	1442.75	71.0675	19.4951	1514.12	1340.53	14.4034	7.8678
10	1579.7	80.5274	4.9061	1653	1560.41	5.3632	1.2081
11	1666.5	99.6824	0.4355	1680	1654.92	0.0069	0.0196
12	1728.22	98.2346	1.1533	1745.58	1695.43	0.2577	0.1366
13	1757.15	98.7495	0.6889	1774.51	1745.58	0.1153	0.0502
14	1930.74	99.0544	0.3196	1948.1	1919.17	0.0953	0.0227
15	2117.84	99.193	0.2042	2129.41	2092.77	0.1049	0.0158
16	2353.16	97.357	1.8344	2376.3	2335.8	0.2856	0.1502
17	2511.32	99.1564	0.5371	2555.68	2490.1	0.1592	0.0772
18	2918.3	98.8249	0.3619	2931.8	2899.01	0.1364	0.0207
19	3116.97	99.1702	0.4314	3134.33	3099.61	0.0919	0.0317
20	3406.29	88.5369	1.1596	3429.43	3373.5	2.7968	0.1783

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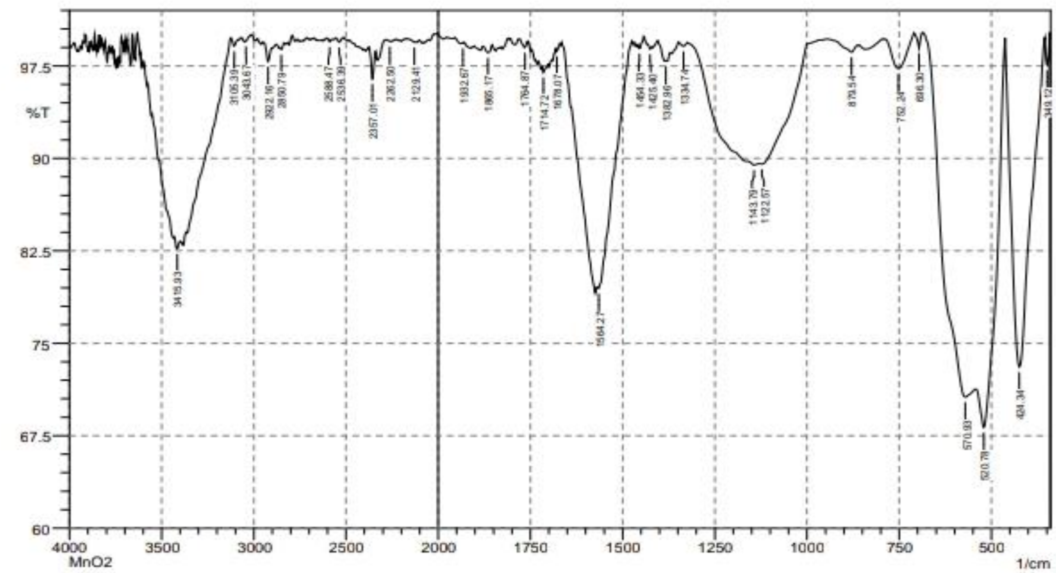


No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	349.12	97.5746	2.4197	354.9	341.4	0.0895	0.0908
2	424.34	73.0876	26.6327	462.92	356.83	7.5228	7.384
3	520.78	68.1754	10.6856	542	464.84	8.9124	3.186
4	570.93	70.6386	6.183	684.73	543.93	13.3998	3.1642
5	696.3	98.9555	1.2414	709.8	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

Date/Time; 10/24/2022 10:43:09 AM
No. of Scans;
Resolution;
Apodization;

Lampiran 10. Karakterisasi dengan XRD

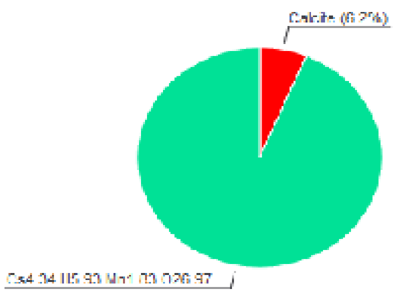
Match! Phase Analysis Report

Sample: KATK DEFA

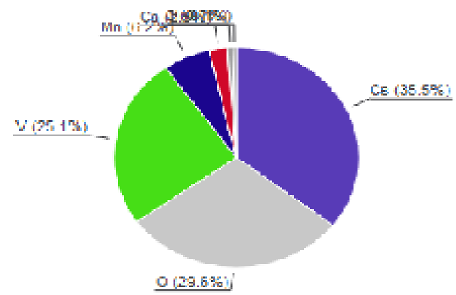
Sample Data	
File name	KATK DEFA.rd
File path	E:/uh
Data collected	Agu 11, 2022 13:34:01
Data range	10.000° - 90.000°
Original data range	10.000° - 90.000°
Number of points	4001
Step size	0.020
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	Yes
Data smoothed	No
Radiation	X-rays
Wavelength	1.541874 Å

Analysis Results

Phase composition



Elemental composition



Index	*Amount (%)*	*Name*	*Formula sum*
A	6.2	Calcite	C Ca O3
B	93.8		Cs4.34 H5.93 Mn1.83 O26.97 V8
	35.3	*Unidentified peak area*	

Amounts calculated by RIR (Reference Intensity Ratio) method

Element	*Amount (weight %)*
Cs	35.5%
O	*29.6%(*)*
V	25.1%
Mn	6.2%
Ca	2.5%
C	*0.7%(*)*
H	*0.4%(*)*
**LE (sum)*	*30.7%*

Details of identified phases

A: Calcite (6.2 %)[*]	
Formula sum	C Ca O3
Entry number	96-901-5391
Figure-of-Merit (FoM)	0.631713[*]
Total number of peaks	182
Peaks in range	182
Peaks matched	10
Intensity scale factor	0.01[*]
Space group	R -3 c
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 4.9903 Å c= 17.0687 Å
I/Ic	3.10
Calc. density	2.709 g/cm³
Reference	Sitepu H., "Texture and structural refinement using neutron diffraction data frommolybdite (MoO3) and calcite (CaCO3) powders and a Ni-rich Ni50.7Ti49.30 alloyNote: March model", Powder Diffraction **24**, 315-326 (2009)