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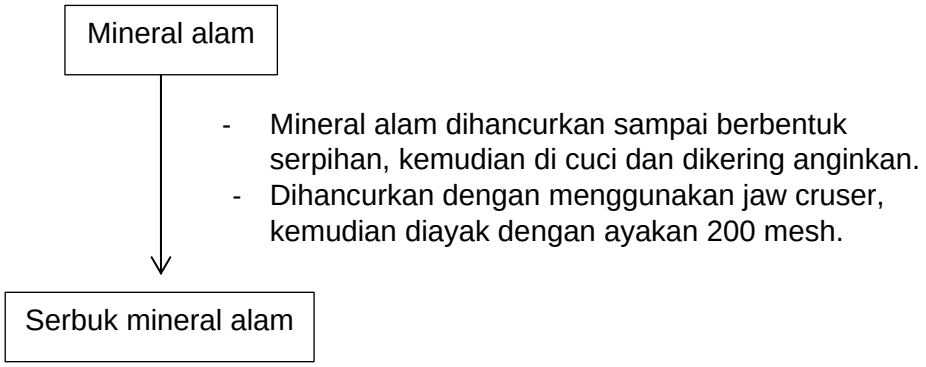
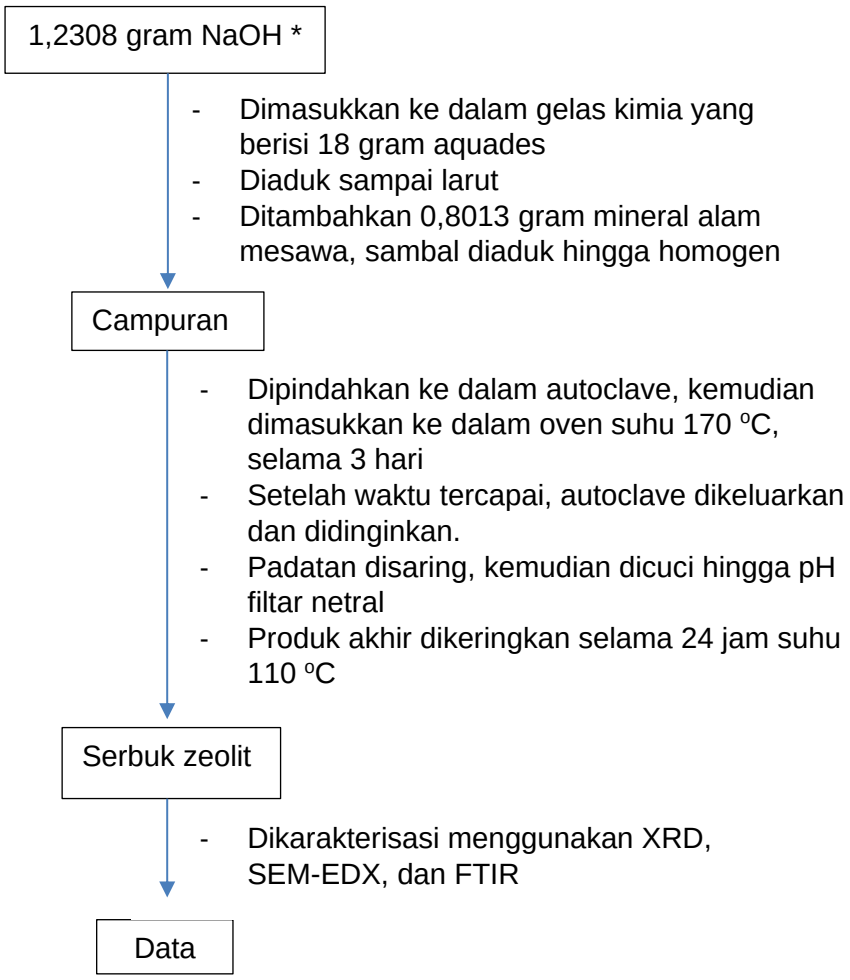
Lampiran 1. Preparasi Mineral alam

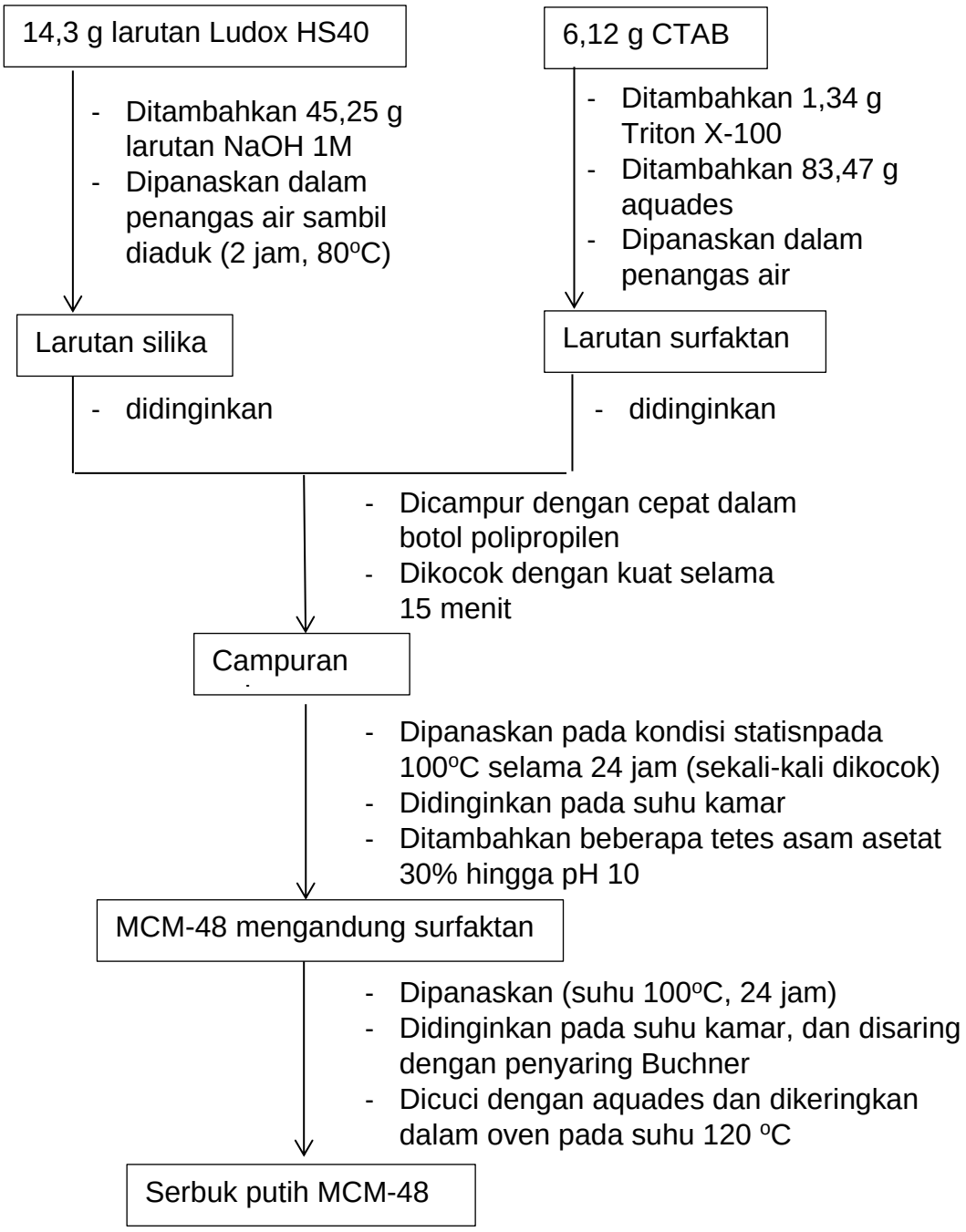


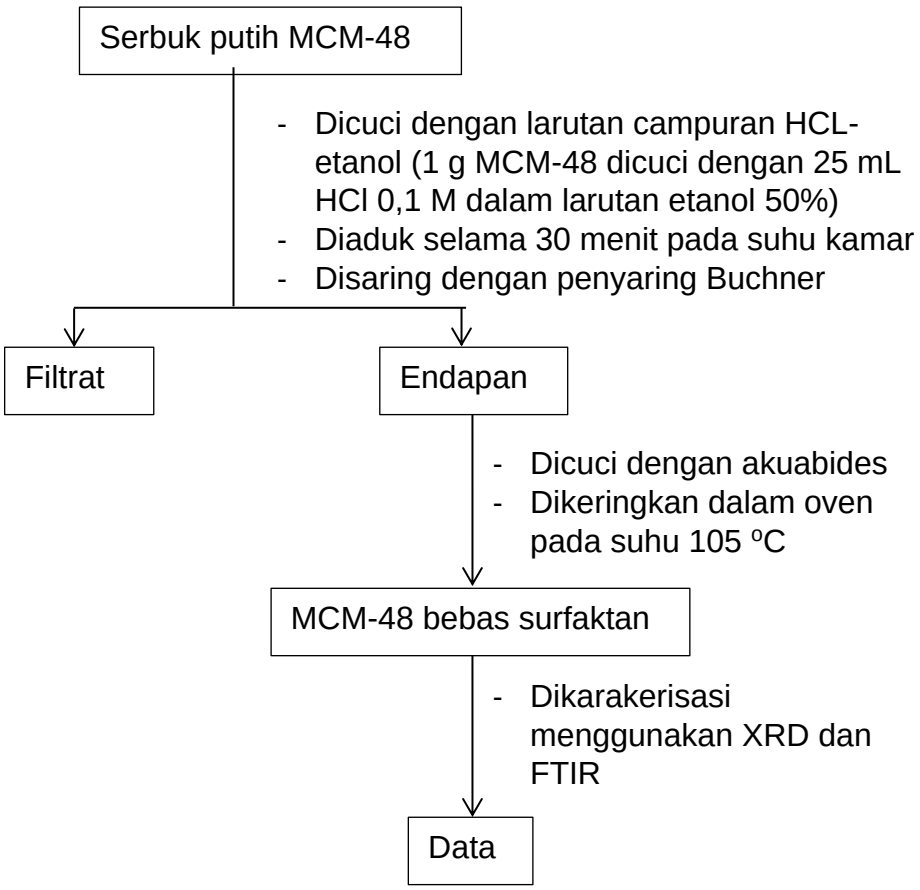
Lampiran. Skema Rekristalisasi



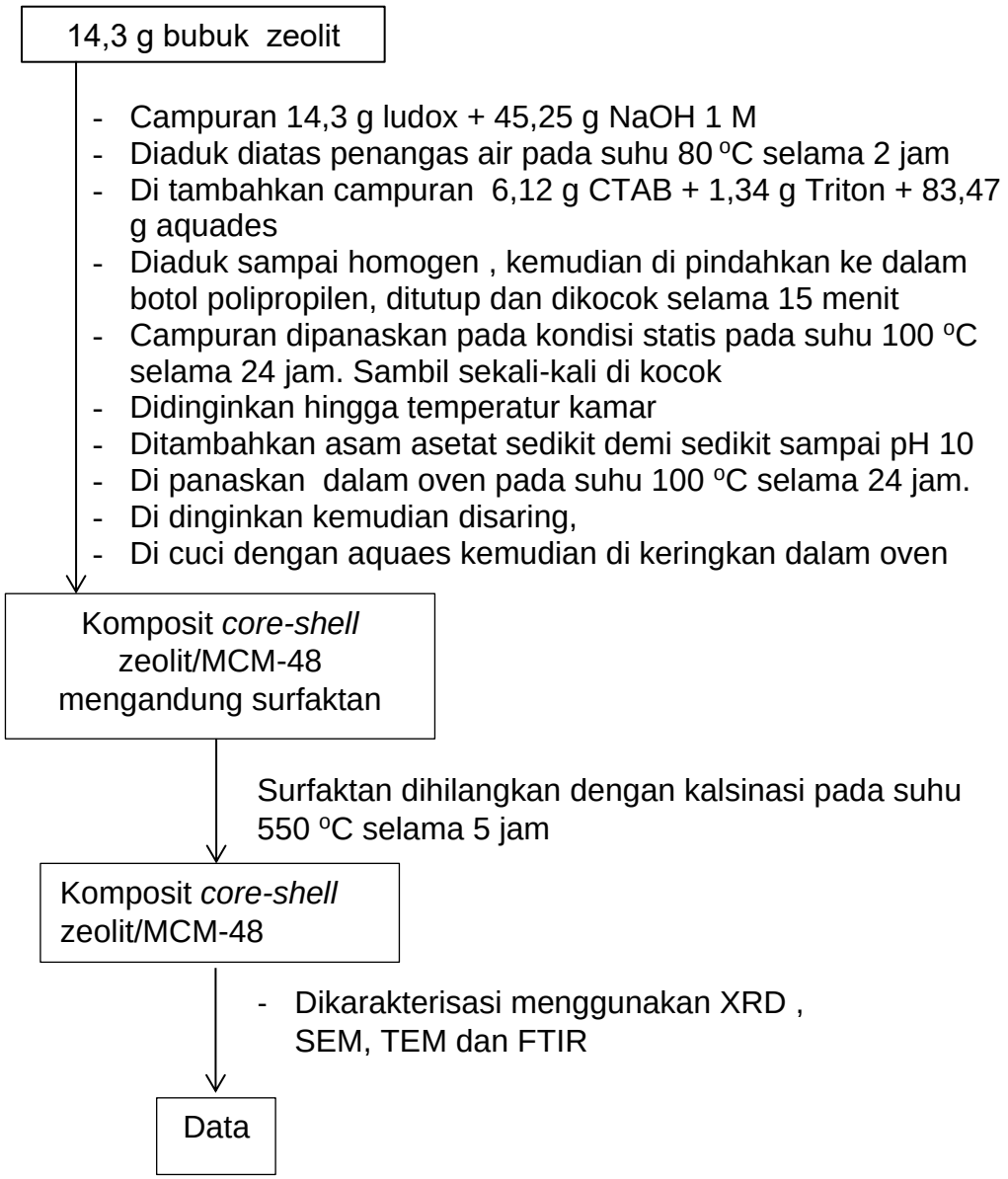
Catatan : * variasi selanjutnya untuk 2,1509 gram (F2) dan 3,2402 gram (F3) NaOH

Lampiran 2. Skema sintesis silika mesopori MCM-48

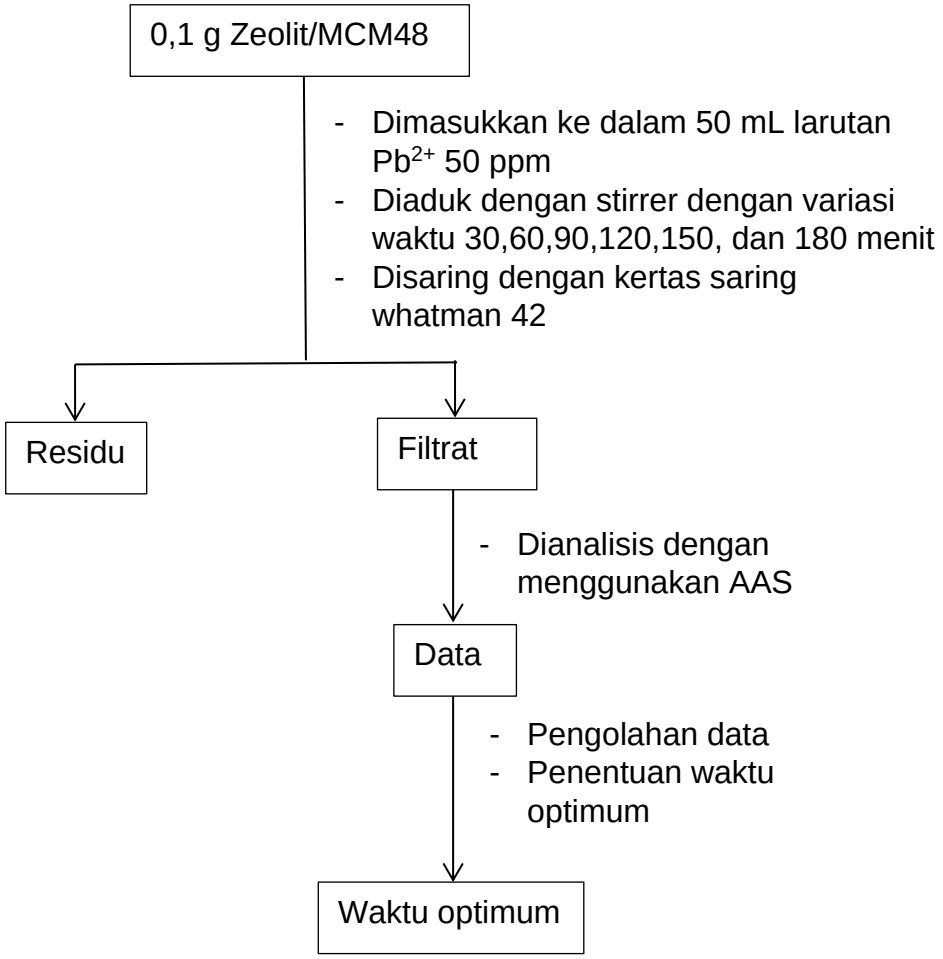



Serbuk putih MCM-48
- Dicuci dengan larutan campuran HCL-etanol (1 g MCM-48 dicuci dengan 25 mL HCl 0,1 M dalam larutan etanol 50%)
- Diaduk selama 30 menit pada suhu kamar
- Disaring dengan penyaring Buchner
Filtrat
Endapan
- Dicuci dengan akuabides
- Dikeringkan dalam oven pada suhu 105 oC
MCM-48 bebas surfaktan
- Dikarakerisasi menggunakan XRD dan FTIR
Data

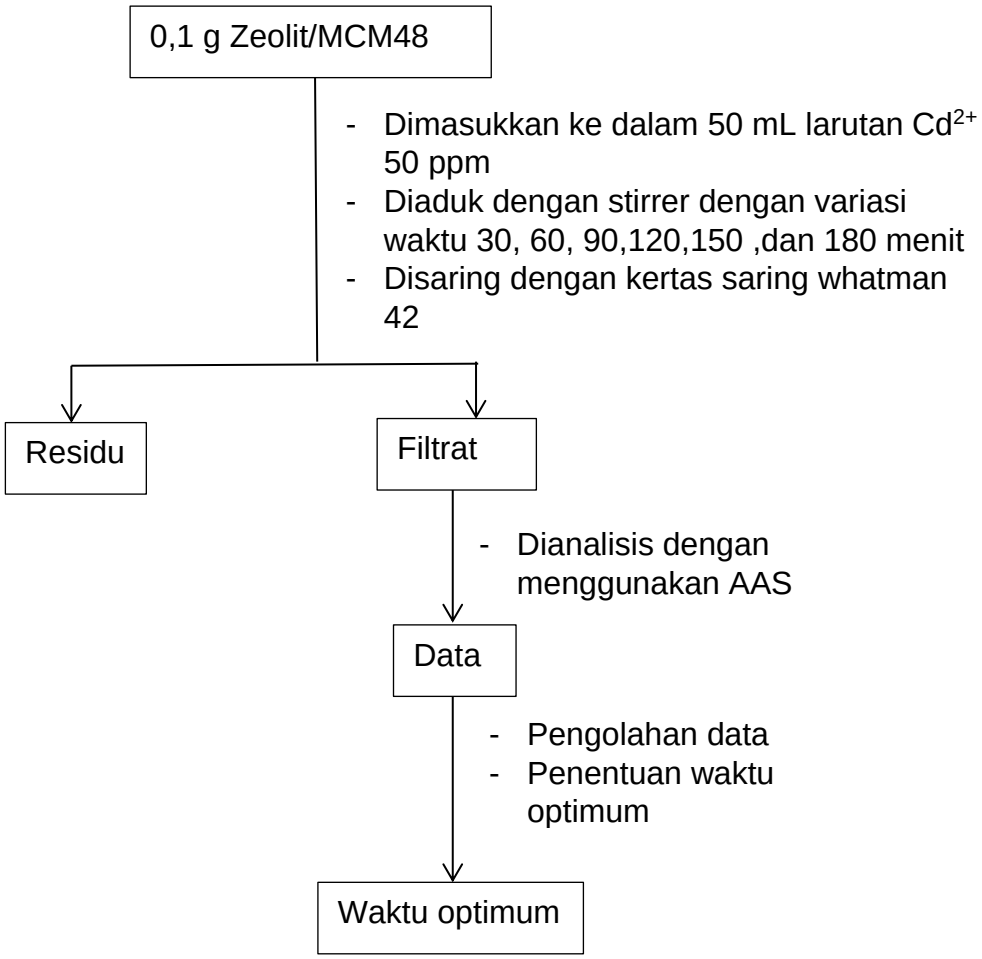
Lampiran 3. Sintesis komposit *core-shell* zeolit/MCM-48



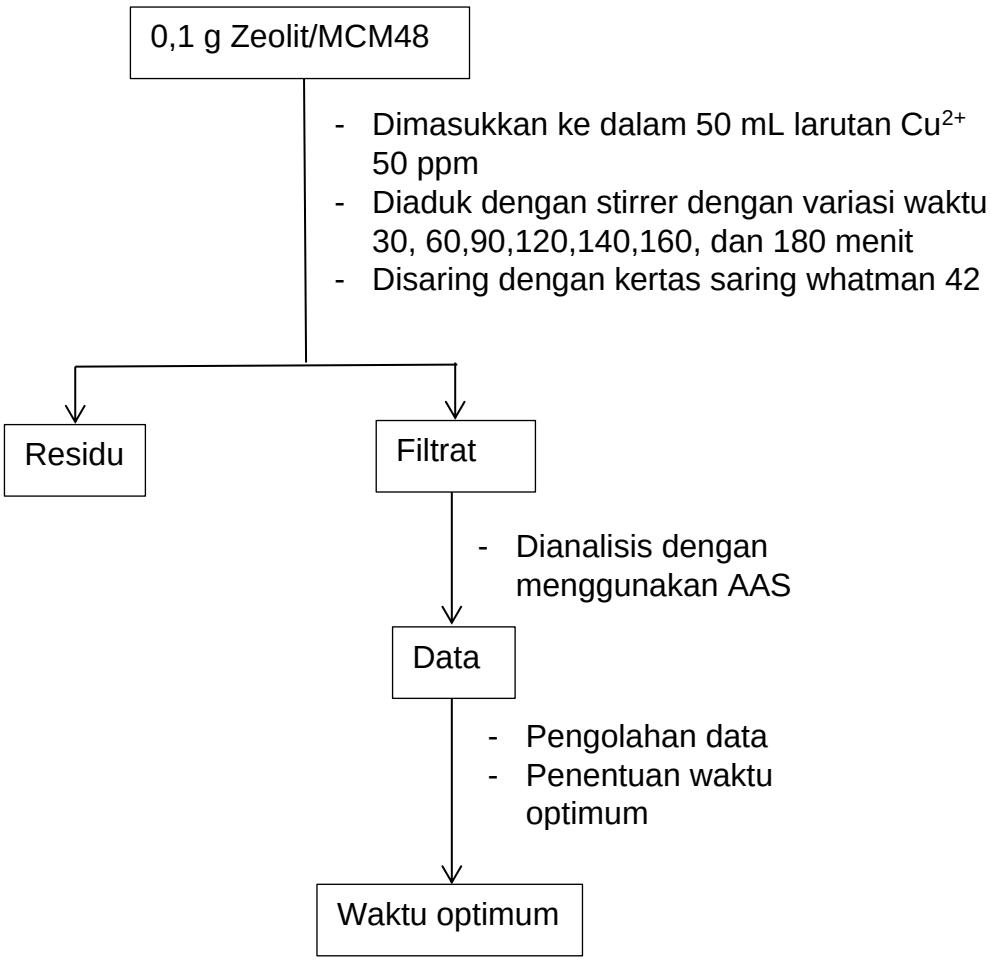
Lampiran 4. Skema Penentuan Waktu Optimum Adsorpsi Ion Pb^{2+}



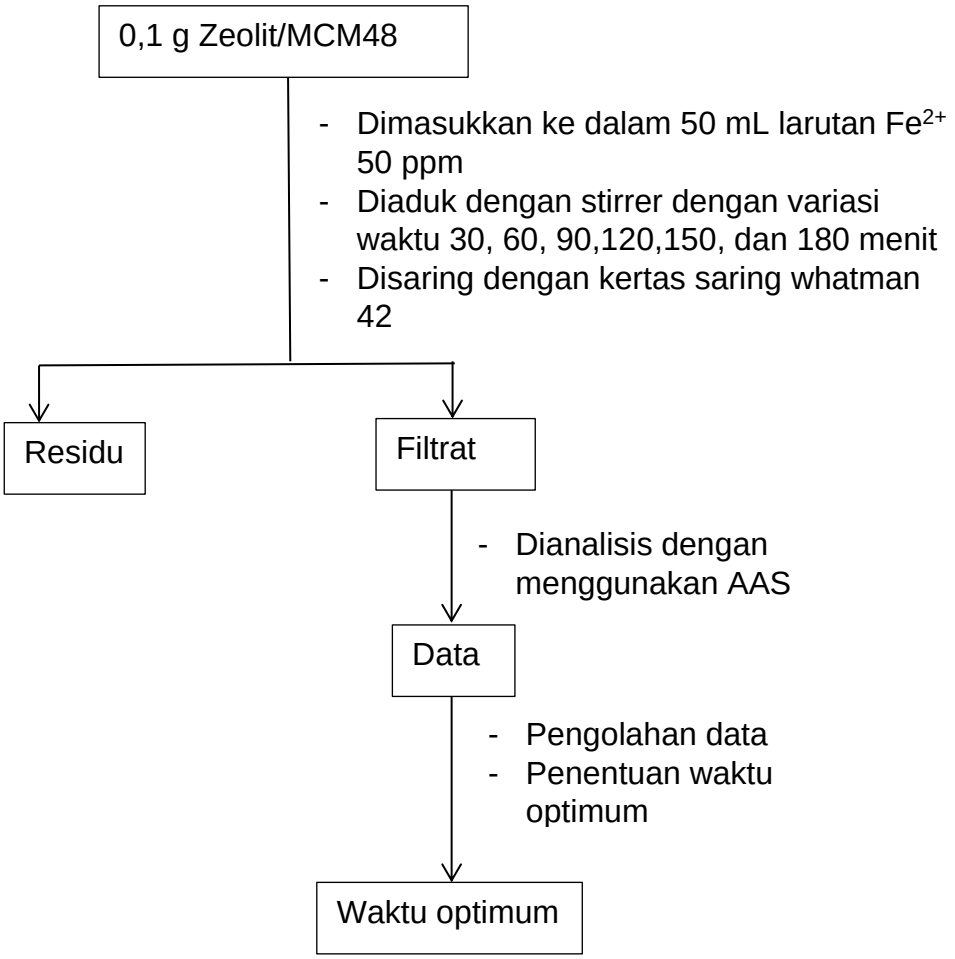
Lampiran 5. Skema Penentuan Waktu Optimum Adsorpsi Ion Cd^{2+}



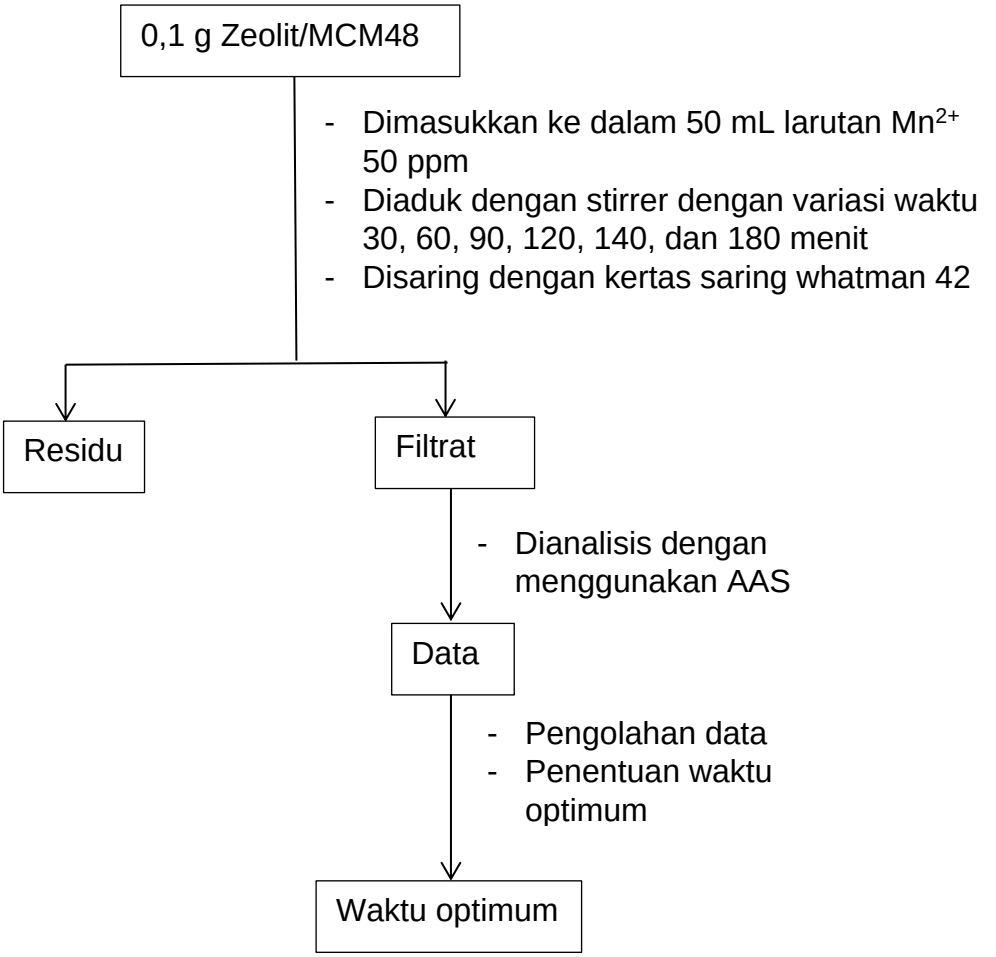
Lampiran 6. Skema Penentuan Waktu Optimum Adsorpsi Ion Cu^{2+}



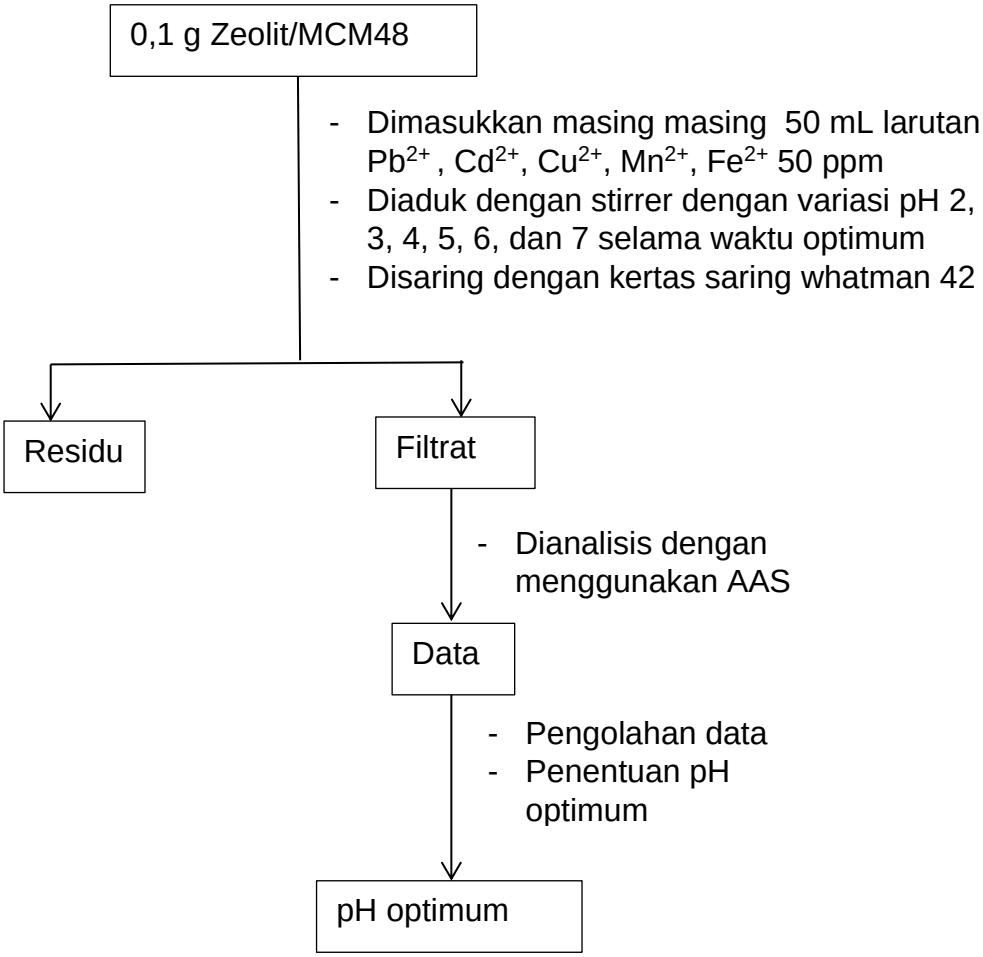
Lampiran 7. Skema Penentuan Waktu Optimum Adsorpsi Ion Fe^{2+}



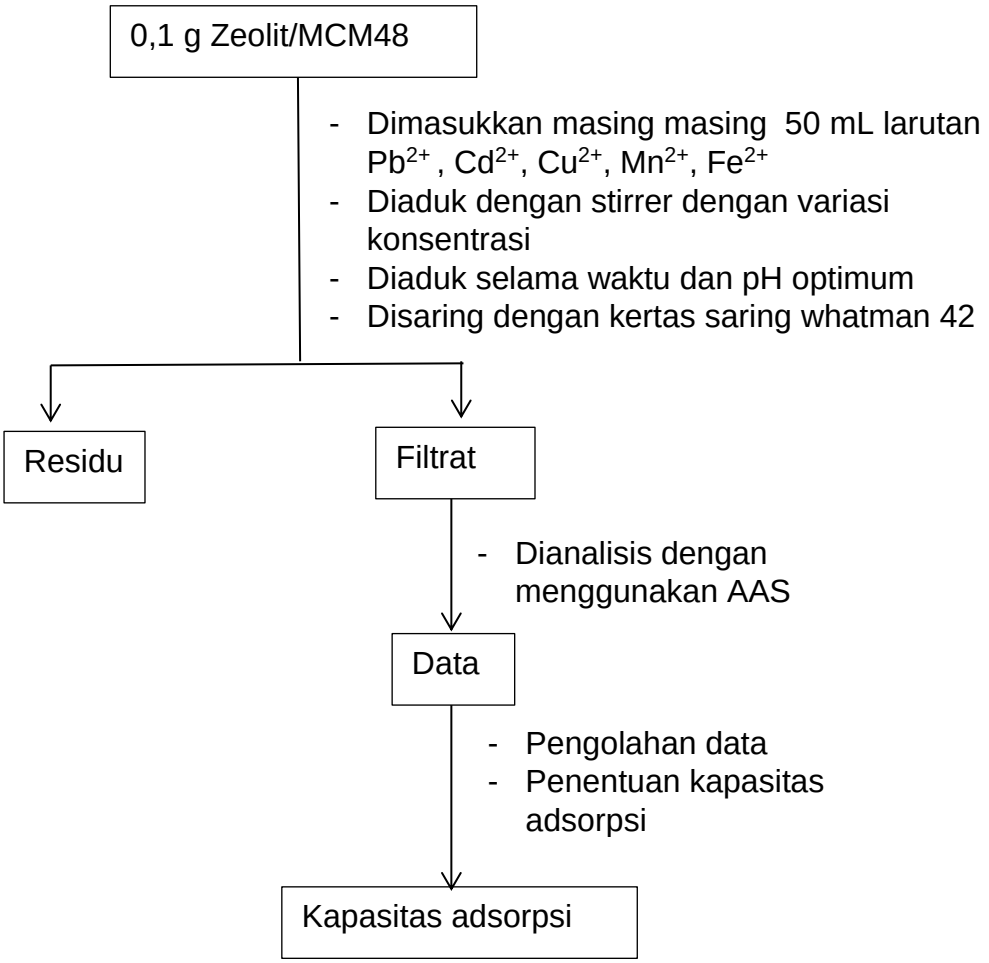
Lampiran 8. Skema Penentuan Waktu Optimum Adsorpsi Ion Mn^{2+}



Lampiran 9. Skema Penentuan pH Optimum Adsorpsi

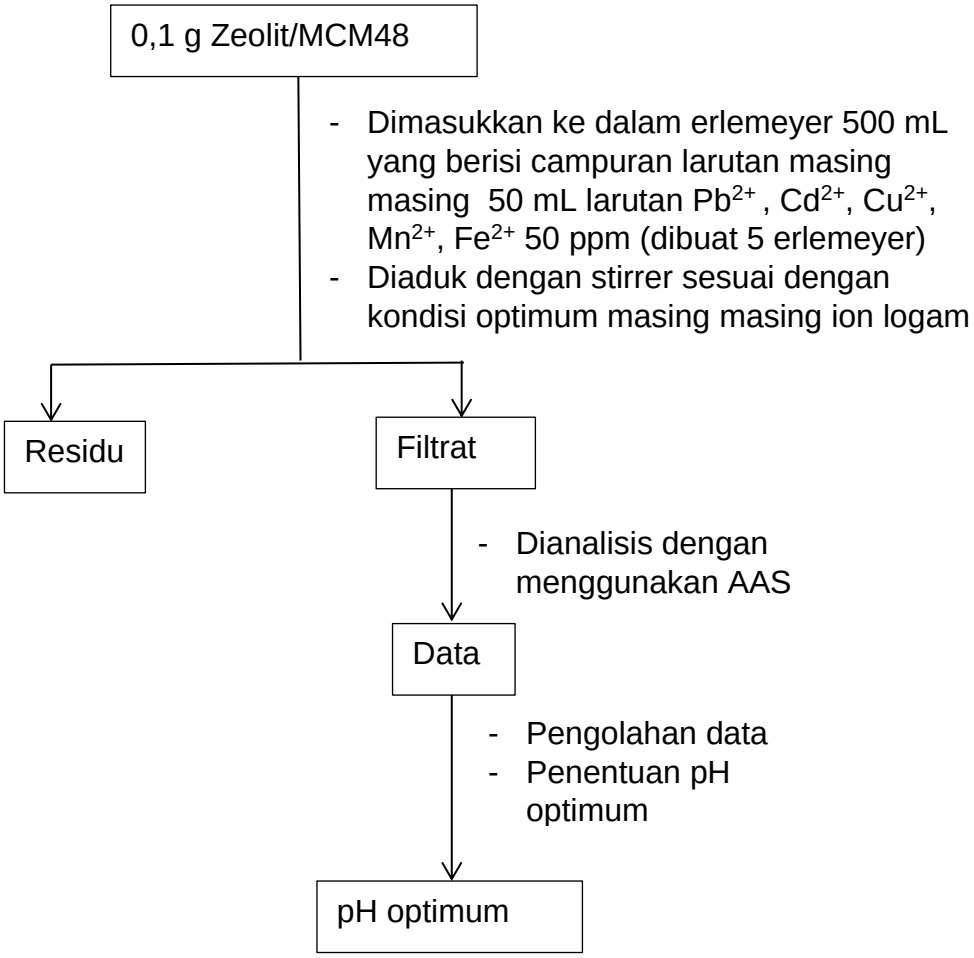


Lampiran 10. Skema Penentuan Kapasitas Adsorpsi

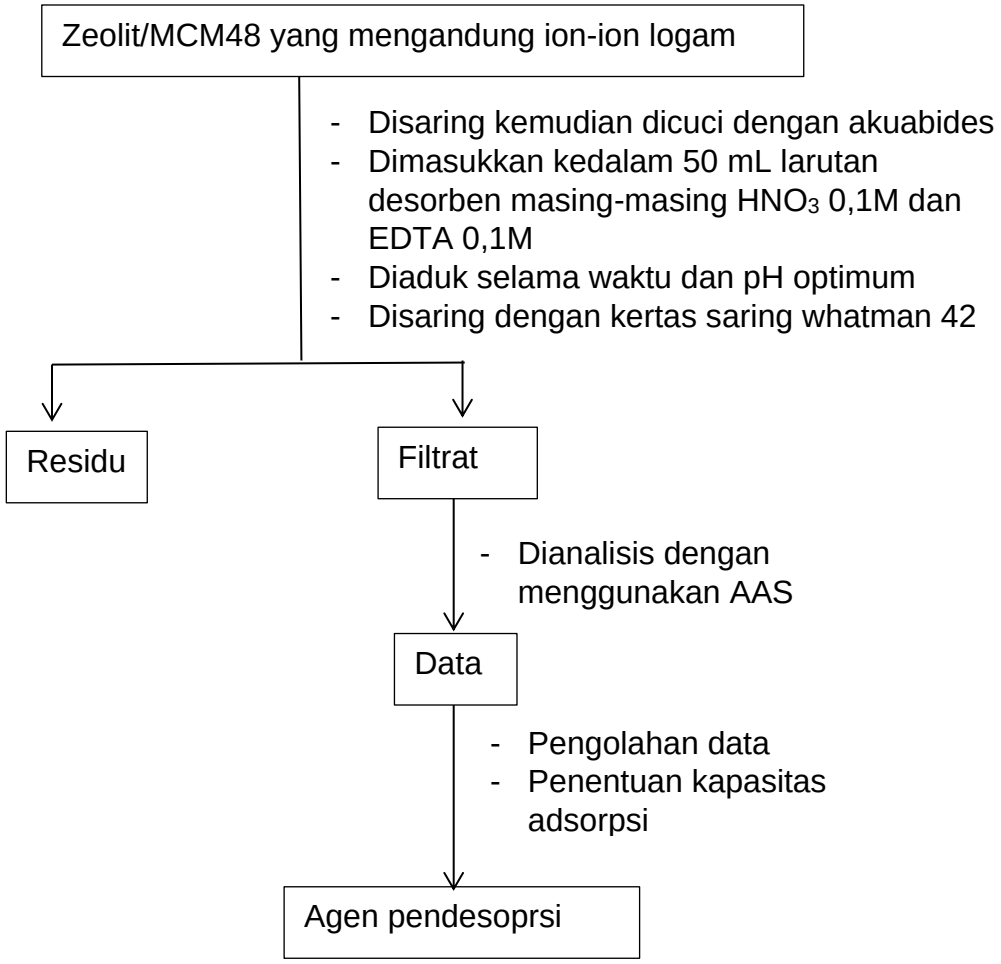


Catatan: Variasi konsentrasi ion logam Cd^{2+}, Mn^{2+}, Fe^{2+}, Pb^{2+}, dan Cu^{2+}. Berturut turut adalah 50, 100, 200, 300, dan 400 ppm

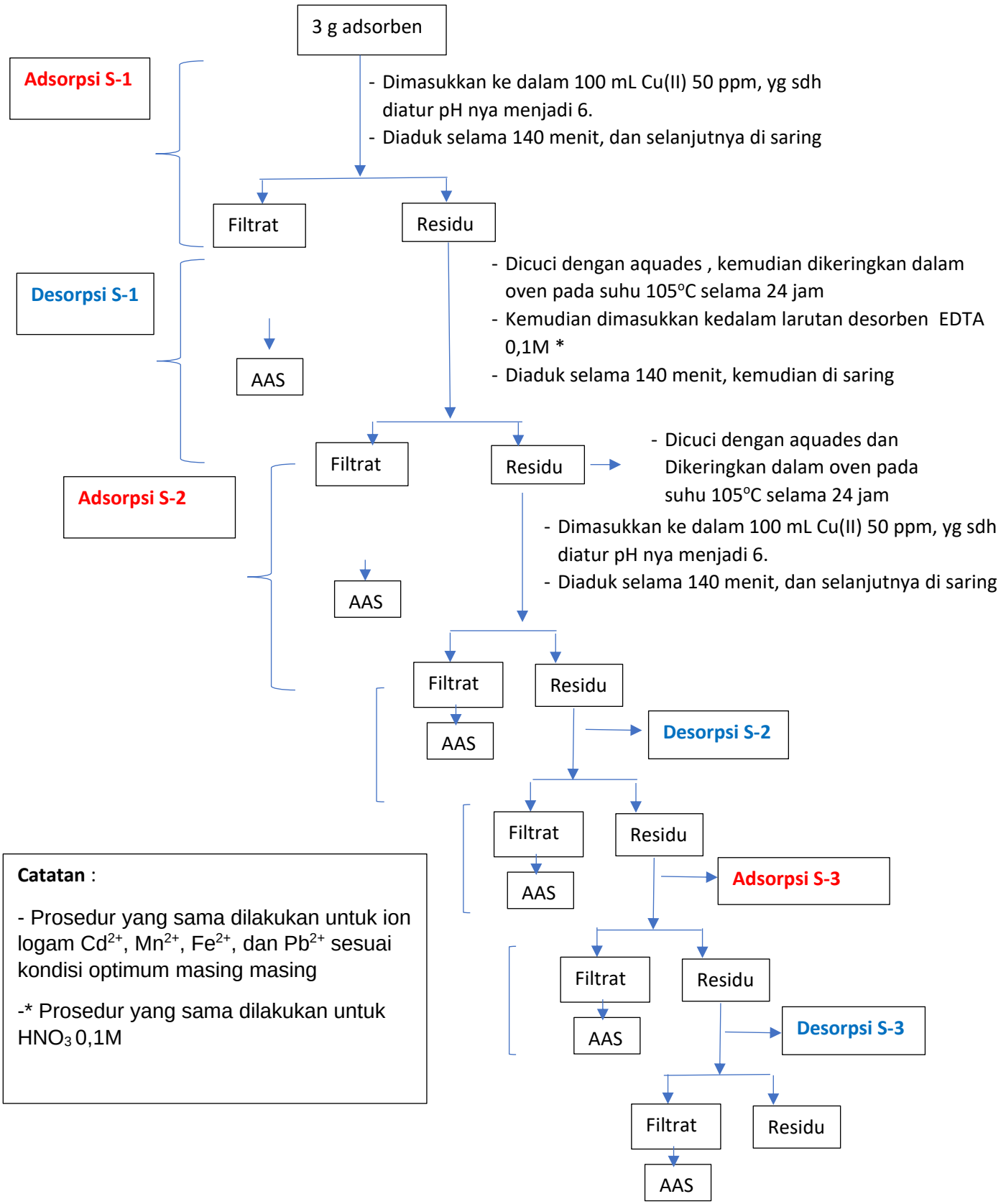
Lampiran 11. Selektivitas adsorpsi ion logam dalam sistem multi logam



Lampiran 12 a. Skema Desorpsi



Lampiran 12b. Skema prosedur Regenerasi

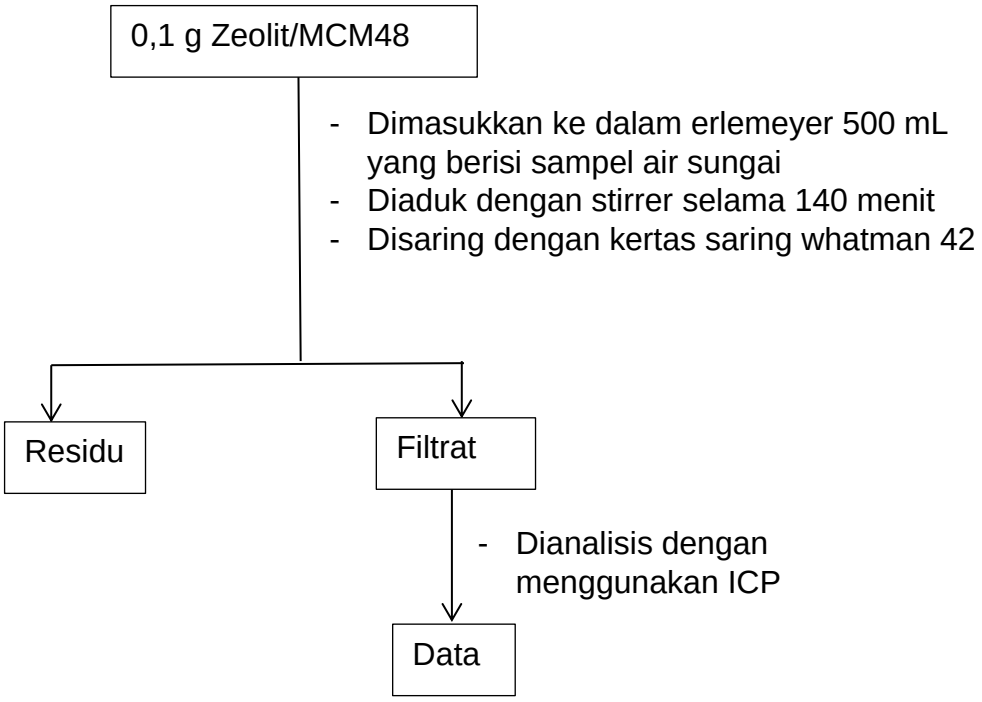


Catatan :

- Prosedur yang sama dilakukan untuk ion logam Cd^{2+}, Mn^{2+}, Fe^{2+}, dan Pb^{2+} sesuai kondisi optimum masing masing

-* Prosedur yang sama dilakukan untuk HNO_3 0,1M

Lampiran 13. Aplikasi pada Limbah Perairan



Lampiran 14. Perhitungan Pembuatan Larutan Ion Cd^{2+}, Cu^{2+}, Mn^{2+}, Pb^{2+}dan Fe^{2+} 1000 ppm

a. Pembuatan Larutan Cd^{2+} 1000 ppm

$$X = \frac{\text{Mr } Cd(NO_3)_2.4H_2O}{\text{Ar } Cd} \text{ x 1000 mg/L x 1 L}$$

$$X = \frac{308,4}{112,40} \text{ x 1000 mg/L x 1 L}$$

X = 2743,77 mg

X = 2,74 g

dimana X = berat $Cd(NO_3)_2.4H_2O$ yang ditimbang

b. Pembuatan Larutan Cu^{2+} 1000 ppm

$$X = \frac{\text{Mr } Cu(NO_3)_2.3H_2O}{\text{Ar } Cu} \text{ x 1000 mg/L x 1 L}$$

$$X = \frac{241,55}{63,55} \text{ x 1000 mg/L x 1 L}$$

X = 3800,94 mg

X = 3,80 g

dimana X = berat $Cu(NO_3)_2.3H_2O$ yang ditimbang

c. Pembuatan Larutan Mn^{2+} 1000 ppm

$$X = \frac{\text{Mr } Mn(NO_3)_2.4H_2O}{\text{Ar } Mn} \text{x 1000 mg/L x 1 L}$$

$$X = \frac{250,938}{54,938} \text{ x 1000 mg/L x 1 L}$$

X = 4567,66 mg

X = 4,57 g

dimana X = berat $Mn(NO_3)_2.4H_2O$ yang ditimbang

d. Pembuatan Larutan Pb^{2+} 1000 ppm

$$X = \frac{\text{Mr } Pb(NO_3)_2}{\text{Ar Pb}} \text{x 1000 mg/L x 1 L}$$

$$X = \frac{331}{207} \text{ x 1000 mg/L x 1 L}$$

X = 1599 mg

X = 1,59 g

dimana X = berat $Pb(NO_3)_2$ yang ditimbang

e. Pembuatan Larutan Fe^{2+} 1000 ppm

$$X = \frac{\text{Mr } Fe(SO_4) \quad .7H_2O}{\text{Ar Fe}} \text{x 1000 mg/L x 1 L}$$

$$X = \frac{278}{56} \text{ x 1000 mg/L x 1 L}$$

X = 4964 mg

X = 4,96 g

dimana X = berat $Mn(NO_3)_2.4H_2O$ yang ditimbang

Lampiran 15. Data Penentuan Waktu Optimum Adsorpsi ion logam Cd^{2+}, Mn^{2+}, Fe^{2+}, Pb^{2+}, dan Cu^{2+}oleh ANA/MCM-48.

- **Ion Logam** Cd^{2+}, Mn^{2+}, Fe^{2+}, Pb^{2+}, dan Cu^{2+}

Waktu (menit)	Co (mg/L)	Ce (mg/L)	Vol. (L)	Adsorben (g)	qt (mg/g)
30	53.5	23	0.05	0.1001	15.23
60	53.5	15	0.05	0.1001	19.23
90	53.5	10.5	0.05	0.1	21.50
120	53.5	7.5	0.05	0.1001	**22.98**
150	53.5	8.5	0.05	0.1006	22.37
180	53.5	9	0.05	0.1002	22.21

- **Ion Logam** Mn^{2+}

Waktu (menit)	Co (mg/L)	Ce (mg/L)	Vol. (L)	Adsorben (g)	qt (mg/g)
30	50.65	23.50	0.05	0.1	13.58
60	50.65	14.83	0.05	0.1003	17.85
90	50.65	9.50	0.05	0.1002	20.53
120	50.65	8.00	0.05	0.1	21.33
140	50.65	6.67	0.05	0.1002	**21.95**
160	50.65	7.00	0.05	0.1007	21.67
180	50.65	7.00	0.05	0.1009	21.63

- **Ion Logam** Fe^{2+}

Waktu (menit)	Co (mg/L)	Ce (mg/L)	Vol. (L)	Adsorben (g)	qt (mg/g)
30	49	14.56	0.05	0.1005	17.13
60	49	10.36	0.05	0.1	19.31
90	49	6.06	0.05	0.1006	21.34
120	49	3.19	0.05	0.1002	**22.86**
160	49	3.31	0.05	0.1002	22.80
180	49	3.56	0.05	0.1003	22.65

- **Ion Logam** Pb^{2+}

Waktu (menit)	Co (mg/L)	Ce (mg/L)	Vol. (L)	Adsorben (g)	qt (mg/L)
30	51	12.4	0.05	0.1004	19.22
60	51	6.2	0.05	0.1	22.40
90	51	4.6	0.05	0.1001	23.18
120	51	2.4	0.05	0.1001	**24.28**
150	51	2.6	0.05	0.1005	24.08
180	51	3	0.05	0.1002	23.95

- **Ion Logam** Cu^{2+}

Waktu (menit)	Co (mg/L)	Ce (mg/L)	Vol. (L)	Adsorban (g)	qt (mg/L)
30	46.91	22.85	0.05	0.1007	11.95
60	46.91	13.66	0.05	0.1004	16.56
90	46.91	8.11	0.05	0.1	19.40
120	46.91	3.04	0.05	0.1002	21.89
140	46.91	0.91	0.05	0.1004	**22.91**
160	46.91	1.62	0.05	0.1002	22.60
180	46.91	1.40	0.05	0.1007	22.60

Nilai q_t dihitung berdasarkan persamaan (5).

Contoh perhitungan jumlah **ion Cd^{2+}** yang teradsorpsi (waktu = 30 menit):

$$q_t = \frac{(53{,}5 - 23)\text{mg/L}}{0{,}1001\text{ g}} \text{ x } 0{,}05\text{ L}$$

q_t = 15,23 mg/g

Lampiran 16. Data Studi Kinetika Adsorpsi Ion logam Cd^{2+}, Mn^{2+}, Fe^{2+}, Pb^{2+}, dan Cu^{2+} oleh ANA/MCM-48.

- **ion logam Cd^{2+}, Mn^{2+}, Fe^{2+}, Pb^{2+}, dan Cu^{2+}**

Waktu (menit)	qt (mg/g)	qe (mg/g)	**qe**-qt (mg/g)	ln qe-qt	t/qt g mg^{-1}menit-^{1}	Efektivitas adsorpsi (%)
30	15.23	22.98	7.74	2.05	1.97	57.01
60	19.23	22.98	3.75	1.32	3.12	71.96
90	21.50	22.98	1.48	0.39	4.19	80.37
120	22.98	22.98	0.00	0.00	5.22	85.98
150	22.37	22.98	0.61	-0.49	6.71	84.11
180	22.21	22.98	0.77	-0.26	8.11	83.18

- **ion logam Mn^{2+}**

Waktu (menit)	qt (mg/g)	qe (mg/g)	qe-qt (mg/g)	ln qe-qt	t/qt g mg^{-1}menit-^{1}	Efektivitas adsoprsi (%)
30	13.58	21.95	8.37	2.12	2.21	53.60
60	17.85	21.95	4.09	1.41	3.36	70.71
90	20.53	21.95	1.41	0.35	4.38	81.24
120	21.33	21.95	0.62	-0.47	5.63	84.21
140	21.95	21.95	0.00	0.00	6.38	86.84
160	21.67	21.95	0.27	-1.29	7.38	86.18
180	21.63	21.95	0.32	-1.15	8.32	86.18

- **ion logam Fe^{2+}**

Waktu (menit)	qt (mg/g)	qe (mg/g)	qe-qt (mg/g)	ln qe-qt	t/qt g mg^{-1}menit-^{1}	Efektivitas adsorpsi (%)
30	17.13	22.86	5.73	1.75	1.75	70.28
60	19.31	22.86	3.55	1.27	3.11	78.83
90	21.34	22.86	1.52	0.42	4.22	87.63
120	22.86	22.86	0.00	0.00	5.25	93.49
160	22.80	22.86	0.06	-2.77	7.02	93.24
180	22.65	22.86	0.21	-1.56	7.95	92.73

- **ion logam Pb^{2+}**

Waktu (menit)	qt (mg/g)	qe (mg/g)	qe-qt (mg/g)	ln qe-qt	t/qt g mg^{-1}menit-^{1}	Efektivitas adsorpsi (%)
30	19.22	24.28	5.05	1.62	1.56	75.69
60	22.40	24.28	1.88	0.63	2.68	87.84
90	23.18	24.28	1.10	0.09	3.88	90.98
120	24.28	24.28	0.00	0.00	4.94	95.29
150	24.08	24.28	0.20	-1.63	6.23	94.90
180	23.95	24.28	0.32	-1.13	7.52	94.12

- **ion logam Cu^{2+}**

Waktu (menit)	qt (mg/g)	**qe** (mg/g)	**qe**-qt (mg/g)	ln qe-qt	t/qt g mg^{-1}menit^{-1}	Efektivitas adsorpsi (%)
30	11.95	22.91	10.96	2.39	2.51	51.29
60	16.56	22.60	6.04	1.80	3.62	70.88
90	19.40	22.91	3.50	1.25	4.64	82.72
120	21.89	22.91	1.02	0.02	5.48	93.51
140	**22.91**	22.91	0.00	0.00	6.11	98.05
160	22.60	22.91	0.30	-1.19	7.08	96.55
180	22.60	22.91	0.31	-1.17	7.97	97.01

Catatan :
qt adalah qe pada waktu t
qe adalah qe pada waktu optimum

Bentuk persamaan kinetika orde satu semu

Log (qe-qt) = log qe-K_1.t/2,303

Data grafik kinetika orde satu semu **ion logam Cd^{2+}** diperoleh persamaan garis :

y = -0.0165x + 2.237

dari persamaan garis diperoleh nilai slope (a) = -0,0165 dan nilai intersep (b) = 2,237

Nilai k_1 dapat dihitung sebagai berikut :

$$\text{slope} = -\frac{k_1}{2{,}303}$$

k_1 = - (slope x 2,303)

= - (-0,0165 x 2,303)

= 0,038 menit^{-1}

Nilai adsorpsi dapat dihitung sebagai berikut :

intersep = log q_e

q_e = invers log intersep

= invers log 2,237

= 9,3652 mg/g

Lanjutan Lampiran 16

Bentuk persamaan kinetika orde dua semu
$t/q_t = 1/k_2q_e^2 + t/q_e$

Data grafik kinetika orde dua semu diperoleh persamaan garis :

$$y = 0.0405x + 0.637$$

dari persamaan garis diperoleh nilai slope (a) = 0,0405 dan nilai intersep (b) = 0,637

Nilai adsorpsi dapat dihitung sebagai berikut :

$$\text{slope} = \frac{1}{q_e}$$

$$q_e = \frac{1}{\text{slope}} = \frac{1}{0{,}0404} = 24{,}6913 \text{ mg/g}$$

Nilai K_2 dapat dihitung sebagai berikut :

$$\text{intersep} = \frac{1}{K_2.q_e^2}$$

$$K_2 = \frac{1}{q_e^2.\text{intersep}}$$

$$= \frac{1}{(24{,}6913)^2 \text{ x } (0{,}637)}$$

$$= 0{,}00104 \text{ g}\cdot\text{mg}^{-1}\text{menit}^{-1}$$

Lampiran 17. Data Penentuan pH Optimum Adsorpsi Ion logam Cd^{2+}, Mn^{2+}, Fe^{2+}, Pb^{2+}, dan Cu^{2+} oleh ANA/MCM-48.

- **Ion logam Cd^{2+}, Mn^{2+}, Fe^{2+}, Pb^{2+}, dan Cu^{2+}**

pH	Co (mg/L)	Ce (mg/L)	Vol. (L)	Adsorben (g)	qe (mg/g)	Kd (L/g)	Efektifitas adsorpsi (%)
2	50.5	32	0.05	0.1004	9.21	0.29	36.63
3	50.5	22	0.05	0.1005	14.18	0.64	56.44
4	50.5	12	0.05	0.1	19.25	1.60	76.24
5	50.5	7	0.05	0.1008	21.58	3.08	86.14
6	50.5	4	0.05	0.1002	23.20	5.80	92.08
7	50.5	4.5	0.05	0.1007	22.84	5.08	91.09

- **Ion logam Mn^{2+}**

pH	Co (mg/L)	Ce (mg/L)	Vol. (L)	Adsorben (g)	qe (mg/g)	Kd (L/g)	Efektifitas adsorpsi (%)
2	51.38	36.88	0.05	0.1	7.25	0.20	28.22
3	51.38	28.50	0.05	0.1024	11.17	0.39	44.53
4	51.38	18.13	0.05	0.1001	16.61	0.92	64.72
5	51.38	11.63	0.05	0.1	19.88	1.71	77.37
6	51.38	8.88	0.05	0.1	21.25	2.39	82.73
7	51.38	9.13	0.05	0.1	21.13	2.32	82.24

- **Ion logam Fe^{2+}**

pH	Co (mg/L)	Ce (mg/L)	Vol. (L)	Adsorben (g)	qe (mg/g)	Kd (L/g)	Efektifitas adsorpsi (%)
2	49.71	28.24	0.05	0.1	10.74	0.38	43.20
3	49.71	16.10	0.05	0.1001	16.79	1.04	67.62
4	49.71	7.81	0.05	0.1	20.95	2.68	84.29
5	49.71	6.67	0.05	0.1	21.52	3.23	86.59
6	49.71	7.90	0.05	0.1	20.90	2.64	84.10
7	49.71	7.81	0.05	0.1001	20.93	2.68	84.29

- **Ion logam Pb^{2+}**

pH	Co (mg/L)	Ce (mg/L)	Vol. (L)	Adsorben (g)	qe (mg/g)	Kd (L/g)	Efektifitas adsorpsi (%)
2	52.42	38.08	0.05	0.1	7.17	0.19	27.34
3	52.42	31.42	0.05	0.1024	10.25	0.33	40.06
4	52.42	23.08	0.05	0.1001	14.65	0.63	55.96
5	52.42	9.42	0.05	0.1	21.50	2.28	82.03
6	52.42	1.75	0.05	0.1005	25.32	14.47	96.66
7	52.42	2.08	0.05	0.1001	25.14	12.07	96.03

- **Ion logam Cu^{2+}**

pH	Co (mg/L)	Ce (mg/L)	Vol. (L)	Adsorben (g)	qe (mg/g)	Kd (L/g)	Efektifitas adsorpsi (%)
2	50.84	33.14	0.05	0.1	8.85	0.27	34.82
3	50.84	14.25	0.05	0.1003	18.24	1.28	71.97
4	50.84	9.42	0.05	0.1001	20.69	2.20	81.47
5	50.84	7.69	0.05	0.1002	21.54	2.80	84.88
6	50.84	5.38	0.05	0.1	22.73	4.23	89.43
7	50.84	5.45	0.05	0.1003	22.63	4.15	89.27

Nilai q_e dihitung berdasarkan persamaan (5).

Contoh perhitungan jumlah **ion logam Cu^{2+}** yang teradsorpsi (pH = 2) :

$$\mathbf{q_e} = \frac{(50{,}84 - 33{,}14)\text{mg/L}}{0{,}1\text{ g}} \text{ X } 0{,}05 \text{ L}$$

q_e = 8,85 mg/g

$$\boldsymbol{Kd} = \frac{(\boldsymbol{C_o} - \boldsymbol{C_e})}{\boldsymbol{C_e}} \boldsymbol{x} \frac{\boldsymbol{v}}{\boldsymbol{w}}$$

$$= \frac{\boldsymbol{q_e}}{\boldsymbol{C_e}} \quad = \frac{(\mathbf{50{,}84 - 33{,}14})}{\mathbf{33{,}14}} \boldsymbol{x} \frac{\mathbf{0{,}05}}{\mathbf{0{,}1}}$$

= 0,27 L/g

% Efektifitas adsorpsi = $\frac{(\boldsymbol{C_o} - \boldsymbol{C_e})}{\boldsymbol{C_o}} \; x \; 100$

$= \frac{50{,}84 - 33{,}14}{50{,}84} \; x \; 100$

= 34,82 %

Lampiran 18. Data Penentuan Kapasitas Adsorpsi Ion logam Cd^{2+}, Mn^{2+}, Fe^{2+}, Pb^{2+}, dan Cu^{2+} oleh ANA/MCM-48.

- **Ion logam Cd^{2+}**

Konsentrasi (mg/L)	Co (mg/L)	Ce (mg/L)	Vol. (L)	W (g)	qe (mg/g)	qe (mmol/g)	Efektivitas adsorpsi (%)
50	50.33	9.67	0.05	0.1008	20.17	0.18	80.79
100	103.00	23.00	0.05	0.1001	39.96	0.36	77.67
200	200.33	53.00	0.05	0.1001	73.59	0.65	73.54
300	299.33	96.67	0.05	0.1001	101.23	0.90	67.71
400	401.33	158.33	0.05	0.1006	120.78	1.07	60.55

- **Ion logam Mn^{2+}**

Konsentrasi (mg/L)	Co (mg/L)	Ce (mg/L)	Vol. (L)	W (g)	qe (mg/g)	qe (mmol/g)	Efektivitas adsorpsi (%)
50	51.00	10.07	0.05	0.1004	20.39	0.37	80.26
100	102.67	24.33	0.05	0.1001	39.13	0.71	76.30
200	207.33	66.10	0.05	0.1002	70.48	1.28	68.12
300	299.67	123.33	0.05	0.1001	88.08	1.60	58.84
400	398.00	202.67	0.05	0.1	97.67	1.78	49.08

- **Ion logam Fe^{2+}**

Konsentrasi (mg/L)	Co (mg/L)	Ce (mg/L)	Vol. (L)	W (g)	qe (mg/g)	qe (mmol/g)	Efektivitas adsorpsi (%)
50	51.5	10	0.05	0.1	20.75	0.37	80.58
100	103.5	22	0.05	0.1001	40.71	0.73	78.74
200	219	58.5	0.05	0.1028	78.06	1.40	73.29
300	309	105	0.05	0.1001	101.90	1.82	66.02
400	395.75	158.5	0.05	0.1004	118.15	2.12	59.95

- **Ion logam Pb^{2+}**

Konsentrasi (mg/L)	Co (mg/L)	Ce (mg/L)	Vol. (L)	W (g)	qe (mg/g)	qe (mmol/g)	Efektivitas adsorpsi (%)
50	50	6.5	0.05	0.1	21.75	0.10	87.00
100	106.5	17.5	0.05	0.1005	44.29	0.21	83.57
200	205	38.5	0.05	0.1003	83.00	0.40	81.22
300	306	77.5	0.05	0.1001	114.14	0.55	74.67
400	409	156.5	0.05	0.1	126.25	0.61	61.74

- **Ion logam Cu^{2+}**

Konsentrasi (mg/L)	Co (mg/L)	Ce (mg/L)	Vol. (L)	W (g)	qe (mg/g)	qe (mmol/g)	Efektivitas adsorpsi (%)
50	49.2	11.9	0.05	0.1005	18.56	0.29	75.81
100	103.6	27.1	0.05	0.1012	37.80	0.60	73.84
200	194.3	59.9	0.05	0.1006	66.80	1.05	69.17
300	292.5	106.9	0.05	0.1	92.80	1.46	63.45
400	411.6	172.5	0.05	0.1004	119.07	1.88	58.09

Nilai q_e dihitung berdasarkan persamaan (5).

Contoh perhitungan jumlah **ion logam Cd^{2+}** yang teradsorpsi (C_o = 50,33 mg/L) :

$$q_e = \frac{(50{,}33 - 9{,}67)\text{mg/L}}{0{,}1008\ \text{g}} \text{ x } 0{,}05\ \text{L}$$

q_e = 20,17 mg/g = 0,18 mmol/g

Lampiran 19. Data Penentuan Kapasitas Adsorpsi Ion logam Cd^{2+}, Mn^{2+}, Fe^{2+}, Pb^{2+}, dan Cu^{2+} oleh ANA/MCM-48 untuk pemodelan persamaan isoterm adsorpsi bentuk linear.

- **Ion logam Cd^{2+}**

Ce (mg/L)	Qe (mg/g)	ce/qe	Log Ce	Log qe	ln Ce	ln(q/qm-q)
9.67	20.17	0.48	0.99	1.30	2.27	-2.03
23.00	39.96	0.58	1.36	1.60	3.14	-1.21
53.00	73.59	0.72	1.72	1.87	3.97	-0.31
96.67	101.23	0.95	1.99	2.01	4.57	0.33
158.33	120.78	1.31	2.20	2.08	5.06	0.82

Sips	
Parameter	Nilai
ln K_s	-4.3958
K_s	0.0117
n	1.0422
q_{max}	173.8914
R^2	0.9994

Langmuir	
Parameter	Nilai
1/qmax K	0.4329
1/qmax	0.0055
qmax	181.8182
K	0.0127
R^2	0.9989

Freundlich	
Parameter	Nilai
log K	0.6968
K	2.0073
n	1.5356
R^2	0.9849

- **Ion logam Mn^{2+}**

Ce (mg/L)	Qe (mg/g)	ce/qe	Log Ce	Log qe	ln Ce	ln(q/qm-q)
10.07	20.39	0.49	1.00	1.31	2.31	-1.57
24.33	39.13	0.62	1.39	1.59	3.19	-0.71
66.10	70.48	0.94	1.82	1.85	4.19	0.38
123.33	88.08	1.40	2.09	1.94	4.81	1.06
202.67	97.67	2.08	2.31	1.99	5.31	1.53

Sips	
Parameter	Nilai
ln K_s	-4.0131
K_s	0.017
n	1.056
q_{max}	118.7166
R^2	0.9995

Langmuir	
Parameter	Nilai
1/qmax K	0.4097
1/qmax	0.0082
qmax	121.9512
K	0.020015
R^2	0.9996

Freundlich	
Parameter	Nilai
log K	0.8259
K	2.2839
n	1.8896
R^2	0.9685

- **Ion logam Fe^{2+}**

Ce (mg/L)	Qe (mg/g)	ce/qe	Log Ce	Log qe	ln Ce	ln(q/qm-q)
10	20.75	0.48	1.00	1.32	2.30	-1.95
22	40.71	0.54	1.34	1.61	3.09	-1.12
58.5	78.06	0.75	1.77	1.89	4.07	-0.12
105	101.90	1.03	2.02	2.01	4.65	0.46
158.5	118.15	1.34	2.20	2.07	5.07	0.90

Sips	
Parameter	Nilai
ln K_s	-4.3079
K_s	0.0136
n	1.0255
q_{max}	165.9678
R^2	0.9999

Langmuir	
Parameter	Nilai
1/qmax K	0.4159
1/qmax	0.0058
qmax	172.4138
K	0.01396
R^2	0.9997

Freundlich	
Parameter	Nilai
log K	0.7285
K	2.0720
n	1.5845
R^2	0.9814

- **Ion logam Pb^{2+}**

Ce (mg/L)	Qe (mg/g)	ce/qe	Log Ce	Log qe	ln Ce	ln(q/qm-q)
6.5	21.75	0.30	0.81	1.34	1.872	-1.725
17.5	44.28	0.40	1.24	1.65	2.862	-0.810
38.5	83.00	0.46	1.59	1.92	3.651	0.311
77.5	114.14	0.68	1.89	2.06	4.350	1.347
156.5	126.25	1.24	2.19	2.10	5.053	1.972

Sips	
Parameter	Nilai
ln K_s	-4.0952
K_s	0.0127
n	1.2801
q_{max}	143.8168
R^2	0.9917

Langmuir	
Parameter	Nilai
1/qmax K	0.2498
1/qmax	0.0062
qmax	161.2903
K	0.02482
R^2	0.9911

Freundlich	
Parameter	Nilai
log K	0.9214
K	2.5128
n	1.7343
R^2	0.9527

➢ **Ion logam Cu^{2+}**

Ce (mg/L)	qe (mg/g)	ce/qe	Log Ce	Log qe	ln Ce	ln(q/qm-q)
11.9	18.56	0.64	1.08	1.27	2.42	-2.27
27.1	37.80	0.72	1.43	1.58	3.31	-1.48
59.9	66.80	0.90	1.78	1.82	4.09	-0.71
106.9	92.80	1.15	2.03	1.97	4.62	-0.12
172.5	119.07	1.45	2.24	2.08	5.15	0.35

Sips	
Parameter	Nilai
ln K_s	-4.6599
K_s	0.0086
n	0.9927
q_{max}	202.7154
R^2	0.9987

Langmuir	
Parameter	Nilai
1/qmax K	0.587
1/qmax	0.0051
qmax	196.0784
K	0.0086
R^2	0.9981

Freundlich	
Parameter	Nilai
log K	0.5551
K	1.7421
n	1.4399
R^2	0.9900

- Model persamaan isoterm Langmuir dapat dilihat pada persamaan :

$$\frac{C_e}{q_e} = \frac{1}{q_{m \times} K_L} + \frac{1}{q_m} \times C_e$$

Berdasarkan model **isoterm Langmuir ion logam Cd^{2+}** diperoleh persamaan garis :

y = 0.0055x + 0.4329

dari persamaan garis diperoleh nilai slope (a) = 0,0055 dan nilai intersep (b) = 0,4329

Nilai kapasitas adsorpsi dapat dihitung sebagai berikut :

$$\frac{1}{Q_0} = \text{kemiringan (slope)}$$

$$Q_0 = \frac{1}{0{,}0055} = 181{,}8182 \text{ mg/g}$$

$$= 1{,}62 \text{ mmol/g}$$

Intensitas adsorpsi dapat dihitung sebagai berikut :

$$\frac{1}{Q_0 . b} = \text{intersep}$$

$$b = \frac{1}{181{,}8182\ mg/g \quad x\ 0{,}4329} = 0{,}013\ L\ mg^{-1}$$

- Model persamaan **isoterm Freundlich** dapat dilihat pada persamaan

$$Log\ q_e = log\ K_F + \frac{1}{n} \log C_e$$

Berdasarkan model isoterm Freundlich diperoleh persamaan garis :

y = 0.6512x + 0.6968

dari persamaan garis diperoleh nilai slope (a) = 0,6512 dan nilai intersep (b) = 0,6968

Nilai kapasitas adsorpsi dapat dihitung sebagai berikut :

log k_f = intersep

log k_f = 0,6968

k_f = 2,0073 mg/g

k_f = 0,018 mmol/g

Intensitas adsorpsi dapat dihitung sebagai berikut :

$\frac{1}{n}$ = kemiringan (slope)

$n = \frac{1}{slope} = \frac{1}{0{,}6512} = 1{,}5356\ g\ L^{-1}$

- Model persamaan **isoterm Sips** dapat dilihat pada persamaan

$$\ln \frac{q_e}{q_m - q_e} = \ln K_s + \frac{1}{n} \ln C_e$$

Lampiran 20. Data Penentuan Kapasitas Adsorpsi Ion logam Cd^{2+}, Mn^{2+}, Fe^{2+}, Pb^{2+}, dan Cu^{2+} oleh ANA/MCM-48 untuk pemodelan persamaan isoterm adsorpsi bentuk non-linear.

- **Ion logam Cd^{2+}**

Konsentrasi (mg/L)	Ce (mg/L)	qe (mg/g)	qe S (mg/g)	res^2	qe L (mg/g)	res^2	qe F (mg/g)	res^2
50	9.67	20.17	19.26	0.83	19.91	0.07	26.28	37.32
100	23.00	39.96	40.88	0.85	41.16	1.43	42.71	7.57
200	53.00	73.59	73.59	0.00	73.21	0.15	68.18	29.31
300	96.67	101.23	100.60	0.40	100.25	0.97	95.47	33.20
400	158.33	120.78	121.13	0.12	121.45	0.46	125.87	25.95

Sips			
qmax	K	n	RSS
173.891	0.0117	1.0422	2.2092
Langmuir			
qmax	K	RSS	
181.697	0.0127	3.0731	
Freundlich			
K	n	RSS	
7.373	0.560	133.358	

- **Ion logam Mn^{2+}**

Konsentrasi (mg/L)	Ce (mg/L)	qe (mg/g)	qe S (mg/g)	res^2	qe L (mg/g)	res^2	qe F (mg/g)	res^2
50	10.07	20.39	19.73	0.43	20.46	0.01	27.53	50.98
100	24.33	39.13	39.89	0.59	40.02	0.80	40.64	2.28
200	66.10	70.48	70.34	0.02	69.76	0.52	63.16	53.51
300	123.33	88.08	87.55	0.28	87.30	0.61	83.18	23.98
400	202.67	97.67	98.06	0.15	98.49	0.68	103.57	34.85

Sips			
qmax	K	n	RSS
118.7166	0.0173	1.0568	1.4704
Langmuir			
qmax	K	RSS	
123.0147	0.01987	2.613	
Freundlich			
K	n	RSS	
9.9333	0.4414	165.596	

- **Ion logam Fe^{2+}**

Konsentrasi (mg/L)	Ce (mg/L)	qe (mg/g)	qe S (mg/g)	res^2	qe L (mg/g)	res^2	qe F (mg/g)	res^2
50	10	20.75	20.93	0.03	21.29	0.29	27.39	44.10
100	22	40.71	40.60	0.01	40.73	0.00	42.04	1.77
200	58.5	78.06	77.83	0.06	77.54	0.28	71.52	42.83
300	105	101.90	102.35	0.20	102.19	0.09	98.28	13.11
400	158.5	118.15	117.92	0.05	118.14	0.00	122.92	22.73

Sips			
qmax	K	n	RSS
165.9678	0.0136	1.025578	0.3554

Langmuir		
qmax	K	RSS
170.3100	0.0143	0.6546

Freundlich		
K	n	RSS
7.8392	0.543334	124.5374

- **Ion logam Pb^{2+}**

Konsentrasi (mg/L)	Ce (mg/L)	qe (mg/g)	qe S (mg/g)	res^2	qe L (mg/g)	res^2	qe F (mg/g)	res^2
50	6.5	21.75	17.72	16.27	22.90	1.32	33.14	129.74
100	17.5	44.28	47.89	13.04	49.86	31.17	51.49	52.06
200	38.5	83.00	83.13	0.02	80.36	6.95	73.13	97.34
300	77.5	114.14	110.79	11.20	108.09	36.49	99.84	204.23
400	156.5	126.25	128.27	4.06	130.54	18.42	136.50	105.10

Sips			
qmax	K	n	RSS
143.817	0.0128	1.280185	44.584

Langmuir		
qmax	K	RSS
163.938	0.0250	94.351

Freundlich		
K	n	RSS
14.409	0.444975446	588.473

- **Ion logam Cu^{2+}**

Konsentrasi (mg/L)	Ce (mg/L)	qe (mg/g)	qe S (mg/g)	res^2	qe L (mg/g)	res^2	qe F (mg/g)	res^2
50	11.2	18.91	17.68	1.49	17.58	1.75	23.11	17.69
100	27.5	37.60	38.33	0.53	38.28	0.47	40.04	5.95
200	59.9	66.80	68.02	1.48	68.08	1.63	64.46	5.46
300	101.9	95.30	93.48	3.32	93.55	3.08	89.22	36.94
400	172.5	119.07	119.74	0.45	119.68	0.37	123.12	16.37

Sips			
qmax	K	n	RSS
202.715	0.008683	0.992789	7.271
Langmuir			
qmax	K	RSS	
200.556	0.008579	7.302	
Freundlich			
K	n	RSS	
5.272	0.61175	82.414	

Isoterm Langmuir non-linear di hitung dengan persamaan :

$$q_e = \frac{q_m . K_L . C_e}{1 + K_L \times C_e}$$

Isoterm Freundlich non-linear di hitung dengan persamaan :

$$q_e = K_F . C_e^n$$

Isoterm Sips non-linear di hitung dengan persamaan :

$$q_e = \frac{q_m . K_S . C_e^n}{1 + K_S . C_e^n}$$

Lampiran 21. Data perhitungan % perolehan kembali kemampuan adsorpsi desorpsi komposit ANA/MCM-48 terhadap ion logam Cd^{2+}, Mn^{2+}, Fe^{2+}, Pb^{2+}, dan Cu^{2+}

Logam	Agen pendesorpsi	Siklus ke-	qe Adsorpsi mg/g	qe desorpsi (mg/g)	% perolehan kembali
Cd^{2+}	EDTA	1	4.488	4.442	98.99
		2	4.498	4.214	93.69
		3	3.077	2.560	83.18
	HNO_3	1	4.700	3.116	66.31
		2	2.716	1.593	58.66
		3	2.890	1.206	41.73
Mn^{2+}	EDTA	1	4.798	4.311	89.85
		2	5.067	3.870	76.38
		3	3.531	2.535	71.80
	HNO_3	1	4.692	3.453	73.59
		2	4.641	2.729	58.79
		3	3.508	1.511	43.09
Fe^{2+}	EDTA	1	4.981	4.464	89.61
		2	5.764	4.803	83.33
		3	3.665	2.555	69.71
	HNO_3	1	4.725	3.587	75.91
		2	5.764	3.136	54.40
		3	3.665	1.838	50.15
Pb^{2+}	EDTA	1	4.915	4.372	88.94
		2	4.064	3.303	81.26
		3	3.490	2.211	63.34
	HNO_3	1	4.985	3.444	69.09
		2	5.527	3.672	66.44
		3	3.141	1.689	53.77
Cu^{2+}	EDTA	1	5.491	5.034	91.67
		2	4.278	3.513	82.11
		3	2.807	2.033	72.41
	HNO_3	1	5.099	4.072	79.87
		2	4.793	3.338	69.64
		3	2.853	1.412	49.50

$$\%\ Perolehan\ kembali = \frac{jumlah\ ion\ logam\ terdesorpsi}{jumlah\ ion\ logam\ teradsorpsi}\ X\ 100$$

$$= \frac{4{,}442}{4{,}488}\ x\ 100 = 98{,}99\ \%$$

Lampiran.22

Tabel parameter adsorpsi ion Cd^{2+}, Mn^{2+}, Fe^{2+}, Pb^{2+}, dan Cu^{2+} oleh ANA/MCM-48 yang diperoleh dari kurva isotherm Langmuir dan Freundlich (Qo, b, R^2, k, n, R^2)

Logam	**Isoterm Langmuir**				**Isoterm Freundlich**			
	qo (mmol/g)	b (L/mg)	R^2	R_L	K_F	n_F(g/L)	R^2	1/n
Cd	1.62	0.013	0.9989	**0.164**	0.018	**1.536**	0.9849	0.651
Mn	2.22	0.020	0.9996	**0.113**	0.042	**1.890**	0.9685	0.529
Fe	3.09	0.779	0.9997	**0.003**	0.037	**1.585**	0.9814	0.631
Pb	0.78	0.025	0.9911	**0.090**	0.012	**1.734**	0.9527	0.577
Cu	3.09	0.009	0.9981	**0.219**	0.027	**1.440**	0.9868	0.695

$$RL = \frac{1}{1+b.Co}$$

$$= \frac{1}{1+ 1{,}62\ x}$$

Lampiran 23.

Tabel Persentase efektivitas adsorpsi terhadap konsentrasi ion logam Cd^{2+}, Mn^{2+}, Fe^{2+}, Pb^{2+}, dan Cu^{2+}

Konsentrasi (mg/g)	Cd	Mn	Fe	Pb	Cu
50	80.79	80.26	80.58	87	75.81
100	77.67	76.30	78.74	83.57	73.84
200	73.54	68.12	73.29	81.22	69.17
300	67.71	58.84	66.02	74.67	63.45
400	60.55	49.08	59.95	61.74	58.09

Lampiran 24. Data proses adsorpsi-desorpsi 3 kali siklus

Logam	Agen pendesorpsi	Siklus ke-	q_e Adsorpsi (mg/g)	q_e desorpsi (mg/g)	% perolehan kembali
Cd	EDTA	1	4.488	4.442	98.99
		2	4.498	4.214	93.69
		3	3.077	2.560	83.18
	HNO_3	1	4.700	3.116	66.31
		2	2.716	1.593	58.66
		3	2.890	1.206	41.73
Mn	EDTA	1	4.798	4.311	89.85
		2	5.067	3.870	76.38
		3	3.531	2.535	71.80
	HNO_3	1	4.692	3.453	73.59
		2	4.641	2.729	58.79
		3	3.508	1.511	43.09
Fe	EDTA	1	4.981	4.464	89.61
		2	5.764	4.803	83.33
		3	3.665	2.555	69.71
	HNO_3	1	4.725	3.587	75.91
		2	5.764	3.136	54.40
		3	3.665	1.838	50.15
Pb	EDTA	1	4.915	4.372	88.94
		2	4.064	3.303	81.26
		3	3.490	2.211	63.34
	HNO_3	1	4.985	3.444	69.09
		2	5.527	3.672	66.44
		3	3.141	1.689	53.77
Cu	EDTA	1	5.491	5.034	91.67
		2	4.278	3.513	82.11
		3	2.807	2.033	72.41
	HNO_3	1	5.099	4.072	79.87
		2	4.793	3.338	69.64
		3	2.853	1.412	49.50

Lampiran 25. XRF Mineral alam Mesawa

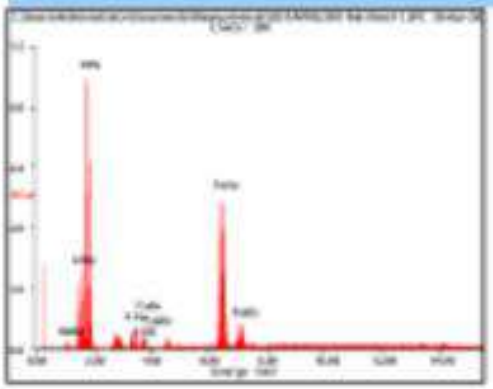
MicroXRF Analysis Report

EDAX TSL

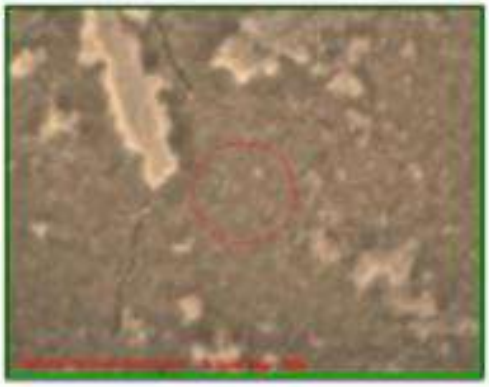
AMETEK

Prepared for: *Company Name Here*

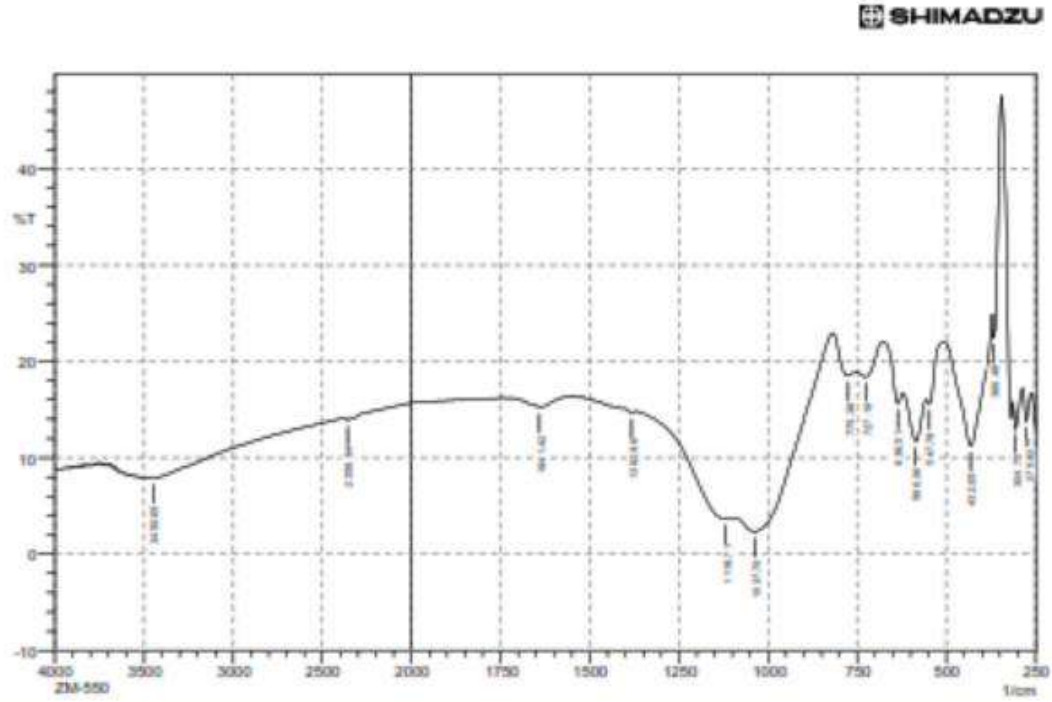
Prepared by: *Your Name Here* *4/28/2021*



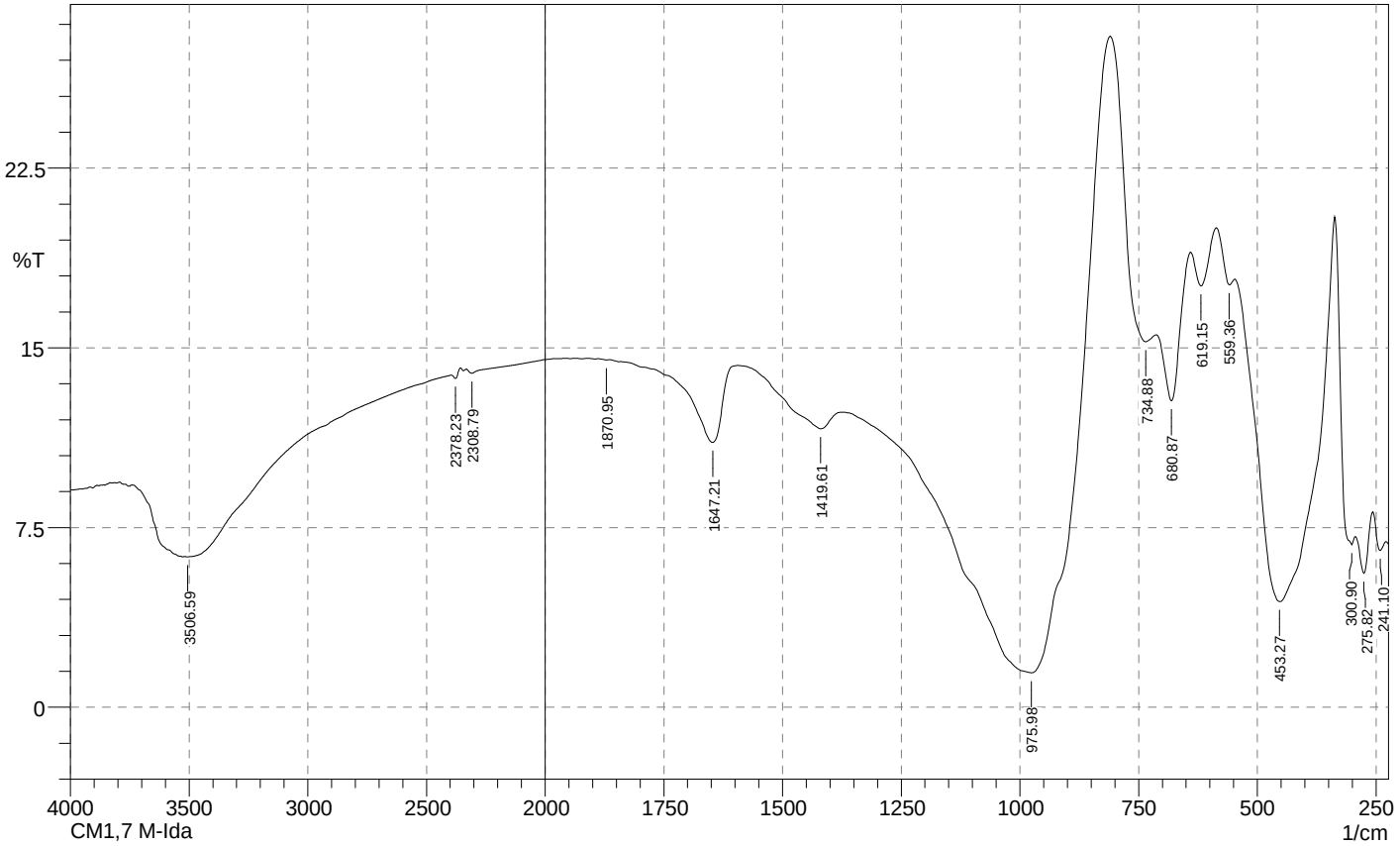
Element	Wt%	At%
NaK	20.01	23.76
AlK	20.51	20.77
SiK	52.97	51.52
K K	2.57	1.80
CaK	1.10	0.75
FeK	2.83	1.39



Lampiran 26. FTIR Mineral alam Mesawa



	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	248.82	13.059	0	262.32	248.82	11.071	-0.14
2	248.82	13.059	0	262.32	248.82	11.071	-0.14
3	248.82	13.059	0	262.32	248.82	11.071	-0.14
4	275.82	13.808	3.164	287.39	262.32	20.291	0.964
5	304.75	13.076	3.121	314.4	287.39	22.302	1.099
6	368.48	22.395	5.946	370.33	345.26	12.479	0.851
7	432.05	11.207	12.331	505.35	370.33	105.493	20.256
8	547.78	15.589	1.572	557.43	505.35	37.621	-0.167
9	586.36	11.698	4.667	621.08	557.43	54.58	4.591
10	636.51	15.625	2.513	676.94	621.08	42.192	0.71
11	727.16	18.405	1.557	752.24	676.94	51.991	1.384
12	775.38	18.513	1.767	819.75	752.24	47.466	1.474
13	1037.7	2.354	5.289	1093.64	819.75	315.409	34.821
14	1116.71	3.696	0.957	1369.46	1095.57	294.425	3.493
15	1382.96	14.674	0.276	1404.18	1371.39	27.158	0.133
16	1641.42	15.221	0.097	1647.21	1637.56	7.569	0.014
17	2358.94	13.87	0.266	2380.16	2339.65	34.563	0.146
18	3450.65	7.9	0.012	3452.58	2382.09	1020.663	0.202



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	241.1	6.543	0.899	256.53	229.53	31.256	0.816
2	275.82	5.586	2.04	293.18	258.46	41.097	2.314
3	300.9	6.781	2.223	335.61	295.11	41.665	4.026
4	453.27	4.406	14.612	545.85	337.54	219.962	70.335
5	559.36	17.635	0.875	586.36	547.78	28.316	0.379
6	619.15	17.583	1.817	640.37	588.29	38.153	1.184
7	680.87	12.787	4.277	711.73	642.3	56.991	3.938
8	734.88	15.258	3.081	808.17	713.66	69.055	4.624
9	975.98	1.439	21.947	1373.32	810.1	661.797	250.39
10	1419.61	11.624	1.092	1593.2	1375.25	194.677	3.502
11	1647.21	11.05	3.25	1840.09	1595.13	214.531	7.958
12	1870.95	14.494	0.023	1888.31	1865.17	19.4	0.007
13	2308.79	13.945	0.198	2331.94	1977.04	300.234	0.821
14	2378.23	13.723	0.275	2395.59	2357.01	33.081	0.166
15	3506.59	6.277	0.077	3516.23	2397.52	1089.457	0.867

Comment;

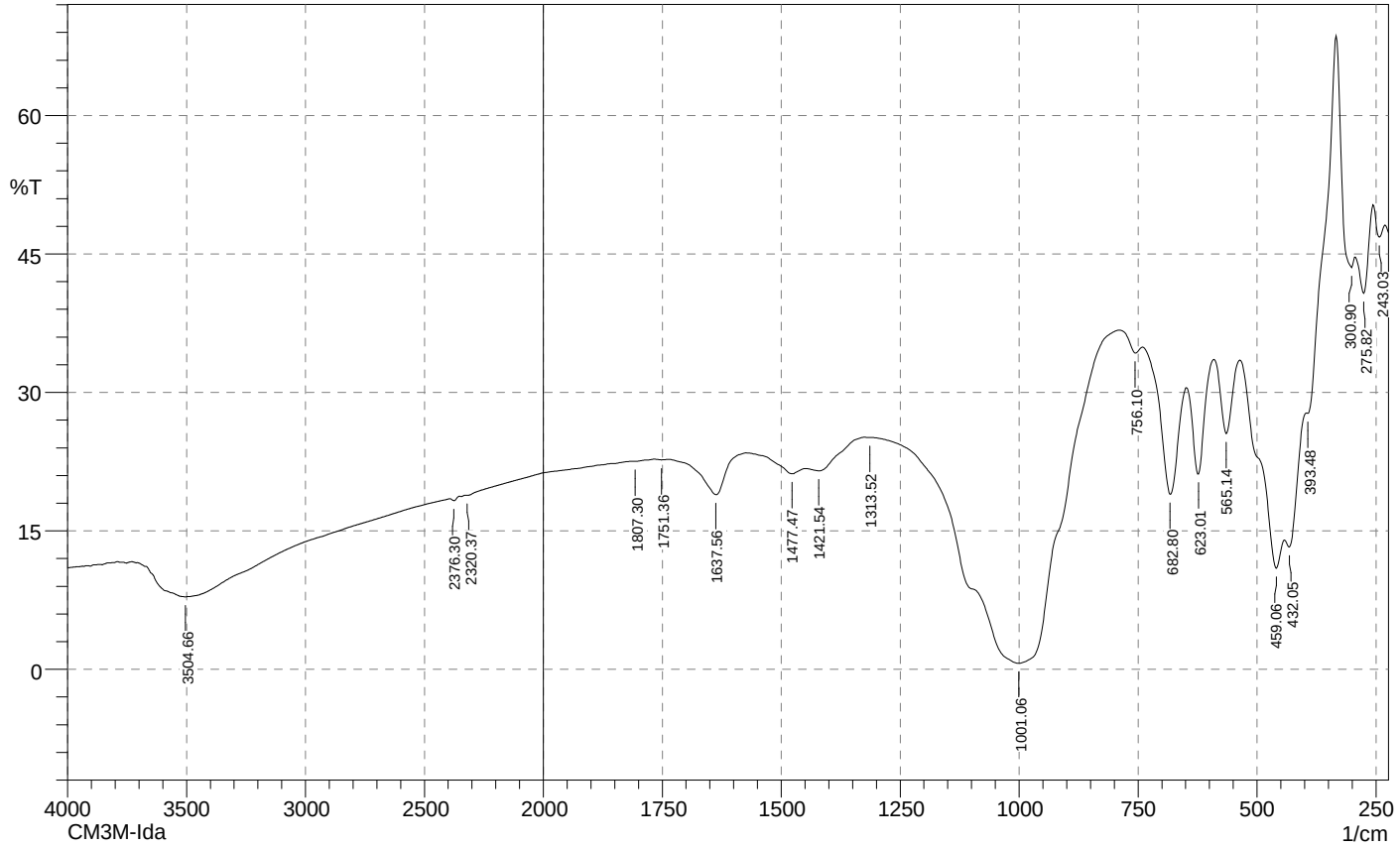
CM1,7 M-Ida

Date/Time; 1/11/2022 11:20:28 AM

No. of Scans;

Resolution;

Apodization;



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	243.03	46.812	2.343	254.6	231.46	7.439	0.28
2	275.82	40.732	6.623	293.18	256.53	13.005	1.18
3	300.9	43.51	4.743	333.69	295.11	11.835	1.766
4	393.48	27.745	1.315	395.41	335.61	22.061	0.859
5	432.05	13.264	3.743	441.7	397.34	32.243	1.582
6	459.06	10.936	6.316	536.21	443.63	65.534	3.988
7	565.14	25.526	7.996	590.22	538.14	27.53	2.806
8	623.01	21.155	10.73	648.08	592.15	31.776	4.14
9	682.8	18.965	13.142	738.74	650.01	51.025	7.791
10	756.1	34.255	1.259	788.89	740.67	21.777	0.282
11	1001.06	0.651	31.368	1307.74	790.81	497.302	230.007
12	1313.52	25.107	0.01	1325.1	1309.67	9.258	0.001
13	1421.54	21.503	0.942	1446.61	1325.1	77.332	0.839
14	1477.47	21.185	0.957	1571.99	1448.54	80.41	0.695
15	1637.56	18.924	4.253	1737.86	1573.91	109.152	4.818
16	1751.36	22.693	0.063	1764.87	1739.79	16.137	0.016
17	1807.3	22.532	0.033	1813.09	1766.8	29.866	0.017
18	2320.37	18.841	0.064	2326.15	1815.02	349.085	0.039
19	2376.3	18.283	0.306	2391.73	2353.16	28.297	0.138
20	3504.66	7.859	4.247	3670.54	2393.66	1146.698	71.18

Comment;

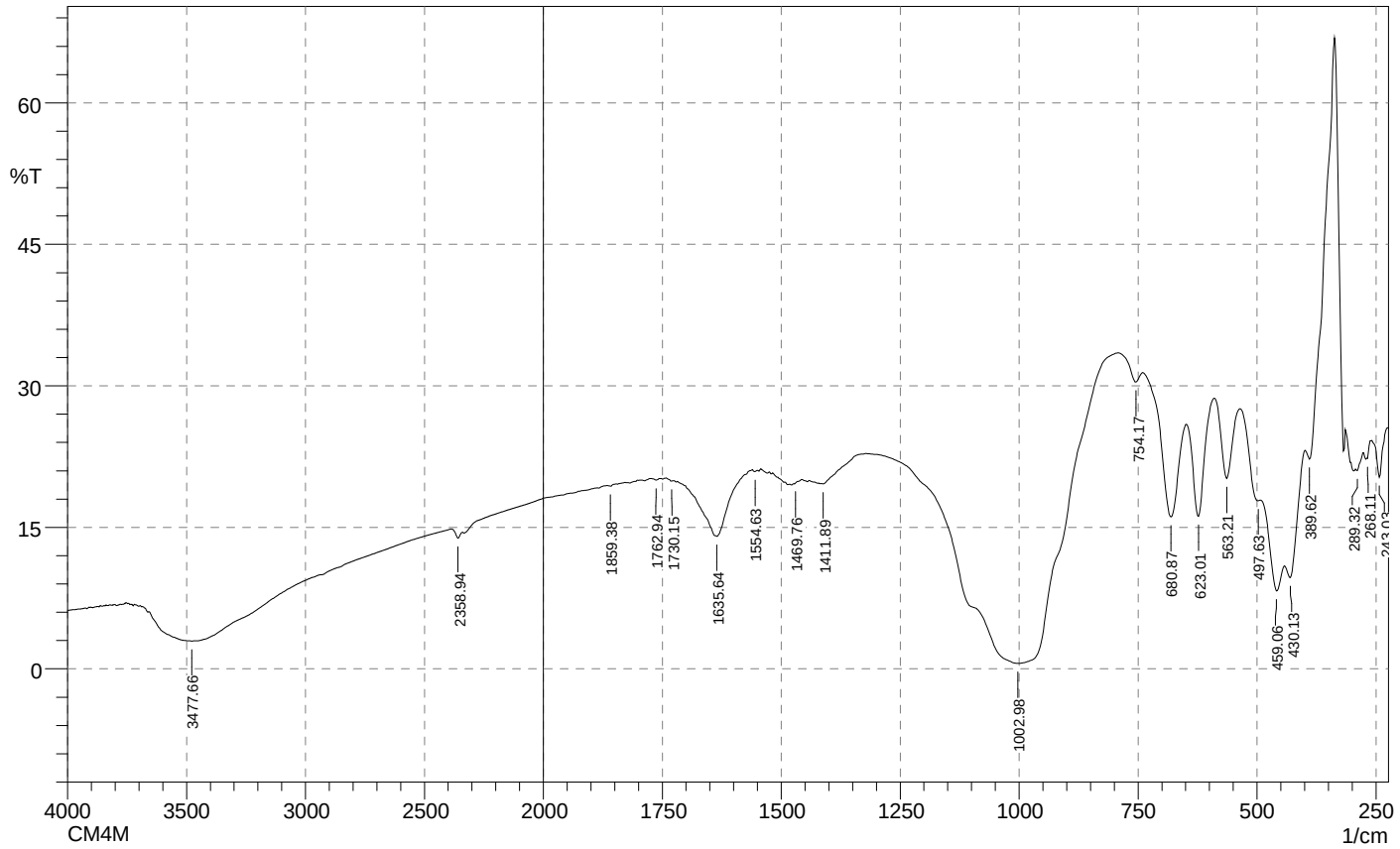
CM3M-Ida

Date/Time; 1/11/2022 11:13:36 AM

No. of Scans;

Resolution;

Apodization;



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	243.03	20.308	4.535	258.46	225.67	20.836	1.045
2	268.11	22.312	1.328	275.82	262.32	8.657	0.198
3	289.32	21.029	0.576	293.18	277.75	10.21	0.102
4	389.62	22.238	6.501	397.34	337.54	25.795	2.017
5	430.13	9.687	4.581	441.7	399.26	35.852	2.433
6	459.06	8.248	4.874	491.85	443.63	44.976	3.63
7	497.63	17.814	0.994	534.28	493.78	27.049	0.595
8	563.21	20.188	7.939	588.29	536.21	32.021	3.296
9	623.01	16.187	10.937	648.08	590.22	37.717	5.109
10	680.87	16.106	11.697	738.74	650.01	56.188	7.751
11	754.17	30.412	1.562	790.81	740.67	24.918	0.39
12	1002.98	0.578	28.675	1321.24	792.74	544.197	249.323
13	1411.89	19.616	0.392	1421.54	1323.17	66.062	0.167
14	1469.76	19.601	0.067	1471.69	1458.18	9.472	0.003
15	1554.63	20.909	0.171	1560.41	1550.77	6.541	0.02
16	1635.64	14.036	6.226	1716.65	1577.77	105.473	9.008
17	1730.15	19.897	0.124	1741.72	1726.29	10.782	0.021
18	1762.94	20.024	0.155	1774.51	1753.29	14.776	0.028
19	1859.38	19.363	0.116	1865.17	1847.81	12.333	0.017
20	2358.94	13.852	0.761	2385.95	2341.58	37.443	0.43
21	3477.66	2.954	0.024	3493.09	3466.08	41.26	0.052

Comment;

CM4M

Date/Time; 1/20/2022 2:26:44 PM

No. of Scans;

Resolution;

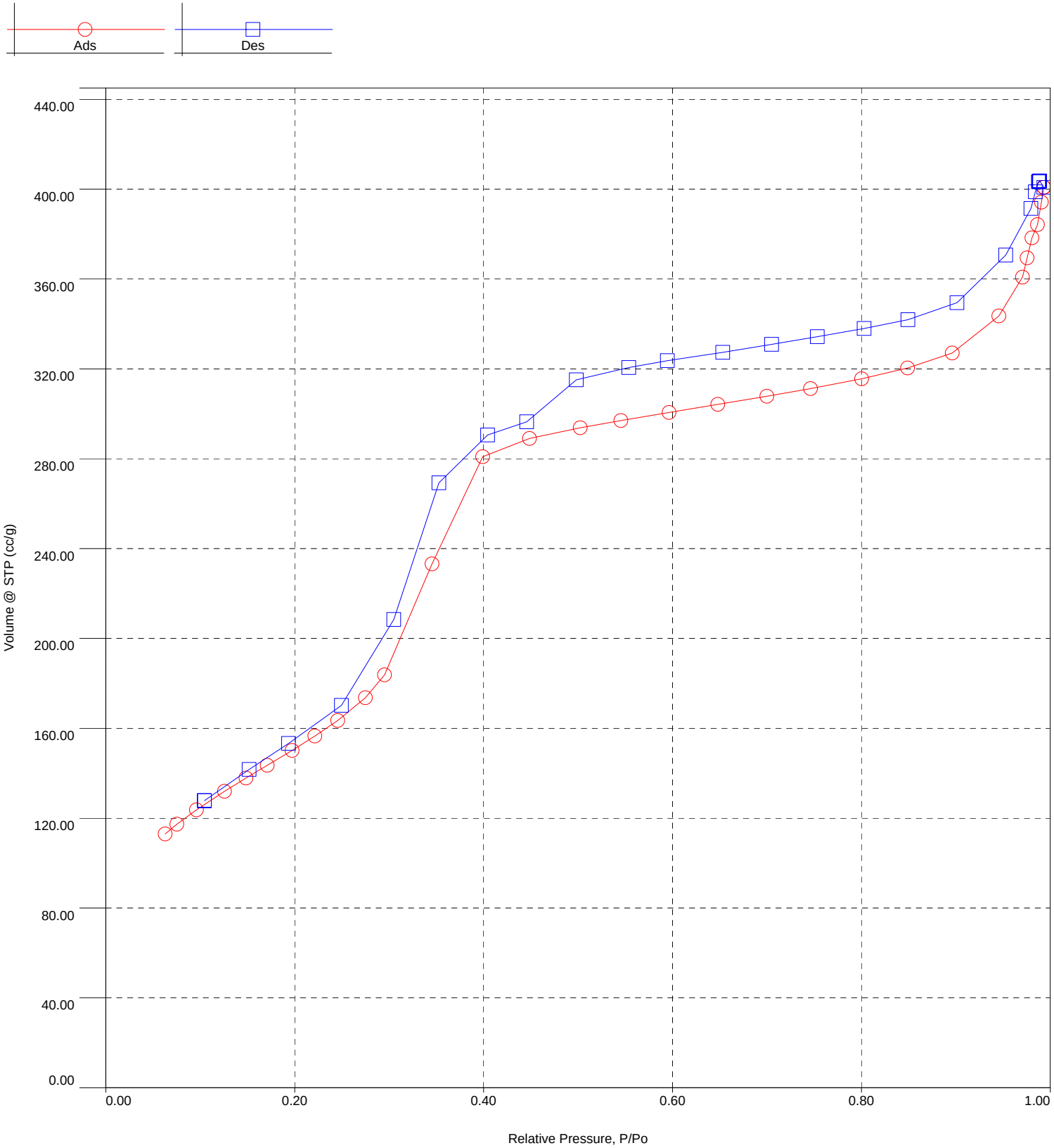
Apodization;

Analysis				**Report**			
Operator:	quantachrome	**Date:**	2022/08/04	**Operator:**	quantachrome	**Date:**	2022/08/04
Sample ID:	49735	**Filename:**		sttn_A_03082022_7461_BET_EK_49735.qps			
Sample Desc:	ANA(5%)	**Comment:**					
Sample weight:	0.1039 g	**Sample Volume:**	0.03047 cc			**Sample Density:**	3.41 g/cc
Outgas Time:	3.0 hrs	**OutgasTemp:**	250.0 C				
Analysis gas:	Nitrogen	**Bath Temp:**	273.0 K				
Press. Tolerance:	0.100/0.100 (ads/des)	**Equil time:**	60/60 sec (ads/des)			**Equil timeout:**	240/240 sec (ads/des)
Analysis Time:	709.8 min	**End of run:**	2022/08/04 1:15:52			**Instrument:**	Nova Station A
Cell ID:	9						

Isotherm : Linear

Data Reduction Parameters

Adsorbate	**Nitrogen**		**Temperature**	77.350K		
	Molec. Wt.:	28.013	**Cross Section:**	16.200 Å²	**Liquid Density:**	0.808 g/cc

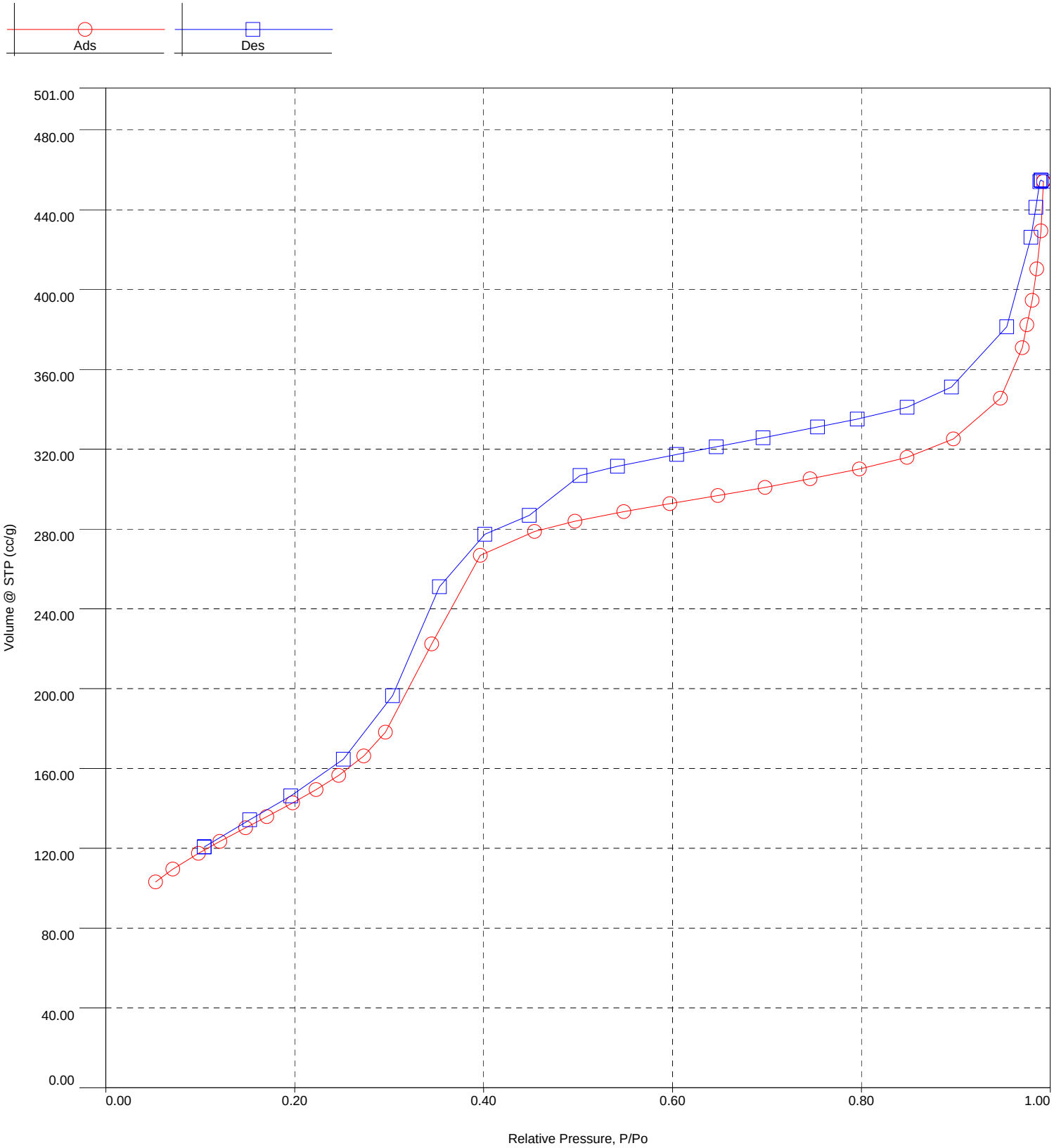


Analysis				**Report**			
Operator:	quantachrome	**Date:**	2022/08/04	**Operator:**	quantachrome	**Date:**	2022/08/04
Sample ID:	49735	**Filename:**		sttn_B_03072022_7462_BET_EK_49735.qps			
Sample Desc:	CAN(15%)	**Comment:**					
Sample weight:	0.1032 g	**Sample Volume:**	0.03026 cc			**Sample Density:**	3.41 g/cc
Outgas Time:	3.0 hrs	**OutgasTemp:**	250.0 C				
Analysis gas:	Nitrogen	**Bath Temp:**	273.0 K				
Press. Tolerance:	0.100/0.100 (ads/des)	**Equil time:**	60/60 sec (ads/des)			**Equil timeout:**	240/240 sec (ads/des)
Analysis Time:	715.3 min	**End of run:**	2022/08/04 1:21:23			**Instrument:**	Nova Station B
Cell ID:	16						

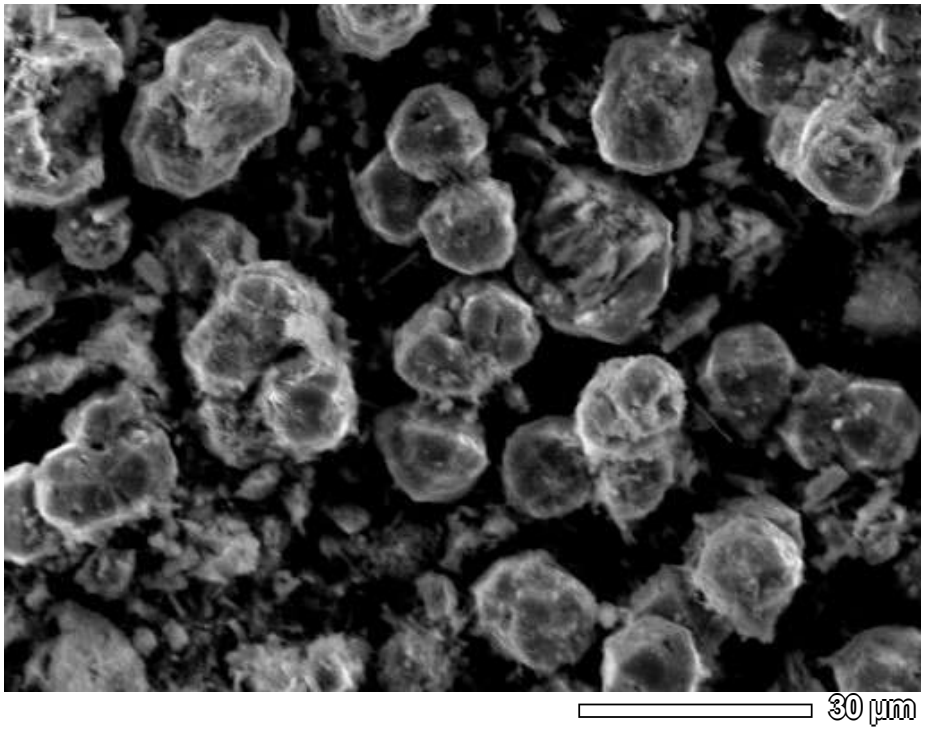
Isotherm : Linear

Data Reduction Parameters

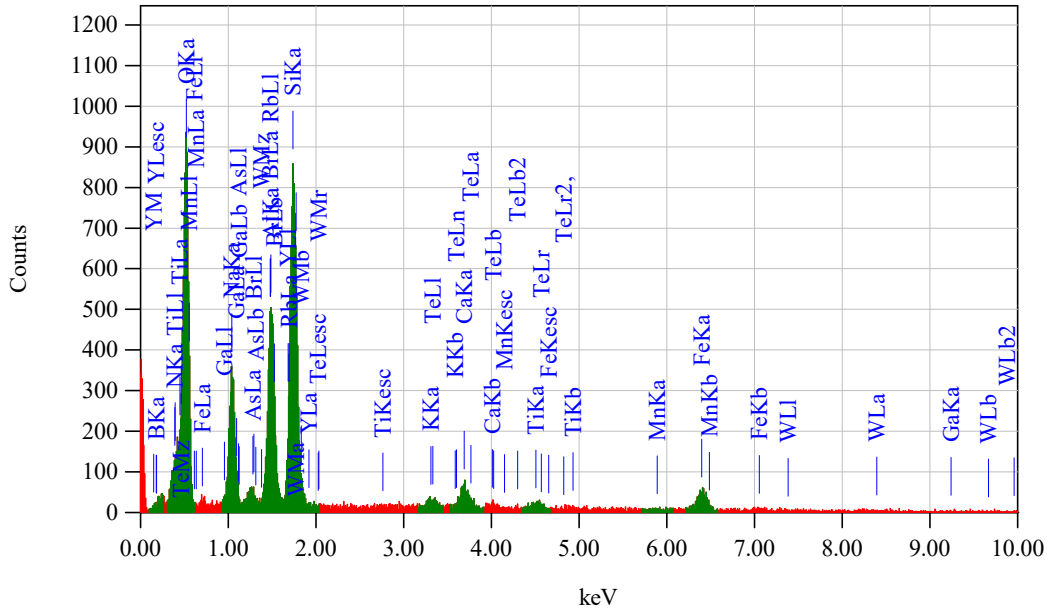
Adsorbate	**Nitrogen**		**Temperature**	77.350K		
	Molec. Wt.:	28.013	**Cross Section:**	16.200 Å²	**Liquid Density:**	0.808 g/cc



View000



Title	: IMG1
Instrument	: JCM-6000PLUS
Volt	: 15.00 kV
Mag.	: x 1,000
Date	: 2021/11/24
Pixel	: 512 x 384



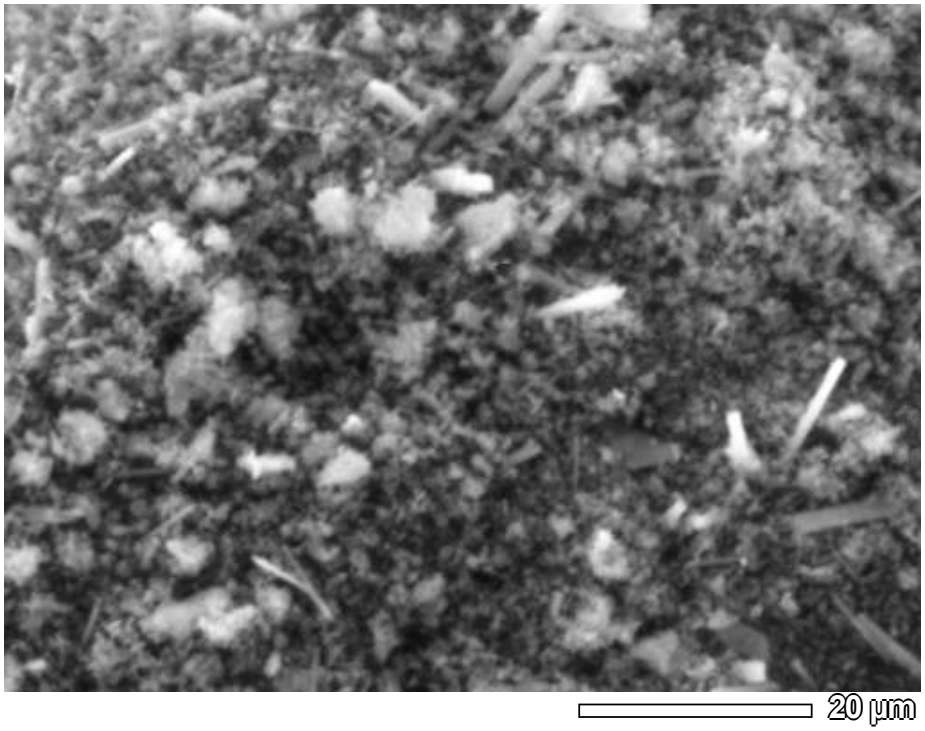
Acquisition Parameter
Instrument : JCM-6000PLUS
Acc. Voltage : 15.0 kV
Probe Current: 1.00000 nA
PHA mode : T3
Real Time : 50.42 sec
Live Time : 50.00 sec
Dead Time : 0 %
Counting Rate: 781 cps
Energy Range : 0 - 20 keV

Thin Film Standardless Standardless Quantitative Analysis
Fitting Coefficient : 0.1466

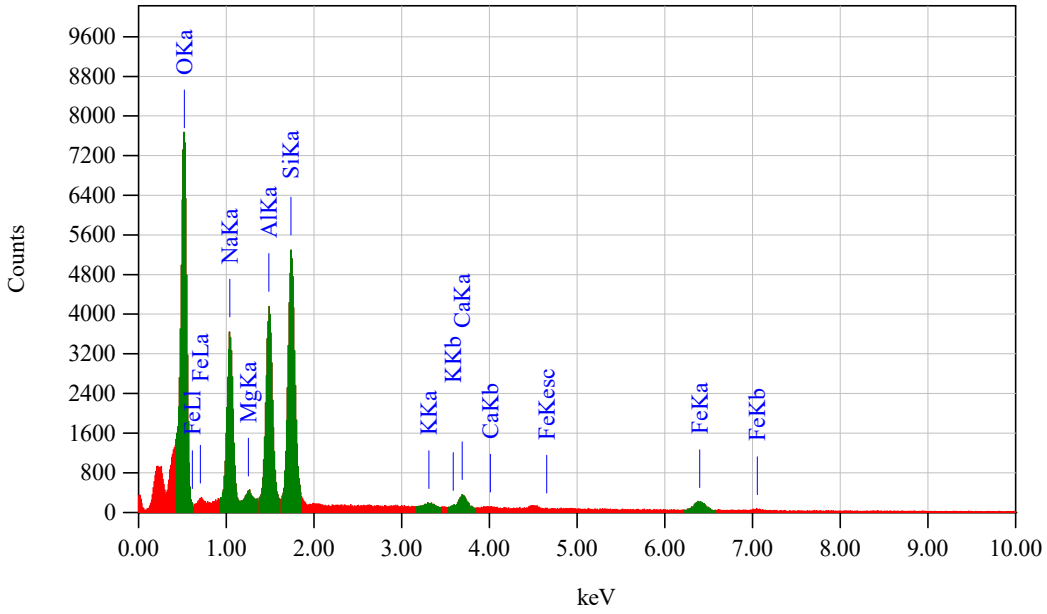
Element	(keV)	Mass%	Counts	Sigma	Atom%	Compound	Mass%	Cation	K
B K	0.183	1.25	22.17	0.07	3.77				18.6733
N K	0.392	0.64	120.22	0.07	1.49				1.7651
O K*	0.525	17.55	4704.10	0.29	35.59				1.2308
Na K	1.041	6.44	2241.67	0.20	9.09				0.9481
Al K*	1.486	7.72	2611.70	0.64	9.28				0.9748
Si K* (Ref.)	1.739	17.45	5758.05	0.37	20.16				1.0000
K K	3.312	0.95	197.64	0.12	0.79				1.5846
Ca K*	3.690	2.86	556.08	0.19	2.31				1.6953
Ti K*	4.508	0.98	143.38	0.14	0.66				2.2439
Mn K	5.894	0.21	20.98	0.12	0.13				3.3574
Fe K*	6.398	7.54	647.28	0.42	4.38				3.8436
Ga L*	1.098	2.78	225.25	0.38	1.29				4.0678
As L*	1.282	1.36	114.69	0.28	0.59				3.9059
Br L	1.480	10.36	893.47	2.35	4.21				3.8263
Rb L	1.694	9.10	763.18	0.94	3.45				3.9313
Y L	1.922	2.26	172.98	0.35	0.82				4.3095
Te L*	3.769	1.61	92.96	0.31	0.41				5.7208

W M	1.774	8.93	933.46	0.68	1.58		3.1562
Total		100.00			100.00		

View003



Title	: IMG1
Instrument	: JCM-6000PLUS
Volt	: 15.00 kV
Mag.	: x 1,500
Date	: 2022/02/03
Pixel	: 512 x 384

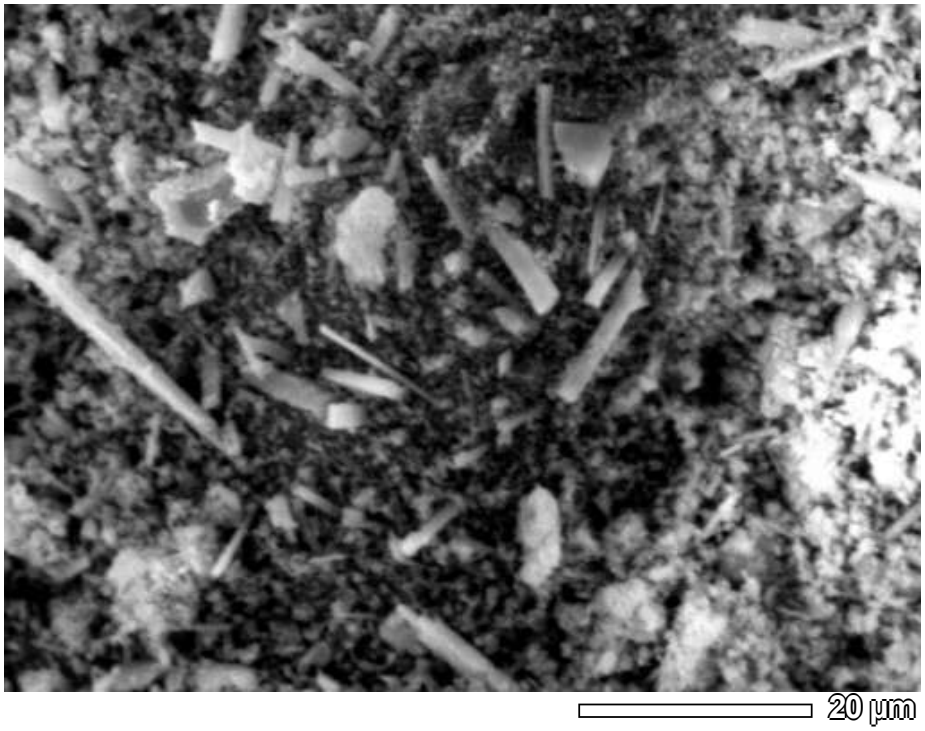


Acquisition Parameter
Instrument : JCM-6000PLUS
Acc. Voltage : 15.0 kV
Probe Current: 1.00000 nA
PHA mode : T3
Real Time : 50.94 sec
Live Time : 50.00 sec
Dead Time : 1 %
Counting Rate: 5814 cps
Energy Range : 0 - 20 keV

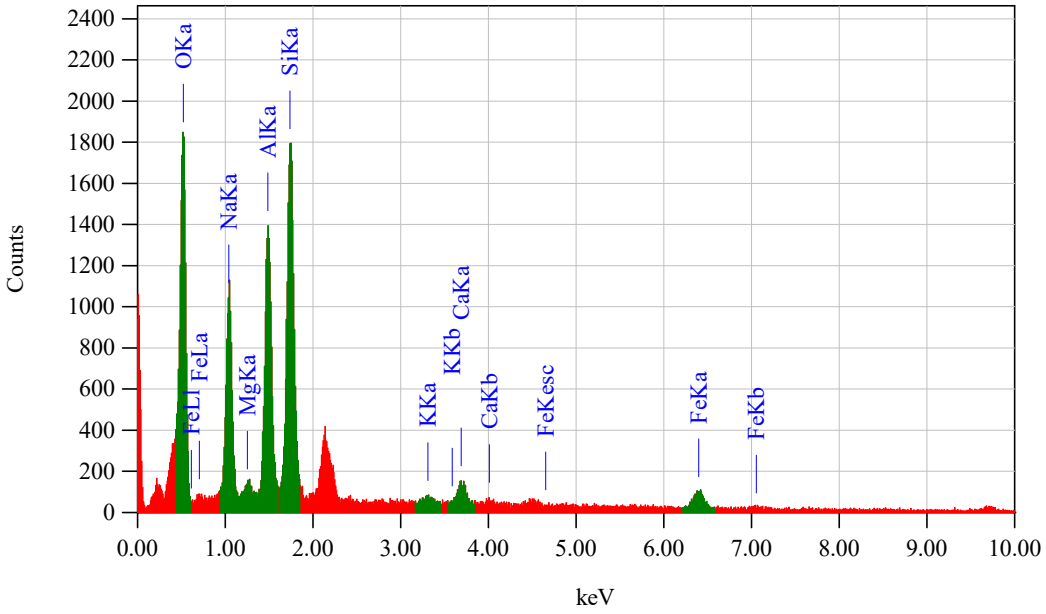
Thin Film Standardless Standardless Quantitative Analysis
Fitting Coefficient : 0.0896

Element	(keV)	Mass%	Counts	Sigma	Atom%	Compound	Mass%	Cation	K
O K (Ref.)	0.525	31.93	39704.16	0.18	45.19				1.0000
Na K	1.041	13.76	22208.77	0.13	13.55				0.7703
Mg K	1.253	1.02	1692.91	0.04	0.95				0.7512
Al K	1.486	18.93	29724.28	0.17	15.89				0.7920
Si K	1.739	24.71	37813.51	0.20	19.92				0.8125
K K	3.312	0.73	709.18	0.05	0.43				1.2875
Ca K	3.690	2.86	2577.19	0.09	1.61				1.3774
Fe K	6.398	6.05	2408.01	0.18	2.45				3.1229
Total		100.00			100.00				

View004



Title	: IMG1
Instrument	: JCM-6000PLUS
Volt	: 15.00 kV
Mag.	: x 1,500
Date	: 2022/02/03
Pixel	: 512 x 384



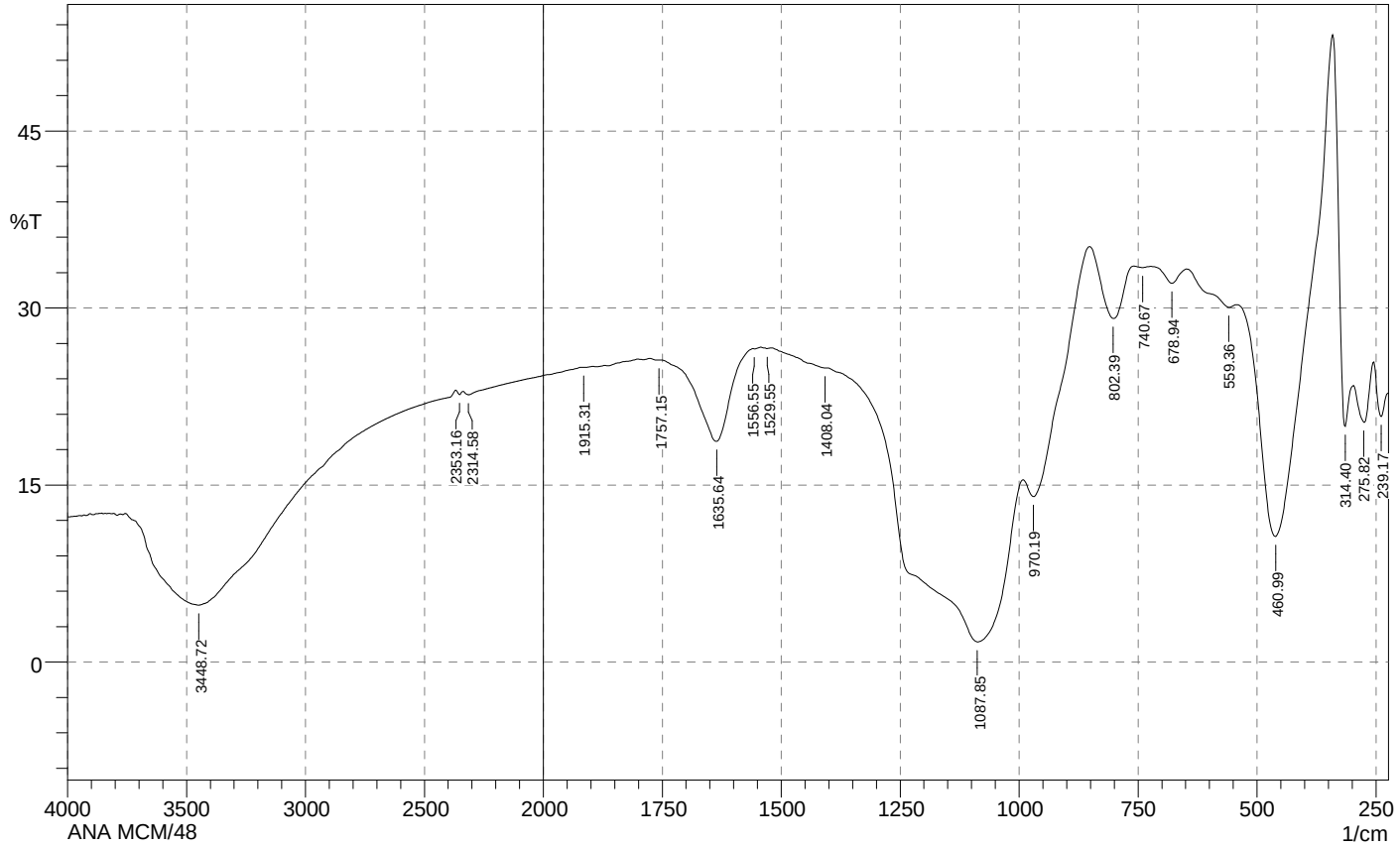
Acquisition Parameter

Instrument	: JCM-6000PLUS
Acc. Voltage	: 15.0 kV
Probe Current	: 1.00000 nA
PHA mode	: T3
Real Time	: 50.92 sec
Live Time	: 50.00 sec
Dead Time	: 1 %
Counting Rate	: 2189 cps
Energy Range	: 0 - 20 keV

Thin Film Standardless Standardless Quantitative Analysis

Fitting Coefficient : 0.1845

Element	(keV)	Mass%	Counts	Sigma	Atom%	Compound	Mass%	Cation	K
O K	0.525	24.43	9485.17	0.28	36.84				1.2308
Na K	1.041	13.06	6582.50	0.23	13.71				0.9481
Mg K	1.253	1.04	537.49	0.08	1.03				0.9246
Al K	1.486	20.55	10072.33	0.32	18.37				0.9748
Si K (Ref.)	1.739	27.09	12943.92	0.38	23.27				1.0000
K K	3.312	0.83	250.33	0.11	0.51				1.5846
Ca K	3.690	3.88	1092.78	0.19	2.33				1.6953
Fe K	6.398	9.11	1132.72	0.40	3.94				3.8436
Total		100.00			100.00				



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	239.17	20.81	3.306	254.6	223.74	20.163	1.033
2	275.82	20.313	4.149	297.04	256.53	26.617	1.834
3	314.4	19.964	14.651	339.47	298.97	22.652	3.958
4	460.99	10.646	28.879	542	341.4	127.632	48.318
5	559.36	30.065	0.677	646.15	543.93	51.669	0.709
6	678.94	32.097	1.299	723.31	648.08	36.333	0.52
7	740.67	33.433	0.105	758.02	725.23	15.582	0.025
8	802.39	29.112	5.211	850.61	759.95	45.392	3.319
9	970.19	14.022	4.441	991.41	852.54	92.26	5.266
10	1087.85	1.713	15.9	1404.18	993.34	435.448	145.063
11	1408.04	24.932	0.031	1521.84	1406.11	68.234	0.079
12	1529.55	26.559	0.085	1543.05	1523.76	11.09	0.014
13	1556.55	26.536	0.036	1558.48	1544.98	7.765	0.006
14	1635.64	18.705	7.472	1749.44	1560.41	120.633	10.295
15	1757.15	25.582	0.05	1774.51	1751.36	13.691	0.018
16	1915.31	24.971	0.012	1917.24	1897.95	11.612	0.005
17	2314.58	22.649	0.401	2337.72	1919.17	261.637	1.768
18	2353.16	22.656	0.331	2368.59	2339.65	18.564	0.09
19	3448.72	4.827	10.086	3757.33	2370.51	1262.224	197.763

Comment;

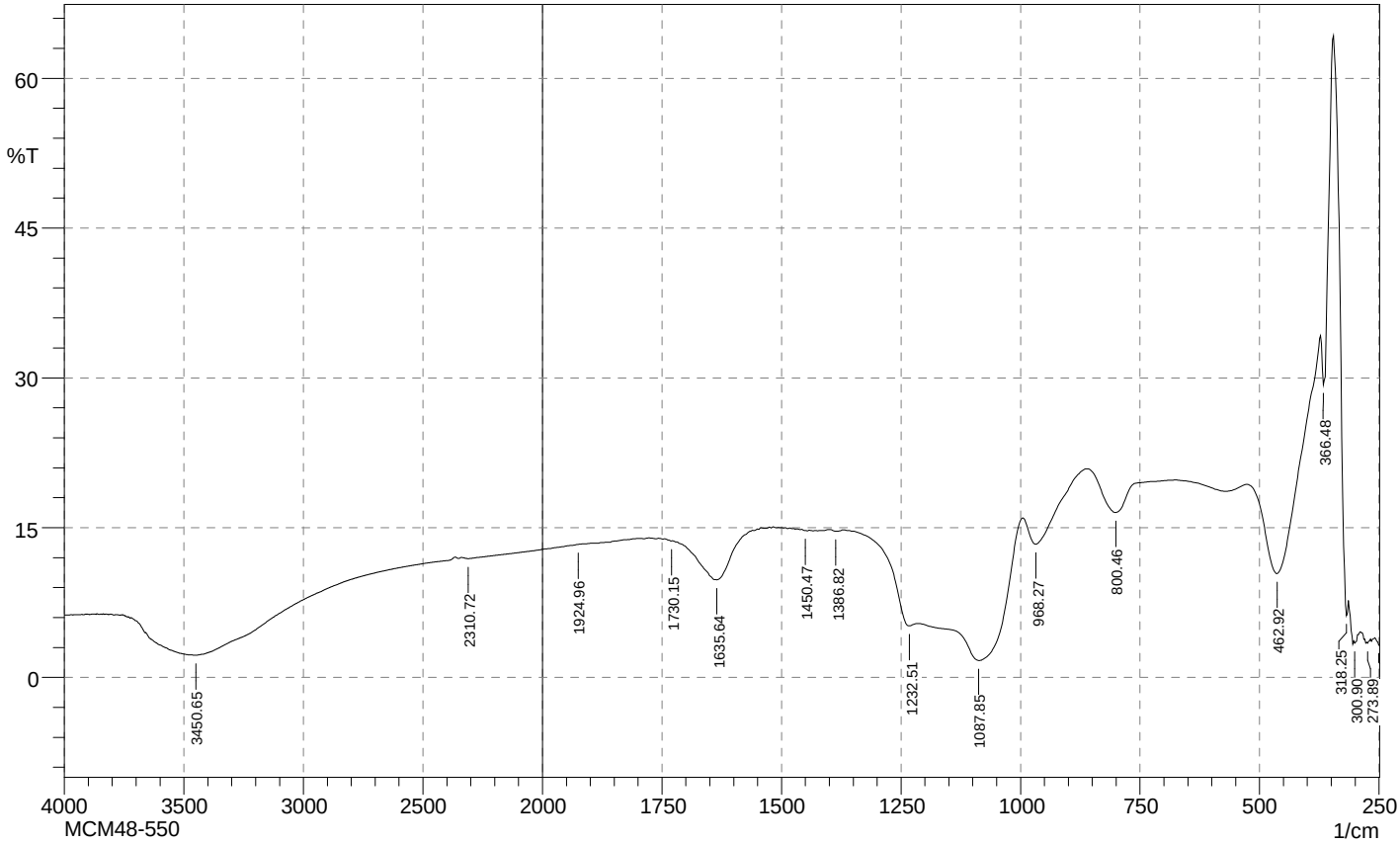
ANA MCM/48

Date/Time; 1/11/2022 10:43:46 AM

No. of Scans;

Resolution;

Apodization;



	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	248.82	3.203	0	258.46	248.82	13.965	0.01
2	250.75	3.203	0.156	258.46	248.82	14.057	0.033
3	273.89	3.43	0.425	289.32	270.03	27.317	0.493
4	300.9	3.433	2.12	312.47	291.25	29.464	2.626
5	318.25	6.185	8.584	345.26	314.4	19.078	-1.069
6	366.48	29.329	11.333	372.26	345.26	10.324	1.445
7	462.92	10.41	15.07	526.57	372.26	116.19	25.21
8	800.46	16.519	3.995	860.25	684.73	127.111	5.653
9	968.27	13.341	3.618	995.27	860.25	104.936	5.267
10	1087.85	1.699	9.825	1213.23	997.2	291.269	68.759
11	1232.51	5.171	1.282	1371.39	1215.15	152.079	-11.714
12	1386.82	14.639	0.163	1398.39	1371.39	22.482	0.077
13	1450.47	14.698	0.027	1458.18	1448.54	8.018	0.006
14	1635.64	9.763	4.423	1718.58	1560.41	145.395	11.051
15	1730.15	13.675	0.034	1745.58	1728.22	14.945	0.005
16	1924.96	13.335	0.006	1926.89	1913.39	11.805	-0.001
17	2310.72	11.901	0.218	2337.72	1926.89	371.807	3.16
18	3450.65	2.229	0.159	3466.08	2364.73	1266.301	0.788

Comment;

MCM48-550

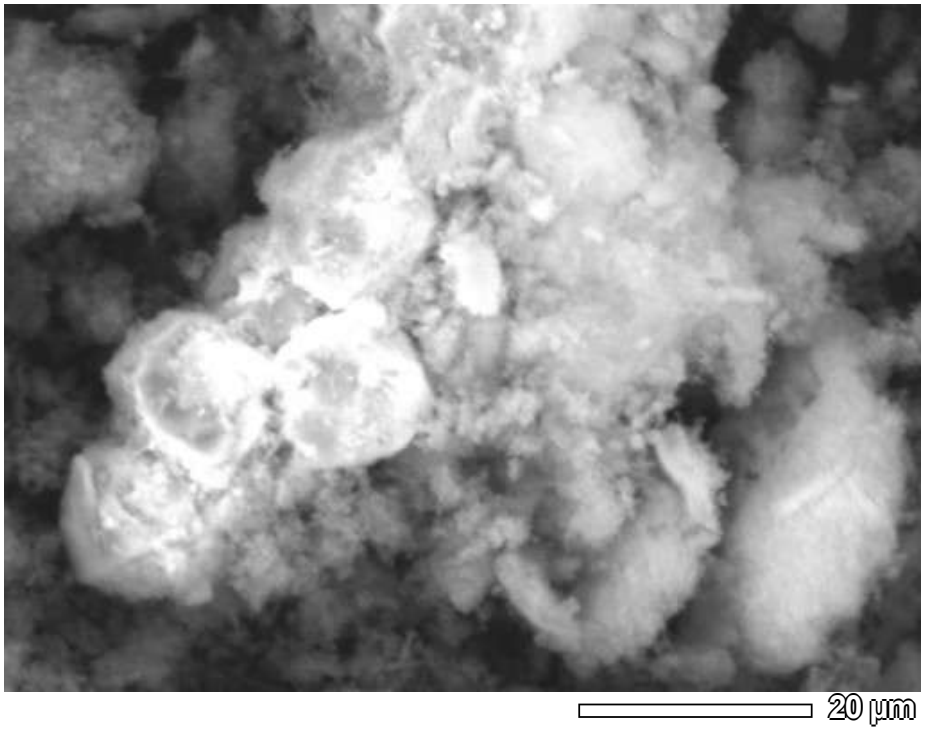
Date/Time; 2/11/2021 2:46:49 PM

No. of Scans;

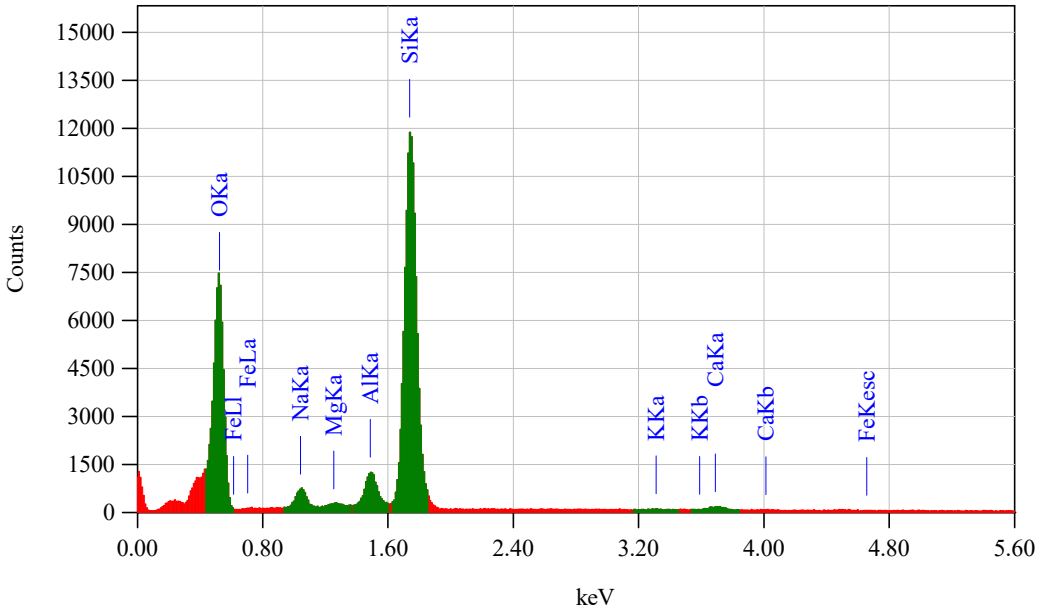
Resolution;

Apodization;

View010



Title	: IMG1
Instrument	: JCM-6000PLUS
Volt	: 15.00 kV
Mag.	: x 1,500
Date	: 2022/07/21
Pixel	: 512 x 384

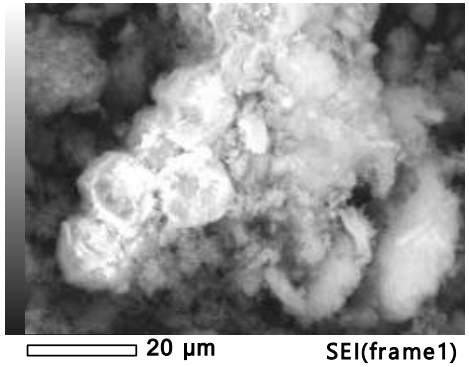


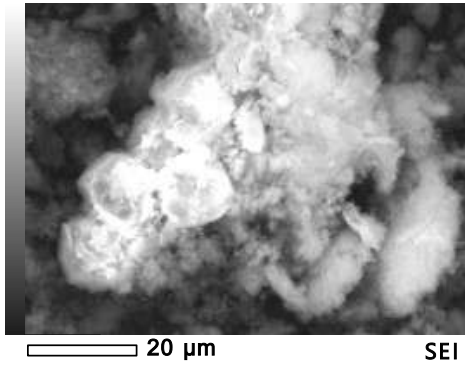
Acquisition Parameter
Instrument : JCM-6000PLUS
Acc. Voltage : 15.0 kV
Probe Current: 1.00000 nA
PHA mode : T3
Real Time : 51.04 sec
Live Time : 50.00 sec
Dead Time : 2 %
Counting Rate: 5594 cps
Energy Range : 0 - 20 keV

Thin Film Standardless Standardless Quantitative Analysis
Fitting Coefficient : 0.0958

Element	(keV)	Mass%	Counts	Sigma	Atom%	Compound	Mass%	Cation	K
O K	0.525	30.42	37888.06	0.17	43.63				1.2308
Na K	1.041	2.39	3858.80	0.06	2.38				0.9481
Mg K	1.253	0.41	679.27	0.03	0.39				0.9246
Al K	1.486	5.06	7954.41	0.09	4.30				0.9748
Si K (Ref.)	1.739	58.41	89550.08	0.31	47.72				1.0000
K K	3.312	0.21	198.69	0.04	0.12				1.5846
Ca K	3.690	1.15	1044.30	0.06	0.66				1.6953
Fe K	6.398	1.95	778.61	0.11	0.80				3.8436
Total		100.00			100.00				

View010


20 µm
SEI(frame1)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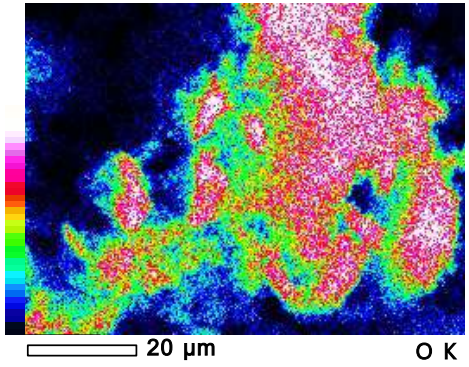
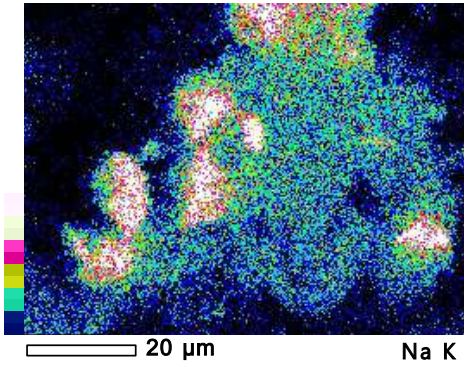
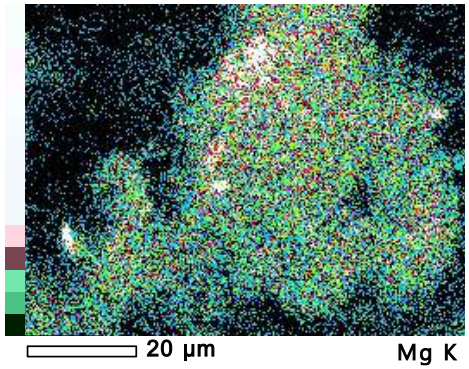
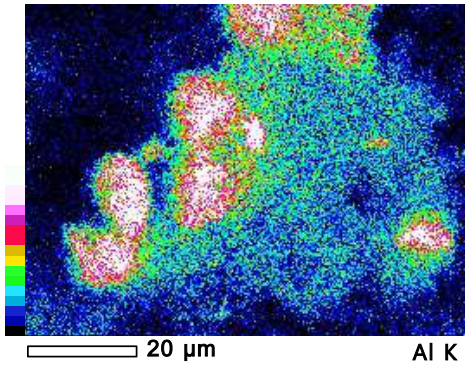
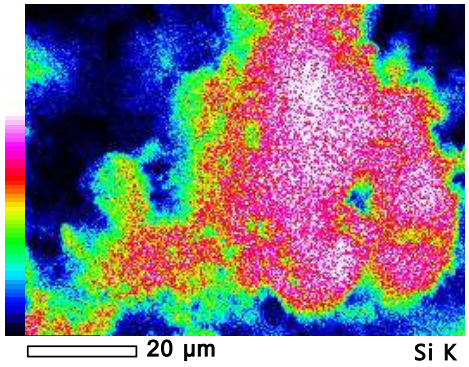
SEI

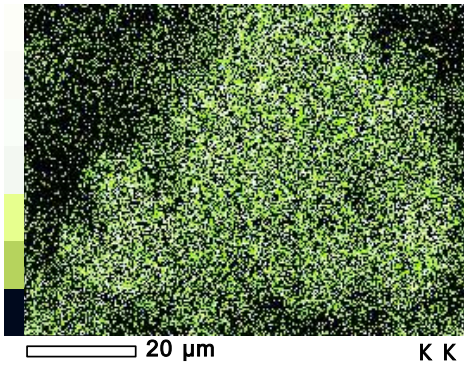

20 µm
O K

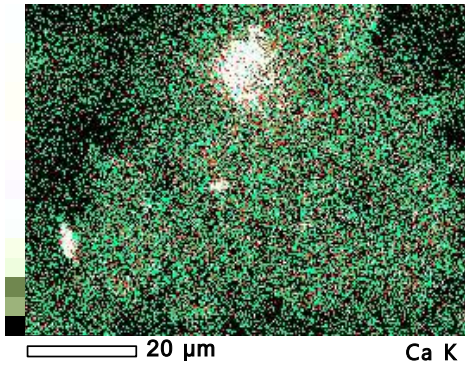

20 µm
Na K

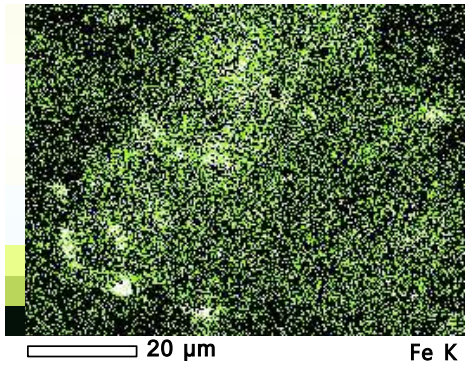

20 µm
Mg K


20 µm
Al K


20 µm
Si K


20 µm
K K


20 µm
Ca K

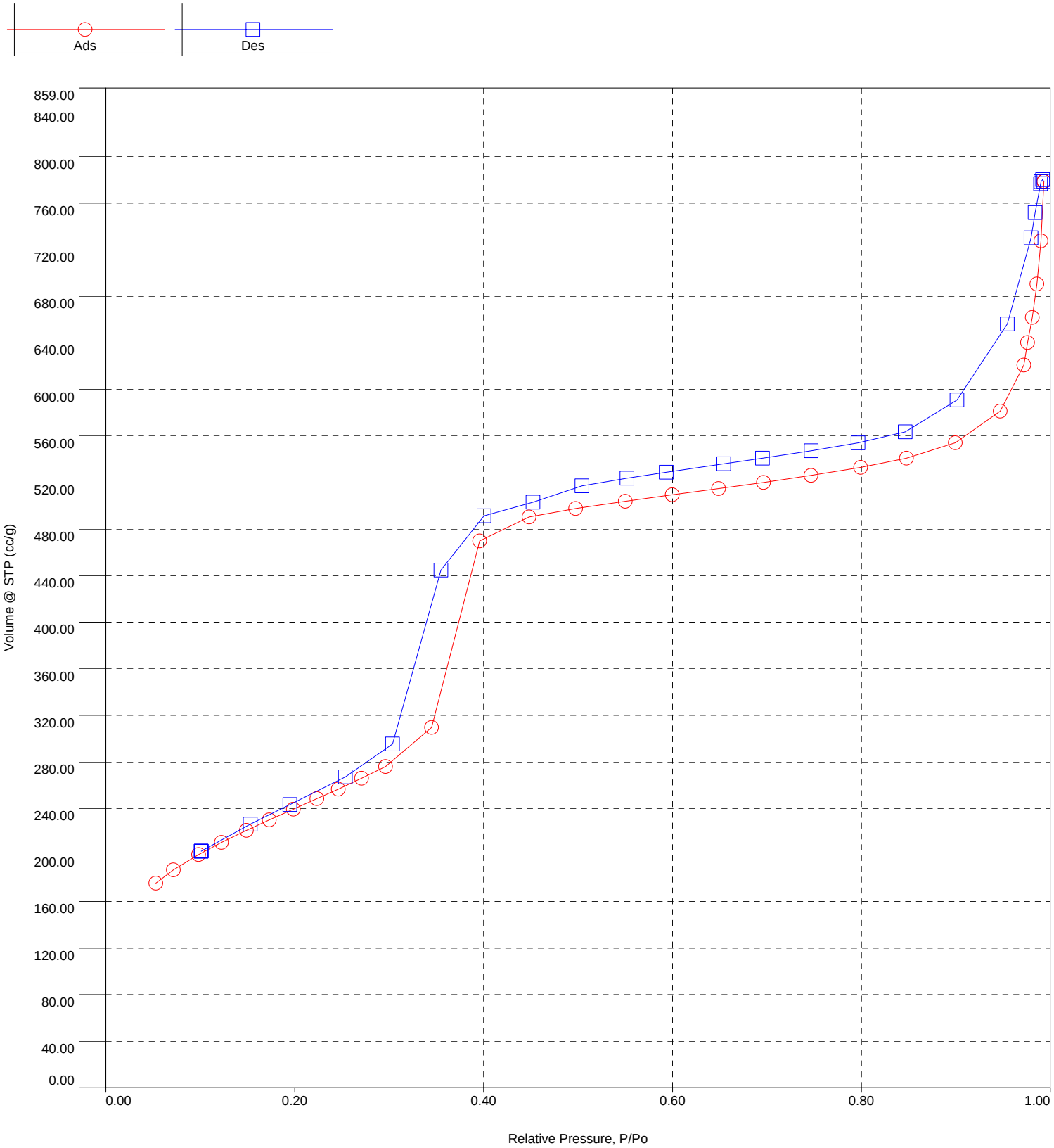

20 µm
Fe K

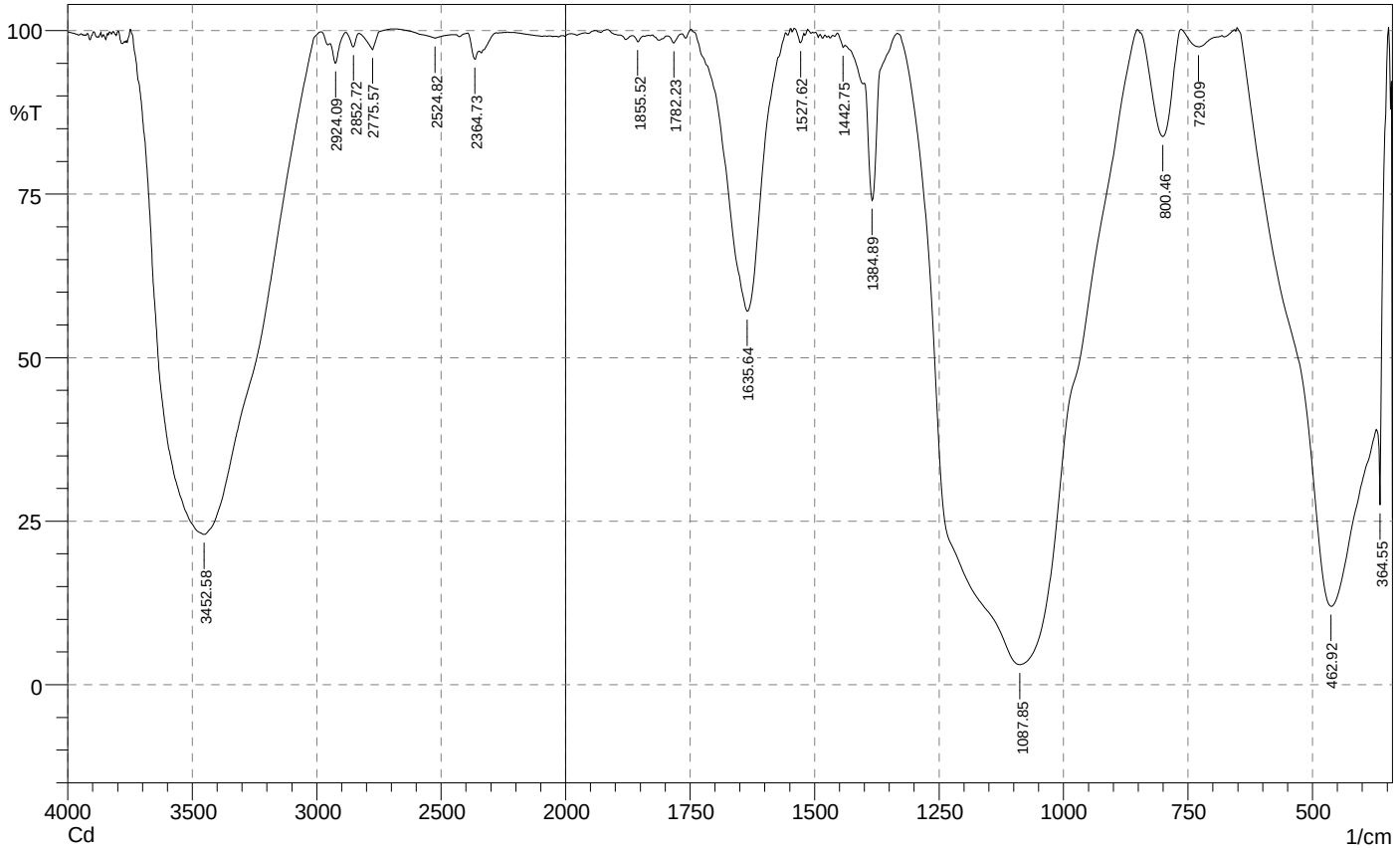
Analysis				**Report**			
Operator:	quantachrome	**Date:**	2021/09/26	**Operator:**	quantachrome	**Date:**	2021/09/28
Sample ID:	20753	**Filename:**		sttn_D_25092021_7005_BET_EK_20753.qps			
Sample Desc:	CM/MCM-48 (5%)	**Comment:**					
Sample weight:	0.085 g	**Sample Volume:**	0.02493 cc		**Sample Density:**	3.41 g/cc	
Outgas Time:	3.0 hrs	**OutgasTemp:**	250.0 C				
Analysis gas:	Nitrogen	**Bath Temp:**	273.0 K				
Press. Tolerance:	0.100/0.100 (ads/des)	**Equil time:**	60/60 sec (ads/des)		**Equil timeout:**	240/240 sec (ads/des)	
Analysis Time:	1103.9 min	**End of run:**	2021/09/26 10:35:29		**Instrument:**	Nova Station D	
Cell ID:	14						

Isotherm : Linear

Data Reduction Parameters

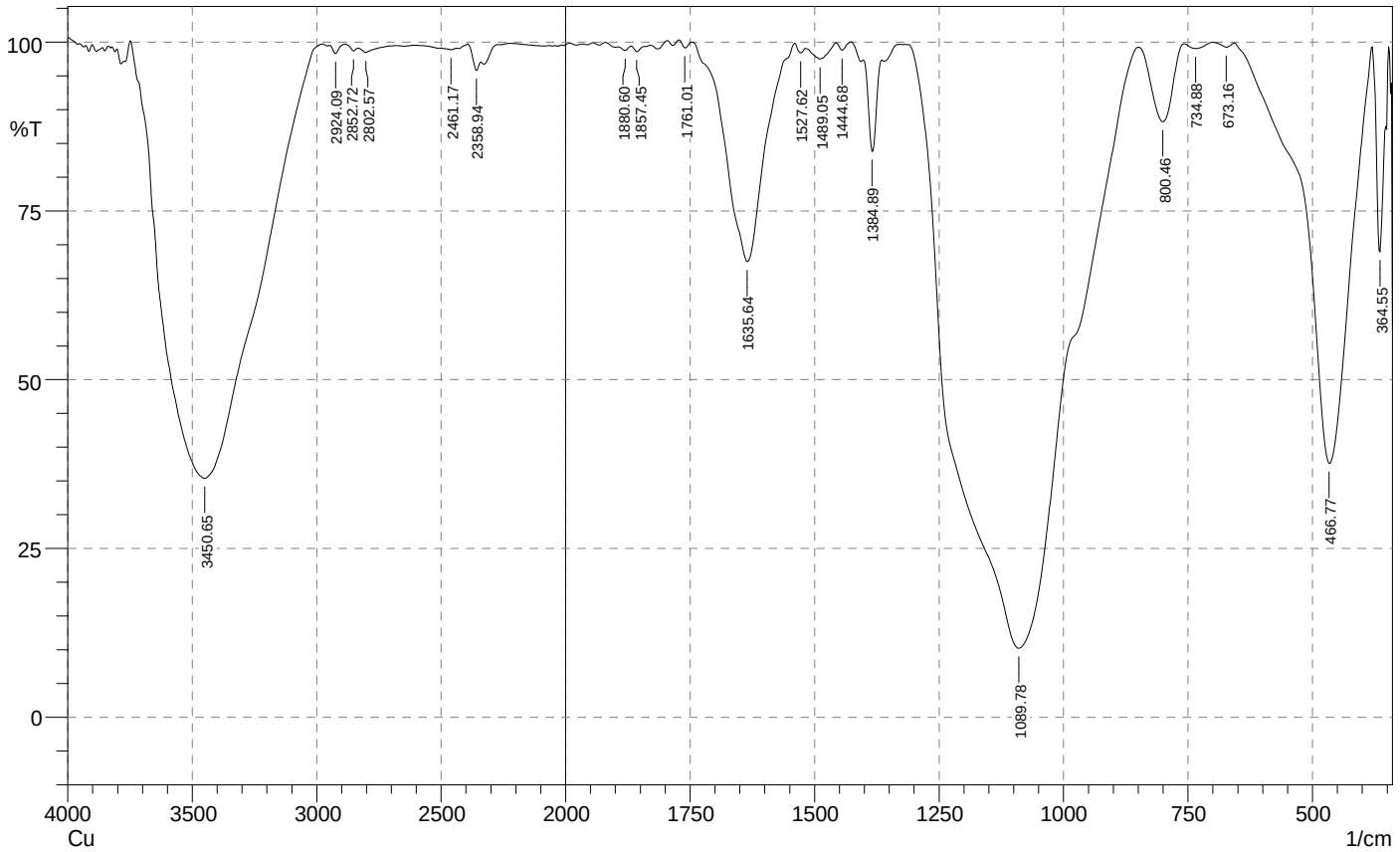
Adsorbate	**Nitrogen**		**Temperature**	77.350K		
	Molec. Wt.:	28.013	**Cross Section:**	16.200 Å²	**Liquid Density:**	0.808 g/cc





No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	364.55	27.5	31.59	372.26	349.12	5.52	1.35
2	462.92	11.98	47.03	650.01	372.26	114.04	57.07
3	729.09	97.53	2.25	763.81	682.8	0.52	0.42
4	800.46	83.8	16.35	850.61	765.74	3.28	3.34
5	1087.85	3.06	96.79	1332.81	852.54	278.61	278.29
6	1384.89	74.06	19.32	1398.39	1334.74	2.94	1.72
7	1442.75	97.44	0.78	1454.33	1438.9	0.11	0.02
8	1527.62	98.16	1.62	1541.12	1521.84	0.07	0.06
9	1635.64	57.11	42.76	1747.51	1558.48	17.75	17.69
10	1782.23	98.1	1.24	1797.66	1766.8	0.15	0.06
11	1855.52	98.32	0.9	1867.09	1843.95	0.12	0.04
12	2364.73	95.6	2.3	2393.66	2347.37	0.57	0.21
13	2524.82	98.85	0.8	2690.7	2453.45	0.49	0.3
14	2775.57	97.06	2.78	2829.57	2690.7	0.49	0.44
15	2852.72	97.5	2.15	2883.58	2829.57	0.3	0.22
16	2924.09	95.02	3.62	2947.23	2883.58	0.71	0.4
17	3452.58	22.97	77.08	3747.69	2983.88	239.01	239.04

Date/Time; 6/2/2022 3:04:22 PM
No. of Scans;
Resolution;
Apodization;



	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	364.55	68.93	22.73	379.98	354.9	2.38	1.52
2	466.77	37.61	61.78	655.8	381.91	36.91	36.34
3	673.16	99.23	0.68	698.23	657.73	0.07	0.06
4	734.88	99.05	0.8	758.02	698.23	0.15	0.11
5	800.46	88.21	11.3	848.68	759.95	2.52	2.33
6	1089.78	10.24	89.19	1309.67	850.61	180.35	179.19
7	1384.89	83.83	13.44	1400.32	1365.6	1.48	1.06
8	1444.68	98.8	1.13	1456.26	1425.4	0.08	0.07
9	1489.05	97.5	1.93	1517.98	1456.26	0.43	0.28
10	1527.62	98.41	1	1539.2	1517.98	0.1	0.05
11	1635.64	67.47	32.39	1745.58	1541.12	13.51	13.39
12	1761.01	99.14	1.03	1772.58	1745.58	0.04	0.06
13	1857.45	98.6	0.78	1869.02	1840.09	0.12	0.04
14	1880.6	98.76	0.58	1894.1	1869.02	0.1	0.03
15	2358.94	95.78	2.14	2393.66	2341.58	0.58	0.21
16	2461.17	98.88	0.21	2511.32	2438.02	0.32	0.03
17	2802.57	98.45	0.74	2835.36	2679.13	0.64	0.16
18	2852.72	98.68	0.64	2885.51	2835.36	0.19	0.06
19	2924.09	98.3	1.28	2949.16	2885.51	0.25	0.14
20	3450.65	35.38	64.61	3747.69	2978.09	165.38	165.17

Date/Time; 6/2/2022 3:15:18 PM
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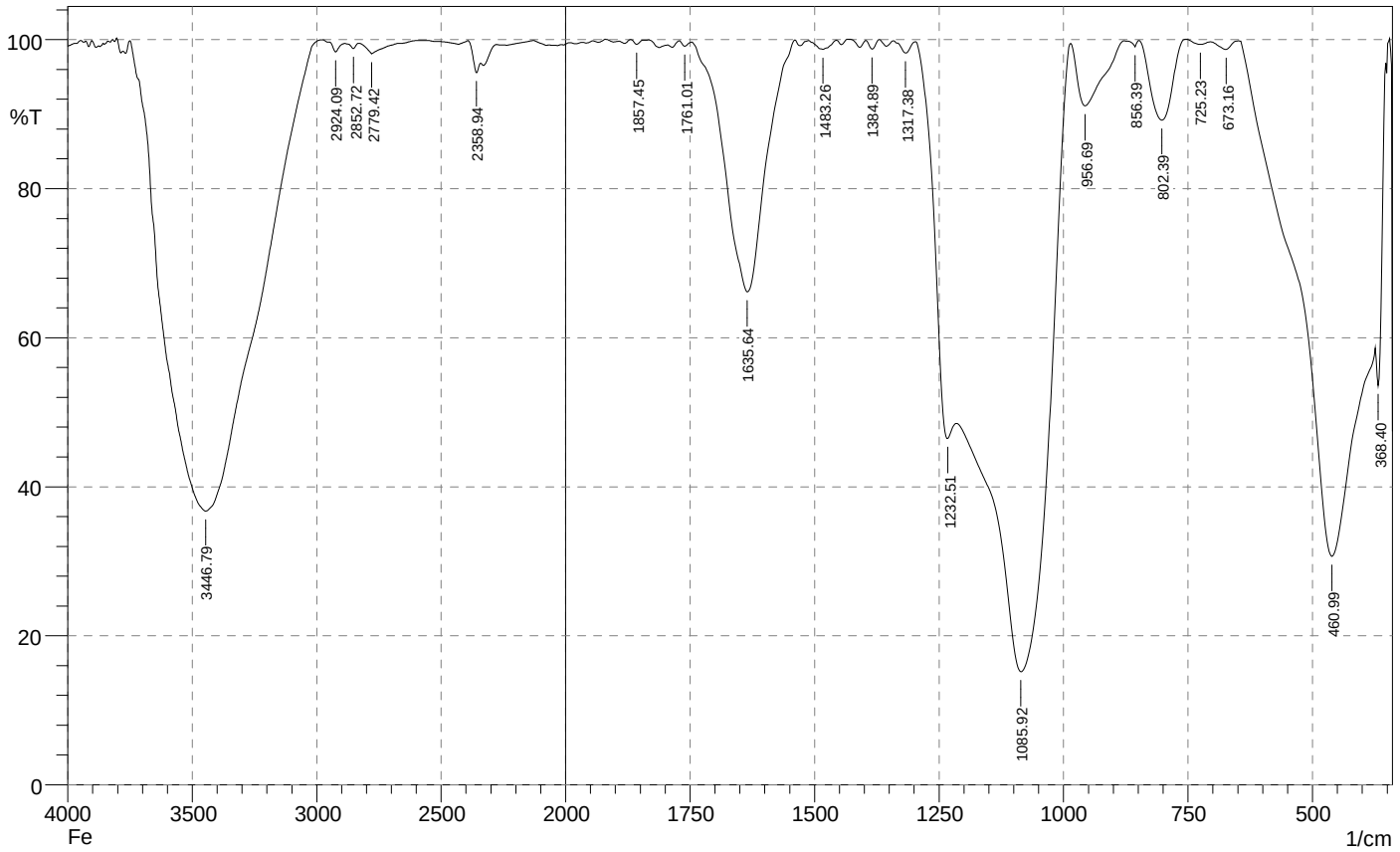
Resolution;
Apodization;



	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	368.4	53.57	16.04	374.19	354.9	3.44	1.21
2	460.99	30.68	40.28	644.22	376.12	62.09	29.63
3	673.16	98.67	1.1	705.95	650.01	0.18	0.12
4	725.23	99.36	0.48	754.17	705.95	0.08	0.05
5	802.39	89.19	10.75	846.75	756.1	2.36	2.34
6	856.39	99.03	0.84	871.82	848.68	0.04	0.03
7	956.69	91.13	8.46	985.62	879.54	2.31	2.16
8	1085.92	15.18	62.23	1215.15	987.55	100.16	64.41
9	1232.51	46.49	11.98	1296.16	1217.08	13.71	2.1
10	1317.38	98.2	1.58	1342.46	1298.09	0.18	0.14
11	1384.89	98.73	1.21	1396.46	1371.39	0.08	0.07
12	1483.26	98.7	0.21	1487.12	1456.26	0.11	0.02
13	1635.64	66.14	33.7	1745.58	1539.2	14.93	14.77
14	1761.01	99.11	0.66	1772.58	1747.51	0.06	0.03
15	1857.45	99.37	0.61	1869.02	1842.02	0.03	0.03
16	2358.94	95.56	2.33	2391.73	2341.58	0.57	0.21
17	2779.42	98.09	1.41	2831.5	2669.48	0.75	0.4
18	2852.72	98.81	0.66	2877.79	2831.5	0.17	0.06
19	2924.09	98.36	1.25	2951.09	2887.44	0.25	0.14
20	3446.79	36.74	63.17	3749.62	2980.02	157.62	157.36

Date/Time; 6/2/2022 2:56:40 PM
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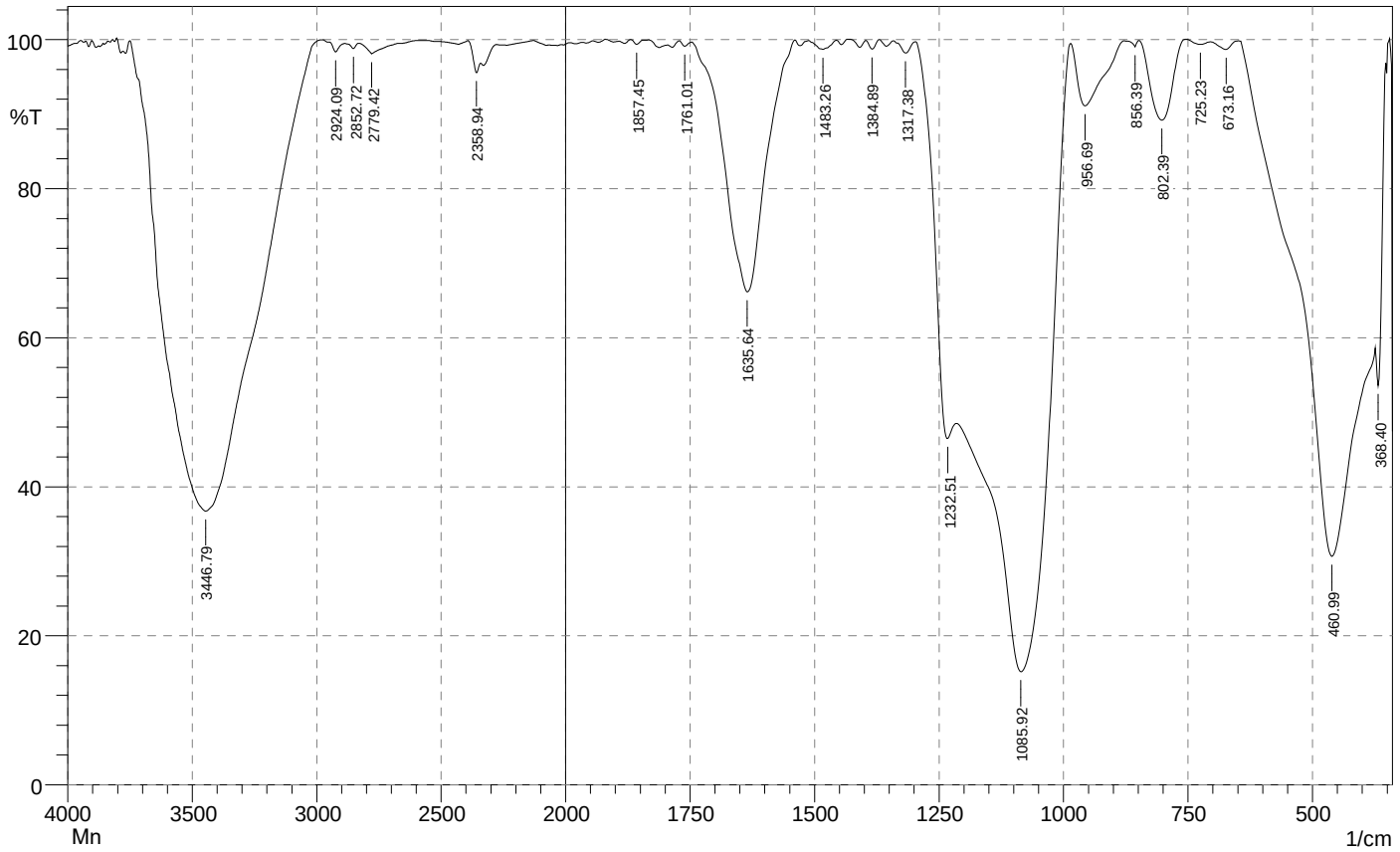
Apodization;



	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	368.4	53.57	16.04	374.19	354.9	3.44	1.21
2	460.99	30.68	40.28	644.22	376.12	62.09	29.63
3	673.16	98.67	1.1	705.95	650.01	0.18	0.12
4	725.23	99.36	0.48	754.17	705.95	0.08	0.05
5	802.39	89.19	10.75	846.75	756.1	2.36	2.34
6	856.39	99.03	0.84	871.82	848.68	0.04	0.03
7	956.69	91.13	8.46	985.62	879.54	2.31	2.16
8	1085.92	15.18	62.23	1215.15	987.55	100.16	64.41
9	1232.51	46.49	11.98	1296.16	1217.08	13.71	2.1
10	1317.38	98.2	1.58	1342.46	1298.09	0.18	0.14
11	1384.89	98.73	1.21	1396.46	1371.39	0.08	0.07
12	1483.26	98.7	0.21	1487.12	1456.26	0.11	0.02
13	1635.64	66.14	33.7	1745.58	1539.2	14.93	14.77
14	1761.01	99.11	0.66	1772.58	1747.51	0.06	0.03
15	1857.45	99.37	0.61	1869.02	1842.02	0.03	0.03
16	2358.94	95.56	2.33	2391.73	2341.58	0.57	0.21
17	2779.42	98.09	1.41	2831.5	2669.48	0.75	0.4
18	2852.72	98.81	0.66	2877.79	2831.5	0.17	0.06
19	2924.09	98.36	1.25	2951.09	2887.44	0.25	0.14
20	3446.79	36.74	63.17	3749.62	2980.02	157.62	157.36

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Resolution;
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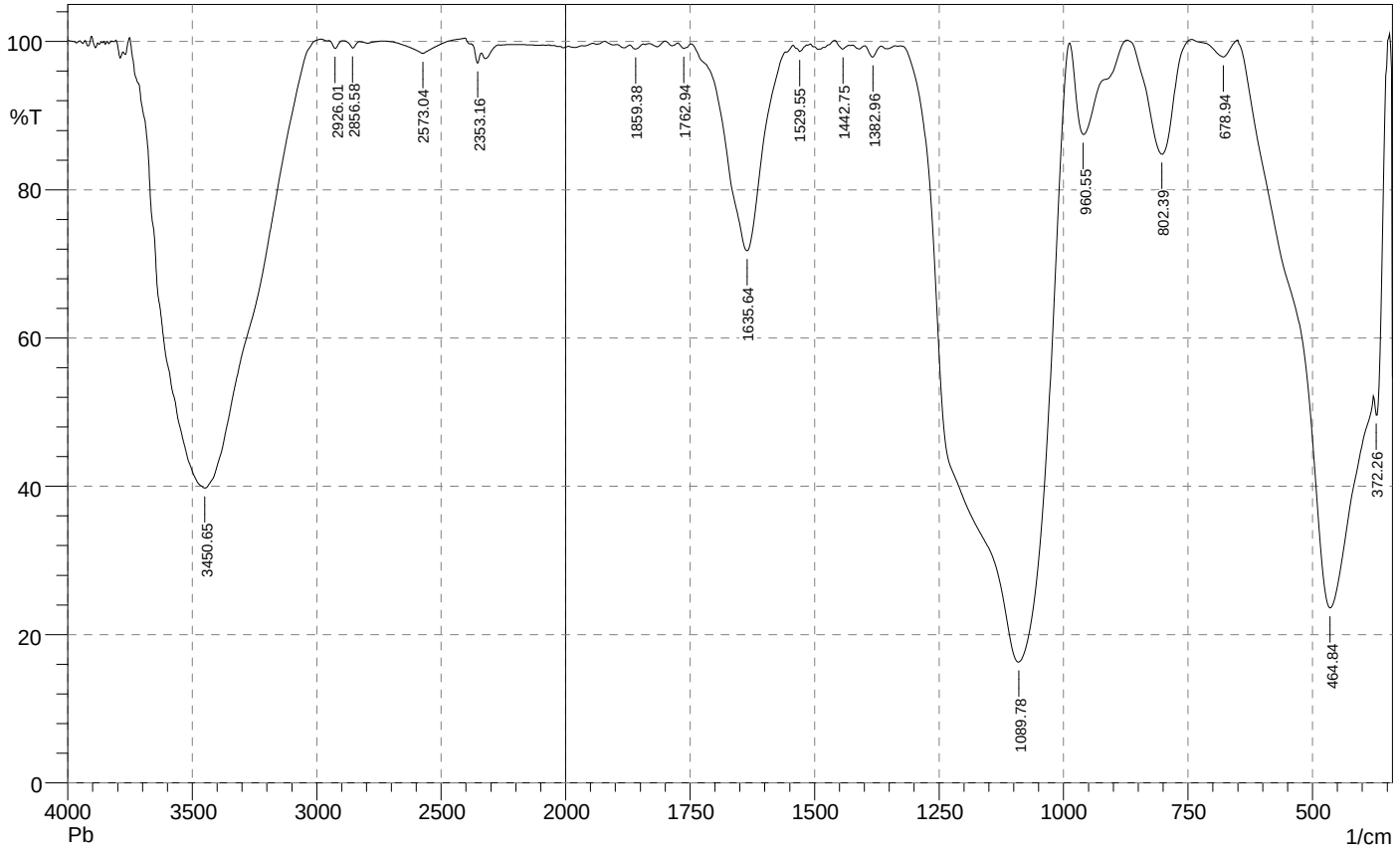

No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	372.26	49.58	8.66	376.12	347.19	4.5	0.9
2	464.84	23.59	43.9	650.01	378.05	75.35	36.77
3	678.94	97.92	2.28	742.59	651.94	0.3	0.39
4	802.39	84.79	15.45	871.82	744.52	3.85	3.98
5	960.55	87.45	12.42	987.55	873.75	3.13	3.13
6	1089.78	16.29	83.33	1327.03	989.48	124.21	123.55
7	1382.96	97.89	1.51	1400.32	1365.6	0.2	0.1
8	1442.75	98.97	0.8	1458.18	1431.18	0.07	0.05
9	1529.55	98.65	0.86	1543.05	1516.05	0.11	0.05
10	1635.64	71.77	27.22	1747.51	1560.41	11.07	10.33
11	1762.94	99.09	0.65	1774.51	1747.51	0.07	0.04
12	1859.38	98.98	0.61	1870.95	1843.95	0.09	0.04
13	2353.16	97.08	1.83	2372.44	2339.65	0.28	0.14
14	2573.04	98.4	1.83	2721.56	2403.3	0.64	0.97
15	2856.58	99.12	0.91	2895.15	2829.57	0.09	0.1
16	2926.01	99.06	1.05	2951.09	2895.15	0.08	0.11
17	3450.65	39.77	60.66	3751.55	2983.88	146.14	147.51

Date/Time; 6/2/2022 2:45:56 PM
No. of Scans;
Resolution;
Apodization;

KEMENTERIAN KESEHATAN REPUBLIK INDONESIA
DIREKTORAT JENDERAL
PENCEGAHAN DAN PENGENDALIAN PENYAKIT
BALAI TEKNIK KESEHATAN LINGKUNGAN DAN PENGENDALIAN PENYAKIT KELAS I MAKASSAR
Jalan Wijaya Kusuma Raya No. 29 -31 Makassar, Telp/Fax : 0411-871620,
Email : btklmakassar@gmail.com

LAPORAN HASIL UJI

Nomor LHU : 2724/AL-K/LHU/BTKLPP-MKS/VIII/2022
Nama *Customer* : Ida Ifdaliah
Alamat : Jl. Pendidikan 1 Komp UNM Blok B5 No. 4, Makassar
Tlp/Fax : 081343607963
Pengambil Sampel : *Customer*
Jenis Sampel/Metode Sampling : Air Limbah/Sesaat
Lokasi/Titik Sampling : LS1
Tanggal Sampling : 28 Juli 2022
Tanggal Penerimaan : 25 Agustus 2022
Tanggal Pengujian : 25 Agustus 2022 s/d 26 September 2022
Hasil Pengujian :

No.	Parameter	Satuan	Hasil Pengujian	Batas Maksimum * Yang Diperbolehkan	Spesifikasi Metode
A.	**Kimia**				
1	Besi Terlarut	mg/L	0,3724	-	IKM/BTKLPP-MKS/7.2/01/04 (ICP)
2	Krom Total	mg/L	<0,0061	-	IKM/BTKLPP-MKS/7.2/01/09 (ICP)
3	Mangan Terlarut	mg/L	0,5280	-	IKM/BTKLPP-MKS/7.2/01/05 (ICP)
4	Nikel Terlarut	mg/L	<0,0101	-	IKM/BTKLPP-MKS/7.2/01/10 (ICP)
5	Kobalt Total	mg/L	<0,0077	-	APHA 2012.3111C
6	Seng	mg/L	0,0912	-	IKM/BTKLPP-MKS/7.2/01/06 (ICP)
7	Tembaga	mg/L	0,0787	-	IKM/BTKLPP-MKS/7.2/01/07 (ICP)

Keterangan :

- : Tidak diatur Berdasarkan Peraturan Menteri Lingkungan Hidup dan Kehutanan RI Nomor P.68/Menlh.Setjen/Kum.1/8/2016 Tentang Baku Mutu Air Limbah Domestik Lampiran I

Catatan:

1. Hasil uji di atas hanya berlaku untuk sampel yang diuji.
2. Laporan Hasil Uji ini terdiri dari 1 (satu) halaman.
3. Laporan Hasil Uji ini tidak boleh digandakan, kecuali secara lengkap dan seijin tertulis dari BTKLPP Kelas I Makassar.
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Makassar, 28 September 2022
Koordinator Instalasi,

Isnadiyah, S.Si., M.Biomed
NIP. 19810428201012003

F/BTKLPP-MKS/7.8/01/00/17

KAN Komite Akreditasi Nasional
Laboratorium Penguji
LP-530-IDN

KEMENTERIAN KESEHATAN REPUBLIK INDONESIA
DIREKTORAT JENDERAL
PENCEGAHAN DAN PENGENDALIAN PENYAKIT
BALAI TEKNIK KESEHATAN LINGKUNGAN DAN PENGENDALIAN PENYAKIT KELAS I MAKASSAR
Jalan Wijaya Kusuma Raya No. 29 -31 Makassar, Telp/Fax : 0411-871620,
Email : btklmakassar@gmail.com

LAPORAN HASIL UJI

Nomor LHU : 2724/AL-K/LHU/BTKLPP-MKS/VIII/2022
Nama *Customer* : Ida Ifdaliah
Alamat : Jl. Pendidikan 1 Komp UNM Blok B5 No. 4, Makassar
Tlp/Fax : 081343607963
Pengambil Sampel : *Customer*
Jenis Sampel/Metode Sampling : Air Limbah/Sesaat
Lokasi/Titik Sampling : LS1
Tanggal Sampling : 28 Juli 2022
Tanggal Penerimaan : 25 Agustus 2022
Tanggal Pengujian : 25 Agustus 2022 s/d 26 September 2022
Hasil Pengujian

No.	Parameter	Satuan	Hasil Pengujian	Batas Maksimum * Yang Diperbolehkan	Spesifikasi Metode
A.	**Kimia**				
1	Kadmium Terlarut	mg/L	12,3589	-	SNI 06-6989.38-2005
2	Timbal Terlarut	mg/L	2,0983	-	SNI 6989-46:2009

Keterangan :

- : Tidak diatur Berdasarkan Peraturan Menteri Lingkungan Hidup dan Kehutanan RI Nomor P.68/Menlh.Setjen/Kum.1/8/2016 Tentang Baku Mutu Air Limbah Domestik Lampiran I

Catatan:

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Jalan Wijaya Kusuma Raya No. 29 -31 Makassar, Telp/Fax : 0411-871620,
Email : btklmakassar@gmail.com

LAPORAN HASIL UJI

Nomor LHU : 2725/AL-K/LHU/BTKLPP-MKS/VIII/2022
Nama *Customer* : Ida Ifdaliah
Alamat : Jl. Pendidikan 1 Komp UNM Blok B5 No. 4, Makassar
Tlp/Fax : 081343607963
Pengambil Sampel : *Customer*
Jenis Sampel/Metode Sampling : Air Limbah/Sesaat
Lokasi/Titik Sampling : LL2
Tanggal Sampling : 28 Juli 2022
Tanggal Penerimaan : 25 Agustus 2022
Tanggal Pengujian : 25 Agustus 2022 s/d 26 September 2022
Hasil Pengujian

No.	Parameter	Satuan	Hasil Pengujian	Batas Maksimum * Yang Diperbolehkan	Spesifikasi Metode
A.	**Kimia**				
1	Kadmium Terlarut	mg/L	0,2992	-	SNI 06-6989.38-2005
2	Timbal Terlarut	mg/L	0,0068	-	SNI 6989-46:2009

Keterangan :

- : Tidak diatur Berdasarkan Peraturan Menteri Lingkungan Hidup dan Kehutanan RI Nomor P.68/Menlh.Setjen/Kum.1/8/2016 Tentang Baku Mutu Air Limbah Domestik Lampiran I

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Jalan Wijaya Kusuma Raya No. 29 -31 Makassar, Telp/Fax : 0411-871620,
Email : btklmakassar@gmail.com

LAPORAN HASIL UJI

Nomor LHU : 2726/AL-K/LHU/BTKLPP-MKS/VIII/2022
Nama *Customer* : Ida Ifdaliah
Alamat : Jl. Pendidikan 1 Komp UNM Blok B5 No. 4, Makassar
Tlp/Fax : 081343607963
Pengambil Sampel : *Customer*
Jenis Sampel/Metode Sampling : Air Limbah/Sesaat
Lokasi/Titik Sampling : LS2
Tanggal Sampling : 28 Juli 2022
Tanggal Penerimaan : 25 Agustus 2022
Tanggal Pengujian : 25 Agustus 2022 s/d 26 September 2022
Hasil Pengujian :

No.	Parameter	Satuan	Hasil Pengujian	Batas Maksimum * Yang Diperbolehkan	Spesifikasi Metode
A.	**Kimia**				
1	Besi Terlarut	mg/L	<0,0098	-	IKM/BTKLPP-MKS/7.2/01/04 (ICP)
2	Krom Total	mg/L	<0,0061	-	IKM/BTKLPP-MKS/7.2/01/09 (ICP)
3	Mangan Terlarut	mg/L	0,0250	-	IKM/BTKLPP-MKS/7.2/01/05 (ICP)
4	Nikel Terlarut	mg/L	<0,0101	-	IKM/BTKLPP-MKS/7.2/01/10 (ICP)
5	Kobalt Total	mg/L	<0,0077	-	APHA 2012.3111C
6	Seng	mg/L	<0,0074	-	IKM/BTKLPP-MKS/7.2/01/06 (ICP)
7	Tembaga	mg/L	<0,0056	-	IKM/BTKLPP-MKS/7.2/01/07 (ICP)

Keterangan :

- : Tidak diatur Berdasarkan Peraturan Menteri Lingkungan Hidup dan Kehutanan RI Nomor P.68/Menlh.Setjen/Kum.1/8/2016 Tentang Baku Mutu Air Limbah Domestik Lampiran I

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3. Laporan Hasil Uji ini tidak boleh digandakan, kecuali secara lengkap dan seijin tertulis dari BTKLPP Kelas I Makassar.
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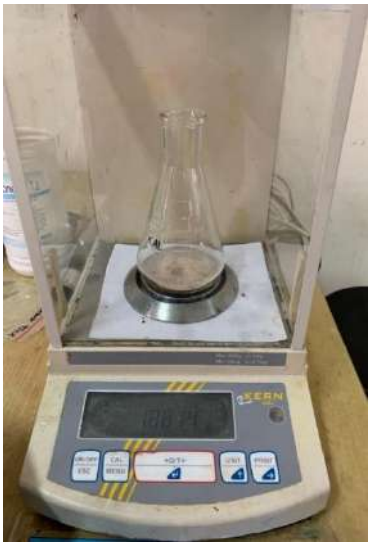
KAN Komite Akreditasi Nasional
Laboratorium Penguji
LP-530-IDN

Lampiran 40. Foto Lokasi Pengambilan Sampel Mineral Alam Mesawa

Lampiran 41. Foto Preparasi Sampel Mineral Alam Mesawa

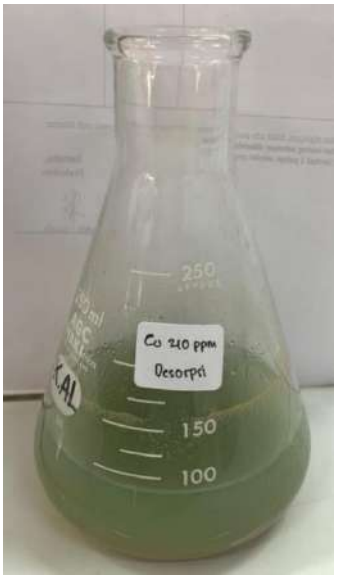
Lampiran 42. Foto Sintesis ANA, CAN, MCM-48, ANA/MCM-48

Lampiran 43. Foto Proses Adsorpsi



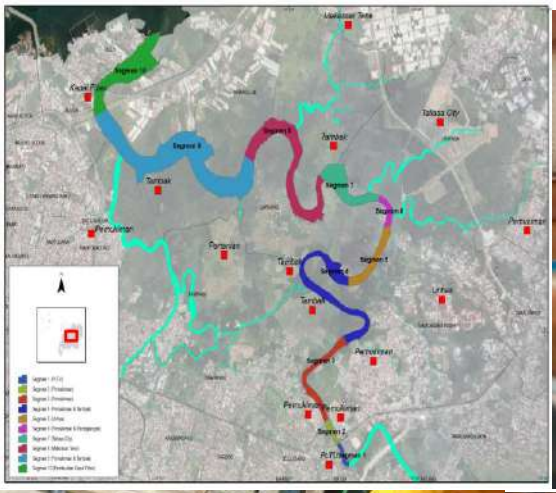


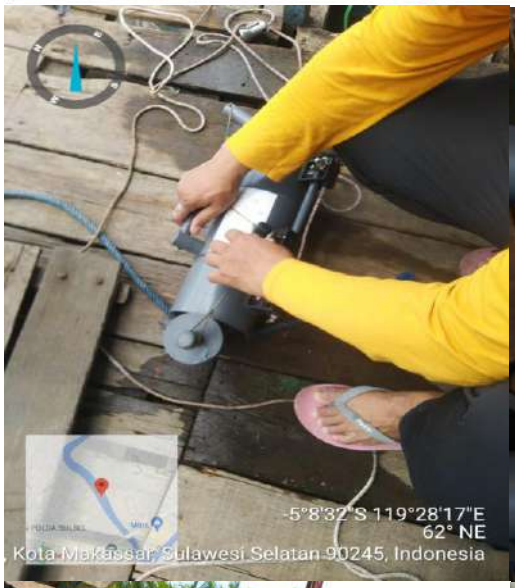
Cu 210 ppm
Adsorpsi 1
150
100


250
Cu 210 ppm
Desorpsi
150
100

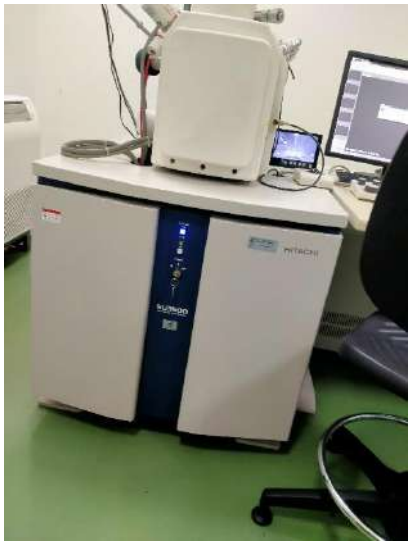

VARIAN

Lampiran 44. Foto Lokasi Pengambilan Sampel Air Sungai Tallo





Lampiran 45. Foto karakterisasi



PRESIDEN
REPUBLIK INDONESIA

LAMPIRAN VI
PERATURAN PEMERINTAH REPUBLIK INDONESIA
NOMOR 22 TAHUN 2021
TENTANG
PENYELENGGARAAN PERLINDUNGAN DAN
PENGELOLAAN LINGKUNGAN HIDUP

BAKU MUTU AIR NASIONAL

I. BAKU MUTU AIR SUNGAI DAN SEJENISNYA

No	Parameter	Unit	Kelas 1	Kelas 2	Kelas 3	Kelas 4	Keterangan
1.	Temperatur	°C	Dev 3	Dev 3	Dev 3	Dev 3	Perbedaan dengan suhu udara di atas permukaan air
2.	Padatan terlarut total (TDS)	mg/L	1.000	1.000	1.000	2.000	Tidak berlaku untuk muara
3.	Padatan tersuspensi total (TSS)	mg/L	40	50	100	400	
4.	Warna	Pt-Co Unit	15	50	100	-	Tidak berlaku untuk air gambut (berdasarkan kondisi alaminya)
5.	Derajat keasaman (pH)		6-9	6-9	6-9	6-9	Tidak berlaku untuk air gambut (berdasarkan kondisi alaminya)
6.	Kebutuhan oksigen biokimiawi (BOD)	mg/L	2	3	6	12	

7. Kebutuhan . . .

No	Parameter	Unit	Kelas 1	Kelas 2	Kelas 3	Kelas 4	Keterangan
7.	Kebutuhan oksigen kimiawi (COD)	mg/L	10	25	40	80	
8.	Oksigen terlarut (DO)	mg/L	6	4	3	1	Batas minimal
9.	Sulfat (SO_4^{2-})	mg/L	300	300	300	400	
10.	Klorida (Cl^-)	mg/L	300	300	300	600	
11.	Nitrat (sebagai N)	mg/L	10	10	20	20	
12.	Nitrit (sebagai N)	mg/L	0,06	0,06	0,06	-	
13.	Amoniak (sebagai N)	mg/L	0,1	0,2	0,5	-	
14.	Total Nitrogen	mg/L	15	15	25	-	
15.	Total Fosfat (sebagai P)	mg/L	0,2	0,2	1,0	-	
16.	Fluorida (F^-)	mg/L	1	1,5	1,5	-	
17.	Belerang sebagai H_2S	mg/L	0,002	0,002	0,002	-	
18.	Sianida (CN^-)	mg/L	0,02	0,02	0,02	-	
19.	Klorin bebas	mg/L	0,03	0,03	0,03	-	Bagi air baku air minum tidak dipersyaratkan
20.	Barium (Ba) terlarut	mg/L	1,0	-	-	-	
21.	Boron (B) terlarut	mg/L	1,0	1,0	1,0	1,0	
22.	Merkuri (Hg) terlarut	mg/L	0,001	0,002	0,002	0,005	
23.	Arsen (As) terlarut	mg/L	0,05	0,05	0,05	0,10	
24.	Selenium (Se) terlarut	mg/L	0,01	0,05	0,05	0,05	
25.	Besi (Fe) terlarut	mg/L	0,3	-	-	-	
26.	Kadmium (Cd) terlarut	mg/L	0,01	0,01	0,01	0,01	

27. Kobalt . . .

No	Parameter	Unit	Kelas 1	Kelas 2	Kelas 3	Kelas 4	Keterangan
27.	Kobalt (Co) terlarut	mg/L	0,2	0,2	0,2	0,2	
28.	Mangan (Mn) terlarut	mg/L	0,1	-	-	-	
29.	Nikel (Ni) terlarut	mg/L	0,05	0,05	0,05	0,1	
30.	Seng (Zn) terlarut	mg/L	0,05	0,05	0,05	2	
31.	Tembaga (Cu) terlarut	mg/L	0,02	0,02	0,02	0,2	
32.	Timbal (Pb) terlarut	mg/L	0,03	0,03	0,03	0,5	
33.	Kromium heksavalen (Cr-(VI))	mg/L	0,05	0,05	0,05	1	
34.	Minyak dan lemak	mg/L	1	1	1	10	
35.	Deterjen total	mg/L	0,2	0,2	0,2	-	
36.	Fenol	mg/L	0,002	0,005	0,01	0,02	
37.	Aldrin/ Dieldrin	µg/L	17	-	-	-	
38.	BHC	µg/L	210	210	210	-	
39.	Chlordane	µg/L	3	-	-	-	
40.	DDT	µg/L	2	2	2	2	
41.	Endrin	µg/L	1	4	4	-	
42.	Heptachlor	µg/L	18	-	-	-	
43.	Lindane	µg/L	56	-	-	-	
44.	Methoxychlor	µg/L	35	-	-	-	
45.	Toxapan	µg/L	5	-	-	-	
46.	Fecal Coliform	MPN/100 mL	100	1.000	2.000	2.000	
47.	Total Coliform	MPN/100 mL	1.000	5.000	10.000	10.000	
48.	Sampah		nihil	nihil	nihil	nihil	
49.	Radioaktivitas						
	Gross-A	Bq/L	0,1	0,1	0,1	0,1	
	Gross-B	Bq/L	1	1	1	1	

II. BAKU . . .