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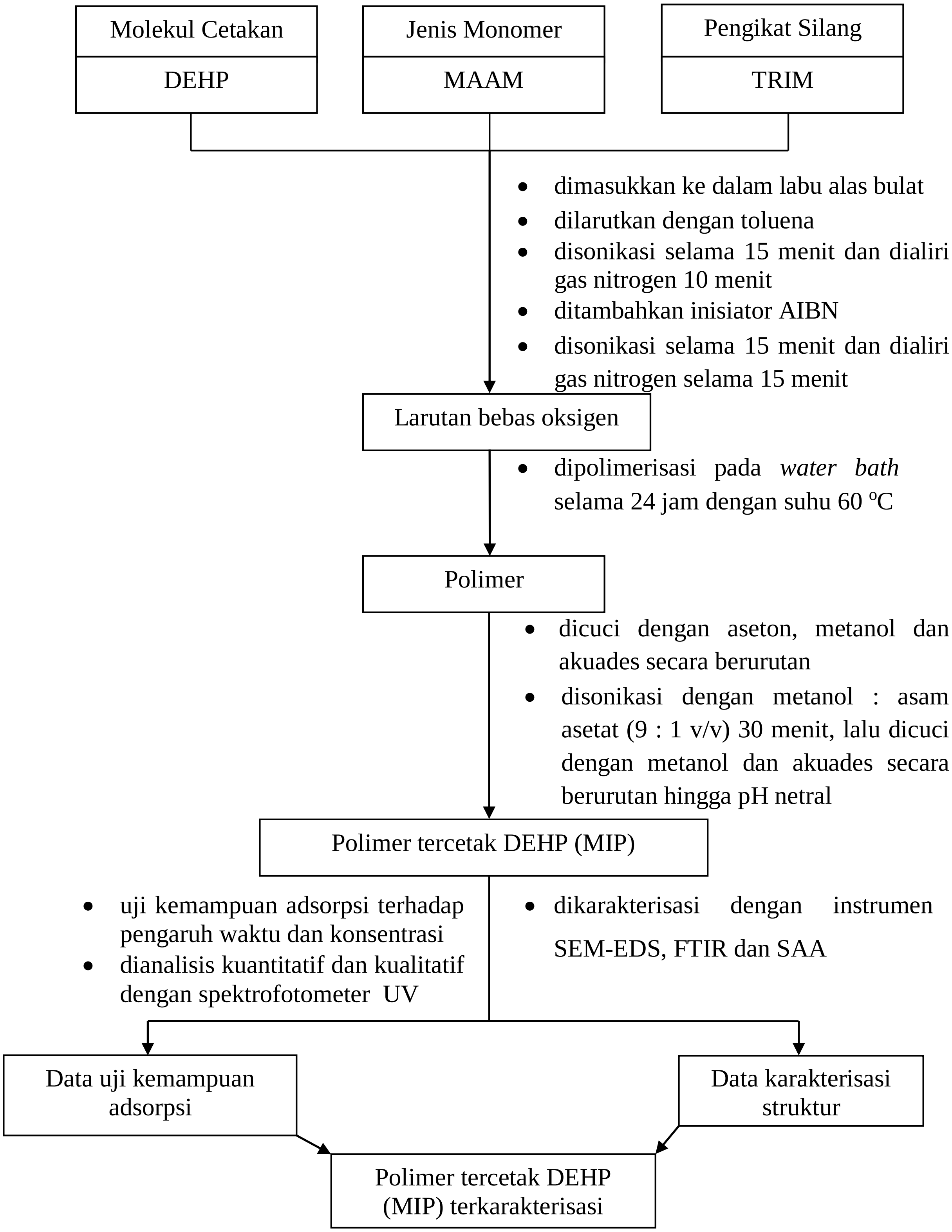
Skema 1. Sintesis Polimer Bercetakan Molekul DEHP menggunakan Metode Polimerisasi Presipitasi



Catatan: Sintesis NIP dibuat dengan metode yang sama dengan MIP, tapi tanpa DEHP dan proses ekstraksi.

Lampiran 2. Bagan Kerja

1. Sintesis MIP dan NIP

Cairan DEHP

- dipipet sebanyak 0,3945 mL (1 mmol) dalam labu alas bulat
- ditambahkan monomer ma sebanyak 0,3404 g (4 mmol)
- didiamkan selama 5 menit
- ditambahkan pengikat silang trim sebanyak 2,5685 mL (8 mmol)
- ditambahkan pelarut porogen toluena sebanyak 50 mL
- didiamkan selama 5 menit
- disonikasi selama 15 menit
- dialiri gas nitrogen selama 10 menit
- ditambahkan inisiator aibn sebanyak 5 mL (1 mmol)
- disonikasi selama 15 menit
- dialiri gas nitrogen selama 15 menit

Larutan bebas oksigen

- dipolimerisasi dengan cara dimasukkan ke dalam *water bath* selama 24 jam dengan suhu 60°C

Polimer

- dicuci dengan aseton, metanol dan akuades secara berurutan
- disonikasi dengan campuran metanol : asetat (9:1 v/v) selama 30 menit

Filtrat

- dianalisis kuantitatif dengan menggunakan spektrofotometer UV pada λ= 260nm

Data

Polimer tercetak molekul DEHP

- dicuci dengan metanol dan akuades secara berurutan hingga pH netral
- dikeringkan

Material MIP

Material MIP

- dikarakterisasi dengan instrumen SEM-EDS, FTIR dan SAA

Data

Catatan: Sintesis NIP dibuat dengan metode yang sama dengan MIP, tetapi tanpa menggunakan molekul cetakan (DEHP).

2. Pembuatan Larutan Standar DEHP 100 mg/L

Cairan DEHP

- dipipet sebanyak 0,001 mL ke dalam labu ukur 10 mL
- ditambahkan metanol hingga tanda batas
- dikocok

Larutan Standar DEHP 100 mg/L

- divariasikan konsentrasinya menjadi 3, 9, 15, 18, dan 24 mg/L

Deret Standar DEHP

3. Karakterisasi MIP dan NIP Menggunakan SEM-EDS

Material MIP dan NIP

- dipreparasi
- dianalisis masing-masing menggunakan instrumen SEM-EDS dengan perbesaran 20.000x

Data

4. Karakterisasi MIP dan NIP Menggunakan FTIR

Material MIP dan NIP

- dimasukkan masing-masing ke dalam oven dengan suhu 50 ^oC
- dipreparasi
- dianalisis masing-masing menggunakan spektroskopi FTIR

Data Spektrum

5. Karakterisasi MIP Menggunakan SAA

Material $MIP_{(TE)}$

- dipreparasi
- dihilangkan gas-gas yang terjerap pada permukaan material selama 6 jam (*degassing*)
- dianalisis menggunakan instrumen SAA dengan metode BJH

Data

6. Uji Kemampuan Adsorpsi MIP dan NIP

Material MIP dan NIP

- ditimbang masing-masing sebanyak 30 mg
- dimasukkan masing-masing ke dalam botol vial yang berbeda
- ditambahkan masing-masing 5 mL larutan dehp 15 mg/L ke dalam botol vial
- diaduk dengan *shaker* selama 60 menit pada suhu ruang
- disaring

Endapan | Filtrat

Filtrat
- dianalisis dengan menggunakan spektrofotometer UV pada λ= 252,60 nm

Data

7. Pengaruh Waktu terhadap Kemampuan Adsorpsi MIP

Material MIP

- ditimbang masing-masing 30 mg
- dimasukkan ke dalam 5 botol vial yang berbeda
- ditambahkan larutan standar dehp 15 mg/L sebanyak 5 ml ke dalam masing-masing botol vial
- diletakkan di atas *shaker*
- diaduk dengan variasi waktu 30, 90, 120, 150 dan 180 menit pada suhu ruang
- disaring

Endapan | Filtrat

Filtrat
- dianalisis dengan menggunakan spektrofotometer UV pada λ= 252,60 nm

Data

8. Pengaruh Konsentrasi terhadap Kemampuan Adsorpsi MIP

Material MIP

- ditimbang masing-masing 30 mg
- dimasukkan ke dalam 5 botol vial yang berbeda
- ditambahkan larutan standar dehp sebanyak 5 mL dengan variasi konsentrasi 6, 9, 12, 18 dan 21 mg/L pada pH 6,8
- diaduk dengan *shaker* pada waktu optimum dengan suhu ruang
- disaring

Endapan

Filtrat

- dianalisis dengan menggunakan spektrofotometer UV pada λ= 252,60 nm

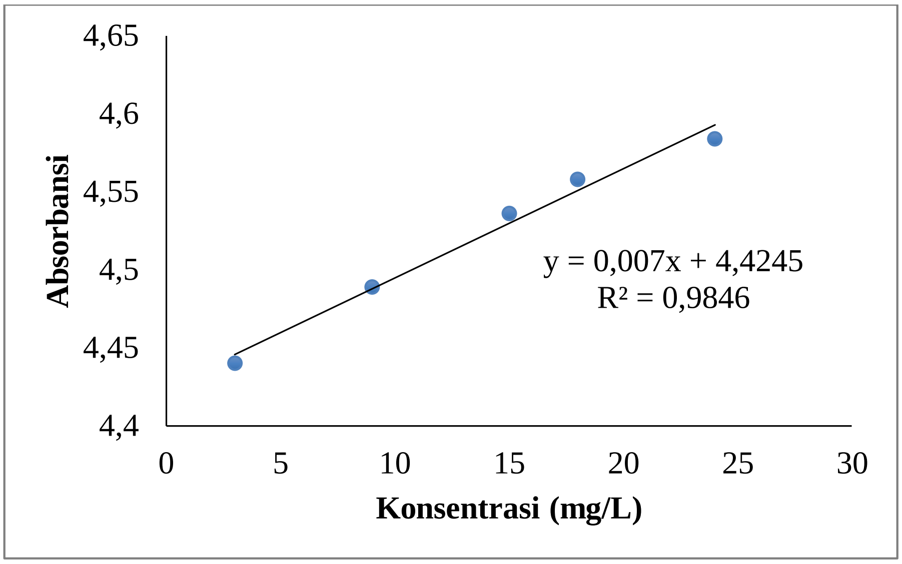
Data

Lampiran 3. Data Spektrofotometer UV-Vis

1. Data absorbansi larutan standar DEHP

No.	Sampel	Konsentrasi (mg/L)	Absorbansi
1	DEHP 1	3	4,440
2	DEHP 2	9	4,489
3	DEHP 3	15	4,536
4	DEHP 4	18	4,558
5	DEHP 5	24	4,584

2. Kurva hubungan antara absorbansi vs konsentrasi larutan standar DEHP



3. Data absorbansi kemampuan adsorpsi MIP dan NIP

No.	Sampel	Absorbansi	q_e (mg/g)	Δq_e (mg/g)
1	Adsorpsi DEHP oleh MIP	4,499	0,73	0,50
2	Adsorpsi DEHP oleh NIP	4,520	0,23	

4. Data absorbansi adsorpsi DEHP oleh MIP terhadap pengaruh waktu

No.	Sampel	Waktu (menit)	Absorbansi
1	DEHP	30	4,502
2	DEHP	90	4,450
3	DEHP	120	4,461
4	DEHP	150	4,496
5	DEHP	180	4,490

5. Data penentuan waktu optimum adsorpsi MIP terhadap DEHP

No.	Waktu	C_e (mg/L)	q_t (mg/g)	q_e-q_t
1	0	0	0	1,89
2	30	11,07	0,65	1,24
3	90	3,64	**1,89**	0
4	120	5,21	1,63	0,24
5	150	10,21	0,80	1,1
6	180	9,36	0,94	0,86

Catatan:

q_t adalah q_e pada waktu t

q_e adalah q_t pada waktu optimum

6. Data absorbansi adsorpsi DEHP oleh MIP terhadap pengaruh konsentrasi

No.	Sampel	Konsentrasi (mg/L)	Absorbansi
1	DEHP	6	4,441
2	DEHP	9	4,451
3	DEHP	12	4,468
4	DEHP	18	4,487
5	DEHP	21	4,500

7. Data persamaan isotermal adsorpsi Langmuir dan Freundlich

No.	Sampel	C_o (mg/L)	C_e (mg/L)	q_e (mg/g)	Log C_e	Log q_e	1/C_e	1/q_e
1	MIP_DEHP	6	2,36	0,61	0,37	-0,22	0,42	1,65
2	MIP_DEHP	9	3,78	0,87	0,58	-0,06	0,26	1,15
3	MIP_DEHP	12	6,21	0,96	0,79	-0,02	0,16	1,04
4	MIP_DEHP	18	8,93	1,51	0,95	0,18	0,11	0,66
5	MIP_DEHP	21	10,79	1,70	1,03	0,23	0,09	0,59

8. Data kurva non linear untuk persamaan isotermal adsorpsi Langmuir

No.	C_o	1/K_L	1/C_e	1/q_mK_L	1/C_e x 1/q_mK_L	1/q_e	q_e
1	6	0,3767	0,42	3,0359	1,29	1,66	0,60
2	9	0,3767	0,26	3,0359	0,80	1,18	0,85
3	12	0,3767	0,16	3,0359	0,49	0,87	1,16
4	18	0,3767	0,11	3,0359	0,34	0,72	1,40
5	21	0,3767	0,09	3,0359	0,28	0,66	1,52

9. Data kurva non linear untuk persamaan isotermal adsorpsi Freundlich

No.	C_o	log K_F	1/n	log C_e	1/n x log C_e	log q_e	q_e
1	6	-0,467	0,6578	0,37	0,24	-0,22	0,60
2	9	-0,467	0,6578	0,58	0,38	-0,09	0,82
3	12	-0,467	0,6578	0,79	0,52	0,05	1,13
4	18	-0,467	0,6578	0,95	0,63	0,16	1,44
5	21	-0,467	0,6578	1,03	0,68	0,21	1,63

Lampiran 4. Perhitungan

1. Nilai konsentrasi adsorpsi DEHP oleh MIP dan NIP

$y = 0{,}007x + 4{,}4245$

a. Adsorpsi DEHP oleh MIP

$y = 4{,}499$

$y = 0{,}007x + 4{,}4245$

$4{,}499 = 0{,}007x + 4{,}4245$

$$x = \frac{4{,}499 - 4{,}4245}{0{,}007}$$

$x = 10{,}64$ mg/L

b. Adsorpsi DEHP oleh NIP

$y = 4{,}520$

$y = 0{,}007x + 4{,}4245$

$4{,}520 = 0{,}007x + 4{,}4245$

$$x = \frac{4{,}520 - 4{,}4245}{0{,}007}$$

$x = 13{,}64$ mg/L

2. Nilai Kemampuan Adsorpsi DEHP oleh MIP dan NIP

$$q_e = \frac{(C_o - C_e)\,V}{W}$$

Diketahui:	C_o	= 15 mg/L	W	= 0,03 g
	V	= 0,005 L	C_e	= Konsentrasi setelah adsorpsi

a. Kemampuan Adsorpsi DEHP oleh MIP

$$q_e = \frac{(15 - 10{,}64)\ 0{,}005}{0{,}03}$$

$$q_e = \frac{0{,}021785}{0{,}03}$$

$$q_e = 0{,}73 \text{ mg/g}$$

b. Kemampuan Adsorpsi DEHP oleh NIP

$$q_e = \frac{(15 – 13{,}64)\ 0{,}005}{0{,}03}$$

$$q_e = \frac{0{,}006785}{0{,}03}$$

$$q_e = 0{,}23 \text{ mg/g}$$

3. Nilai konsentrasi adsorpsi dan kemampuan adsorpsi DEHP oleh MIP terhadap pengaruh waktu

Waktu (menit)	y (absorbansi)	x (konsentrasi) (mg/L)	q_e (mg/g)
30	4,502	11,07	0,65
90	4,450	3,64	1,89
120	4,461	5,21	1,63
150	4,496	10,21	0,80
180	4,490	9,36	0,94

Contoh perhitungan konsentrasi adsorpsi dan kemampuan adsorpsi DEHP oleh MIP terhadap pengaruh waktu:

a. Konsentrasi Adsorpsi DEHP oleh MIP 30 menit

$y = 0,007x + 4,4245$

$y = 4,502$

$y = 0,007x + 4,4245$

$4,502 = 0,007x + 4,4245$

$$x = \frac{4,502 - 4,4245}{0,007}$$

$x = 11,07$ mg/L

b. Kemampuan Adsorpsi DEHP oleh MIP 30 menit

$$q_e = \frac{(C_o - C_e)\, V}{W}$$

Diketahui:	C_o	= 15 mg/L	W	= 0,03 g
	C_e	= Konsentrasi setelah adsorpsi	V	= 0,005 L

$$q_e = \frac{(15 – 11,0714)\ 0,005}{0,03}$$

$$q_e = \frac{0,0196}{0,03}$$

$q_e = 0,65$ mg/g

4. Nilai konsentrasi adsorpsi dan kemampuan adsorpsi DEHP oleh MIP terhadap pengaruh konsentrasi

Konsenrasi awal (mg/L)	y (absorbansi)	x (konsentrasi) (mg/L)	q_e (mg/g)
6	4,441	2,36	0,61
9	4,451	3,79	0,87
12	4,468	6,21	0,96
18	4,487	8,93	1,51
21	4,500	10,79	1,70

Contoh perhitungan konsentrasi adsorpsi dan kemampuan adsorpsi DEHP oleh MIP terhadap pengaruh konsentrasi:

a. Konsentrasi Adsorpsi DEHP oleh MIP 6 mg/L

$y = 0,007x + 4,4245$

$y = 4,441$

$y = 0,007x + 4,4245$

$4,441 = 0,007x + 4,4245$

$$x = \frac{4,441 - 4,4245}{0,007}$$

$x = 2,3571$ mg/L

b. Kemampuan Adsorpsi DEHP oleh MIP 6 mg/L

$$q_e = \frac{(C_o - C_e)\,V}{W}$$

Diketahui: C_o = konsentrasi awal W = 0,03 g

C_e = Konsentrasi setelah adsorpsi V = 0,005 L

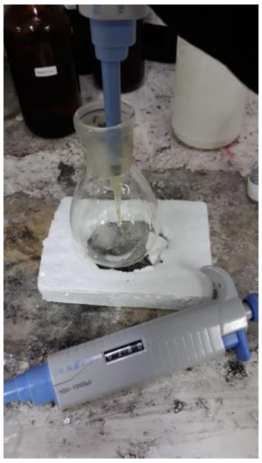
$$q_e = \frac{(6 - 2,3571)\,0,005}{0,03}$$

$$q_e = \frac{0,0182}{0,03}$$

$$q_e = 0,6071 \text{ mg/g}$$

Lampiran 5. Foto Hasil Penelitian

Proses persiapan alat dan bahan



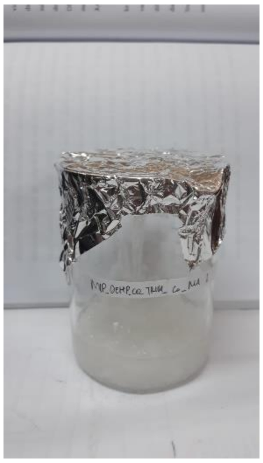
Proses pencampuran bahan dan prapolimerisasi

Sonikasi

Pengaliran gas nitrogen untuk menghilangkan gas oksigen

Polimerisasi dalam *waterbath*

Polimer terbentuk berwarna putih



Pengeringan polimer

Proses pencucian polimer dengan aseton, metanol, dan akuades agar bersih dari pengotor

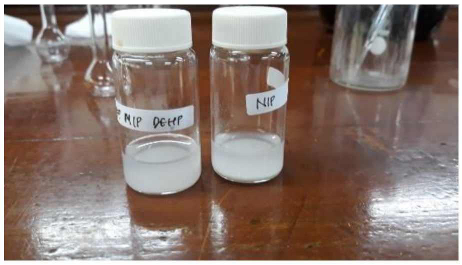
Proses ekstraksi (sonikasi)

Pencucian polimer dengan akuades

Penentuan pH

Penimbangan polimer hasil sintesis

Pembuatan deret standar DEHP



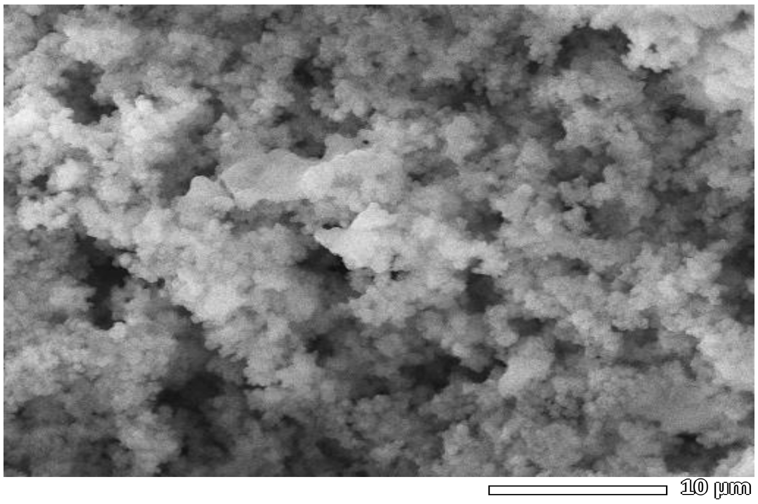
Uji kemampuan adsorpsi MIP dan NIP

Pengocokan dengan alat *shaker* untuk pengaruh waktu dan konsentrasi terhadap adsorpsi DEHP

Polimer hasil sintesis MIP_DEHP_MAA-co-EGDMA dan NIP_MAA-co-EGDMA disimpan

Lampiran 6. Karakterisasi EDS

1. NIP_MA-co-_TRIM



Title : IMG1

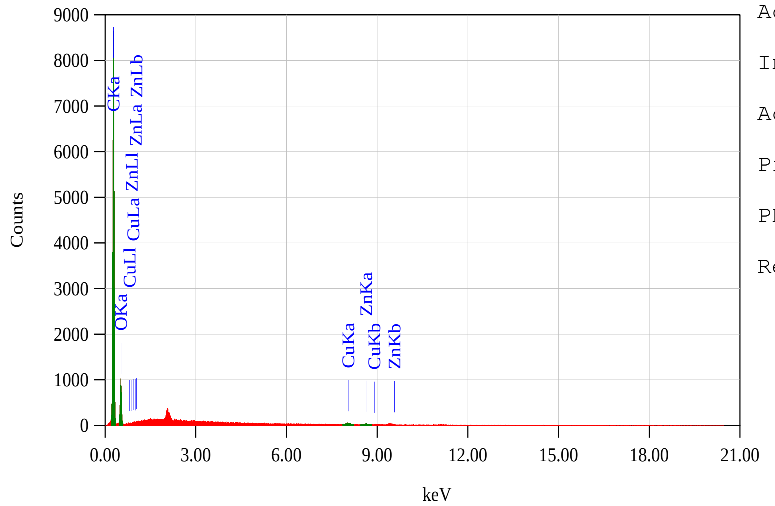
Instrument : 6510(LA)

Volt : 20.00 kV

Mag. : x 3,000

Date : 2021/12/10

Pixel : 512 x 384



Acquisition Parameter

Instrument : 6510(LA)

Acc. Voltage : 20.0 kV

Probe Current: 1.00000 nA

PHA mode : T3

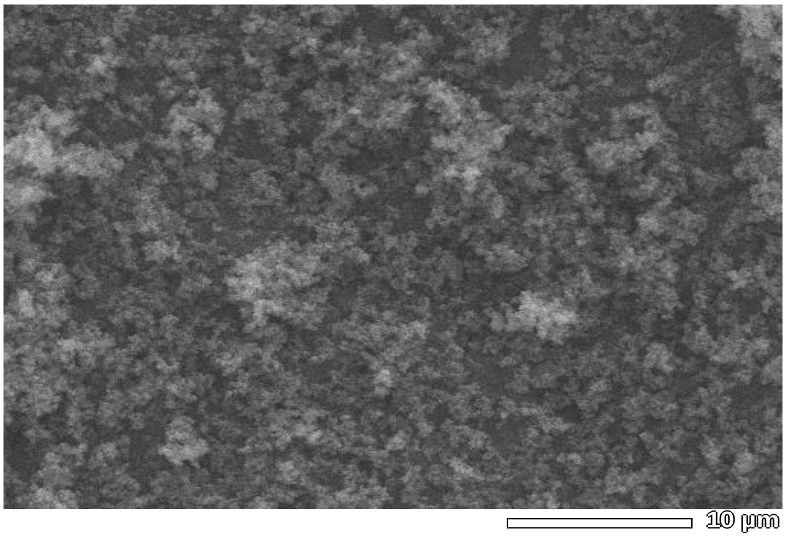
Real Time : 51.04 sec

ZAF Method Standardless Quantitative Analysis

Fitting Coefficient : 0.0317

Element	(keV)	Mass%	Sigma	Atom%	Compound	Mass%	Cation	K
C K	0.277	76.13	0.03	81.49				85.2900
O K	0.525	22.76	0.10	18.29				13.2582
Cu K	8.040	0.67	0.03	0.14				0.8801
Zn K	8.630	0.44	0.03	0.09				0.5716
Total		100.00		100.00				

2. MIP_DEHP_MAAM-co-TRIM(BE)



Title : IMG1

-

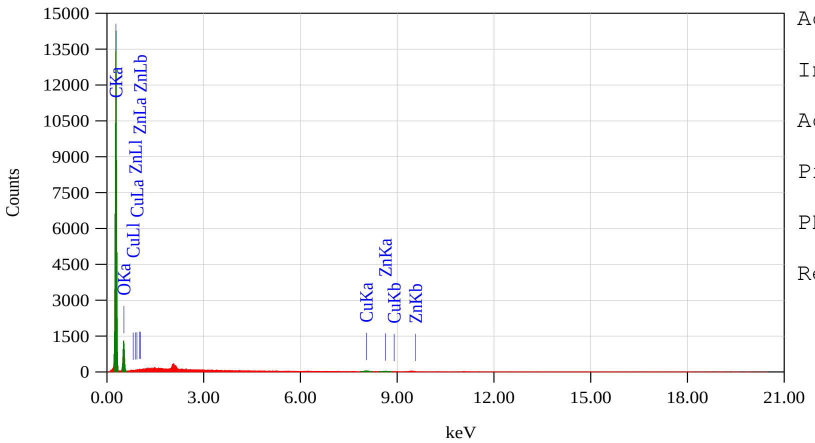
Instrument : 6510(LA)

Volt : 20.00 kV

Mag. : x 3,000

Date : 2021/12/10

Pixel : 512 x 384



Acquisition Parameter

Instrument : 6510(LA)

Acc. Voltage : 20.0 kV

Probe Current: 1.00000 nA

PHA mode : T3

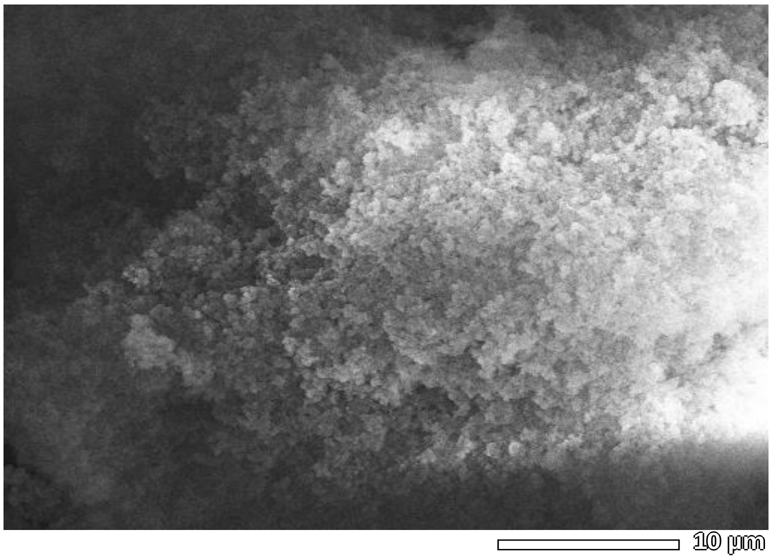
Real Time : 51.24 sec

ZAF Method Standardless Quantitative Analysis

Fitting Coefficient : 0.0247

Element	(keV)	Mass%	Sigma	Atom%	Compound	Mass%	Cation	K
C K	0.277	78.76	0.17	83.48				88.2524
O K	0.525	20.61	0.26	16.40				10.9629
Cu K	8.040	0.39	0.03	0.08				0.4903
Zn K	8.630	0.24	0.03	0.05				0.2945
Total		100.00		100.00				

3. MIP_DEHP_MAAM-co-TRIM$_{(TE)}$



Title : IMG1

-

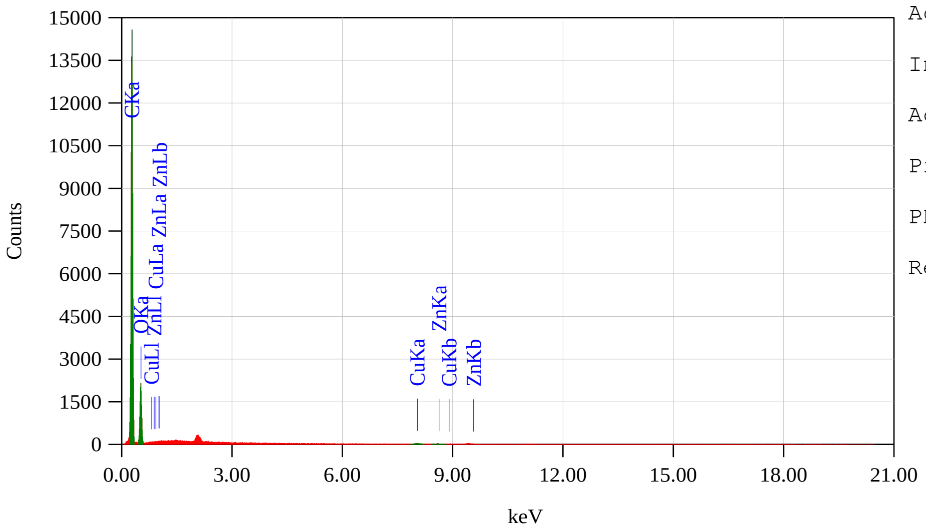
Instrument : 6510(LA)

Volt : 20.00 kV

Mag. : x 3,000

Date : 2021/12/10

Pixel : 512 x 384



Acquisition Parameter

Instrument : 6510(LA)

Acc. Voltage : 20.0 kV

Probe Current: 1.00000 nA

PHA mode : T3

Real Time : 51.21 sec

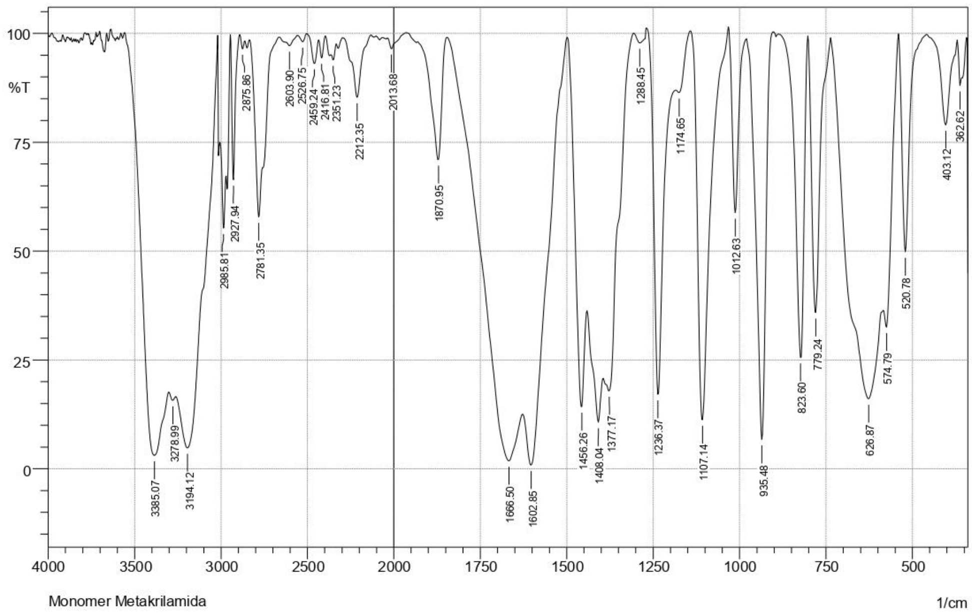
ZAF Method Standardless Quantitative Analysis

Fitting Coefficient : 0.0262

Element	(keV)	Mass%	Sigma	Atom%	Compound	Mass%	Cation	K
C K	0.277	73.25	0.15	78.68				83.0763
O K	0.525	26.34	0.26	21.24				16.3838
Cu K	8.040	0.26	0.02	0.05				0.3393
Zn K	8.630	0.15	0.02	0.03				0.2006
Total		100.00		100.00				

Lampiran 7. Karakterisasi FTIR

1. Spektrum Monomer MAAM



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	362.62	88.048	10.596	370.33	343.33	0.91	0.764
2	403.12	78.997	19.43	457.13	372.26	3.148	2.655
3	520.78	49.845	49.998	540.07	459.06	6.427	6.363
4	574.79	32.578	15.506	582.5	542	10.177	1.807
5	626.87	16.088	37.739	734.88	584.43	68.962	34.936
6	779.24	35.88	62.593	800.46	736.81	10.16	9.774
7	823.6	25.622	73.87	887.26	802.39	13.525	13.377
8	935.48	6.775	92.943	979.84	902.69	23.22	23.091
9	1012.63	58.842	41.206	1029.99	981.77	4.295	4.23
10	1107.14	11.282	89.593	1141.86	1031.92	26.148	26.647
11	1174.65	86.399	3.789	1184.29	1143.79	1.476	0.378
12	1236.37	17.137	78.434	1269.16	1186.22	18.715	16.351
13	1288.45	97.805	2.798	1305.81	1269.16	0.192	0.292
14	1377.17	17.931	18.692	1394.53	1307.74	28.455	3.84
15	1408.04	10.746	13.942	1440.83	1396.46	31.462	6.244
16	1456.26	14.286	37.353	1496.76	1442.75	21.957	9.561
17	1602.85	0.884	27.322	1625.99	1498.69	77.902	26.359
18	1666.5	1.836	26.049	1845.88	1627.92	129.427	40.037
19	1870.95	71.016	27.771	1930.74	1847.81	4.957	4.442
20	2013.68	96.5	2.816	2036.83	1963.53	0.559	0.411
21	2212.35	85.333	13.986	2295.29	2133.27	4.305	3.821
22	2351.23	93.905	2.268	2364.73	2333.87	0.666	0.163
23	2416.81	94.397	4.506	2434.17	2395.59	0.552	0.375
24	2459.24	93.082	5.864	2503.6	2436.09	1.034	0.787
25	2526.75	98.106	1.676	2557.61	2503.6	0.249	0.192
26	2603.9	97.193	2.204	2663.69	2557.61	0.806	0.516
27	2781.35	57.904	19.719	2833.43	2760.14	9.425	3.251
28	2875.86	96.472	2.466	2891.3	2862.36	0.287	0.159
29	2927.94	66.43	33.271	2945.3	2893.22	3.591	3.521
30	2985.81	55.314	14.934	3005.1	2972.31	6.479	1.521
31	3194.12	4.821	34.455	3261.63	3020.53	158.506	63.967
32	3278.99	15.748	1.254	3300.2	3263.56	28.866	0.709
33	3385.07	3.132	41.189	3558.67	3302.13	168.031	75.404

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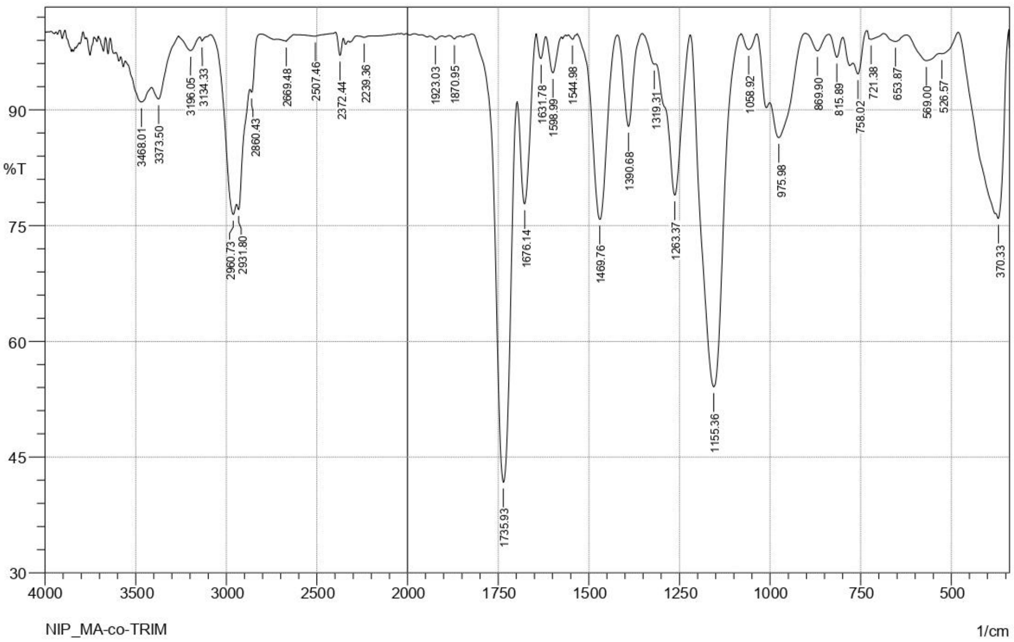
No. of Scans;

2. Spektrum NIP_MAAM-co-TRIM



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	370.33	75.914	4.737	376.12	343.33	2.363	0.578
2	526.57	97.281	0.334	532.35	480.28	0.411	0.11
3	569	96.382	1.864	623.01	534.28	0.998	0.406
4	653.87	98.871	0.931	686.66	623.01	0.191	0.137
5	721.38	99.153	1.027	732.95	686.66	0.104	0.121
6	758.02	94.655	2.885	771.53	732.95	0.537	0.224
7	815.89	96.825	2.759	837.11	798.53	0.284	0.217
8	869.9	97.651	2.216	902.69	837.11	0.32	0.282
9	975.98	86.392	6.703	999.13	904.61	3.608	1.677
10	1058.92	97.808	2.054	1080.14	1035.77	0.247	0.22
11	1155.36	54.117	45.664	1219.01	1080.14	16.329	16.202
12	1263.37	78.944	19.033	1313.52	1220.94	4.725	3.847
13	1319.31	95.917	0.456	1352.1	1315.45	0.349	0.013
14	1390.68	87.842	11.923	1419.61	1354.03	1.568	1.505
15	1469.76	75.796	23.917	1529.55	1421.54	5.297	5.163
16	1544.98	99.149	0.552	1556.55	1537.27	0.048	0.024
17	1598.99	94.81	4.643	1618.28	1573.91	0.545	0.439
18	1631.78	96.667	3.008	1645.28	1618.28	0.231	0.192
19	1676.14	77.816	16.806	1697.36	1647.21	3.274	2.235
20	1735.93	41.748	51.765	1820.8	1699.29	16.194	13.567
21	1870.95	99.187	0.376	1886.38	1861.31	0.062	0.016
22	1923.03	99.13	0.443	1938.46	1905.67	0.088	0.027
23	2239.36	99.409	0.168	2279.86	2196.92	0.174	0.022
24	2372.44	97.052	2.56	2397.52	2353.16	0.285	0.22
25	2507.46	99.542	0.336	2601.97	2397.52	0.243	0.145
26	2669.48	98.897	0.607	2717.7	2630.91	0.31	0.109
27	2860.43	92.28	1.497	2870.08	2808.36	0.938	-0.107
28	2931.8	77.066	2.672	2941.44	2870.08	5.086	0.279
29	2960.73	76.44	3.993	3086.11	2943.37	7.785	0.92
30	3134.33	98.914	0.605	3143.97	3086.11	0.153	0.055
31	3196.05	97.678	1.838	3263.56	3143.97	0.737	0.489
32	3373.5	91.418	3.217	3412.08	3263.56	3.259	0.796
33	3468.01	91.033	3.168	3556.74	3414	4.585	1.13

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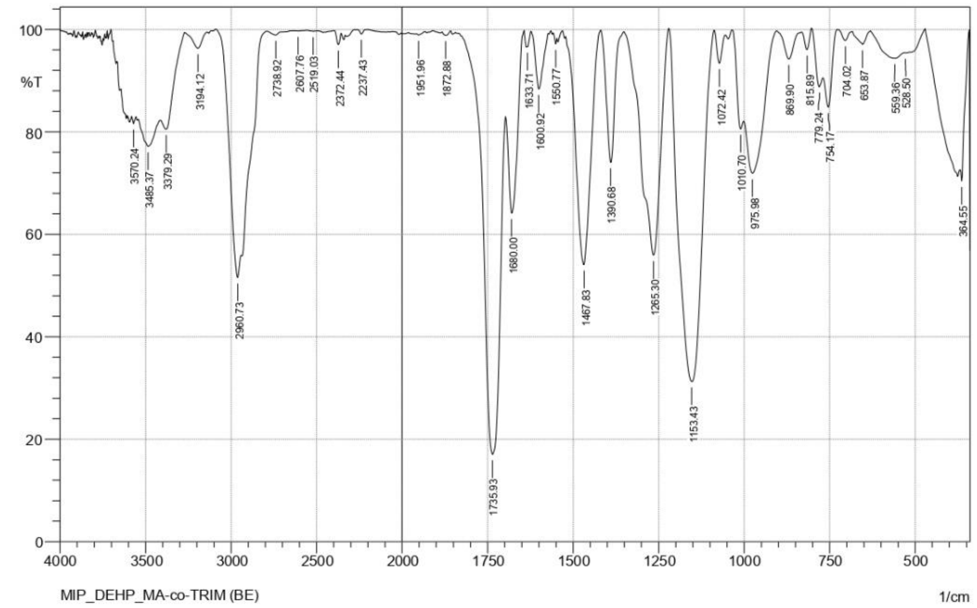
No. of Scans;

3. Spektrum MIP_DEHP_MAAM-co-TRIM$_{(BE)}$



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	364.55	70.426	6.306	368.4	343.33	1.899	0.274
2	376.12	95.428	0.041	532.35	514.99	0.349	0.002
3	559.36	94.37	2.251	630.72	532.35	1.802	0.732
4	653.87	97.078	2.595	682.8	630.72	0.385	0.309
5	704.02	97.837	1.946	727.16	682.8	0.196	0.156
6	754.17	84.833	9.304	769.6	729.09	1.661	0.832
7	779.24	88.835	4.055	802.39	771.53	1.018	0.324
8	815.89	96.063	3.834	833.25	802.39	0.27	0.25
9	869.9	94.232	5.288	904.61	839.03	0.805	0.672
10	975.98	71.93	14.752	1001.06	904.61	7.952	3.88
11	1010.7	80.588	5.879	1033.85	1002.98	1.819	0.441
12	1072.42	93.386	6.023	1087.85	1055.06	0.519	0.431
13	1153.43	31.269	68.714	1219.01	1087.85	32.517	32.506
14	1265.3	55.933	44.027	1350.17	1220.94	14.32	14.238
15	1390.68	74.027	25.65	1417.68	1352.1	3.317	3.219
16	1467.83	54.08	45.206	1521.84	1419.61	11.729	11.4
17	1550.77	97.153	1.472	1558.48	1546.91	0.091	0.03
18	1600.92	88.372	11.024	1622.13	1573.91	1.349	1.215
19	1633.71	96.602	0.547	1635.64	1624.06	0.118	0.023
20	1680	64.136	23.499	1695.43	1645.28	5.636	3.553
21	1735.93	17.059	70.669	1824.66	1697.36	34.226	28.623
22	1872.88	98.87	0.113	1882.52	1870.95	0.048	0.007
23	1951.96	98.918	0.341	1957.75	1932.67	0.088	0.019
24	2237.43	99.111	0.856	2266.36	2200.78	0.084	0.075
25	2372.44	97.042	2.406	2397.52	2357.01	0.288	0.202
26	2519.03	99.656	0.102	2561.47	2492.03	0.084	0.014
27	2607.76	99.684	0.057	2621.26	2582.68	0.046	0.004
28	2738.92	98.909	0.661	2791	2706.13	0.271	0.118
29	2960.73	51.592	10.103	3088.03	2941.44	18.654	2.687
30	3194.12	96.319	3.111	3271.27	3140.11	1.134	0.804
31	3379.29	80.547	5.75	3412.08	3273.2	7.568	1.605
32	3485.37	77.155	5.189	3541.31	3414	12.732	1.984
33	3570.24	81.63	1.291	3579.88	3556.74	1.961	0.079

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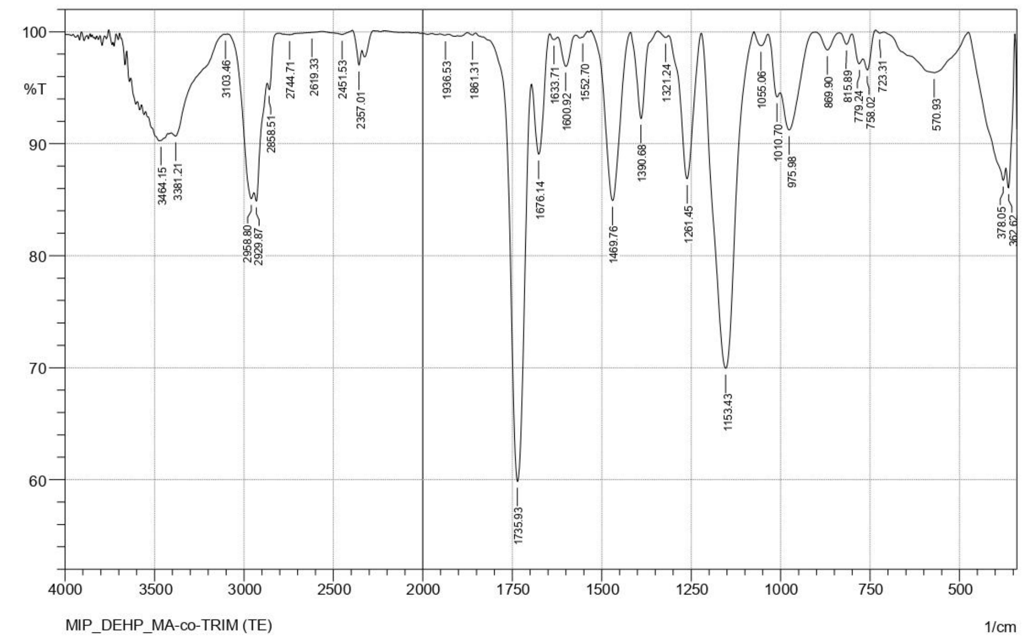
No. of Scans;

4. Spektrum MIP_DEHP_MAAM-co-TRIM(TE)



	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	362.62	86.053	5.471	370.33	345.26	1.083	0.421
2	378.05	86.726	1.608	474.49	372.26	3.579	0.591
3	570.93	96.358	3.609	711.73	476.42	2.167	2.137
4	723.31	99.881	0.192	734.88	711.73	0.003	0.01
5	758.02	96.596	1.849	769.6	734.88	0.307	0.135
6	779.24	97.15	1.136	800.46	769.6	0.259	0.083
7	815.89	98.885	0.975	837.11	800.46	0.089	0.068
8	869.9	98.386	1.562	902.69	837.11	0.211	0.197
9	975.98	91.226	4.742	1001.06	904.61	2.034	0.91
10	1010.7	94.181	1.831	1035.77	1001.06	0.549	0.112
11	1055.06	98.757	1.143	1074.35	1035.77	0.134	0.117
12	1153.43	69.944	29.948	1220.94	1076.28	10.106	10.04
13	1261.45	86.87	12.895	1311.59	1222.87	2.406	2.311
14	1321.24	99.494	0.27	1342.46	1313.52	0.035	0.017
15	1390.68	92.267	7.728	1419.61	1342.46	0.915	0.918
16	1469.76	84.931	15.065	1527.62	1419.61	3.16	3.159
17	1552.7	99.521	0.069	1554.63	1539.2	0.017	0.002
18	1600.92	96.925	2.684	1622.13	1571.99	0.368	0.285
19	1633.71	99.31	0.366	1645.28	1622.13	0.054	0.021
20	1676.14	89.066	8.041	1695.43	1647.21	1.473	0.968
21	1735.93	59.842	36.566	1851.66	1697.36	9.559	7.94
22	1861.31	99.707	0.208	1874.81	1851.66	0.019	0.01
23	1936.53	99.71	0.082	1951.96	1928.82	0.025	0.005
24	2357.01	97.031	1.885	2393.66	2339.65	0.349	0.169
25	2451.53	99.758	0.344	2559.54	2393.66	0.059	0.122
26	2619.33	99.945	0.009	2625.12	2559.54	0.003	0.001
27	2744.71	99.738	0.092	2777.5	2696.48	0.073	0.015
28	2858.51	94.833	1.397	2870.08	2806.43	0.625	-0.039
29	2929.87	84.869	2.567	2943.37	2870.08	3.343	0.254
30	2958.8	85.104	1.818	3091.89	2945.3	4.553	0.375
31	3103.46	99.776	0.019	3111.18	3093.82	0.016	0.001
32	3381.21	90.683	1.032	3406.29	3111.18	5.789	0.192
33	3464.15	90.285	0.07	3468.01	3427.51	1.752	0.019

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No. of Scans;

Lampiran 8. Karakterisasi SAA

micromeritics

TriStar II 3020 2.00 | TriStar II 3020 Version 2.00 Unit 1 Port 1 | Serial #: 1108 | Page 1

Sample: MIP_DEHP_MA_Co_TRIM
Operator: Sarah
Submitter: 25991
File: C:\TriStar II 3020\data\SAMPEL\20...\MIP_DEHP_MA_Co_TRIM.SMP

Started: 1/7/2022 7:05:13 AM
Completed: 1/7/2022 11:08:05 AM
Report Time: 1/7/2022 1:11:21 PM
Sample Mass: 0.0551 g
Cold Free Space: 33.0250 cm³
Low Pressure Dose: None
Automatic Degas: No

Analysis Adsorptive: N2
Analysis Bath Temp.: -195.850 °C
Thermal Correction: No
Warm Free Space: 11.4392 cm³ Measured
Equilibration Interval: 5 s
Sample Density: 1.000 g/cm³

Summary Report

Surface Area

Single point surface area at P/Po = 0.303234883: 357.5634 m²/g

BET Surface Area: 362.0731 m²/g

t-Plot Micropore Area: 137.9785 m²/g

t-Plot External Surface Area: 224.0946 m²/g

BJH Adsorption cumulative surface area of pores between 1.7000 nm and 300.0000 nm diameter: 193.092 m²/g

BJH Desorption cumulative surface area of pores between 1.7000 nm and 300.0000 nm diameter: 174.2059 m²/g

D-H Adsorption cumulative surface area of pores between 1.7000 nm and 300.0000 nm diameter: 164.879 m²/g

D-H Desorption cumulative surface area of pores between 1.7000 nm and 300.0000 nm diameter: 154.4766 m²/g

Pore Volume

Single point adsorption total pore volume of pores less than 240.3666 nm diameter at P/Po = 0.991973315: 0.442559 cm³/g

t-Plot micropore volume: 0.072140 cm³/g

BJH Adsorption cumulative volume of pores between 1.7000 nm and 300.0000 nm diameter: 0.359706 cm³/g

BJH Desorption cumulative volume of pores between 1.7000 nm and 300.0000 nm diameter: 0.330791 cm³/g

Pore Size

Adsorption average pore width (4V/A by BET): 4.88917 nm

BJH Adsorption average pore diameter (4V/A): 7.4515 nm

BJH Desorption average pore diameter (4V/A): 7.5954 nm

D-H Adsorption average pore diameter (4V/A): 8.0798 nm

D-H Desorption average pore diameter (4V/A): 8.1945 nm

Sample: MIP_DEHP_MA_Co_TRIM
Operator: Sarah
Submitter: 25991
File: C:\TriStar II 3020\data\SAMPEL\20...\MIP_DEHP_MA_Co_TRIM.SMP

Started: 1/7/2022 7:05:13 AM
Completed: 1/7/2022 11:08:05 AM
Report Time: 1/7/2022 1:11:21 PM
Sample Mass: 0.0551 g
Cold Free Space: 33.0250 cm³
Low Pressure Dose: None
Automatic Degas: No

Analysis Adsorptive: N2
Analysis Bath Temp.: -195.850 °C
Thermal Correction: No
Warm Free Space: 11.4392 cm³ Measured
Equilibration Interval: 5 s
Sample Density: 1.000 g/cm³

Isotherm Tabular Report

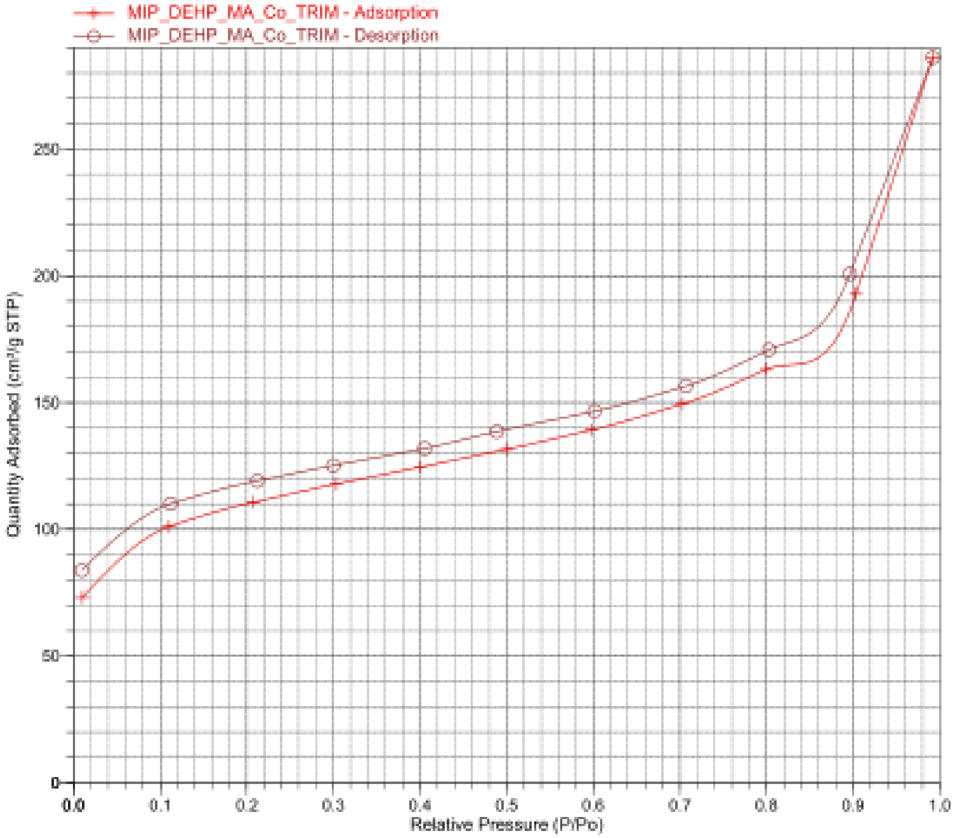
Relative Pressure (P/Po)	Absolute Pressure (mmHg)	Quantity Adsorbed (cm³/g STP)	Elapsed Time (h:min)	Saturation Pressure (mmHg)
				760.000000
0.010004170	7.603169	72.9769	01:37	
0.110378004	83.887283	101.0690	01:59	
0.207913991	158.014633	110.6729	02:06	
0.303234883	230.458511	117.8849	02:11	
0.400497959	304.378448	124.5734	02:14	
0.499579339	379.680298	131.5470	02:18	
0.597817752	454.341492	139.1830	02:22	
0.702672858	534.031372	149.3914	02:27	
0.799710324	607.779846	163.0793	02:32	
0.903295256	686.504395	192.8225	02:42	
0.991973315	753.899719	286.1125	02:49	
0.896344958	681.222168	200.6629	03:02	
0.802937879	610.232788	170.8213	03:09	
0.707111720	537.404907	156.5428	03:13	
0.601480584	457.125244	146.5617	03:16	
0.488706408	371.416870	138.5477	03:20	
0.405511073	308.188416	131.9219	03:24	
0.299760798	227.818207	125.1567	03:27	
0.212366787	161.398758	119.1374	03:30	
0.112060216	85.165764	110.0602	03:36	
0.009741831	7.403792	83.8048	04:01	

TriStar II 3020 2.00 TriStar II 3020 Version 2.00 Unit 1 Port 1 Serial #: 1108 Page 4

Sample: MIP_DEHP_MA_Co_TRIM
Operator: Sarah
Submitter: 25991
File: C:\TriStar II 3020\data\SAMPEL\20...\MIP_DEHP_MA_Co_TRIM.SMP

Started:	1/7/2022 7:05:13 AM	Analysis Adsorptive:	N2
Completed:	1/7/2022 11:08:05 AM	Analysis Bath Temp.:	-195.850 °C
Report Time:	1/7/2022 1:11:21 PM	Thermal Correction:	No
Sample Mass:	0.0551 g	Warm Free Space:	11.4392 cm³ Measured
Cold Free Space:	33.0250 cm³	Equilibration Interval:	5 s
Low Pressure Dose:	None	Sample Density:	1.000 g/cm³
Automatic Degas:	No		

Isotherm Linear Plot



micrometrics

Sample: MIP_DEHP_MA_Co_TRIM
Operator: Sarah
Submitter: 25991
File: C:\TriStar II 3020\data\SAMPEL\20...\MIP_DEHP_MA_Co_TRIM.SMP

Started: 1/7/2022 7:05:13 AM
Completed: 1/7/2022 11:08:05 AM
Report Time: 1/7/2022 1:11:21 PM
Sample Mass: 0.0551 g
Cold Free Space: 33.0250 cm³
Low Pressure Dose: None
Automatic Degas: No

Analysis Adsorptive: N2
Analysis Bath Temp.: -195.850 °C
Thermal Correction: No
Warm Free Space: 11.4392 cm³ Measured
Equilibration Interval: 5 s
Sample Density: 1.000 g/cm³

BJH Adsorption Pore Distribution Report

Faas Correction
Harkins and Jura
t = [13.99 / (0.034 - log(P/Po))] ^ 0.5

Diameter Range: 1.7000 nm to 300.0000 nm
Adsorbate Property Factor: 0.95300 nm
Density Conversion Factor: 0.0015468
Fraction of Pores Open at Both Ends: 0.00

Pore Diameter Range (nm)	Average Diameter (nm)	Incremental Pore Volume (cm³/g)	Cumulative Pore Volume (cm³/g)	Incremental Pore Area (m²/g)	Cumulative Pore Area (m²/g)
240.5 - 21.5	22.9	0.187138	0.187138	32.619	32.619
21.5 - 10.7	12.6	0.054378	0.241517	17.247	49.866
10.7 - 7.3	8.3	0.022766	0.264283	11.029	60.894
7.3 - 5.3	5.9	0.016747	0.281030	11.291	72.186
5.3 - 4.2	4.6	0.012674	0.293704	11.097	83.283
4.2 - 3.3	3.6	0.012359	0.306063	13.564	96.847
3.3 - 2.7	3.0	0.012817	0.318880	17.339	114.186
2.7 - 2.2	2.4	0.015730	0.334610	26.145	140.332
2.2 - 1.7	1.9	0.025096	0.359706	52.761	193.092

Lampiran 9. Contoh Perhitungan Nilai Kapasitas Adsorpsi berdasarkan Model Persamaan Isotermal Adsorpsi Langmuir dan Isotermal Adsorpsi Freundlich

1. Isotermal Adsorpsi Langmuir

Persamaan:

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

Keterangan:

C_e = Konsentrasi saat kesetimbangan (mg/L)
q_e = Jumlah zat teradsorpsi saat kesetimbangan (mg/g)
q_m = Kapasitas adsorpsi monolayer (mg/g)
K_L = Konstanta afinitas adsorpsi atau konstanta kesetimbangan (L/mg)

Berdasarkan model isotermal Langmuir diperoleh persamaan garis:

$$y = 3{,}0359x + 0{,}3767$$

$\frac{1}{q_m}$ = 0,3767 maka, $q_m = \frac{1}{0{,}3767} = 2{,}65$ mg/g

$\frac{1}{q_m K_L}$ = 3,0359 maka, $K_L = \frac{1}{3{,}0359 \text{ x } 2{,}6545} = 0{,}12$ L/mg

2. Isotermal Adsorpsi Freundlich

Persamaan:

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

Keterangan:

C_e = Konsentrasi saat kesetimbangan (mg/L)
q_e = Jumlah zat teradsorpsi saat kesetimbangan (mg/g)
K_F = Kapasitas adsorpsi (mg/g)
$\frac{1}{n}$ = Konstanta Freundlich menyatakan faktor heterogenitas
n = Intensitas adsorpsi

Berdasarkan model isotermal Freundlich diperoleh persamaan garis:

$$y = 0,6578x - 0,467$$

$$\frac{1}{n} = 0,6578 \qquad \text{maka,} \qquad n = \frac{1}{0,6578} = 1,52$$

$\log K_F = -0,467$

$K_F = \text{Inv. log } (-0,467)$

$K_F = 0,34$ mg/g