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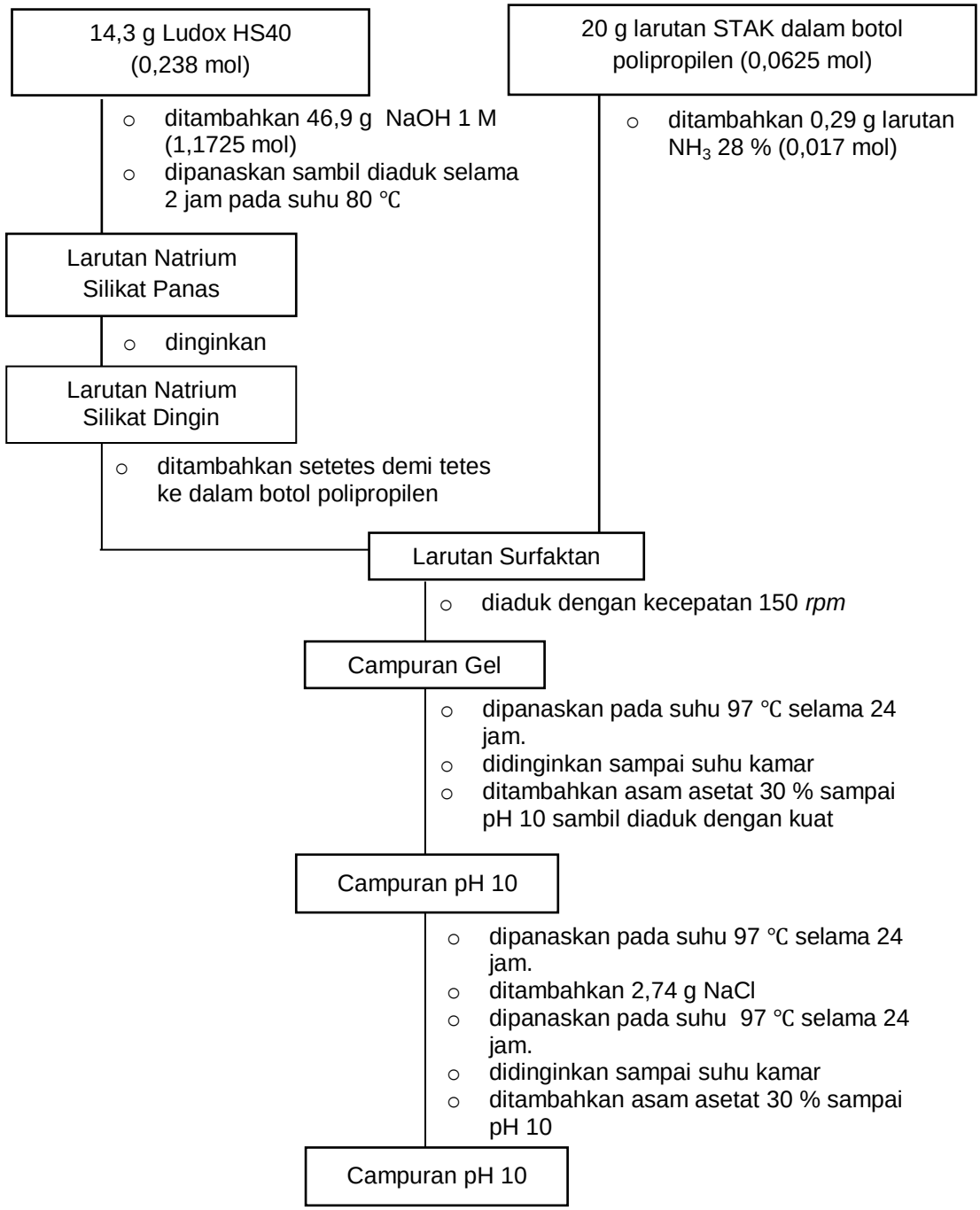
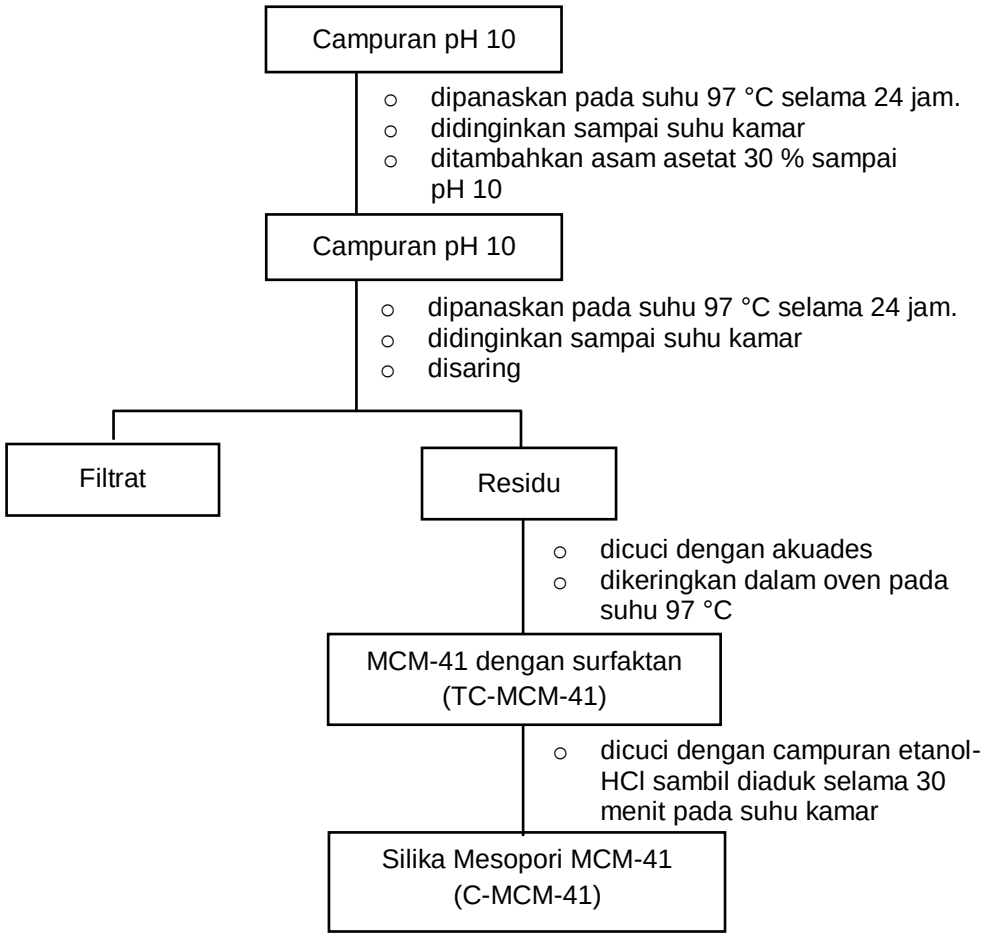
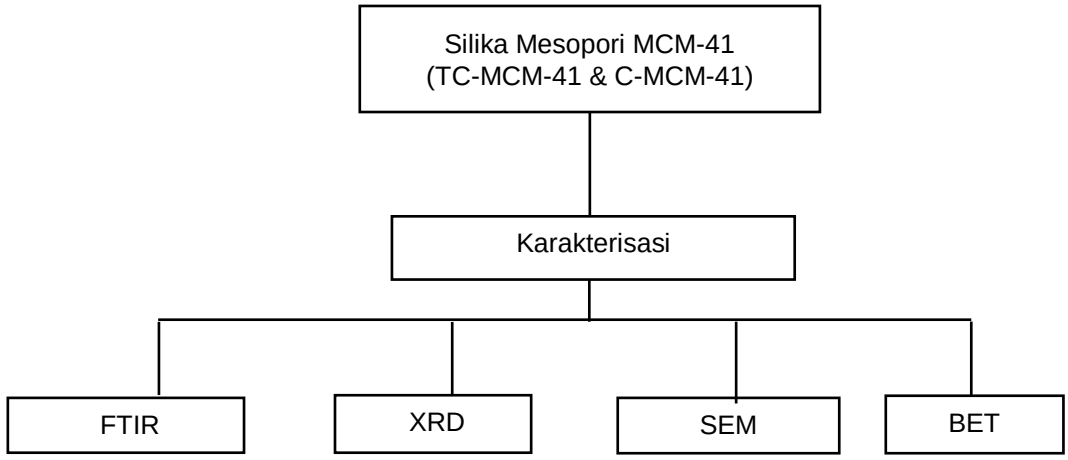
Lampiran 1. Diagram Alir Penelitian

1. Sintesis Silika Mesopori MCM-41

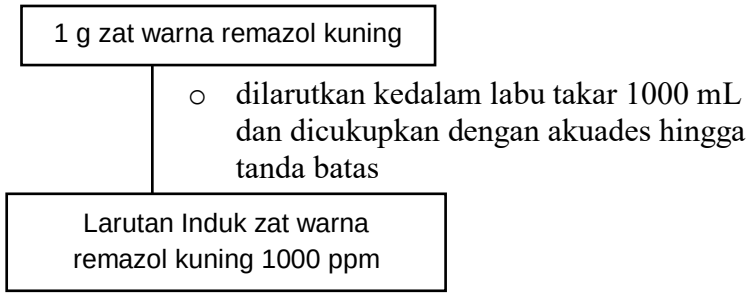




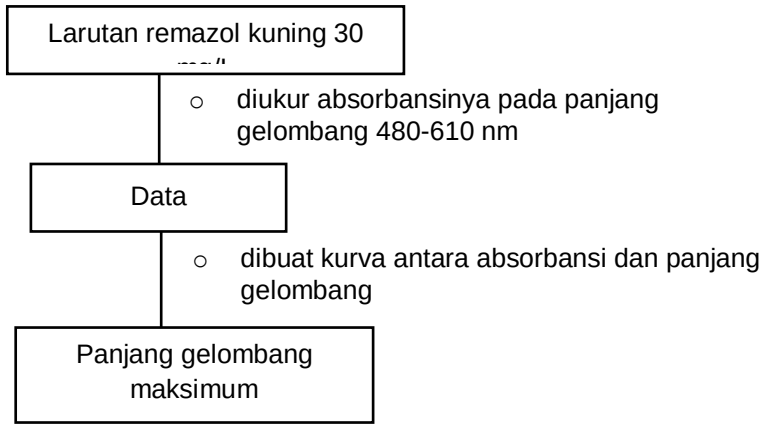
2. Karakterisasi Silika Mesopori MCM-41



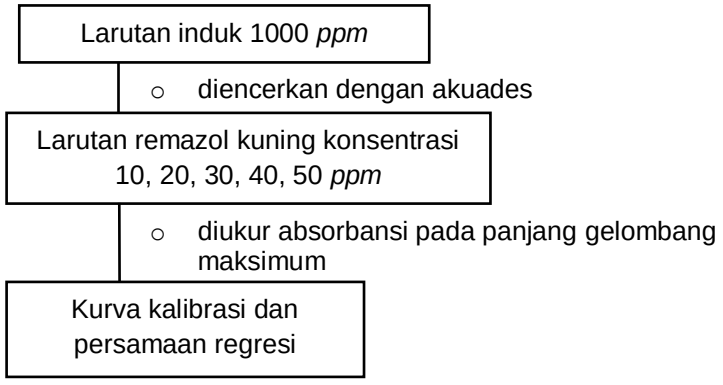
3. Pembuatan Larutan Induk Remazol Kuning



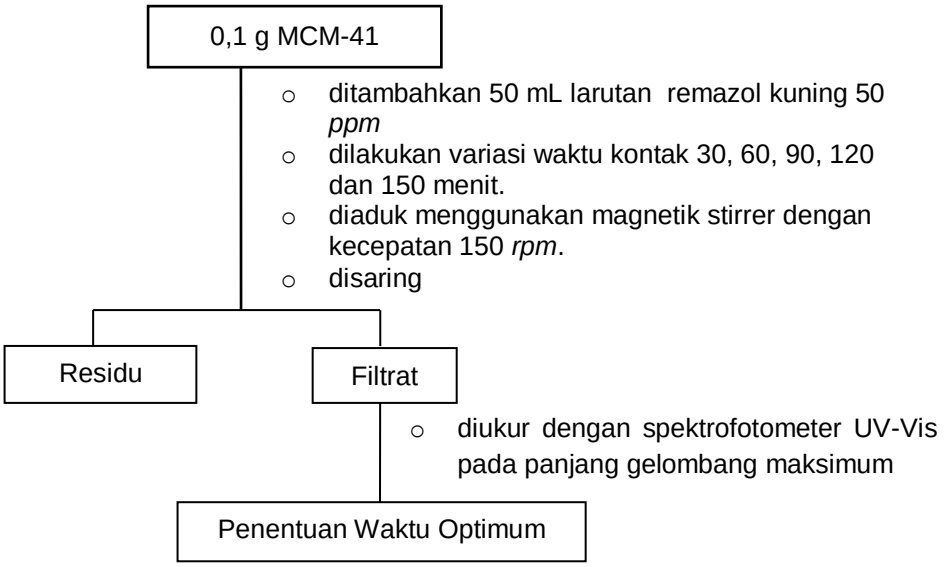
4. Penentuan Panjang Gelombang Maksimum



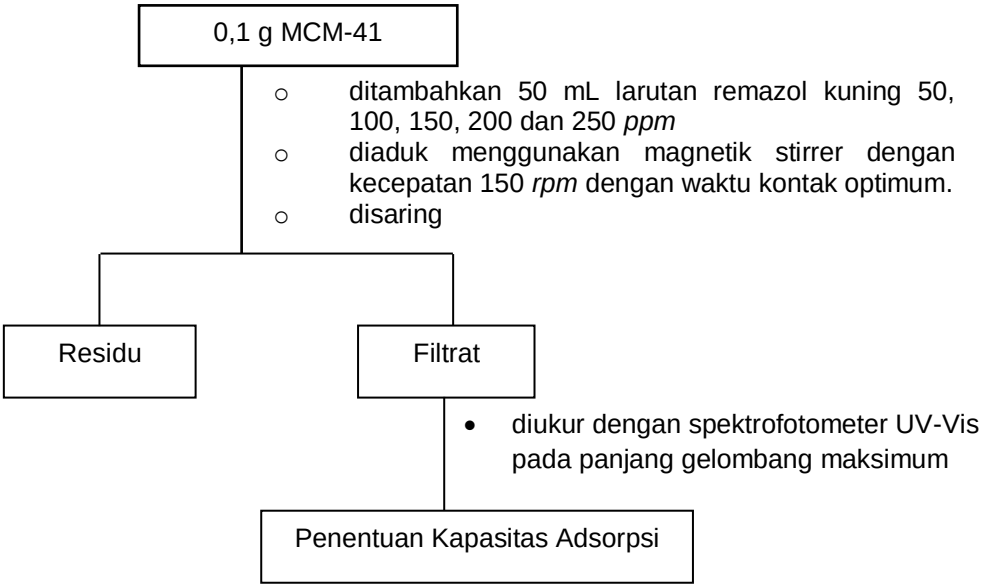
5. Pembuatan Kurva Kalibrasi Larutan Standar Zat Warna Remazol Kuning



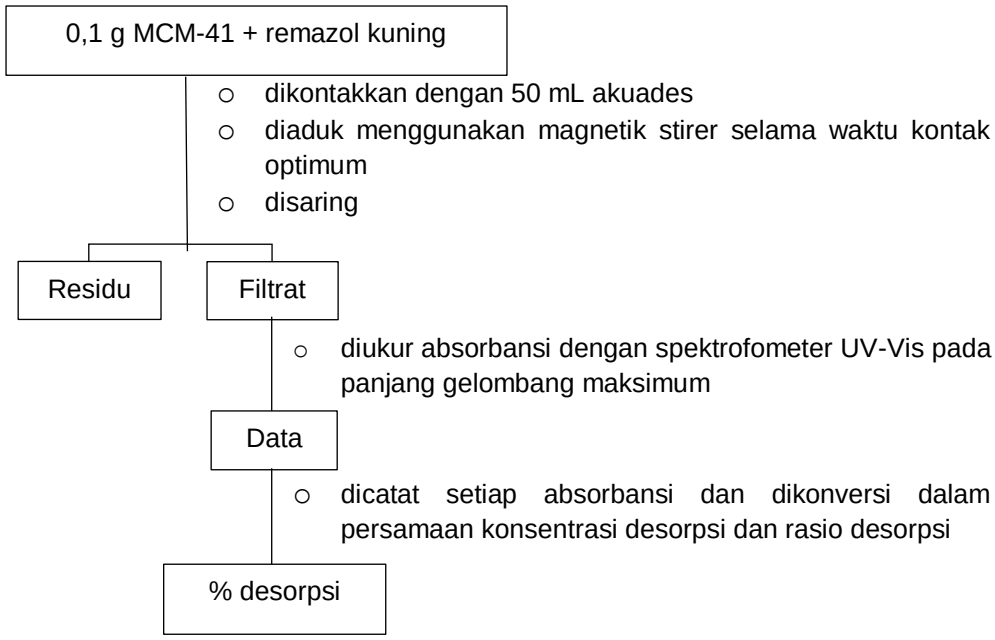
6. Penentuan Waktu Kontak Optimum



7. Penentuan Kapasitas Adsorpsi



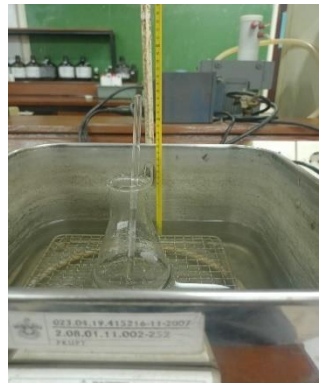
8. Desorpsi Zat Warna Remazol Kuning



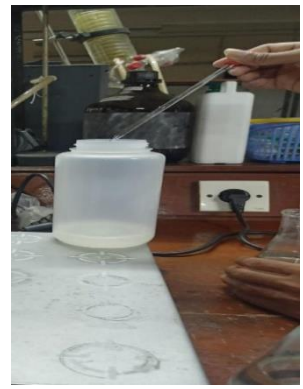
Lampiran 2. Dokumentasi Penelitian

Sintesis silika mesopori MCM-41

Pembuatan natrium silika



Pemanasan pada suhu 80^{0}C



Pencampuran larutan natrium silika dan surfaktan

Pemanasan pada suhu 97^{o}C

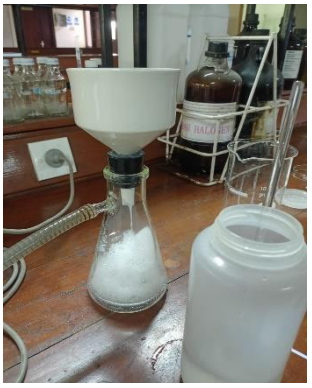
Pengaturan pH 10

Penyaringan dengan akuades

MCM-41-TC

Penghilangan surfaktan dengan pencucian HCl-etanol satu kali

Pengadukan selama 30 menit



Penyaringan dengan akuades

MCM-41-C

Proses adsorpsi

Waktu kontak MCM-41-TC-RK

Waktu kontak MCM-41-C-RK

Variasi konsentrasi MCM-41-TC-RK

Variasi konsentrasi MCM-41-C-RK

Proses desorpsi

Desorpsi zat warna Remazol Kuning

Lampiran 3. Karakterisasi XRD

Match! Phase Analysis Report

Sample: MCM-41-C-MHD (2-80)

Sample Data

File name	MCM-41-C-MHD.RAW
File path	C:/Users/MSI MODERN/Documents/xrd/MCM/MCM-41-C-MHD
Data collected	Dec 5, 2022 12:05:45
Data range	2.000° - 80.000°
Original data range	2.000° - 80.000°
Number of points	7801
Step size	0.010
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.540600 Å

Peak List

No.	*2theta [°]*	*d [Å]*	*I/I0 (peak height)*	*Counts (peak area)*	*FWHM*
1	6.73	13.1234	39.15	1.93	0.3200
2	22.01	4.0352	697.64	34.37	0.3200
3	44.31	2.0426	56.25	2.77	0.3200
4	64.64	1.4408	104.88	5.17	0.3200
5	77.67	1.2284	149.60	6.45	0.2800

Integrated Profile Areas

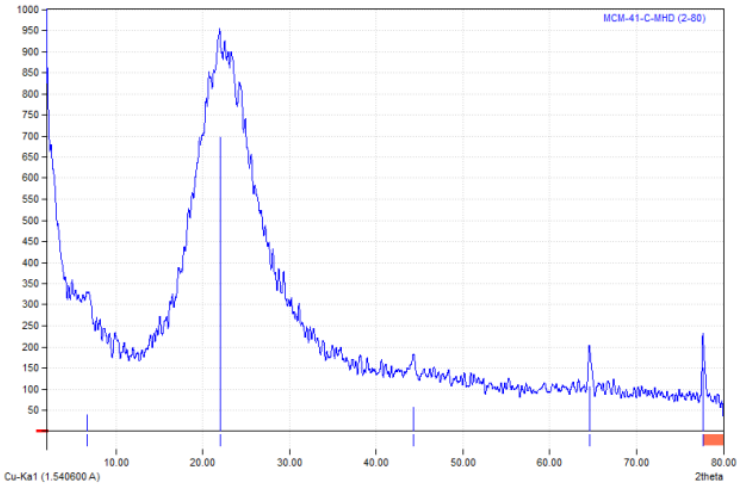
Based on calculated profile

Profile area	*Counts*	*Amount*
Overall diffraction profile	221687	100.00%
Background radiation	150514	67.89%
Diffraction peaks	71173	32.11%
Peak area belonging to selected phases	0	0.00%
Unidentified peak area	71173	32.11%

Peak Residuals

Peak data	*Counts*	*Amount*
Overall peak intensity	51	100.00%
Peak intensity belonging to selected phases	30	58.25%
Unidentified peak intensity	21	41.75%

Diffraction Pattern Graphics



Match! Phase Analysis Report

Sample: MCM-41-TC-MHD (2-80)

Sample Data

File name	MCM-41-TC-MHD.RAW
File path	C:/Users/MSI MODERN/Documents/xrd/MCM/MCM-41-TC-MHD
Data collected	Dec 5, 2022 12:05:45
Data range	2.000° - 80.000°
Original data range	2.000° - 80.000°
Number of points	7801
Step size	0.010
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.540600 Å

Peak List

No.	*2theta [°]*	*d [Å]*	*I/I0 (peak height)*	*Counts (peak area)*	*FWHM*
1	5.86	15.0697	22.47	19.63	6.8400
2	21.85	4.0644	1000.00	370.35	2.9000
3	44.07	2.0532	25.89	18.20	5.5039
4	64.72	1.4392	49.12	10.73	1.7103
5	77.64	1.2288	53.30	15.46	1.7103

Integrated Profile Areas

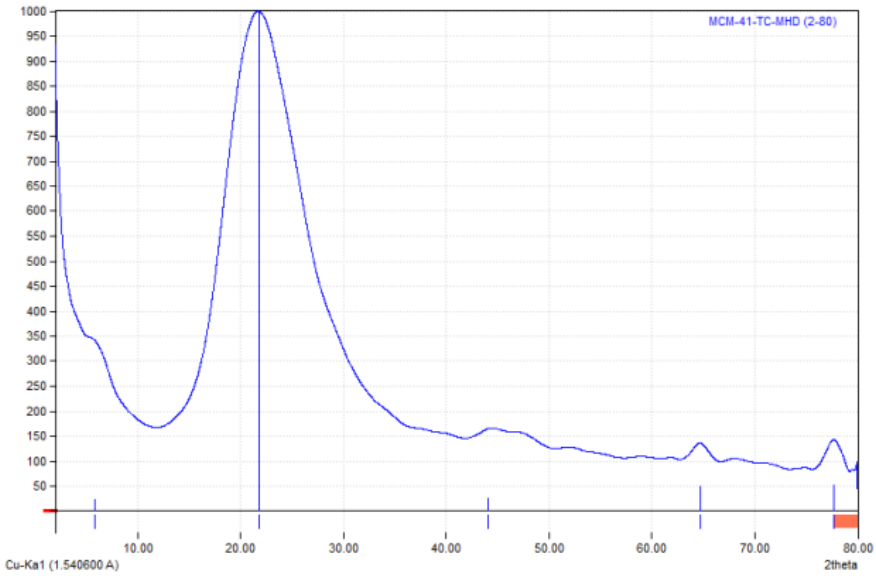
Based on calculated profile

Profile area	***Counts***	***Amount***
Overall diffraction profile	260564	100.00%
Background radiation	173352	66.53%
Diffraction peaks	87212	33.47%
Peak area belonging to selected phases	0	0.00%
Unidentified peak area	87212	33.47%

Peak Residuals

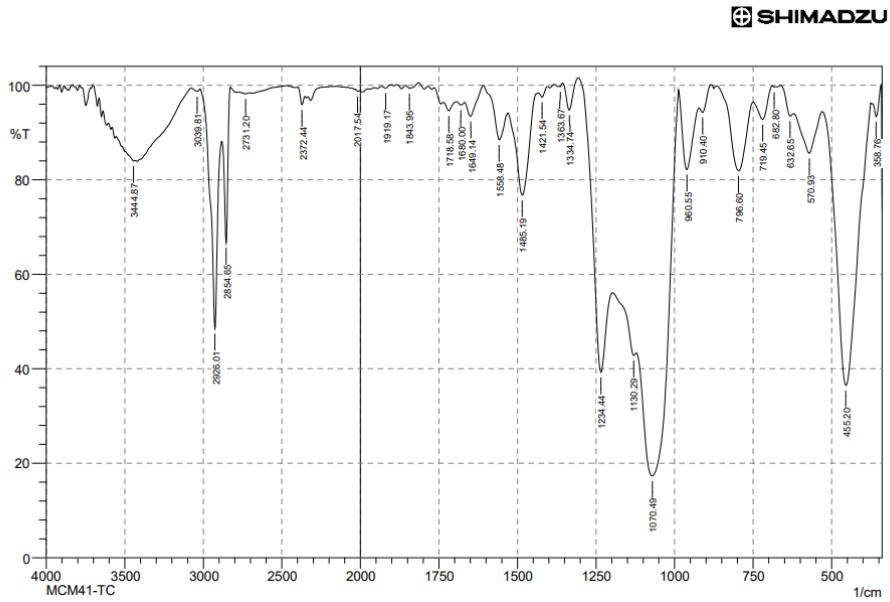
Peak data	***Counts***	***Amount***
Overall peak intensity	434	100.00%
Peak intensity belonging to selected phases	0	0.00%
Unidentified peak intensity	434	100.00%

Diffraction Pattern Graphics



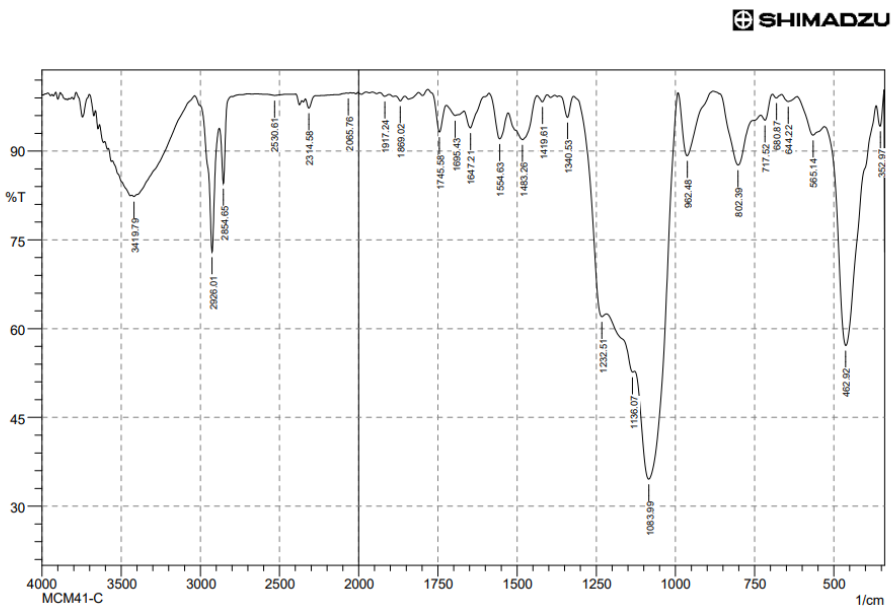
Lampiran 4. Karakterisasi FTIR

MCM-41-TC



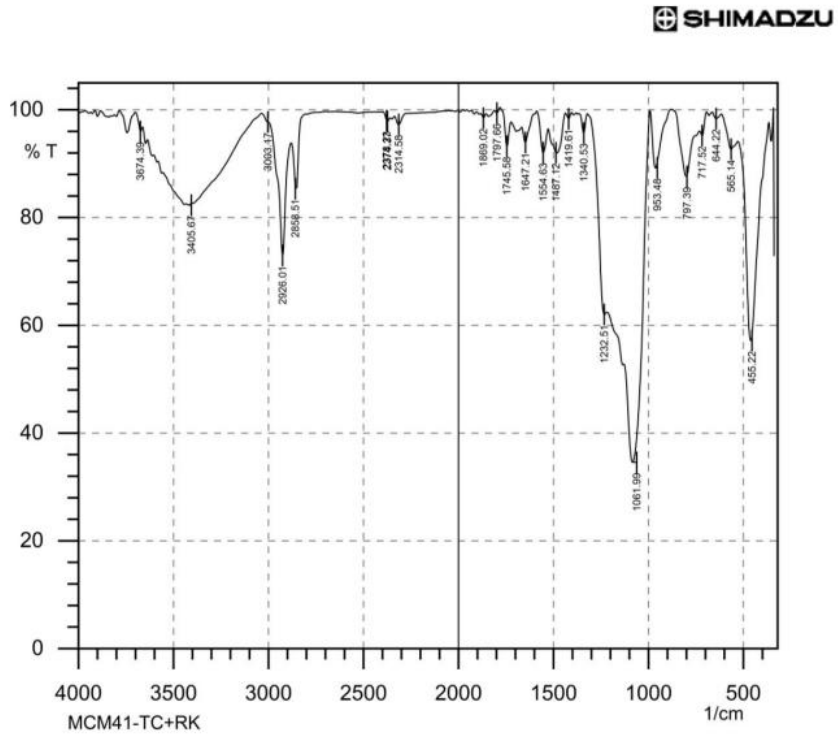
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	358.76	93.346	4.552	372.26	341.4	0.552	0.3
2	455.2	36.481	58.8	528.5	376.12	29.59	26.421
3	570.93	85.609	8.621	621.08	530.42	4.19	1.843
4	632.65	93.492	2.147	663.51	621.08	0.705	0.137
5	682.8	99.618	0.305	688.59	663.51	0.029	0.024
6	719.45	92.747	5.34	748.38	688.59	1.194	0.718
7	796.6	81.899	15.903	866.04	750.31	4.832	3.867
8	910.4	94.24	2.503	921.97	885.33	0.579	0.197
9	960.55	82.145	14.87	985.62	923.9	3.278	2.365
10	1070.49	17.329	46.962	1120.64	987.55	62.758	38.627
11	1130.29	42.816	1.863	1195.87	1122.57	21.948	0.22
12	1234.44	39.239	32.304	1305.81	1197.79	21.44	8.546
13	1334.74	94.756	6.183	1355.96	1305.81	0.386	0.607
14	1363.67	99.709	0.278	1367.53	1355.96	-0.002	0.004
15	1421.54	97.489	1.502	1435.04	1404.18	0.218	0.093
16	1485.19	76.746	19.383	1529.55	1435.04	5.648	4.092
17	1558.48	88.473	7.687	1606.7	1531.48	2.104	1.063
18	1649.14	93.454	3.958	1666.5	1608.63	0.967	0.504
19	1680	95.815	0.635	1693.5	1668.43	0.431	0.038
20	1718.58	94.574	1.863	1735.93	1693.5	0.814	0.148
21	1843.95	99.313	0.823	1855.52	1815.02	0.041	0.087
22	1919.17	99.389	0.54	1932.67	1903.74	0.04	0.032
23	2017.54	98.737	0.206	2056.12	2007.9	0.195	0.01
24	2372.44	95.881	2.597	2397.52	2353.16	0.495	0.223
25	2731.2	98.195	0.243	2775.57	2702.27	0.53	0.034
26	2854.65	66.694	27.142	2881.65	2827.64	4.675	3.194
27	2926.01	48.541	43.015	3020.53	2883.58	14.893	10.85
28	3039.81	98.694	0.579	3076.46	3020.53	0.245	0.072
29	3444.87	83.974	0.509	3554.81	3435.22	7.792	0.28

MCM-41-C



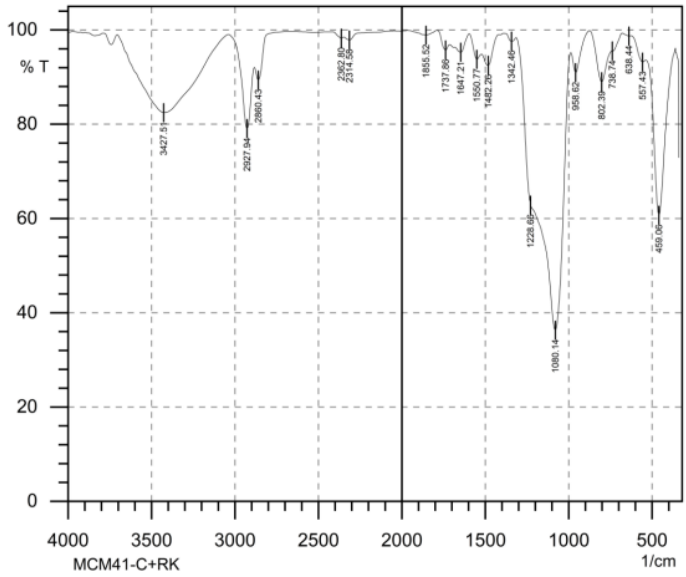
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	352.97	94.222	4.89	366.48	341.4	0.415	0.306
2	462.92	57.153	38.407	528.5	366.48	17.193	14.248
3	565.14	92.689	3.528	615.29	530.42	1.938	0.658
4	644.22	98.381	1.038	665.44	615.29	0.257	0.124
5	680.87	98.977	0.615	694.37	665.44	0.09	0.039
6	717.52	95.221	2.151	731.02	694.37	0.522	0.172
7	802.39	87.659	10.291	881.47	732.95	3.945	2.679
8	962.48	89.223	10.679	991.41	883.4	2.395	2.379
9	1083.99	34.563	33.668	1128.36	993.34	38.595	20.074
10	1136.07	52.664	0.763	1217.08	1130.29	20.555	0.066
11	1232.51	62.019	5.326	1321.24	1219.01	9.797	0.865
12	1340.53	95.686	3.601	1367.53	1321.24	0.441	0.298
13	1419.61	98.316	1.128	1436.97	1404.18	0.154	0.074
14	1483.26	91.928	3.295	1502.55	1436.97	1.662	0.642
15	1554.63	92.066	5.797	1587.42	1529.55	1.265	0.762
16	1647.21	93.929	3.597	1666.5	1604.77	1.005	0.468
17	1695.43	96.007	0.543	1724.36	1685.79	0.562	0.041
18	1745.58	93.223	5.525	1780.3	1724.36	0.743	0.515
19	1869.02	98.472	0.809	1884.45	1853.59	0.142	0.046
20	1917.24	99.249	0.472	1932.67	1903.74	0.063	0.029
21	2065.76	99.763	0.076	2077.33	2052.26	0.021	0.004
22	2314.58	97.278	1.719	2337.72	2270.22	0.48	0.211
23	2530.61	99.398	0.239	2646.34	2438.02	0.4	0.074
24	2854.65	84.523	11.101	2879.72	2804.5	2.206	1.144
25	2926.01	72.954	22.478	3035.96	2881.65	7.122	4.757
26	3419.79	82.317	0.79	3433.29	3037.89	18.204	1.492

MCM-41-TC+ Remazol Kuning



No	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	455.2158	57.15308	58.8	528.5	376.12	0.552	0.3
2	565.3333	92.69376	8.675	621.89	534.76	5.657	1.87
3	643.0222	98.64839	2.878	665.43	631.96	0.87	0.321
4	712.5333	95.47259	6.213	765.125	688.621	1.098	0.459
5	798.4	87.93006	16.761	855.134	785.24	5.258	3.675
6	961.9556	89.71645	13.568	986.209	986.21	3.561	2.871
7	1061.995	34.56338	45.96	1121.65	987.7	62.65	38.543
8	1232.513	62.01863	32.304	1305.87	1198.87	23.99	8.564
9	1342.222	95.86957	5.715	1355.27	1309.12	0.376	0.514
10	1419.911	98.44991	1.659	1354.012	1407.65	0.2	0.089
11	1481.244	92.29679	18.526	1654.88	1456.1	5.987	3.091
12	1550.756	92.29679	7.346	1606.8	1541.09	2.659	1.263
13	1648.889	94.67864	3.156	1666.67	1609.54	0.965	0.808
14	1742.933	93.28922	1.98	1765.98	1678.1	0.898	0.177
15	1796.089	99.44234	1.99	1767.99	1711.2	0.972	0.202
16	1869.689	98.64839	0.822	1799.31	1810.09	0.0321	0.098
17	2376.711	97.85444	2.659	2397.87	2365.18	0.1467	0.2245
18	2858.505	85.35365	27.154	2881.87	2827.12	4.675	3.195
19	2926.014	72.95429	43.015	3021.01	2883.78	14.897	10.89
20	3405.671	82.30687	0.609	3020.87	2889.1	14.87	0.021
21	3672.889	95.86957	0.587	2999.01	2799.01	13.98	0.076
22	3002.311	97.45747	0.521	2889.09	2780.06	13.76	0.879
23	3742.4	95.67108	0.409	2786.08	2777.87	12.766	0.986

MCM-41-C+ Remazol Kuning



No	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	459.0222222	61.1342155	48.095	3061.01	2983.787	18.897	14.89
2	561.2444444	93.28922495	18.526	1654.88	1456.1	5.987	3.091
3	643.0222222	98.84688091	3.156	1666.67	1609.54	0.965	0.808
4	737.0666667	95.47258979	12.878	1665.43	1631.96	0.872	0.981
5	802.4888889	89.12098299	6.213	765.125	688.621	1.098	0.959
6	953.7777778	91.30434783	45.96	1121.65	987.7	62.65	38.543
7	1080.13696	36.30713181	30.351	105.88	1458.17	93.19	18.134
8	1227.733333	63.11909263	32.304	1305.87	1198.87	23.99	8.564
9	1342.222222	97.65595463	80.677	621.89	534.76	5.657	1.87
10	1485.333333	92.4952741	1.888	665.43	631.96	0.87	0.321
11	1550.755556	93.88468809	16.761	855.134	785.24	5.258	3.675
12	1640.711111	95.47258979	13.568	986.209	986.21	3.561	2.871
13	1738.844444	96.06805293	58.8	528.5	376.12	0.552	0.3
14	1861.511111	99.04536862	16.99	109.19	1761.2	0.972	0.202
15	2311.288889	97.85444234	7.346	1606.8	1541.09	2.659	1.263
16	2364.444444	98.05293006	3.156	1666.67	1609.54	0.965	0.808
17	2859.2	89.51795841	13.568	986.209	986.21	3.561	2.871
18	2927.942688	79.08304233	0.609	3020.87	2889.1	14.87	0.021
19	3412.567765	82.48565405	0.822	1799.31	1810.09	0.0321	0.098

Lampiran 5. Karakterisasi BET

MCM-41-TC

micromeritics

TriStar II Plus 3.01 | TriStar II Plus Version 3.01 Serial # 1080 Unit 1 Port 3 | Page 1 of 15

Started:	6/26/2023 3:05:24 PM	Analysis adsorptive:	N2
Completed:	6/26/2023 7:55:34 PM	Analysis bath temp.:	-195,850 °C
Report time:	6/27/2023 7:44:57 AM	Thermal correction:	No
Sample mass:	0,0315 g	Ambient free space:	10,9395 cm³ Measured
Analysis free space:	31,3861 cm³	Equilibration interval:	10 s
Low pressure dose:	None	Sample density:	1,000 g/cm³
Automatic degas:	No		

Summary Report

Surface Area

Single point surface area at P/Po = 0,274088768: 93,5275 m²/g

BET Surface Area: 114,4411 m²/g

Pore Volume

Single point adsorption total pore volume of pores less than 384,1792 nm diameter at P/Po = 0,995000000: 0,102834 cm³/g

Pore Size

Adsorption average pore diameter (4V/A by BET): 3,5943 nm

Desorption average pore diameter (4V/A by BET): 2,7985 nm

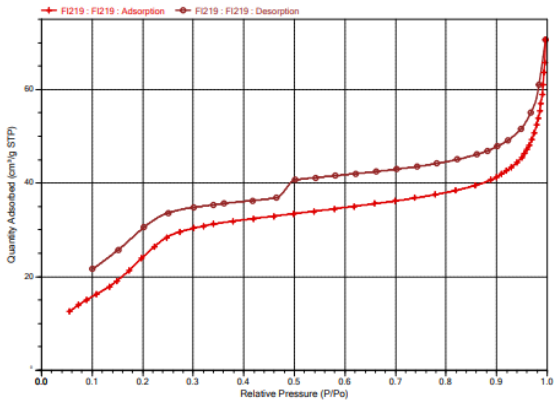
BJH Desorption average pore diameter (4V/A): 3,7918 nm

micromeritics

TriStar II Plus 3.01 | TriStar II Plus Version 3.01 Serial # 1080 Unit 1 Port 3 | Page 5 of 15

Started:	6/26/2023 3:05:24 PM	Analysis adsorptive:	N2
Completed:	6/26/2023 7:55:34 PM	Analysis bath temp.:	-195,850 °C
Report time:	6/27/2023 7:44:57 AM	Thermal correction:	No
Sample mass:	0,0315 g	Ambient free space:	10,9395 cm³ Measured
Analysis free space:	31,3861 cm³	Equilibration interval:	10 s
Low pressure dose:	None	Sample density:	1,000 g/cm³
Automatic degas:	No		

Isotherm Linear Plot



MCM-41-C

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TriStar II Plus 3.01 | TriStar II Plus Version 3.01 Serial # 1080 Unit 1 Port 2 | Page 1 of 15

Started:	6/26/2023 3:05:24 PM	Analysis adsorptive:	N2
Completed:	6/26/2023 7:55:34 PM	Analysis bath temp.:	-195,850 °C
Report time:	6/27/2023 7:44:26 AM	Thermal correction:	No
Sample mass:	0,0320 g	Ambient free space:	10,9358 cm³ Measured
Analysis free space:	31,4049 cm³	Equilibration interval:	10 s
Low pressure dose:	None	Sample density:	1,000 g/cm³
Automatic degas:	No		

Summary Report

Surface Area

Single point surface area at P/Po = 0,295927792: 373,8938 m²/g

BET Surface Area: 402,4458 m²/g

Pore Volume

Single point adsorption total pore volume of pores less than 384,1792 nm diameter at P/Po = 0,995000000: 0,300895 cm³/g

Pore Size

Adsorption average pore diameter (4V/A by BET): 2,9907 nm

Desorption average pore diameter (4V/A by BET): 2,7593 nm

BJH Desorption average pore diameter (4V/A): 2,8148 nm

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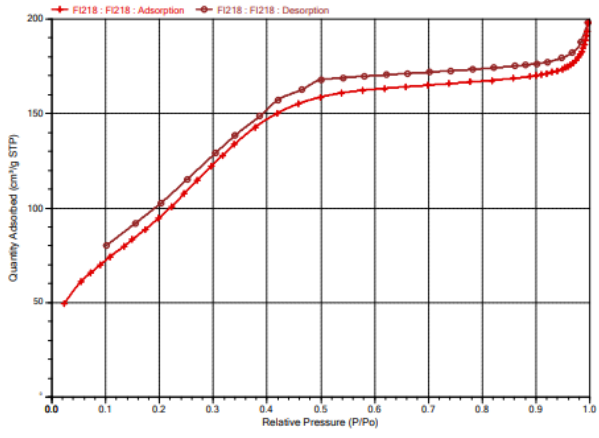
TriStar II Plus 3.01 | TriStar II Plus Version 3.01 Serial # 1080 Unit 1 Port 2 | Page 5 of 15

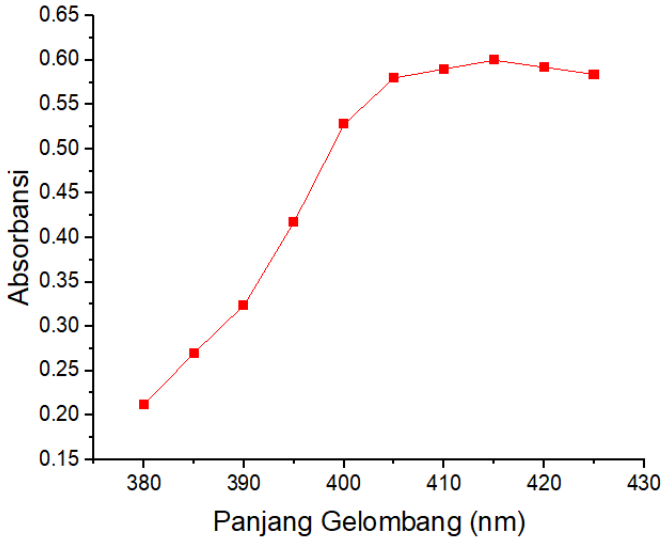
Started:	6/26/2023 3:05:24 PM	Analysis adsorptive:	N2
Completed:	6/26/2023 7:55:34 PM	Analysis bath temp.:	-195,850 °C
Report time:	6/27/2023 7:44:26 AM	Thermal correction:	No
Sample mass:	0,0320 g	Ambient free space:	10,9358 cm³ Measured
Analysis free space:	31,4049 cm³	Equilibration interval:	10 s
Low pressure dose:	None	Sample density:	1,000 g/cm³
Automatic degas:	No		

Isotherm Linear Plot



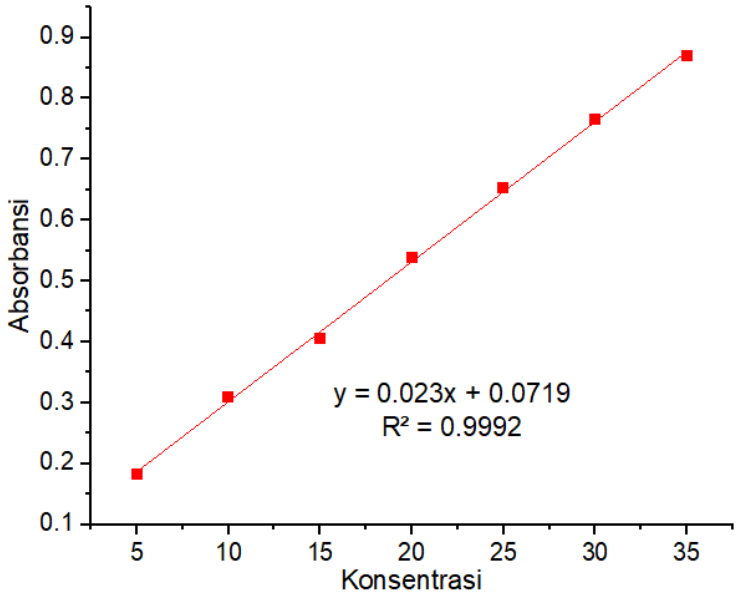
Lampiran 6. Data penentuan panjang gelombang maksimum remazol kuning dengan konsentrasi 20 mg/L.

Panjang Gelombang (nm)	Absorbansi
380	0,212
385	0,270
390	0,324
395	0,418
400	0,528
405	0,580
410	0,590
415	**0,600**
420	0,592
425	0,584



Lampiran 7. Data absorbansi kurva standar larutan remazol kuning

Konsentrasi (ppm)	Absorbansi
10	0.144
20	0.308
30	0.464
40	0.636
50	0.79



Lampiran 8. Penentuan waktu optimum adsorpsi zat warna remazol kuning oleh MCM-41-TC

Waktu kontak (menit)	C_o (mg/L)	C_e (mg/L)	Jumlah adsorben (g)	Jumlah Remazol Kuning yang diadsorpsi, q_e (mg/g)
5	161.78	24.61304348	0.1	68.58347826
10	161.78	16.7	0.1	72.54
15	161.78	11.9173913	0.1	74.93130435
30	161.78	2.743478261	0.1	79.51826087
45	161.78	2.134782609	0.1	79.8226087
60	161.78	0.613043478	0.1	80.58347826
90	161.78	0.004347826	0.1	80.88782609
120	**161.78**	**-2.3**	**0.1**	**82.04**
180	161.78	-2.169565217	0.1	81.97478261
270	161.78	-1.995652174	0.1	81.88782609

Contoh perhitungan remazol kuning yang teradsorpsi pada t = 120 menit

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

$$q_e = \frac{(161{,}78 \text{ mg/L} - (-2{,}3) \text{ mg/L})0{,}05 \text{ L}}{0{,}1 \text{ g}}$$

q_e = 82,04 mg/g

Lampiran 9. Data studi kinetika adsorpsi remazol kuning oleh MCM-41-TC

Waktu Kontak (menit)	q_e (mg/g)	q_t (mg/g)	q_t-q_e (mg/g)	ln (q_t-q_e)	t/q_e
5	68.58347826	82.04	13.45652174	2.599463876	0.072903856
10	72.54	82.04	9.5	2.251291799	0.137854977
15	74.93130435	82.04	7.108695652	1.961318774	0.200183356
30	79.51826087	82.04	2.52173913	0.924948795	0.377271833
45	79.8226087	82.04	2.217391304	0.796331417	0.563750054
60	80.58347826	82.04	1.456521739	0.376051223	0.744569499
90	80.88782609	82.04	1.152173913	0.141650517	1.112651982
120	82.04	82.04	0	0	1.462701121
180	81.97478261	82.04	0.065217391	-2.730029108	2.195797223
270	81.88782609	82.04	0.152173913	-1.882731247	3.297193403

Dari grafik kinetika orde satu semu diperoleh persamaan garis :

$$y = -0{,}018x + 1{,}9326$$

dari persamaan garis diperoleh nilai *slope* (a) = -0,018 dan nilai *intercept* (b) = 1,9326

nilai k_1 dapat dihitung sebagai berikut :

K = -Slope

$k_1 = 0{,}018$ menit^{-1};

log q_e = *intercept*

log q_e = 1,9326

q_e = 85.6248 mg/g

R^2 = 0,8232

Dari grafik kinetika orde dua semu diperoleh persamaan garis :

$$y = 0{,}0121x + 0{,}015$$

dari persamaan garis diperoleh nilai *slope* (a) = 0,0121 dan nilai *intercept* (b) = 0,015

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

$$q_e = \frac{1}{\text{slope}} = \frac{1}{0{,}0121} = 82{,}646 \text{ mg/g}$$

nilai k_2 dapat dihitung sebagai berikut :

$k_2 = \text{Slope}^2/\textit{intercept}$

$k_2 = (0{,}0121)^2/0{,}015$

$= 0.0097606 \text{ g/mg min}^{-1}$

$R^2 = 1$

Lampiran 10. Penentuan waktu optimum adsorpsi remazol kuning oleh MCM-41-C

Waktu Kontak (menit)	Co (mg/L)	Ce (mg/L)	Jumlah Adsorben (gram)	Jumlah Remazol Kuning yang diadsorpsi qe (mg/g)
5	517.3	71.65652174	0.1	222.8217391
10	517.3	67.30869565	0.1	224.9956522
15	517.3	65.56956522	0.1	225.8652174
30	517.3	62.96086957	0.1	227.1695652
45	517.3	61.22173913	0.1	228.0391304
60	517.3	60.35217391	0.1	228.473913
90	517.3	59.04782609	0.1	229.126087
120	**517.3**	**58.61304348**	**0.1**	**229.3434783**
180	517.3	58.9173913	0.1	229.1913043
270	517.3	59.26521739	0.1	229.0173913

Contoh perhitungan remazol kuning yang teradsorpsi pada t = 120 menit

$$q_e = \frac{(C_0 - C_e)V}{m}$$

$$q_e = \frac{(517{,}3\ \text{mg/L} - 58{,}613\ \text{mg/L})0{,}05\ \text{L}}{0{,}1\ \text{g}}$$

q_e= 229.3435 mg/g

Lampiran 11. Data studi kinetika adsorpsi remazol kuning oleh MCM-41-C

Waktu Kontak (menit)	q_e (mg/g)	q_t (mg/g)	q_t-q_e (mg/g)	ln (q_t-q_e)	t/q_e
5	222.8217391	229.7782609	6.95652177	1.939679604	0.022439462
10	224.9956522	229.7782609	4.782608726	1.564986156	0.044445303
15	225.8652174	229.7782609	3.913043509	1.364315462	0.066411288
30	227.1695652	229.7782609	2.608695683	0.958850358	0.132059944
45	228.0391304	229.7782609	1.739130465	0.553385256	0.197334554
60	228.473913	229.7782609	1.304347857	0.265703189	0.262612038
90	229.126087	229.7782609	0.652173943	-0.427443968	0.392796827
120	229.3434783	229.7782609	0	0	0.523232668
180	229.1913043	229.7782609	0.586956552	-0.532804479	0.78537011
270	229.0173913	229.7782609	0.760869596	-0.273293295	1.178949766

Dari grafik kinetika orde satu semu diperoleh persamaan garis :

$$y = -0{,}0081x + 1{,}2093$$

dari persamaan garis diperoleh nilai *slope* (a) = -0,0081 dan nilai *intercept* (b) = 1,2093

nilai k_1 dapat dihitung sebagai berikut :

k_1 = -slope

k_1 = 0,0081 menit^{-1};

log q_e = *intercept*

log q_e = 1,2093

q_e = 16,19198 mg/g

R^2 = 0,6256

Dari grafik kinetika orde dua semu diperoleh persamaan garis :

$$y = 0{,}0044x + 0{,}0008$$

dari persamaan garis diperoleh nilai *slope* (a) = 0,0044 dan nilai *intercept* (b) = 0,0008

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

$q_e = \frac{1}{\text{slope}} = \frac{1}{0{,}0044} = 227.2727$ mg/g

nilai k_2 dapat dihitung sebagai berikut :

k_2 = Slope^2/ *intercept*

$k_2 = (0{,}0044)^2 / 0{,}0008$

$= 0.0242$ g/mg min^{-1}

$R^2 = 1$

Lampiran 12. Penentuan kapasitas adsorpsi remazol kuning oleh MCM-41-TC

C_O (mg/L)	C_e (mg/L)	m (g)	q_e (mg/g)	C_e/q_e	log C_e	log q_e
204.39	8.17826087	0.1	98.10586957	0.083362	0.912661	1.991695
301.78	29.4826087	0.1	136.1486957	0.216547	1.469566	2.134013
451.34	**38.17826087**	**0.1**	**206.5808696**	**0.18481**	**1.581816**	**2.31509**
673.086	264.3913043	0.1	204.3473478	1.293833	2.422247	2.310369
998.346	590.4782609	0.1	203.9338696	2.89544	2.771204	2.309489

Contoh perhitungan RBBR yang teradsorpsi (qe) pada konsentrasi

(C_o) 204,39 mg/L :

$$q_e = \frac{(C_0 - C_e)V}{m}$$

$$q_e = \frac{(204{,}39 \text{ mg/L} - 8{,}178260 \text{ mg/L})0{,}05 \text{ L}}{0{,}1 \text{ g}}$$

q_e = 98.10587 mg/g

Lampiran 13. Isoterm adsorpsi MCM-41-TC

1. Isoterm adsorpsi langmuir bentuk linear

Berdasarkan model isotermal Langmuir diperoleh persamaan garis :

$$y = 0{,}0048x + 0{,}0362$$

dari persamaan garis diperoleh nilai *slope* (a) = 0,0048 dan nilai *intercept* (b) = 0,0362

Nilai kapasitas adsorpsi dapat dihitung sebagai berikut :

$\frac{1}{Q_{maks}}$ = kemiringan (*slope*)

$Q_{maks} = \frac{1}{\text{slope}} = \frac{1}{0{,}0048} = 208{,}3333$ mg/g

Intensitas adsorpsi dapat dihitung sebagai berikut :

$\frac{1}{Q_{maks}.b}$ = *intercept*

$b = \frac{1}{208{,}3333 \text{ mg/g}.\ 0{,}0362}$

$= 0{,}132596706 \text{ L mg}^{-1}$

2. Isoterm adsorpsi Freundlich bentuk linear

Berdasarkan model isotermal Freundlich diperoleh persamaan garis :

$$y = 0{,}1563x + 1{,}926$$

dari persamaan garis diperoleh nilai *slope* (a) = 0,1563 dan nilai *intercept* (b) = 1,926

Nilai kapasitas adsorpsi dapat dihitung sebagai berikut :

Log k = *intercept*

k = invers log *intercept*

k = invers log 1,926

k = 84.3334 mg/g

Intensitas adsorpsi dapat dihitung sebagai berikut :

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

$\frac{1}{n}$ = 0,1563

3. Isoterm adsorpsi Sips bentuk linear

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

Parameter	**Nilai**
Persamaan	y = 0,9122x – 1,0395
K_s	0,105407792
N	1.201130314
q_{maks}	207,5808
R^2	0,4387

Lampiran 14. Penentuan kapasitas adsorpsi remazol kuning oleh MCM-41-C

C_O (mg/L)	C_e (mg/L)	m (g)	q_e (mg/g)	C_e/q_e	log C_e	log q_e
549.21	49.047829	0.1	250.0817	0.1961271	1.6906193	2.3980808
830.86	99.173914	0.1	365.84305	0.2710838	1.9963979	2.5632941
1243.91	220.91305	0.1	511.49843	0.4318933	2.3442219	2.7088443
1870.69	554.86952	0.1	657.91024	0.8433814	2.7441904	2.8181661
2820.52	1520.0867	0.1	650.21657	2.3378167	3.1818682	2.8130581

Contoh perhitungan RBBR yang teradsorpsi (qe) pada konsentrasi (C_o) 549,21 mg/L :

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

$$q_e = \frac{(549{,}21 \text{ mg/L} - 49{,}047826 \text{ mg/L})0{,}05 \text{ L}}{0{,}1 \text{ g}}$$

q_e = 250.081087 mg/g

Lampiran 15. Isoterm adsorpsi MCM-41-C

1. Isoterm adsorpsi langmuir bentuk linear

Berdasarkan model isotermal Langmuir diperoleh persamaan garis :

$$y = 0{,}0015x + 0{,}1053$$

dari persamaan garis diperoleh nilai *slope* (a) = 0,0015 dan nilai *intercept* (b) = 0,01053

Nilai kapasitas adsorpsi dapat dihitung sebagai berikut :

$\frac{1}{Q_{maks}}$ = kemiringan (*slope*)

$$Q_{maks} = \frac{1}{\text{slope}} = \frac{1}{0{,}0015} = 666{,}66 \text{ mg/g}$$

Intensitas adsorpsi dapat dihitung sebagai berikut :

$\frac{1}{Q_{maks}.b}$ = *intercept*

$$b = \frac{1}{666{,}66 \text{ mg/g}.\ 0{,}1053}$$

$= 0.0142451 \text{ L mg}^{-1}$

2. Isoterm adsorpsi Freundlich bentuk linear

Berdasarkan model isotermal Freundlich diperoleh persamaan garis :

$$y = 0{,}2833x + 1{,}9828$$

dari persamaan garis diperoleh nilai *slope* (a) = 0,2833 dan nilai *intercept* (b) = 1,9828

Nilai kapasitas adsorpsi dapat dihitung sebagai berikut :

Log k = *intercept*

k = invers log *intercept*

k = invers log 1,9828

k = 96.116954 mg/g

Intensitas adsorpsi dapat dihitung sebagai berikut :

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

$\frac{1}{n} = 0{,}2833$

3. Isoterm adsorpsi Sips bentuk linear

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

Parameter	Nilai
Persamaan	y = 1,8312x – 7,7279
K_s	0,011753772
N	1,171851003
q_{maks}	658,9102
R^2	0,7142

Lampiran 16. Data desorpsi zat warna remazol kuning oleh MCM-41-TC dan MCM-41-C

Desorpsi menggunakan agen pendesorpsi akuades (H_2O)

Adsorben	Abs	Cdes (mg/L)	V(L)	m(g)	qe(mg/g)	% Desorpsi
TC-MCM-41	1.25	51.2217391	0.05	0.1	25.6108696	12.39750303
C1-MCM-41	0.865	34.4826087	0.05	0.1	17.2413043	2.620616597

dimana:

q_{ads} MCM-41-TC = 206,5808 mg/g

q_{ads} MCM-41-C = 657,9102 mg/g

Contoh perhitungan jumlah remazol kuning yang terdesorpsi oleh MCM-41-TC:

$$q_{des} = \left[\frac{C_{des}}{w}\right] V$$

$$q_{des} = \frac{51.2217 \text{ mg/L}}{0{,}1 \text{ g}} 0{,}05 \text{ L}$$

q_{des} = 25,6108 mg/g

Rasio desorpsi dapat dihitung menggunakan persamaan berikut:

$$\% \text{ Desorpsi} = \frac{\text{Jumlah zat warna terdesorpsi}}{\text{Jumlah zat warna teradsorpsi}} \times 100$$

Contoh perhitungan rasio desorpsi remazol kuning oleh MCM-41-TC:

$$\% \text{ Desorpsi} = \frac{q_{des}}{q_{ads}} \times 100$$

$$\% \text{ Desorpsi} = \frac{25{,}6108 \text{ mg/g}}{206{,}5808 \text{ mg/g}} \times 100$$

$$= 12{,}3 \%$$