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LAMPIRAN I

Perhitungan

1. Perhitungan pembuatan larutan induk timbal 1000 mg/L Pb(NO₃)₂

Diketahui:

- Ar Pb = 207,2
- Mr Pb(NO₃)₂ = 331,22
- Volume = 1000 mL
- Kemurnian = 99%

$$\begin{aligned}M &= \frac{n}{V} \\ &= \frac{gr}{Ar\ Pb \cdot L} \\ &= \frac{gr}{207,2 \cdot L}\end{aligned}$$

$$\frac{gr}{L} = 0,0048\ M$$

Molaritas larutan induk timbal untuk 1000 mg/L yaitu 0,0048 M. Sedangkan, konsentrasi timbal yang digunakan pada penelitian ini sebesar 50 mg/L. Sehingga molaritas untuk 50 mg/L adalah sebesar 0,00024 M.

$$\begin{aligned}M &= \frac{gr}{Mr\ Pb(NO_3)_2} \times \frac{1000}{mL} \\ 0,00024\ M &= \frac{gr}{331,22} \times \frac{1000}{1000} \\ gr &= 0,00024\ M \times 331,22 \\ &= 0,079/0,99 \\ &= 0,08\ gr\ Pb(NO_3)_2\end{aligned}$$

Jadi jumlah serbuk Pb(NO₃)₂ yang dibutuhkan sebesar 0,08 gram untuk dilarutkan dengan 1000 mL aquades.

2. Perhitungan persentase efisiensi adsorpsi logam berat timbal (Pb)

$$\%E = \frac{(C_{awal} - C_{akhir})}{C_{awal}} \times 100\%$$

Keterangan:

$\%E$ = Persentase efisiensi adsorpsi (%)

C_{awal} = Konsentrasi awal timbal dalam larutan (mg/L)

C_{akhir} = Konsentrasi akhir timbal dalam larutan (mg/L)

- **Sampel 1: Karbon aktif tempurung kemiri**

$$\begin{aligned} \%E &= \frac{(C_{awal} - C_{akhir})}{C_{awal}} \times 100\% \\ &= \frac{(28,57 - 11,20) \text{ mg/L}}{28,57 \text{ mg/L}} \times 100\% \\ &= 60,80\% \end{aligned}$$

Jadi, persentase efisiensi adsorpsi karbon aktif tempurung kemiri adalah sebesar 60,80%.

- **Sampel 2: CNT-100% Karbon aktif**

$$\begin{aligned} \%E &= \frac{(C_{awal} - C_{akhir})}{C_{awal}} \times 100\% \\ &= \frac{(28,57 - 24,21) \text{ mg/L}}{28,57 \text{ mg/L}} \times 100\% \\ &= 15,26\% \end{aligned}$$

Jadi, persentase efisiensi adsorpsi CNT dari karbon aktif murni adalah sebesar 15,26%.

- **Sampel 3: CNT-97% Karbon aktif + 3% CoSO₄**

$$\begin{aligned} \%E &= \frac{(C_{awal} - C_{akhir})}{C_{awal}} \times 100\% \\ &= \frac{(28,57 - 18,38) \text{ mg/L}}{28,57 \text{ mg/L}} \times 100\% \\ &= 35,67\% \end{aligned}$$

Jadi, persentase efisiensi adsorpsi CNT dari karbon aktif penambahan katalis adalah sebesar 15,26%.

3. Perhitungan kapasitas adsorpsi logam berat timbal (Pb)

$$Q = \frac{(C_{awal} - C_{akhir}) \cdot V}{W}$$

Keterangan:

Q = Kadar timbal yang teradsorpsi (mg/g)

V = Volume larutan (L)

C_{awal} = Konsentrasi awal timbal dalam larutan (mg/L)

C_{akhir} = Konsentrasi akhir timbal dalam larutan (mg/L)

W = Massa adsorben yang digunakan (g)

- **Sampel 1: Karbon aktif tempurung kemiri**

$$\begin{aligned} Q &= \frac{(C_{awal} - C_{akhir}) \cdot V}{W} \\ &= \frac{(28,57 - 11,20) \text{ mg/L} \cdot 0,05 \text{ L}}{0,1 \text{ g}} \\ &= 8,68 \text{ mg/g} \end{aligned}$$

Jadi, kapasitas adsorpsi karbon aktif tempurung kemiri adalah sebesar 8,68 mg/g.

- **Sampel 2: CNT-100% Karbon aktif**

$$\begin{aligned}
 Q &= \frac{(C_{awal} - C_{akhir}) \cdot V}{W} \\
 &= \frac{(28,57 - 24,21) \text{ mg/L} \cdot 0,05 \text{ L}}{0,1 \text{ g}} \\
 &= 2,18 \text{ mg/g}
 \end{aligned}$$

Jadi, kapasitas adsorpsi CNT dari karbon aktif murni adalah sebesar 2,18 mg/g.

- **Sampel 3: CNT-97% Karbon aktif + 3% CoSO₄**

$$\begin{aligned}
 Q &= \frac{(C_{awal} - C_{akhir}) \cdot V}{W} \\
 &= \frac{(28,57 - 18,38) \text{ mg/L} \cdot 0,05 \text{ L}}{0,1 \text{ g}} \\
 &= 5,09 \text{ mg/g}
 \end{aligned}$$

Jadi, kapasitas adsorpsi CNT dari karbon aktif penambahan katalis adalah sebesar 5,09 mg/g.

LAMPIRAN II

Analisis Karakterisasi X-Ray Diffractometer (XRD)

Data Infomation

Group : Standard
Data : S5
Sample Name : serbuk
Comment :
Date & Time : 03-31-23 10:11:33

Measurement Condition

X-ray tube

target : Cu
voltage : 40.0 (kV)
current : 30.0 (mA)

Slits

Auto Slit : not Used
divergence slit : 1.00000 (deg)
scatter slit : 1.00000 (deg)
receiving slit : 0.30000(mm)

Scanning

drive axis : Theta-2Theta
scan range : 15.0000 - 75.0000 (deg)
scan mode : Continuous Scan
scan speed : 2.0000 (deg/min)
sampling pitch : 0.0200 (deg)
preset time : 0.60 (sec)

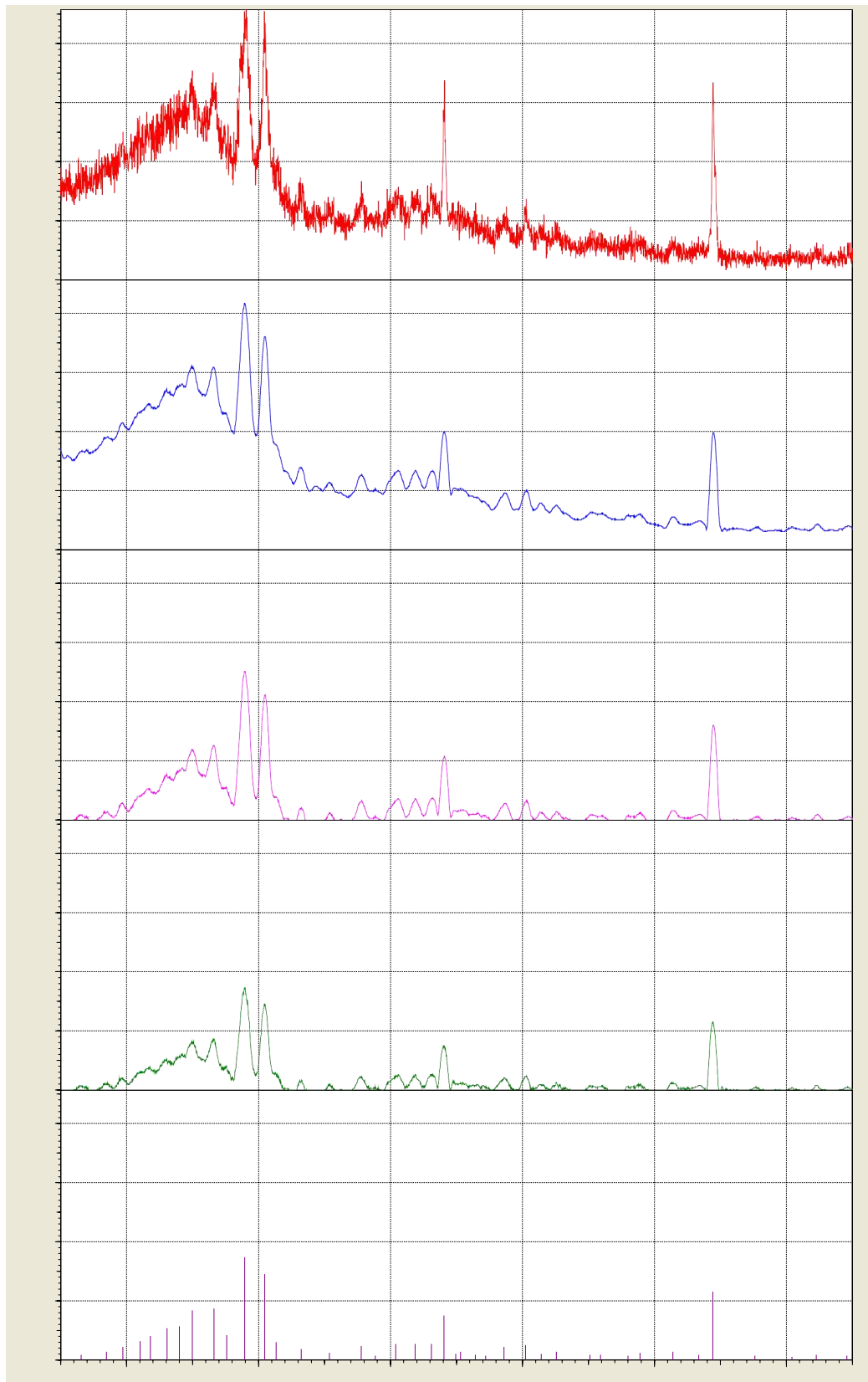
Data Process Condition

Smoothing [AUTO]
smoothing points : 51
B.G.Subtruction [AUTO]
sampling points : 51
repeat times : 30
Ka1-a2 Separate [MANUAL]
Ka1 a2 ratio : 50 (%)
Peak Search [AUTO]
differential points : 45
FWHM threhold : 0.050 (deg)
intensity threhold : 30 (par mil)
FWHM ratio (n-1)/n : 2
System error Correction [NO]
Precise peak Correction [NO]

1. XRD Karbon Aktif Tempurung Kemiri

# Strongest no. peak	3 peaks 2Theta (deg)	d (Å)	I/I ₁	FWHM (deg)	Intensity (Counts)	Integrated (Counts)	Int
1	28.9467	3.08207	100	0.88000	104	4735	
2	30.4660	2.93174	84	0.70800	87	3070	
3	64.4100	1.44535	66	0.55600	69	1904	

# Peak Data peak no.	List 2Theta (deg)	d (Å)	I/I ₁	FWHM (deg)	Intensity (Counts)	Integrated (Counts)	Int
1	16.5500	5.35211	5	0.26000	5	160	
2	18.4600	4.80243	8	0.48000	8	256	
3	19.7100	4.50059	13	0.62000	13	482	
4	21.0200	4.22297	18	1.04000	19	1325	
5	21.8000	4.07360	23	0.00000	24	0	
6	23.0600	3.85379	31	0.00000	32	0	
7	24.0000	3.70494	33	0.00000	34	0	
8	24.9800	3.56176	48	0.00000	50	0	
9	26.6200	3.34594	50	0.88000	52	4200	
10	27.5800	3.23161	24	0.64000	25	913	
11	28.9467	3.08207	100	0.88000	104	4735	
12	30.4660	2.93174	84	0.70800	87	3070	
13	31.3200	2.85372	17	0.60000	18	693	
14	33.2300	2.69393	11	0.38000	11	203	
15	35.3700	2.53569	7	0.26000	7	123	
16	37.7700	2.37990	13	0.66000	14	541	
17	38.8400	2.31676	4	0.04000	4	17	
18	40.3900	2.23135	15	1.10000	16	835	
19	41.8550	2.15658	15	0.79000	16	589	
20	43.1000	2.09712	15	0.72000	16	584	
21	44.0400	2.05452	43	0.58000	45	1415	
22	44.9400	2.01544	6	0.00000	6	0	
23	45.3000	2.00026	8	1.08000	8	439	
24	46.4200	1.95457	5	0.00000	5	0	
25	47.2000	1.92407	4	0.12000	4	92	
26	48.6000	1.87187	13	0.72000	13	526	
27	50.2200	1.81521	14	0.56000	15	435	
28	51.4100	1.77596	6	0.58000	6	234	
29	52.5700	1.73947	8	0.26000	8	215	
30	55.1000	1.66543	5	0.24000	5	106	
31	55.9150	1.64307	5	0.45000	5	177	
32	57.9900	1.58912	4	0.34000	4	129	
33	58.9000	1.56672	7	0.24000	7	177	
34	61.4000	1.50879	8	0.64000	8	301	
35	63.3500	1.46696	5	0.58000	5	229	



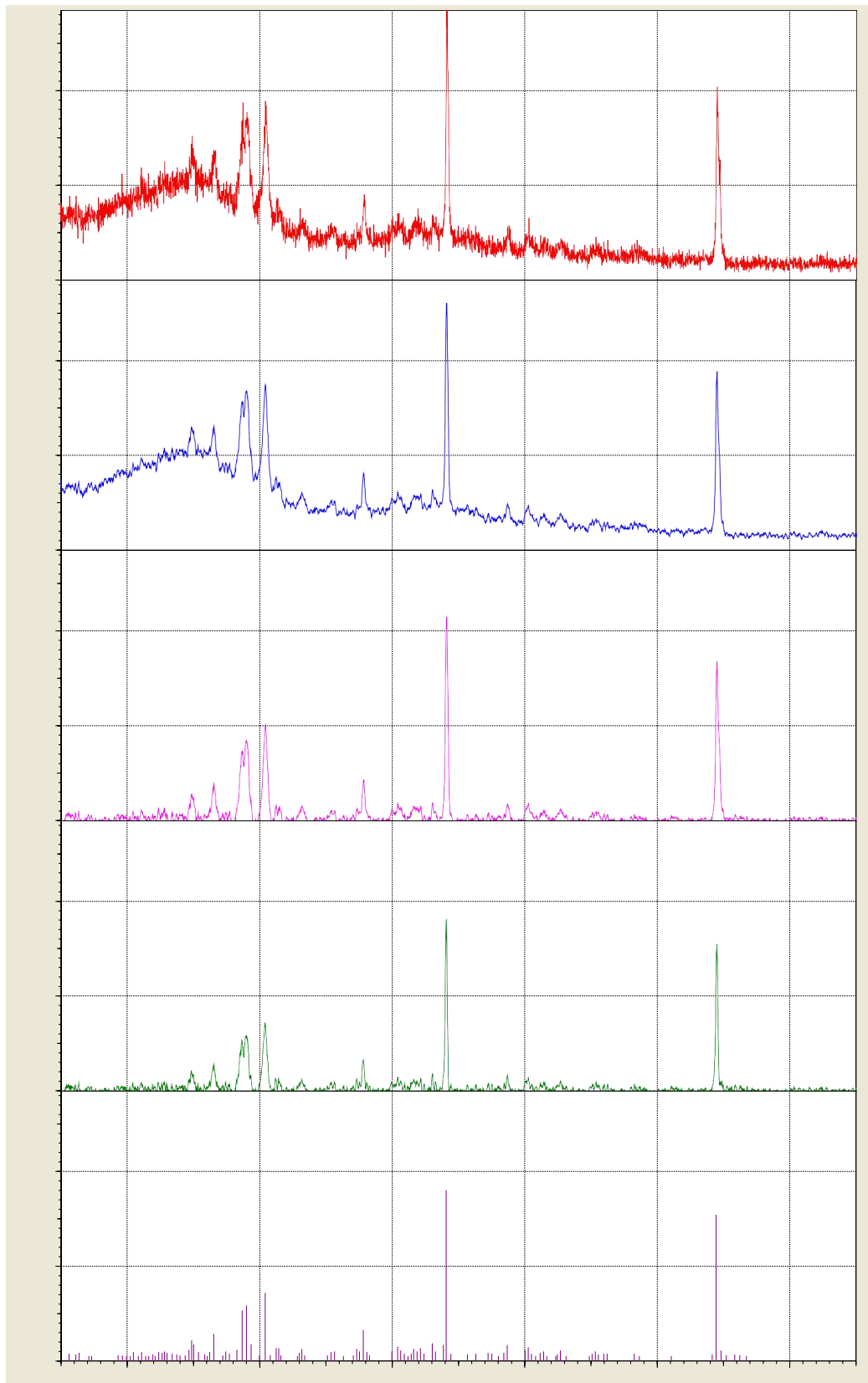
Gambar 1. pola XRD karbon aktif tempurung kemiri

2. XRD CNT-100% Karbon aktif

# Strongest no. peak	peaks 2Theta (deg)	d (Å)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated (Counts)	Int
1	44.0741	2.05301	100	0.17810	216	1919	
2	64.4448	1.44465	86	0.19040	185	1914	
3	30.4230	2.93579	40	0.37400	86	1631	

# Peak Data peak no.	List 2Theta (deg)	d (Å)	I/I1	FWHM (deg)	Intensity (Counts)	Integrated (Counts)	Int
1	15.6150	5.67042	4	0.07000	9	88	
2	16.1255	5.49204	4	0.09900	8	97	
3	16.3717	5.41000	5	0.09000	10	49	
4	17.1100	5.17818	3	0.14000	6	51	
5	17.3116	5.11833	3	0.12330	6	37	
6	19.3150	4.59173	3	0.13000	7	80	
7	19.6400	4.51647	3	0.12000	7	83	
8	19.9425	4.44864	3	0.03500	6	25	
9	20.2416	4.38358	3	0.05670	6	23	
10	20.4625	4.33675	5	0.07500	11	69	
11	20.8500	4.25702	3	0.07000	6	35	
12	21.0833	4.21043	5	0.15330	11	114	
13	21.3850	4.15171	3	0.09000	6	29	
14	21.6233	4.10649	3	0.10000	6	39	
15	21.9350	4.04884	4	0.07000	8	32	
16	22.1033	4.01839	3	0.15330	6	45	
17	22.3833	3.96875	5	0.12670	11	86	
18	22.6391	3.92448	5	0.09170	10	48	
19	22.8175	3.89420	6	0.15500	12	86	
20	23.0050	3.86288	5	0.07000	10	40	
21	23.3950	3.79936	4	0.07000	9	48	
22	23.7416	3.74467	4	0.09670	8	47	
23	23.9800	3.70798	3	0.08000	7	82	
24	24.3850	3.64731	3	0.07000	7	55	
25	24.6600	3.60725	6	0.09340	14	78	
26	24.8600	3.57868	12	0.13340	26	194	
27	25.0200	3.55616	10	0.14000	21	206	
28	25.3820	3.50626	5	0.04400	11	36	
29	25.8533	3.44340	4	0.09330	8	43	
30	26.0400	3.41913	3	0.08000	6	38	
31	26.2200	3.39607	5	0.08000	11	69	
32	26.5350	3.35646	16	0.33000	34	577	
33	27.2083	3.27491	3	0.11670	7	59	
34	27.4475	3.24691	6	0.09500	12	57	
35	27.7071	3.21708	4	0.14570	9	72	
36	28.2800	3.15319	6	0.12660	14	103	
37	28.6800	3.11012	30	0.41720	64	1025	
38	29.0000	3.07652	32	0.41200	70	1215	

39	29.3600	3.03961	10	0.10000	21	137	
40	29.9800	2.97815	3	0.00000	7	0	
41	30.4230	2.93579	40	0.37400	86	1631	
42	30.8000	2.90071	3	0.10000	7	65	
43	31.2390	2.86094	7	0.13530	16	122	
44	32.8400	2.72503	3	0.12000	6	40	
45	33.0000	2.71218	5	0.16000	10	61	
46	33.1800	2.69787	7	0.24000	15	172	
47	35.1116	2.55375	3	0.08330	7	42	
48	35.3850	2.53465	5	0.19000	11	128	
49	35.6450	2.51675	6	0.13000	12	81	
50	36.3150	2.47184	3	0.13000	6	62	
51	37.0616	2.42374	3	0.10330	7	60	
52	37.5425	2.39379	6	0.11500	12	74	
53	37.8157	2.37712	18	0.20860	39	415	
54	38.0841	2.36099	5	0.10170	11	64	
55	38.2925	2.34861	3	0.10500	7	49	
56	39.9708	2.25378	6	0.24830	12	199	
57	40.4166	2.22995	8	0.15330	18	150	
58	40.9150	2.20393	4	0.09000	9	46	
59	41.6200	2.16821	7	0.30660	15	184	
60	41.8800	2.15535	6	0.28000	12	136	
61	42.1250	2.14338	7	0.17000	16	112	
62	42.4050	2.12987	4	0.09000	9	45	
63	43.0275	2.10049	10	0.13500	22	173	
64	43.2600	2.08973	6	0.12000	12	81	
65	43.8600	2.06253	9	0.12000	20	246	
66	44.0741	2.05301	100	0.17810	216	1919	
67	44.4200	2.03782	4	0.08000	9	52	
68	45.6683	1.98498	4	0.12330	8	68	
69	46.3050	1.95915	4	0.11000	9	84	
70	47.2333	1.92279	5	0.14670	10	68	
71	47.5140	1.91209	4	0.09200	9	45	
72	48.0150	1.89330	3	0.21000	6	86	
73	48.6750	1.86916	9	0.17000	20	206	
74	50.0200	1.82200	6	0.12000	13	125	
75	50.5083	1.80553	4	0.15670	9	78	
76	50.8233	1.79507	3	0.16670	6	49	
77	51.1650	1.78389	5	0.15000	10	80	
78	51.6500	1.76827	3	0.12000	6	48	
79	52.3400	1.74657	3	0.13340	6	84	
80	52.6900	1.73579	6	0.18000	13	185	
81	53.1200	1.72275	3	0.12000	6	54	
82	54.8800	1.67159	3	0.10000	6	41	
83	55.0875	1.66578	4	0.13500	9	73	
84	55.5600	1.65273	4	0.14000	8	74	
85	55.9650	1.64172	4	0.09000	9	52	
86	56.2200	1.63488	4	0.08000	9	44	
87	58.2600	1.58240	4	0.08000	9	55	
88	58.6400	1.57305	3	0.16000	6	79	
89	61.0500	1.51659	3	0.14000	6	99	



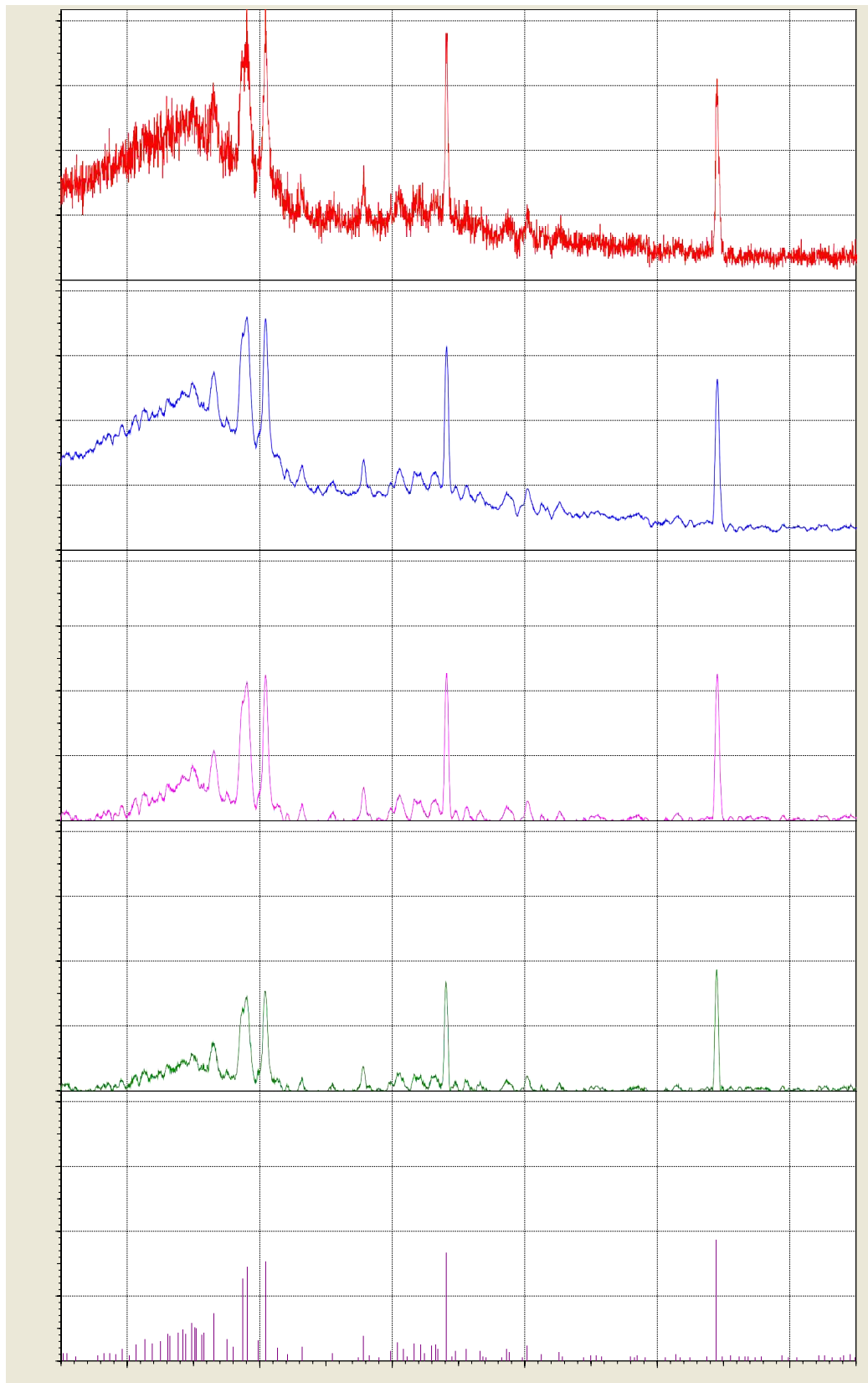
Gambar 2. Pola XRD CNT-100% Karbon aktif

3. XRD CNT-97% Karbon aktif + 3% CoSO₄

# Strongest no. peak	3 peaks 2Theta (deg)	d (Å)	I/I ₁	FWHM (deg)	Intensity (Counts)	Integrated (Counts)	Int
1	64.4387	1.44478	100	0.29590	112	1676	
2	44.0655	2.05339	89	0.30890	100	1567	
3	30.4457	2.93365	82	0.41140	92	2113	

# Peak Data peak no.	List 2Theta (deg)	d (Å)	I/I ₁	FWHM (deg)	Intensity (Counts)	Integrated (Counts)	Int
1	15.1600	5.83957	6	0.08000	7	46	
2	15.4400	5.73430	6	0.36000	7	165	
3	16.1200	5.49390	4	0.16000	4	47	
4	17.7700	4.98732	4	0.22000	5	85	
5	18.2450	4.85853	6	0.15000	7	88	
6	18.6800	4.74636	6	0.20000	7	121	
7	19.1333	4.63492	5	0.25330	6	84	
8	19.6200	4.52103	10	0.32000	11	253	
9	20.1600	4.40113	4	0.00000	5	0	
10	20.6600	4.29574	13	0.40000	15	382	
11	21.3300	4.16229	18	0.60660	20	663	
12	21.8800	4.05889	14	0.00000	16	0	
13	22.5000	3.94843	16	0.00000	18	0	
14	23.0600	3.85379	22	0.58000	25	687	
15	23.2200	3.82760	21	0.00000	23	0	
16	23.8400	3.72944	23	0.00000	26	0	
17	24.2000	3.67477	26	0.00000	29	0	
18	24.4000	3.64510	22	0.00000	25	0	
19	24.8600	3.57868	31	0.00000	35	0	
20	25.1000	3.54501	28	0.00000	31	0	
21	25.2000	3.53117	27	0.00000	30	0	
22	25.6200	3.47422	21	0.00000	24	0	
23	25.7800	3.45302	23	0.00000	26	0	
24	26.5373	3.35618	39	0.69870	44	2188	
25	27.5200	3.23852	18	0.00000	20	0	
26	28.0000	3.18409	12	0.00000	13	0	
27	28.7200	3.10588	68	0.56000	76	1983	
28	29.0600	3.07031	78	0.48000	87	1912	
29	29.8800	2.98789	17	0.16000	19	271	
30	30.4457	2.93365	82	0.41140	92	2113	
31	31.3400	2.85195	11	0.50000	12	430	
32	32.0950	2.78656	5	0.23000	6	62	
33	33.2000	2.69629	12	0.20000	13	195	
34	35.4766	2.52831	6	0.16670	7	114	
35	37.4400	2.40011	3	0.04000	3	21	
36	37.8183	2.37697	21	0.30330	23	376	
37	38.2600	2.35053	4	0.28000	5	87	

38	38.9900	2.30819	3	0.06000	3	25	
39	39.8700	2.25925	8	0.34000	9	189	
40	40.3800	2.23188	15	0.24000	17	330	
41	40.8400	2.20780	10	0.16000	11	163	
42	41.1200	2.19341	4	0.16000	4	47	
43	41.6400	2.16721	14	0.30000	16	287	
44	42.1400	2.14265	13	0.22000	15	209	
45	42.4200	2.12915	6	0.22000	7	106	
46	42.9600	2.10363	13	0.26000	14	319	
47	43.2800	2.08882	13	0.00000	15	0	
48	43.4400	2.08149	10	0.18000	11	166	
49	44.0655	2.05339	89	0.30890	100	1567	
50	44.5000	2.03434	4	0.17340	4	36	
51	44.7700	2.02270	8	0.22000	9	121	
52	45.5733	1.98889	10	0.29330	11	209	
53	46.6300	1.94625	8	0.18000	9	117	
54	46.8400	1.93802	4	0.12000	4	28	
55	47.0800	1.92870	3	0.04000	3	13	
56	48.2600	1.88426	3	0.04000	3	16	
57	48.6200	1.87114	10	0.40000	11	156	
58	48.8200	1.86394	7	0.48000	8	140	
59	49.8200	1.82885	3	0.16000	3	35	
60	50.1700	1.81691	13	0.38000	14	283	
61	51.2450	1.78129	5	0.15000	6	55	
62	52.5833	1.73906	7	0.24670	8	109	
63	52.8300	1.73152	4	0.10000	4	33	
64	54.4350	1.68420	3	0.05000	3	20	
65	54.9700	1.66906	4	0.14000	5	49	
66	55.3800	1.65767	4	0.28000	5	97	
67	55.7900	1.64646	4	0.18000	4	52	
68	57.9600	1.58987	4	0.08000	4	49	
69	58.2800	1.58190	3	0.00000	3	0	
70	58.4700	1.57721	4	0.10000	5	79	
71	59.0800	1.56238	3	0.16000	3	53	
72	60.6000	1.52677	3	0.04000	3	13	
73	61.4000	1.50879	5	0.40000	6	135	
74	61.7200	1.50173	3	0.04000	3	16	
75	62.4550	1.48581	3	0.19000	3	37	
76	63.7300	1.45912	4	0.18000	4	77	
77	64.4387	1.44478	100	0.29590	112	1676	
78	64.9000	1.43562	4	0.06660	4	26	
79	65.5200	1.42353	4	0.08000	5	58	
80	66.1800	1.41092	4	0.24000	4	60	
81	66.6100	1.40285	4	0.10000	4	20	
82	66.8600	1.39821	4	0.40000	4	79	
83	67.3800	1.38868	3	0.12000	3	42	
84	67.8500	1.38020	4	0.18000	4	98	
85	69.4100	1.35294	4	0.18000	5	67	
86	69.8900	1.34482	3	0.10000	3	35	
87	70.5200	1.33434	3	0.04000	3	25	
88	72.1900	1.30753	4	0.22000	5	69	



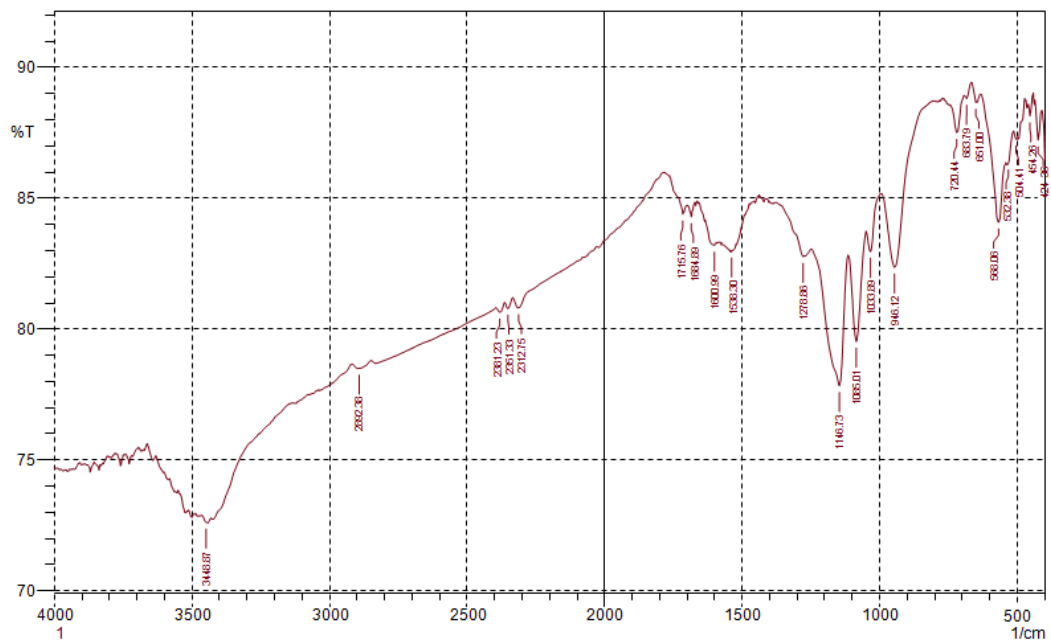
Gambar 3. XRD CNT-97% Karbon aktif + 3% CoSO_4

LAMPIRAN III

Analisis Karakterisasi *Fourier Transform Infrared Spectrometer* (FTIR)

1. Karbon Aktif Tempurung Kemiri

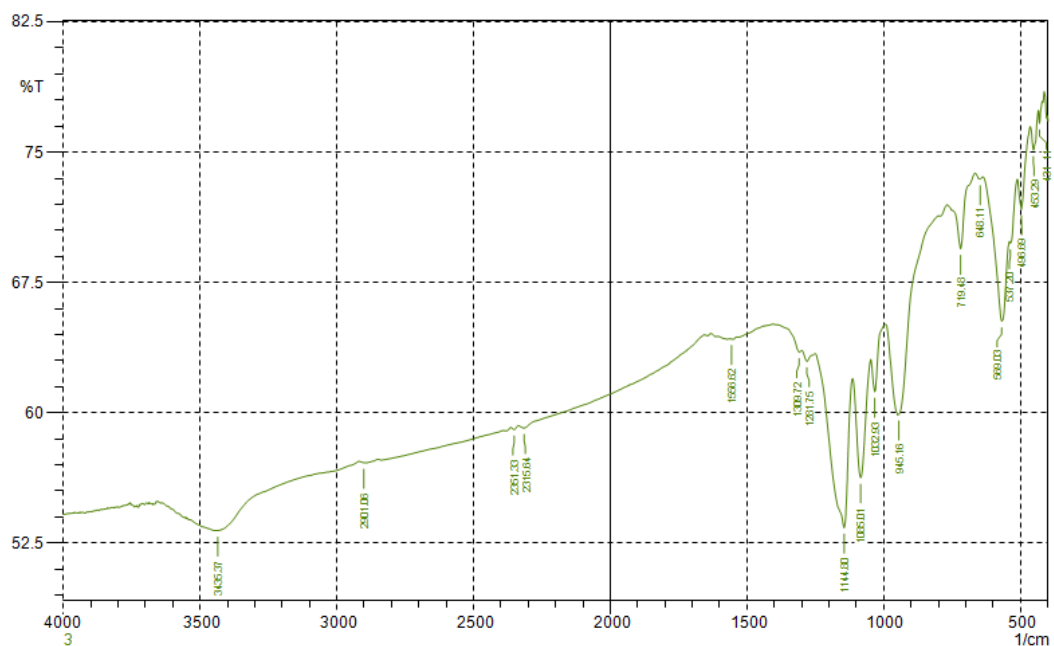
No	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	424.36	87.219	1.357	435.93	410.86	1.403	0.08
2	454.26	88.139	0.597	460.04	441.72	0.968	0.024
3	504.41	87.256	0.123	514.05	500.55	0.791	0.004
4	568.06	84.079	3.028	634.61	542.02	5.859	0.565
5	683.79	88.808	0.322	694.4	666.43	1.408	0.018
6	720.44	87.508	1.217	741.66	694.4	2.581	0.131
7	946.12	82.361	3.901	996.28	847.75	10.316	1.171
8	1033.89	82.961	1.204	1049.32	997.24	3.924	0.116
9	1085.01	79.53	3.717	1113.94	1050.29	5.681	0.627
10	1146.73	77.837	5.053	1249.93	1114.9	12.736	1.772
11	1278.86	82.77	0.092	1355.05	1275.97	6.077	0.006
12	1600.99	83.199	0.071	1605.81	1594.23	0.922	0.002
13	1684.89	84.29	0.291	1700.32	1681.04	1.406	0.009
14	1715.76	84.388	0.184	1734.08	1712.86	1.525	0.003
15	2351.33	80.791	0.311	2363.87	2333.97	2.744	0.027
16	2892.38	78.502	0.013	2894.31	2850.91	4.536	0.01
17	3448.87	72.614	0.034	3463.34	3446.94	2.268	0.002



Gambar 1. Pola FTIR karbon aktif tempurung kemiri

2. Sampel CNT-100% Karbon Aktif

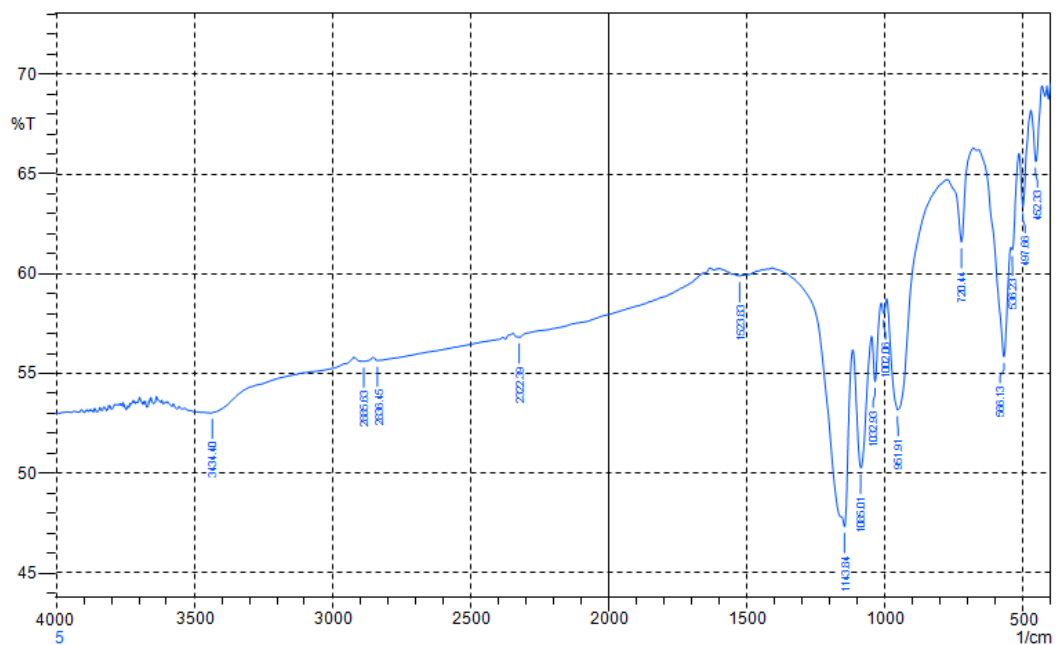
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	431.11	76.662	0.902	434.97	420.5	1.615	0.029
2	453.29	75.122	1.723	464.86	434.97	3.563	0.161
3	496.69	71.722	2.721	512.12	464.86	6.233	0.316
4	537.2	69.763	0.598	541.06	512.12	4.243	0.054
5	569.03	65.277	5.66	639.43	541.06	15.625	1.418
6	648.11	73.452	0.068	652.93	639.43	1.805	0.003
7	719.48	69.445	2.91	745.52	667.4	11.213	0.399
8	945.16	59.908	0.077	946.12	803.39	24.412	-1.94
9	1032.93	61.218	2.511	1047.39	1005.92	8.318	0.282
10	1085.01	56.265	6.193	1113.94	1047.39	15.073	1.501
11	1144.8	53.391	8.916	1250.89	1113.94	32.277	4.512
12	1281.75	62.978	0.553	1299.11	1250.89	9.591	0.083
13	1309.72	63.496	0.274	1385.91	1299.11	16.56	-0.073
14	1556.62	64.252	0.005	1562.41	1555.66	1.297	0
15	2315.64	59.134	0.297	2335.9	1669.46	141.821	2.425
16	2351.33	59.044	0.178	2362.9	2336.86	5.942	0.019
17	2901.06	57.128	0.113	2918.42	2849.95	16.614	0.039
18	3435.37	53.221	0.031	3438.26	3058.27	97.756	0.023



Gambar 2. Pola FTIR CNT-100% karbon aktif

3. Sampel CNT-97% Karbon Aktif + 3% CoSO₄

No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	452.33	65.626	3.078	468.72	431.11	6.507	0.393
2	497.66	63.343	3.407	512.12	468.72	7.923	0.403
3	536.23	61.189	1.055	542.02	512.12	5.947	0.079
4	566.13	55.837	6.525	656.79	542.02	24.374	1.922
5	720.44	61.585	4.003	771.56	677.04	18.159	0.803
6	951.91	53.173	6.76	991.45	800.49	43.44	3.168
7	1002.06	58.002	0.629	1010.74	991.45	4.518	0.047
8	1032.93	54.594	2.904	1046.43	1010.74	8.86	0.336
9	1085.01	50.269	6.217	1114.9	1046.43	18.733	1.769
10	1143.84	47.321	3.04	1156.37	1114.9	12.255	0.423
11	1523.83	59.892	0.012	1527.69	1521.9	1.288	0
12	2322.39	56.823	0.03	2325.29	2293.46	7.787	0.001
13	2836.45	55.652	0.084	2851.88	2821.01	7.845	0.01
14	2885.63	55.609	0.194	2920.35	2851.88	17.419	0.07
15	3434.4	53.043	0.008	3435.37	3099.74	89.082	0.01

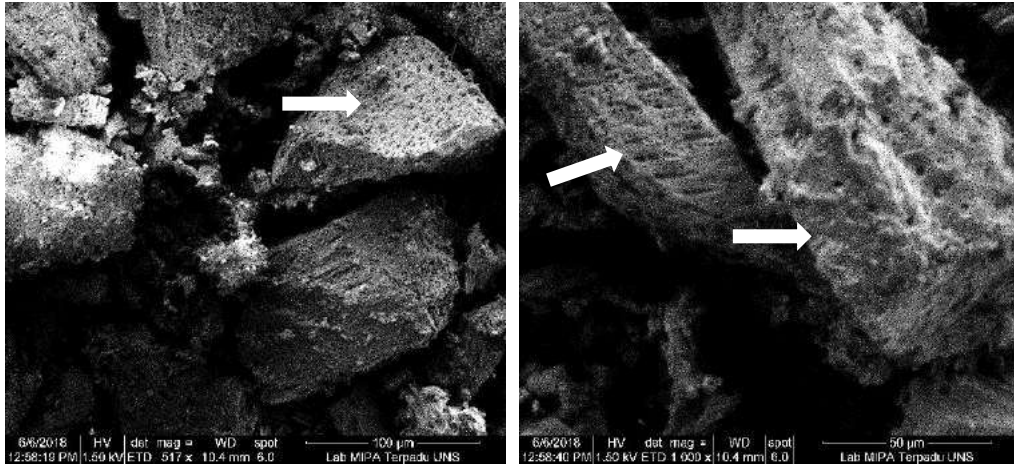


Gambar 3. Pola FTIR CNT 97% karbon aktif + 3% CoSO₄

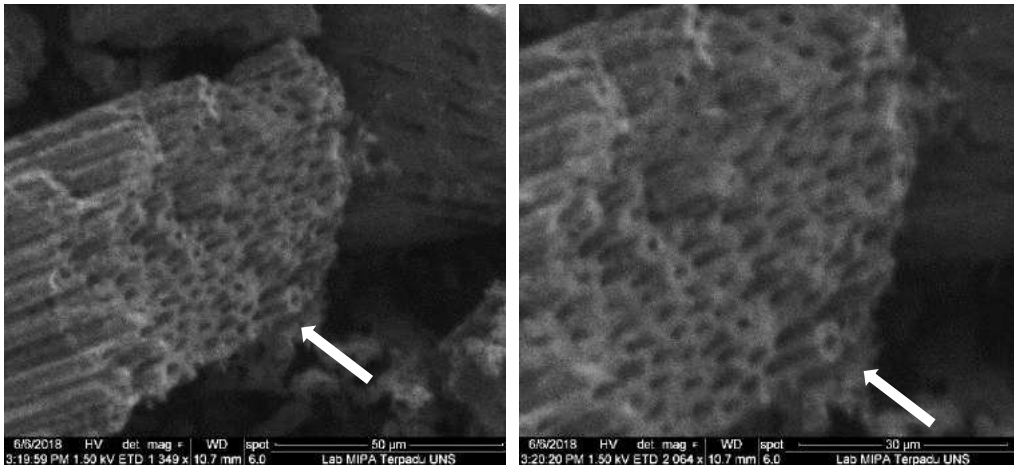
LAMPIRAN IV

Analisis Karakterisasi *Scanning Electron Microscope* (SEM)

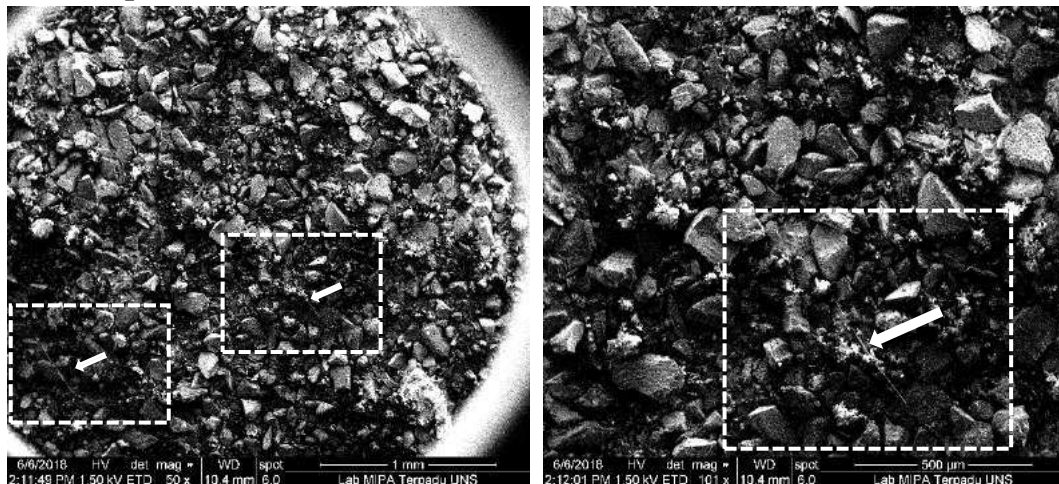
1. Karbon Aktif Tempurung Kemiri



2. Sampel 100% Karbon Aktif



3. Sampel 97% Karbon Aktif + 3% CoSO₄



LAMPIRAN V

Atomic Absorption Spectroscopy (AAS)

Tabel laporan hasil uji pemeriksaan larutan timbal (hasil adsorpsi)

No.	Sampel	Parameter	Satuan	Hasil Uji	Spesifikasi Metode
1.	Pb standar	Timbal (Pb)	mg/L	28,57	AAS
2.	Karbon aktif	Timbal (Pb)	mg/L	11,20	AAS
3.	CNT-100% Karbon aktif	Timbal (Pb)	mg/L	24,21	AAS
4.	CNT-97% Karbon aktif + 3% CoSO ₄	Timbal (Pb)	mg/L	18,38	AAS

LAMPIRAN VI

Dokumentasi

1. Alat Penelitian



Seperangkat alat *chemical vapour deposition* (CVD)



Tungku drum



Furnace



Oven



Timbangan digital



Neraca analitik



Gelas ukur



Labu ukur



Corong



Spatula



Batang pegaduk



Saringan



Sieve shaker



Lumpang Alu



pH Universal



Botol Plastik



Cawan



Pinset



Pipet tetes



Aluminium foil



Hot plate
Lemari asap



X-Ray diffractometer (XRD)



Scanning electron microscopy (SEM)



Fourier Transform Infrared Spectrometer (FTIR)

2. Bahan Penelitian



Tempurung kemiri



H_3PO_4



Aquades



Gas asetilen (C_2H_2)



Gas argon (Ar)



Cobalt sulfate ($CoSO_4$)



Waterone



$Pb(NO_3)_2$

3. Prosedur Penelitian

a. Tahap Pembuatan Karbon Aktif Tempurung Kemiri



Pengambilan sampel



Pencucian dan penjemuran



Pembakaran dengan tungku drum



Penghilangan kandungan air dengan oven



Sampel setelah proses dehidrasi



Persiapan untuk proses karbonisasi



Proses karbonisasi dengan *furnace*



Arang tempurung kemiri



Proses penggerusan arang tempurung kemiri



Serbuk arang tempurung



Proses pengayakan dengan *siever shaker*



Ayakan 100 mesh



Pembuatan larutan H_3PO_4 7%



Proses aktivasi



Penetralkan karbon aktif



Pengeringan dengan oven



Pemanasan pada suhu 600°C



Sampel setelah difurnace



Menimbang sampel karbon aktif



Hasil akhir karbon aktif

b. Preparasi Sampel



Menimbang karbon dan Katalis

3% Katalis CoSO_4 dan 97% karbon aktif

Pelarutan dengan aquades



Proses menguapkan zat pelarut



Proses pengeringan sampel



Sampel sebelum difurnace



Sampel difurnace



Sampel setelah difurnace

c. Sintesis *Carbon Nanotube* (CNT)



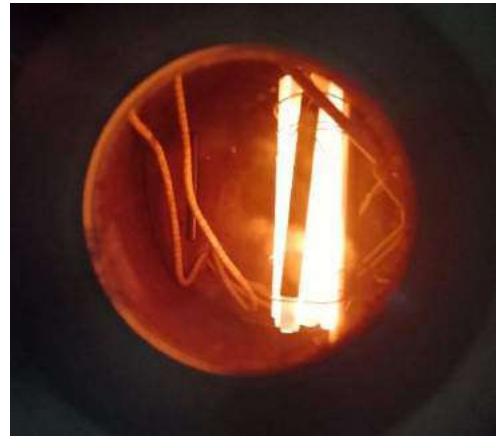
Pemasangan komponen alat CVD



Pemeriksaan alat CVD



Meletakkan sampel di dalam *chamber*



Proses sintesis



Hasil sintesis *carbon nanotube* (CNT)
(a) Karbon aktif 100%; (b) Karbon aktif 97% + CoSO_4 3%