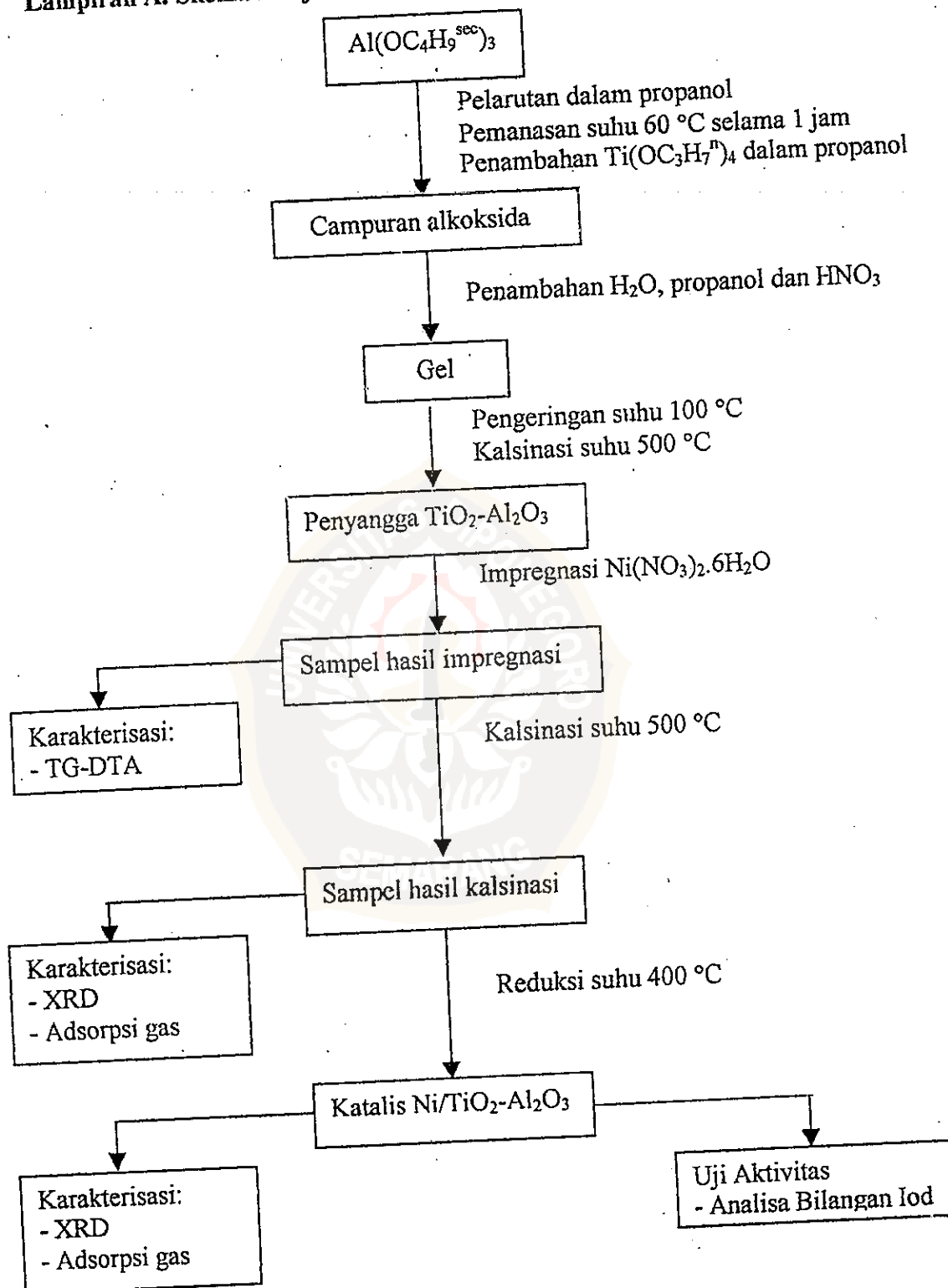


Lampiran A. Skema Kerja



Lampiran B

PERHITUNGAN PREPARASI BAHAN

1. Perbandingan $\text{TiO}_2\text{-Al}_2\text{O}_3 = 0,2 : 0,8$

$$\text{Al}(\text{OC}_4\text{H}_9)_3 = \frac{10,9478 \text{ g}}{246,33 \text{ g mol}^{-1}} = 0,0444 \text{ mol}$$

$$\text{Al}_2\text{O}_3 = \frac{101,94 \text{ g mol}^{-1}}{246,33 \text{ g mol}^{-1}} \times 0,0444 \text{ mol} = 0,01839 \text{ mol}$$

$$\text{TiO}_2 = 0,2 \times \frac{0,01839 \text{ g}}{79,65 \text{ g mol}^{-1}} = 0,01636 \text{ mol}$$

2. $\text{Ti}(\text{OC}_3\text{H}_7)_4 = \frac{284,23 \text{ g mol}^{-1}}{79,65 \text{ g mol}^{-1}} \times 0,046 \text{ mol} = 0,01636 \text{ mol}$

$$\text{berat Ti}(\text{OC}_3\text{H}_7)_4 = 0,01636 \times 284,23 \text{ g mol}^{-1} = 4,65 \text{ g}$$

3. $\text{H}_2\text{O}/\text{Alkoksida} = 2 : 1$

$$\text{H}_2\text{O} = [2 \times (0,0444 + 0,01636) \text{ mol} \times 18 \text{ g mol}^{-1}] : 1 \text{ g ml}^{-1} = 2,2 \text{ mL}$$

4. $\text{HNO}_3/\text{Alkoksida} = 0,06 : 1$

$$\text{HNO}_3 = [0,06(0,06 \text{ mol}) \times 63 \text{ g mol}^{-1}] = 0,23 \text{ mL}$$

5. $\text{n-propanol}/\text{Alkoksida} = 12 : 1$

$$\text{n-propanol} = 12 (0,06) \text{ mol} \times 60 \text{ g mol}^{-1} = 43,2 \text{ mL}$$

6. Menghitung Volume $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$

5 gram katalis dengan kandungan Ni 10% sehingga dibutuhkan 4,5 g katalis dan 0,5 g Ni. Ni yang tersedia dalam bentuk $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

Maka % Ni dalam $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O} = 58,71 \text{ g mol}^{-1} : 290,71 \text{ g mol}^{-1} = 20,19\%$

Untuk mendapatkan 0,5 g Ni dibutuhkan $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ sebanyak $= (100 : 20,19) \times 0,5 \text{ g}$

$$= 2,4765 \text{ g}$$

Densitas $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ 0,5 M $= 0,5 \text{ mol L}^{-1} \times 290,71 \text{ g mol}^{-1} = 145,35 \text{ g L}^{-1} = 0,145 \text{ g mL}^{-1}$

Jadi Volume $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ 0,5 M yang dibutuhkan $= 2,4765 \text{ g} : 0,145 \text{ g mL}^{-1} = 17,079 \text{ mL}$

Sehingga untuk mendapatkan 5 g katalis dibutuhkan 4,5 g penyangga dengan volume $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ sebanyak 17,079 mL.

Membuat suspensi bahan penyangga 10% b/v

berat bahan penyangga = 4,5 g

Volume H_2O yang dibutuhkan untuk membuat 10% suspensi $= 4,5 : 10\% = 45 \text{ mL}$

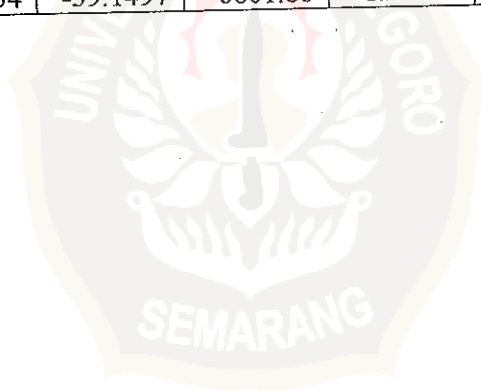
Lampiran C. Data TG-DTA

Tabel 4.2 Data TG-DTA

Time	Temp.	DTA	TG	DTG	% TG
min	Cel	uV	ug	ug/min	
0.016667	23.2383	-3.8099	13233.5	10.3135	100
9.816667	50.7798	-13.9425	12821.5	115.126	96.40226
11.2	60.835	-26.5015	12579	214.218	94.57895
11.28333	61.7271	-25.6179	12560.7	218.6	94.44135
14.86667	94.9435	-30.8192	11887	239.538	89.37594
15.31667	100.211	-24.9866	11773.5	285.962	88.52256
16.25	110.117	-21.0238	11563.1	192.989	86.9406
17.25	120.83	-16.5775	11402.9	141.087	85.73609
18.2	130.99	-13.2814	11284.2	115.063	84.84361
20.08333	150.893	-10.481	11092.2	103.633	83.4
21.08333	160.854	-14.361	10973.5	132.718	82.50752
22.06667	170.907	-16.6762	10829.8	152.202	81.42707
22.95	180.927	-11.7069	10702	136.029	80.46617
23.83333	190.996	-6.93226	10589	126.16	79.61654
24.7	200.783	-4.39184	10476	133.072	78.76692
25.61667	210.849	-2.78662	10362.5	116.304	77.91353
27.45	230.952	-0.61106	10154.8	119.281	76.35188
28.36667	240.836	-0.3701	10035.4	138.229	75.45414
29.3	250.973	-0.67671	9893.39	163.361	74.38639
30.21667	260.851	-1.5212	9727.05	196.792	73.13571
31.16667	270.872	-4.30331	9508.64	262.99	71.49353
32.15	280.91	-9.42194	9186.6	382.857	69.07218
33.13333	290.981	-15.2503	8729.69	522.645	65.63677
33.96667	300.106	-15.2877	8287.48	501.823	62.31188
34.06667	301.267	-14.5592	8239.33	483.26	61.94985
34.81667	310.555	-5.05552	7961.71	289.696	59.86248
35.63333	320.263	1.92562	7784.16	187	58.52752
36.58333	330.999	4.84995	7631.38	145.807	57.3788
37.46667	340.823	6.16569	7511.51	129.801	56.47752
38.33333	350.317	6.90911	7404.42	111.802	55.67233
39.28333	360.737	7.66535	7297.41	108.037	54.86775
40.21667	370.853	8.30757	7201.64	98.04	54.14767
41.13333	380.822	8.87869	7117.95	85.1719	53.51842
42.06667	390.931	9.43391	7046.52	68.8838	52.98135
43	400.943	9.86442	6991.52	51.1992	52.56782
43.86667	410.238	10.3837	6954.81	35.9355	52.2918
44.83333	420.601	10.7061	6927.72	23.3105	52.08812

Tabel 4.2 (lanjutan)

Time	Temp.	DTA	TG	DTG	% TG
min	Cel	uV	ug	ug/min	
45.8	430.918	10.7047	6909.13	17.5947	51.94834
46.75	440.958	10.3626	6895.46	12.7334	51.84556
47.7	450.962	9.85392	6884.45	10.3584	51.76278
48.56667	460.091	9.25661	6875.78	7.81348	51.69759
49.56667	470.49	8.48052	6867.55	8.93359	51.63571
50.48333	480.091	7.68869	6860.26	7.78906	51.5809
51.45	490.195	6.83529	6853.34	7.2168	51.52887
52.4	500.165	5.97414	6847.03	6.32324	51.48143
57.3	550.439	0.670223	6822.92	3.75098	51.30015
62.15	600.196	-4.90933	6810.21	1.7627	51.20459
72.01667	700.62	-15.0024	6809.02	-1.06543	51.19564
81.85	800.751	-24.7217	6821.55	-1.53711	51.28985
91.48333	900.468	-32.909	6840.42	-1.96289	51.43173
101.0167	1002.59	-39.5179	6860.51	-0.58008	51.58278
102.4667	1018.54	-39.1497	6861.86	-1.25684	51.59293



Lampiran D. Identifikasi komponen katalis

Tabel 4.3 Komponen katalis sebelum dikalsinasi

ASTM	d spasing	2 θ (sampel)	Counts	d spasing	Fasa
37,782°	2,38	37,75°	430,5	2,38	Ti ₂ O ₃
45,827°	1,98	45°	767,375	2,01	γ -Al ₂ O ₃
66,822°	1,40	66,56°	876,125	1,42	γ -Al ₂ O ₃

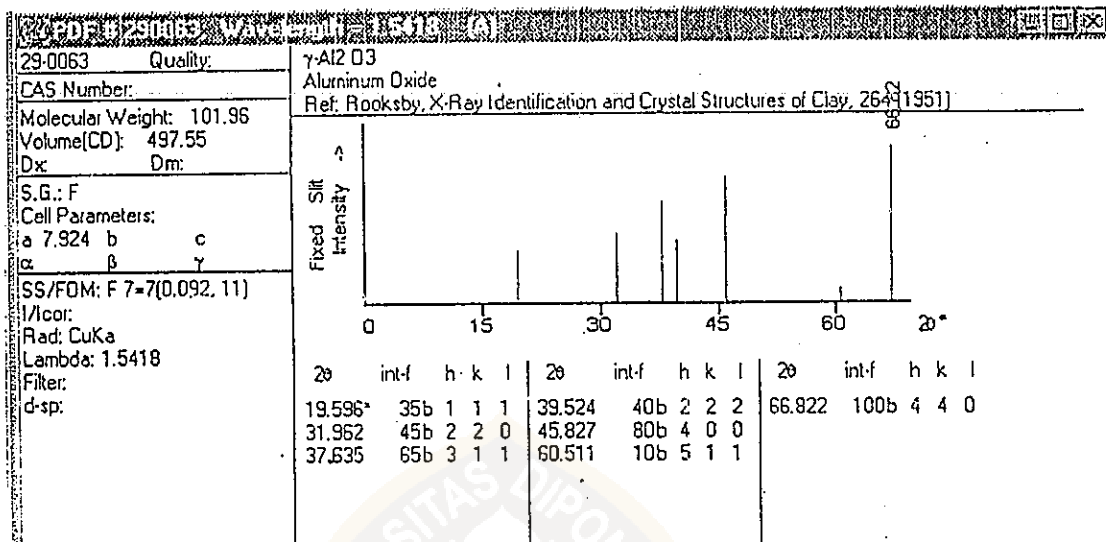
Tabel 4.4 Komponen katalis setelah dikalsinasi

ASTM	d spasing	2 θ (sampel)	Counts	d spasing	Fasa
37,782°	2,38	37,36°	365,625	2,40	Ti ₂ O ₃
43,295°	2,09	43,79°	627	2,07	NiO
45,827°	1,98	45°	670,5	2,01	γ -Al ₂ O ₃
66,822°	1,40	65,51°	875,5	1,40	γ -Al ₂ O ₃
75,439°	1,26	75,57°	568,5	1,26	NiO

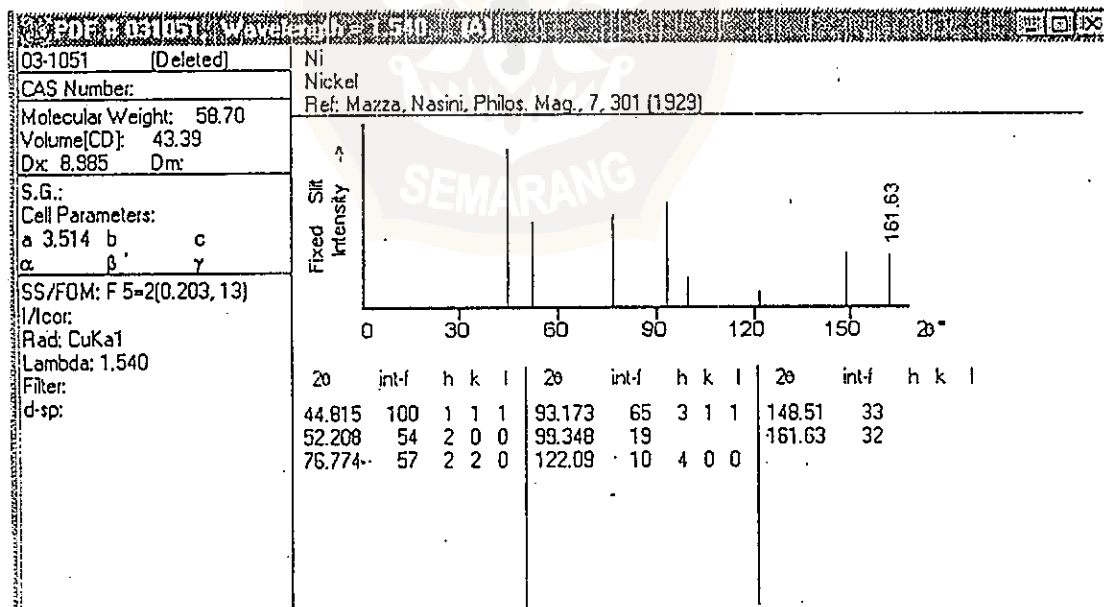
Tabel 4.5 Komponen katalis setelah direduksi

ASTM	d spasing	2 θ (sampel)	Counts	d spasing	Fasa
37,782°	2,38	36,95°	390,25	2,43	Ti ₂ O ₃
45,827°	1,98	45°	826,125	2,01	γ -Al ₂ O ₃
52,208°	1,75	52,64°	529,375	1,74	Ni
66,822°	1,40	66,32°	926,625	1,41	γ -Al ₂ O ₃
76,774°	1,24	77,59°	632,75	1,23	Ni

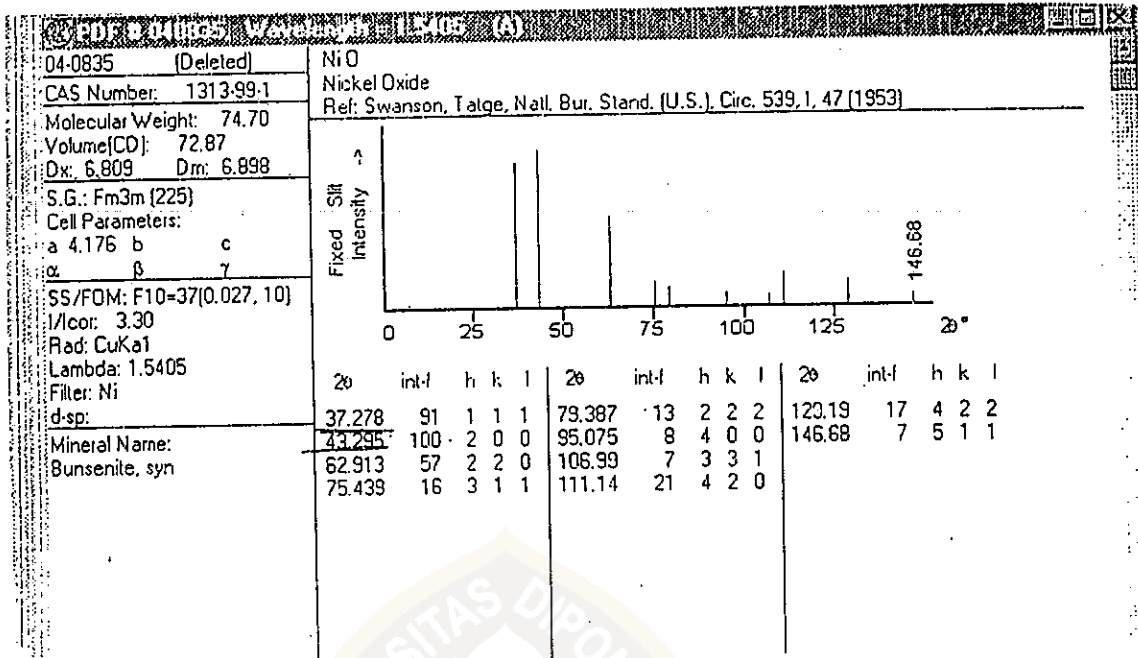
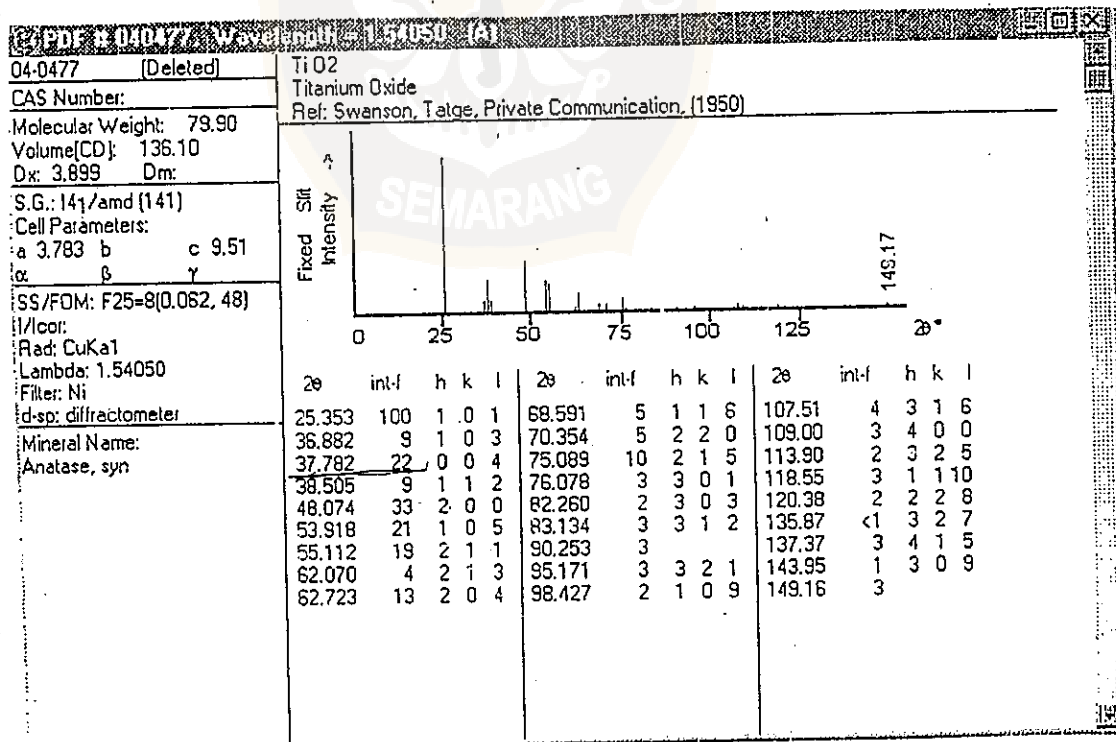
Lampiran E. Data ASTM

1. ASTM γ -Al₂O₃

2. ASTM Ni



3. ASTM NiO

4. ASTM TiO₂

Lampiran F. Data luas permukaan

Specific Surface Area Measurement**Multipoints BET-Method Using Quantosorb^â**

1. Sample Name: Ni/TiO₂-Al₂O₃ (Ni 10%) Date : 29 Mei 2003
 Description : kalsinasi 500 Operator: DEWI S

P_o 750 mmHg $V_{calib.}$ 4,17 ml
 P_{air} 760 mmHg R 62.78 mmHg.L.mol⁻¹.K⁻¹
 T_{air} 296.5 K $\sigma(N_2)$ 16.2 Å²/Molecule
 m_{sample} 0.0605 g

Equations:

$$St = (1-P/P_o) \times (A_{des}/A_{cal}) \times V_{cal} \times 4.30 \text{ meter}^2$$

V_{des} Volume of desorption [ml]
 P_o Saturated pressure of nitrogen [mmHg]
 A_{cal} Area of calibration peak [mV.s]
 Pressure of ambient air
 P_{air} [mmHg]
 T_{air} Temperature of ambient air [K]
 R Ideal gas constant
 N_L 6,022 x 10²³
 St Surface area [m²]

No	Display	V_{cal} [ml]	A_{cal} [mV.s]	A_{des} [mV.s]	$x(N_2)$	A_{des}/A_{cal}	P	P/P_o	$(1-P/P_o)$	St (M ²)
1		4.250	3104.00	2994.00	0.300	0.96	228.00	0.30	0.6960	11.50
2		4.250	3125.00	2967.00	0.300	0.95	228.00	0.30	0.6960	11.32
3		4.000	2957.00	2954.00	0.300	1.00	228.00	0.30	0.6960	11.21

Specific Surface Area = 187.46 M²/g

2. Sample Name: Ni/TiO₂-Al₂O₃ (Ni 15%) Date : 29 Mei 2003
 Description : kalsinasi 500 Operator: DEWI S

P_o 750 mmHg $V_{calib.}$ 3,58 ml
 P_{air} 760 mmHg R 62.78 mmHg.L.mol⁻¹.K⁻¹
 T_{air} 296.5 K $\sigma(N_2)$ 16.2 Å²/Molecule
 m_{sample} 0.0563 g

No	Display	V _{cal} [ml]	A _{cal} [mV.s]	A _{des} [mV.s]	x(N ₂)	A _{des} /A _{cal}	P	P/P ₀	(1-P/P ₀)	S _t (M ²)
1		3.500	2585.00	2650.00	0.300	1.03	228.00	0.30	0.6960	10.06
2		3.750	2727.00	2691.00	0.300	0.99	228.00	0.30	0.6960	10.38
3		3.500	2576.00	2682.00	0.300	1.04	228.00	0.30	0.6960	10.22

Specific Surface Area = 181.55 M²/g

3. Sample Name: Ni/TiO₂-Al₂O₃ (Ni 20%)
 Description : kalsinasi 500

Date : 11 Juni 2003

Operator: DEWI S

P₀ 750 mmHg V_{calib.} 2,75 ml
 P_{air} 760 mmHg R 62.78 mmHg.L.mol⁻¹.K⁻¹
 T_{air} 296.5 K σ(N₂) 16.2 Å²/Molecule
 m_{Sample} 0.0514 g

No	Display	V _{cal} [ml]	A _{cal} [mV.s]	A _{des} [mV.s]	x(N ₂)	A _{des} /A _{cal}	P	P/P ₀	(1-P/P ₀)	S _t (M ²)
1		2.750	2085.00	1976.00	0.300	0.95	228.00	0.30	0.6960	7.31
2		2.750	2080.00	1954.00	0.300	0.94	228.00	0.30	0.6960	7.25
3		2.750	2073.00	1940.00	0.300	0.94	228.00	0.30	0.6960	7.22

Specific Surface Area = 141.21 M²/g

4. Sample Name: Ni/TiO₂-Al₂O₃ (Ni 10%)
 Description : reduksi 400

Date : 28 Mei 2003

Operator: DEWI S

P₀ 750 mmHg V_{calib.} 1,75 ml
 P_{air} 760 mmHg R 62.78 mmHg.L.mol⁻¹.K⁻¹
 T_{air} 296.5 K σ(N₂) 16.2 Å²/Molecule
 m_{Sample} 0.0249 g

No	Display	V _{cal} [ml]	A _{cal} [mV.s]	A _{des} [mV.s]	x(N ₂)	A _{des} /A _{cal}	P	P/P ₀	(1-P/P ₀)	S _t (M ²)
1		1.750	1295.00	1395.00	0.300	1.08	228.00	0.30	0.6960	5.29
2		1.750	1373.00	1373.00	0.300	1.00	228.00	0.30	0.6960	4.91
3		1.750	1342.00	1361.00	0.300	1.01	228.00	0.30	0.6960	4.98

Specific Surface Area = 203.13 M²/g

5. Sample Name: Ni/TiO₂-Al₂O₃ (Ni 15%) Date : 29 Mei 2003
 Description : reduksi 400 Operator: DEWI S

P_o 750 mmHg $V_{calib.}$ 4,25 ml
 P_{air} 760 mmHg R 62.78 mmHg.L.mol⁻¹.K⁻¹
 T_{air} 296.5 K $\sigma(N_2)$ 16.2 Å²/Molecule
 m_{sample} 0.0636 g

No	Display	V_{cal} [ml]	A_{cal} [mV.s]	A_{des} [mV.s]	$x(N_2)$	A_{des}/A_{cal}	P	P/P _o	(1-P/P _o)	St (M ²)
1		4.250	3046.00	3060.00	0.300	1.00	228.00	0.30	0.6960	11.98
2		4.250	3096.00	3041.00	0.300	0.98	228.00	0.30	0.6960	11.71
3		4.250	3078.00	3034.00	0.300	0.99	228.00	0.30	0.6960	11.75

Specific Surface Area = 185.72 M²/g

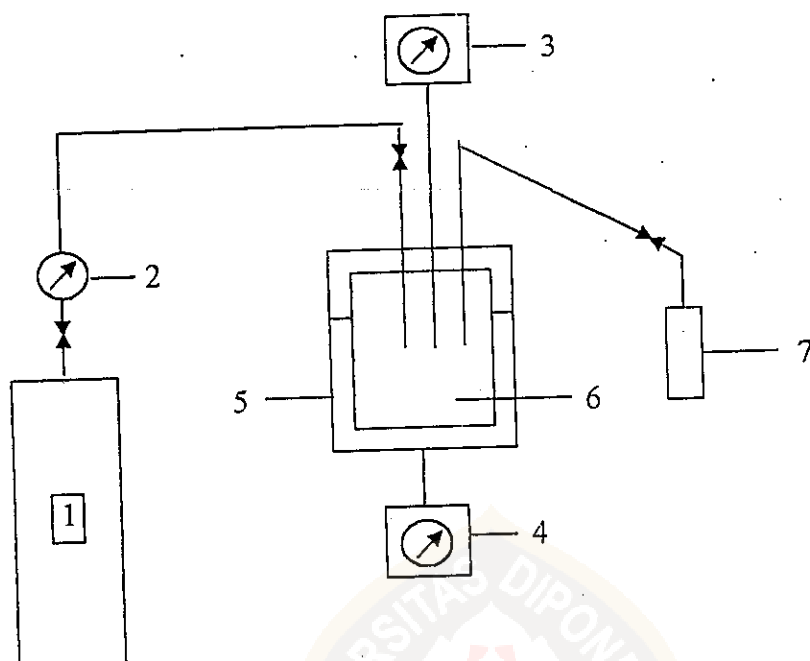
6. Sample Name: Ni/TiO₂-Al₂O₃ (Ni 20%) Date : 29 Mei 2003
 Description : reduksi 400 Operator: DEWI S

P_o 750 mmHg $V_{calib.}$ 3,0 ml
 P_{air} 760 mmHg R 62.78 mmHg.L.mol⁻¹.K⁻¹
 T_{air} 296.5 K $\sigma(N_2)$ 16.2 Å²/Molecule
 m_{sample} 0.0539 g

No	Display	V_{cal} [ml]	A_{cal} [mV.s]	A_{des} [mV.s]	$x(N_2)$	A_{des}/A_{cal}	P	P/P _o	(1-P/P _o)	St (M ²)
1		3.000	2228.00	2254.00	0.300	1.01	228.00	0.30	0.6960	8.51
2		3.000	2199.00	2244.00	0.300	1.02	228.00	0.30	0.6960	8.59
3		3.000	2221.00	2228.00	0.300	1.00	228.00	0.30	0.6960	8.44

Specific Surface Area = 157.95 M²/g

Lampiran G. Gambar alat uji aktivitas hidrogenasi



Keterangan:

1. Gas Hidrogen
2. Pengukur laju alir gas
3. Pengukur tekanan
4. Pengatur suhu
5. Reaktor *batch*
6. Sampel katalis + minyak sawit
7. Penampung sampel

Lampiran H. Perhitungan Bilangan Iodium

$$BI = \frac{12,69 \times [Na_2S_2O_3] \times (V_{\text{blanko}} - V_{\text{sampel}})}{m_{\text{sampel}}}$$

Keterangan:

BI = Bilangan Iodium

V_{blanko} = Volume $Na_2S_2O_3$ yang dibutuhkan untuk mentitrasi tanpa sampel sampai titik akhir titrasi (mL)

V_{sampel} = Volume $Na_2S_2O_3$ yang dibutuhkan untuk mentitrasi sampel sampai titik akhir titrasi (mL)

m_{sampel} = Massa sampel yang digunakan pada proses titrasi (g)

Perhitungan Standarisasi larutan $Na_2S_2O_3$

$$S_2O_3^{-2} = \frac{m(KIO_3)}{V_{\text{thiox}} \times 35,7}$$

m KIO_3 (g)	V thio (mL)	V rata-rata thio (mL)	N [$S_2O_3^{-2}$]
139,9026	38,65	38,42	0,102
-	38,19	-	-

Keterangan:

$[S_2O_3^{-2}]$ = Normalitas $S_2O_3^{-2}$

V thio = Volume thio yang dibutuhkan untuk mentitrasi $Na_2S_2O_3$

Tabel 4.5 Bilangan iodium pada reaksi hidrogenasi dengan penambahan sampel katalis Ni/TiO₂-Al₂O₃ dengan kandungan nikel 10 %, 15 % dan 20 %

Sampel Katalis	t (menit)	V _{blanko} (mL)	V _{sampel} (mL)	m _{sampel} (g)	Bilangan Iod
Tanpa katalis	0	24,8	19,2	0,1120	59,13
	30	-	-	-	-
	60	-	-	-	-
	90	24,8	19,2	0,1240	58,75
10 % Ni	0	24,8	17,8	0,1557	58,61
	30	24,8	19,6	0,1262	53,76
	60	24,8	19,8	0,1260	51,68
	90	24,8	20,1	0,1135	45,08
15 % Ni	0	24,8	17,5	0,1628	58,16
	30	24,8	20,3	0,1562	37,20
	60	24,8	22,8	0,1125	22,82
	90	24,8	23,9	0,1245	9,04
20 % Ni	0	24,8	17,9	0,1527	58,52
	30	24,8	20,14	0,1264	47,77
	60	24,8	22,6	0,1550	18,7
	90	24,8	24,6	0,1615	1,16
katalis komersil	0	24,8	19	0,1342	56,32
	30	24,8	22,6	0,1168	24,29
	60	24,8	24,7	0,1550	1,12
	90	-	-	-	-

Lampiran I. Data EDX

Label: Sample 4 (XKIKR 10%)

KV: 15.0

Tilt: 0.0

Take-off: 8.4

Det Type: SUTW+

Res: 134

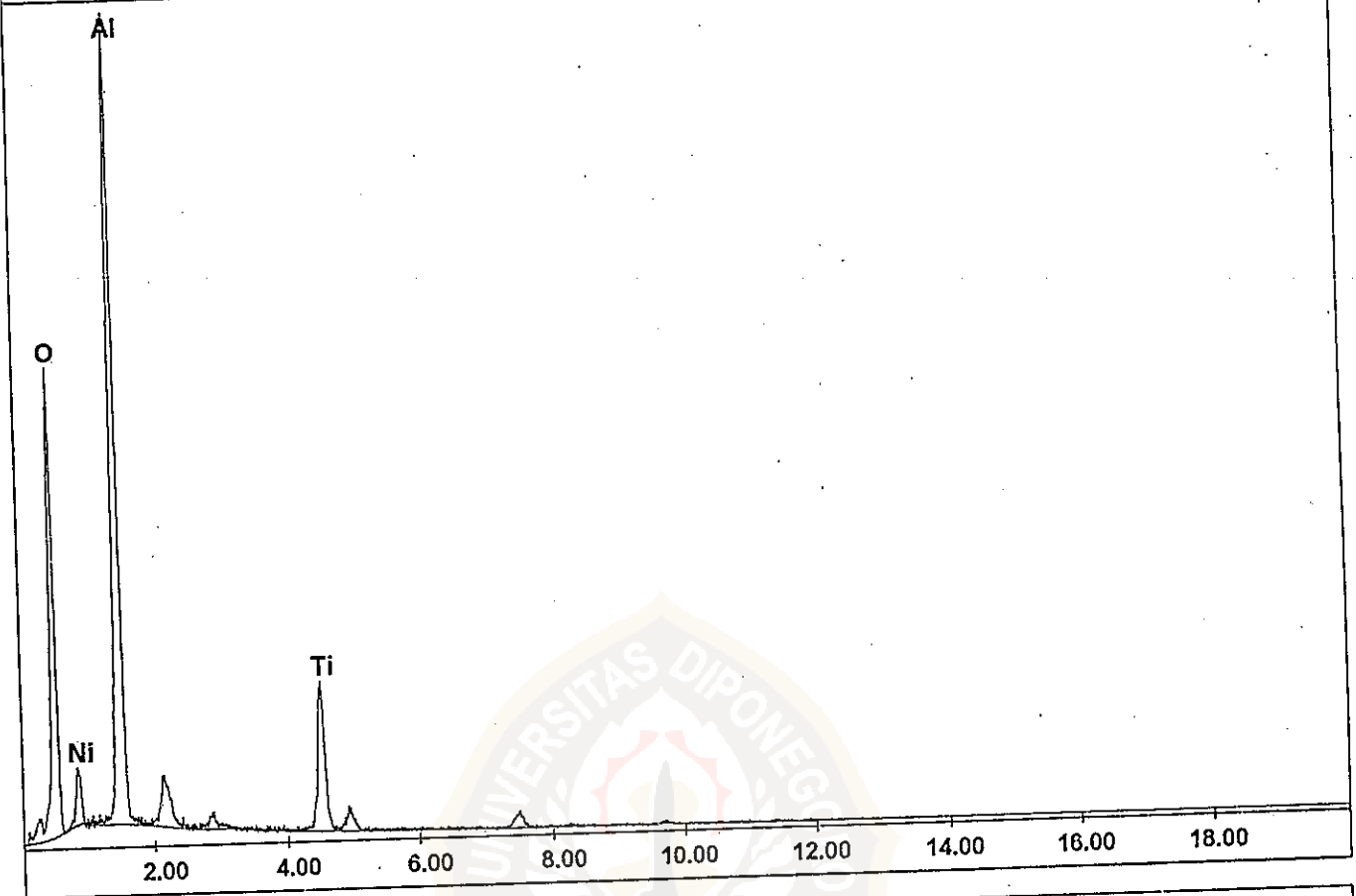
Tc: 40

FS : 2986

Lsec : 56

5-Jun-3

10:50:57

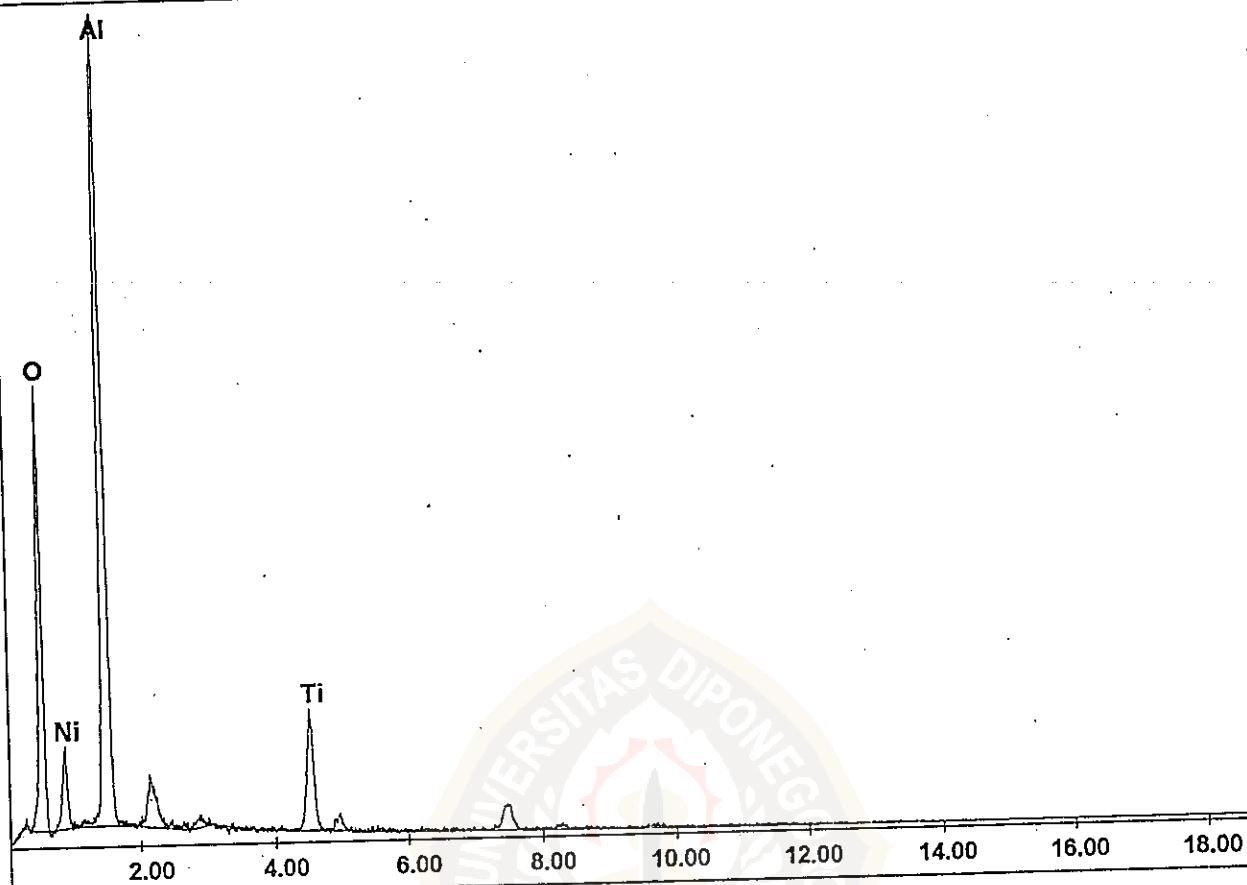


Element	Wt %	At %
O K	47.40	64.90
NiL	10.86	4.05
AlK	33.76	27.41
TiK	7.98	3.65
Total	100.00	100.00

Label: Sample 6.1 (XKIKR 15%)

kV:15.0 Tilt:0.0 Take-off:8.4 Det Type:SUTW+ Res:134 Tc:40

FS : 2256 Lsec : 50 5-Jun-3 11:06:05

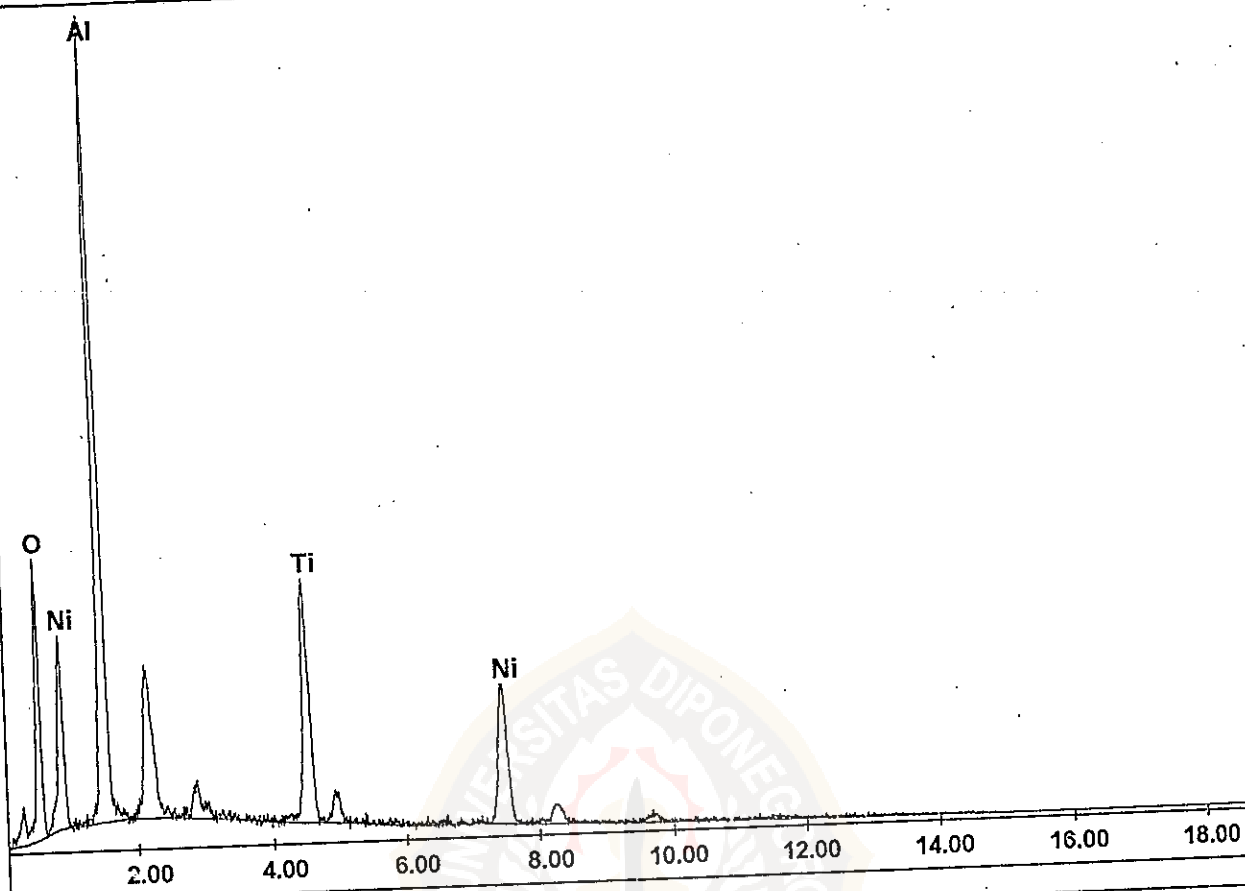


Element	Wt %	At %
O K	43.13	60.98
NiL	13.91	5.36
AlK	36.56	30.65
TiK	6.40	3.02
Total	100.00	100.00

Label: Sample 6 (XKIKR 20 %)

kV:15.0 Tilt:0.0 Take-off:8.4 Det Type:SUTW+ Res:134 Tc:40

FS : 1614 Lsec : 97 5-Jun-3 11:16:43



Element	Wt %	At %
O K	29.89	49.24
AlK	34.34	33.55
TiK	11.36	6.25
NiK	24.41	10.96
Total	100.00	100.00