LAMPIRAN I
DATA PENGAMATAN

Data Hasil Pengamatan Unit Hidrogenasi *Palm Fatty Acid Distillate* (PFAD)

Umpan PFAD = 300 ml

Katalis ($NiMo/Al_2O_3$) = 0,15 gr

Tekanan H_2 masuk = 25 psi

Waktu operasi = 1 jam

1. Data Temperatur Reaksi terhadap Volume Produk

Temperatur (˚C)	Volume Produk (ml)
270	93
285	92
300	110
315	148
330	133

2. Data Temperatur Reaksi terhadap %Yield

Temperatur (˚C)	Yield (%)
270	28,7831
285	28,2142
300	34,0201
315	45,9360
330	40,1902

3. Data Temperatur Reaksi terhadap Densitas

Temperatur (˚C)	Densitas (gr/ml)
270	0,8078
285	0,8004
300	0,8072
315	0,8101
330	0,7887

4. Data Temperatur Reaksi terhadap Viskositas (T= 40˚C)

Sampel	Konstanta Bola (mPa.s cm3/gr.s)	Densitas Bola (gr/cm^3)	t_1 (s)	t_2 (s)	t_2 (s)
1	0,09	8,1	05.23	05.34	05.20
2	0,09	8,1	04.60	04.62	04.79
3	0,09	8,1	04.85	04.40	04.88
4	0,09	8,1	04.83	04.65	04.99
5	0,09	8,1	05.77	05.28	05.40

5. Data Temperatur Reaksi terhadap Kadar Air

Temperatur (˚C)	Kadar Air (%)
270	1,1658
285	3,5374
300	1,4829
315	1,1637
330	0,9452

6. Data Unsur Kimia dalam Katalis $NiMo/Al_2O_3$

Element	No. Atom	Netto	Mass (%)	Mass. Norm (%)	Atom (%)
Oxygen	8	12071	37,43	39,94	66,96
Molybdenum	42	67629	31,68	33,80	9,45
Aluminium	13	22459	9,02	9,63	9,57
Nickel	28	12362	7,80	8,33	3,81
Silicon	14	8079	2,15	2,30	2,19
Carbon	6	316	2,02	2,16	4,82
Calcium	20	3424	1,45	1,54	1,03
Magnesium	12	2389	1,30	1,39	1,53
Potassium	19	2236	0,87	0,92	0,63
		Sum	**93,73**	**100,00**	**100,00**

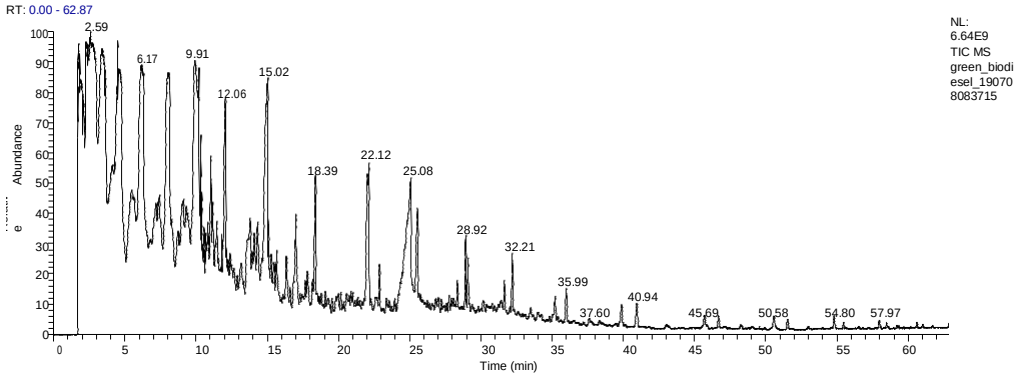
7. Data Hasil Uji Titik Nyala

Temperatur (˚C)	Titik Nyala (˚C)
270	67,5
285	85,4
300	77,9
315	67,7
330	82,1

8. Data Hasil Analisa Nilai Kalor

Sampel	Kondisi Operasi			GHV (Cal/gr)
	H_2 in 25 (psi)	T (℃)	Berat Katalis (gr)	
A		285	0,15	10801,548
B	25	315	0,15	10692,486

9. Hasil GC-MS Produk *Green Diesel* pada Temperatur 300˚C



Fraksi	Komponen	Komposisi Senyawa (%)
$<C_5$	Gas	0
C_5-C_{15}	Gasoline, Kerosine, Nafta	17,55
C_{15}-C_{18}	Diesel	39,63
C_{18}-C_{20}	Minyak Pelumas	6,28
$>C_{20}$	Parafin	3,82
$C_xH_xO_x$	Senyawa Lainnya	33,44
	Total:	100,72

LAMPIRAN II
PERHITUNGAN

A. Perhitungan Densitas

1) Menghitung Volume Piknometer

Berat Piknometer Kosong = 33,6209 gram

Berat Piknometer + Aquadest = 59,2003 gram

Densitas Aquadest = 992,24 kg/m^3

= 0,99224 gr/ml

Berat Aquadest = (Berat Piknometer +Aquadest) – (Berat Piknometer Kosong)

= 59,2003 gram – 33,6209 gram

= 25,5794 gram

Volume Piknometer = , ’ /

= 25,7794 ml

2) Menghitung Densitas Umpan dan Sampel Densitas Umpan (PFAD)

T= 40˚C

Berat Umpan = 54,4451 gram – 33,6209 gram

= 20,8242 gram

Densitas =

= ’

,

= 0,8700 gr/ml

Massa Umpan = V_{Umpan} x

= 300 ml x 0,8700 gr/ml

= 261 gram

Sampel I (T = 270˚C)

Berat Sampel = 54,4451 gram – 33,6209 gram

= 20,8242 gram

Densitas = ——————

= ,
——
,

= 0,8078 gr/ml

Sampel II (T = 285˚C)

Berat Sampel = 54,2554 gram – 33,6209 gram

= 20,6345 gram

Densitas = ——————

=,——
,

= 0,8004 gr/ml

Sampel III (T = 300˚C)

Berat Sampel = 54,4302 gram – 33,6209 gram

= 20,8093 gram

Densitas = ——————

= ,
——
,

= 0,8072 gr/ml

Sampel IV (T = 315˚C)

Berat Sampel = 54,5045 gram – 33,6209 gram

= 20,8836 gram

Densitas = ——————

= ’
——————
’

= 0,8101 gr/ml

Sampel V (T = 315˚C)

Berat Sampel = 53,9530 gram – 33,6209 gram

= 20,3321 gram

Densitas = ——————

= ——’——

= 0,7886941’ gr/ml

B. Perhitungan %Yield

Sampel I

V_1 = 93 ml

Massa Produk = V_1 x

= 93 ml x 0,8078 gr/ml

= 75,1238 gram

%Yield I = ——————— x 100%

= ’
———————

= 28,7831%

Sampel II

V_2 = 92 ml

Massa Produk = V_2 x

= 92 ml x 0,8004 gr/ml

= 73,6390 gram

%Yield II = ——————— x 100%

———————

= ,

= 28,2142%

Sampel III

V_3 = 110 ml

Massa Produk = V_3 x

= 110 ml x 0,8072 gr/ml

= 88,7926 gram

$$\%\text{Yield III} = \frac{\quad}{\quad} \times 100\%$$

$$= \frac{\quad}{\quad}$$

= ,

= 34,0201%

Sampel IV

V_4 = 148 ml

Massa Produk = V_4 x

= 148 ml x 0,8101 gr/ml

= 119,8929 gram

$$\%\text{Yield IV} = \frac{\quad}{\quad} \times 100\%$$

$$= \frac{\quad}{\quad}$$

= ,

= 45,9360%

Sampel V

V_5 = 133 ml

Massa Produk = V_5 x

= 133 ml x 0,7887 gr/ml

= 104,8963 gram

$$\%\text{Yield IV} = \frac{\quad}{\quad} \times 100\%$$

$$= \frac{\quad}{\quad}$$

= ,

= 40,1902%

C. Perhitungan Kadar Air

Sampel I

Berat Cawan Kosong (m_1) = 106,2018 gram

Berat Sampel (m_2) = 2,0401 gram

Berat Cawan + Sampel (m_3) = $m_1 + m_2$

= 106,2018 gr + 2,0401 gr

= 108,2419

Berat Cawan Setelah Dioven (m_4) = 106,9800 gram

Kadar Air (%) = $\frac{\quad}{\quad}$ x 100%

= $\frac{\quad}{\quad}$ x 100%

= 1,1658%

Kadar Air (ppm) = 11,658 ppm

Sampel II

Berat Cawan Kosong (m_1) = 30,4013 gram

Berat Sampel (m_2) = 2,0776 gram

Berat Cawan + Sampel (m_3) = $m_1 + m_2$

= 30,4013 gr + 2,0776 gr

= 32,4789 gram

Berat Cawan Setelah Dioven (m_4) = 31,3300 gram

Kadar Air (%) = $\frac{\quad}{\quad}$ x 100%

= $\frac{\quad}{\quad}$ x 100%

= 3,5374%

Kadar Air (ppm) = 35,74 ppm

Sampel III

Berat Cawan Kosong (m_1) = 108,9542 gram

Berat Sampel (m_2) = 2,0216 gram

Berat Cawan + Sampel (m_3) = $m_1 + m_2$

= 108,9542 gr + 2,0216 gr

= 110,9758 gram

Berat Cawan Setelah Dioven (m_4) = 109,3301 gram

Kadar Air (%) = _____ x 100%

= _____ x 100%

= 1,4829%

Kadar Air (ppm) = 14,829 ppm

Sampel IV

Berat Cawan Kosong (m_1) = 77,6513 gram
Berat Sampel (m_2) = 2,0360 gram
Berat Cawan + Sampel (m_3) = $m_1 + m_2$
= 77,6513 gr + 2,0360 gr
= 79,6873 gram
Berat Cawan Setelah Dioven (m_4) = 78,7600 gram

Kadar Air (%) = _____ x 100%

= _____ x 100%

= 1,1637%

Kadar Air (ppm) = 11,637 ppm

Sampel V

Berat Cawan Kosong (m_1) = 108,9302 gram
Berat Sampel (m_2) = 2,0185 gram
Berat Cawan + Sampel (m_3) = $m_1 + m_2$
= 108,9302 gr + 2,0185 gr
= 110,9487 gram
Berat Cawan Setelah Dioven (m_4) = 109,9000 gram

Kadar Air (%) = _____ x 100%

= _____ x 100%

= 0,9452%

Kadar Air (ppm) = 9,452 ppm

D. Perhitungan Viskositas (μ)

Densitas Bola (ρ_1) = 8,1 gr/cm^3
Konstanta Bola (K) = 0,09 mPa.s cm3/gr.s

Sampel I

Densitas Sampel (ρ_2) = 0,8078 gr/cm^3

Rata-Rata Waktu Tempuh (t) = ———————

= ———————————
= , , ,
= 5,26 s

Viskositas Dinamik (μ) = K t
= 0,09 8,1 0,8078 5,26
= 3,4499 Mpa.s
= 0,0345 gr/cm.s

Viskositas Kinematik (υ) = Viskositas Dinamik μ / Densitas ρ2

= , / .

= 0,0427, cm/ 2/s
= 4,2709 mm^2/s

Sampel II

Densitas Sampel (ρ_2) = 0,8004 gr/cm^3

Rata-Rata Waktu Tempuh (t) = ———————

= ———————————
= , , ,
= 4,67 s

Viskositas Dinamik (μ) = K t
= 0,09 8,1 0,8004 4,67
= 3,0680 Mpa.s
= 0,0307 gr/cm.s

Viskositas Kinematik (υ) = Viskositas Dinamik μ / Densitas ρ2

= , / .
, /
= 0,0383 cm^2/s
= 3,8330 mm2/s

Sampel III Densitas

Sampel (ρ_2) = 0,8072 gr/cm^3

Rata-Rata Waktu Tempuh (t) = ———

= , , ,
= 4,7100 s

Viskositas Dinamik (μ) = K t
= 0,09 8,1 0,8072 4,7100
= 3,0914 Mpa.s
= 0,0309 gr/cm.s

Viskositas Kinematik (υ) = Viskositas Dinamik μ / Densitas ρ2

= , / .
, /
= 0,0383 cm^2/s
= 3,8298 mm^2/s

Sampel IV Densitas

Sampel (ρ_2) = 0,8101 gr/cm^3

Rata-Rata Waktu Tempuh (t) = ———

= , , ,
= 4,82 s

Viskositas Dinamik (μ) = K t
= 0,09 8,1 0,8101 4,82
= 3,1646 Mpa.s
= 0,0316 gr/cm.s

Viskositas Kinematik (υ) = Viskositas Dinamik μ / Densitas ρ2

= , / .
, /

= 0,03906 cm^2/s

= 3,9064 mm^2/s

Sampel V Densitas

Sampel (ρ_2) = 0,7887 gr/cm^3

Rata-Rata Waktu Tempuh (t) = ———

= , , ,

= 5,48 s

Viskositas Dinamik (μ) = K t

= 0,09 8,1 0,7887 5,48

= 3,6081 Mpa.s

= 0,0361 gr/cm.s

Viskositas Kinematik (υ) = Viskositas Dinamik μ / Densitas ρ2

= , / .
, /

= 0,0457 cm^2/s

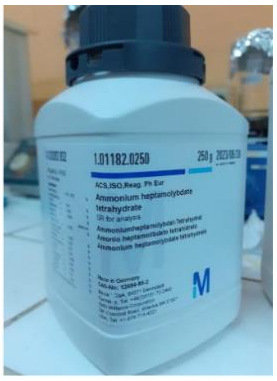
= 4,5748 mm^2/s

LAMPIRAN III
DOKUMENTASI

Bahan Baku Pembuatan Katalis

Aquadest

Nickel (II) Nitrate Hexahydrate



Ammonium Heptamolybdate Tetrahydrare

Aluminium Oksida

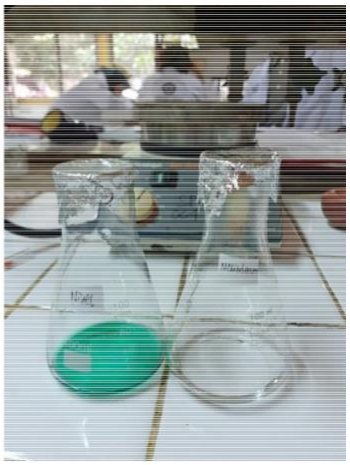
Penimbangan Bahan Baku

Penimbangan Ammonium Heptamolybdate Tetrahydrare

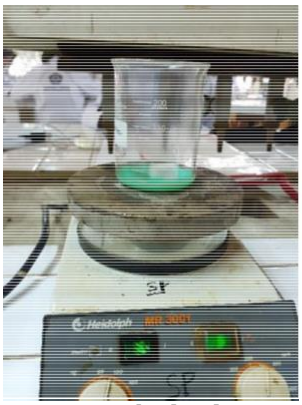
Penimbangan Nickel (II) Nitrate Hexahydrate

Penimbangan Aluminium Oksida

Pembuatan Larutan



Impregnasi Katalis



Campuran kedua larutan dipanaskan dan dihomogenkan (T= 80˚C)

Penambahan Al_2O_3 pada campuran

Pengeringan pada suhu 80˚C

Katalis yang telah dikeringkan pada suhu 80˚C

Dikeringkan pada suhu 120˚C di dalam oven

Setelah dioven pada suhu 120˚C

Penumbukan katalis yang telah dioven

Dikalsinasi pada suhu 600˚C di dalam *furnace*

Katalis yang telah dikalsinasi

Katalis yang didinginkan di dalam desikator

Katalis yang telah diimpregnasi

Bahan Baku Pembuatan *Green diesel*

Gas Hidrogen

Palm Fatty Acid Distillate

Katalis $NiMo/Al_2O_3$

Tahapan *Hydroprocessing*

Unit Produksi *Green Diesel*

Valve Input

Pressure Gauge

Jaket Reaktor

Valve Hidrogen Masuk

Valve Output

Pengambilan bahan baku ([PFAD)

PFAD dipanaskan dengan menggunakan hot plate

Memasukkan Katalis ke dalam reaktor

Bahan baku di masukkan kedalam reaktor

Memasukkan gas hydrogen ke dalam reaktor

Mengatur Temperatur pada thermocontroller

Produk dimasukkan kedalam kondensor

Produk dan hasil samping dipisahkan dengan *decanter*

Volume sampel diukur

Analisa Produk

Uji Viskositas

Uji Densitas

Uji Kadar Air

Uji Titik Nyala