Lampiran 1

Data Hasil Pengujian Asam Lemak Universitas Airlangga

NO: F-04

LAPORAN HASIL UJI
No. 069 / LHU / X / 2016

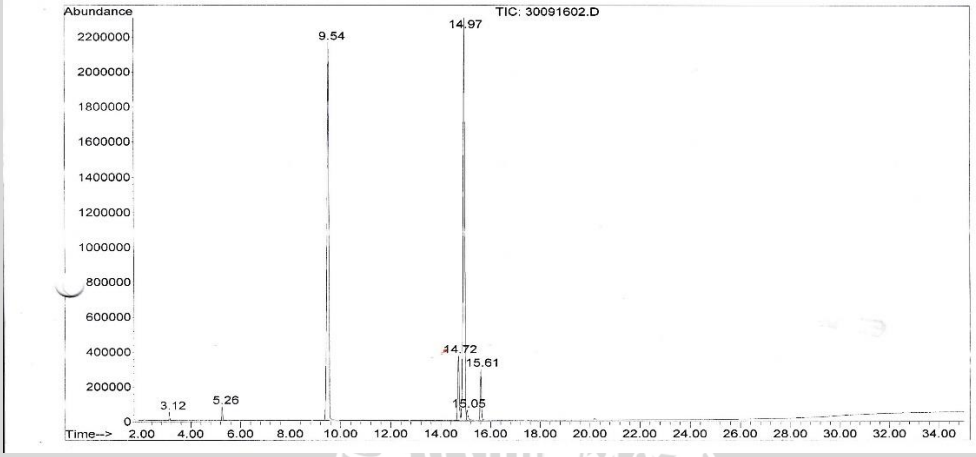
1. Tanggal / No. Surat Perintah Uji : 28.09.16 / 069 / SPU / IX /16
2. Tanggal Selesai Uji : 07.10.16
3. Nama Sampel : Minyak Kelapa Sawit
4. Kode Sampel : GC-MSD 09 – 230
5. Hasil Pemeriksaan :

No.	Parameter	Metode + BD	Hasil	Syarat	Ket
1.	Profil GC-MSD	GC-MSD	Terlampir	-	

Surabaya, 07.10.16
Manajer Teknis,

Drs. Harjana, M.Sc., Apt.

```
File       :C:\MSDChem\1\DATA\FAME\30091602.D
Operator   : C009
Acquired   : 30 Sep 2016  12:08      using AcqMethod FAME.M
Instrument :      Instrument #1
Sample Name: 9-230 E
Misc Info  : 1ul
Vial Number: 1
```



Area Percent Report

```
Data Path : C:\MSDChem\1\DATA\FAME\
Data File : 30091602.D
Acq On    : 30 Sep 2016  12:08
Operator  : C009
Sample    : 9-230 E
Misc      : 1ul
ALS Vial  : 1   Sample Multiplier: 1

Integration Parameters: AUTOINT1.E
Integrator: ChemStation

Method    : C:\MSDCHEM\1\METHODS\PROFILE1.M
Title     :

Signal    : TIC
```

peak #	R.T. min	first scan	max scan	last scan	PK TY	peak height	corr. area	corr. % max.	% of total
1	3.114	175	188	208	BB	48386	1031839	0.93%	0.416%
2	5.261	449	469	490	BV	80247	2071692	1.86%	0.835%
3	9.541	986	1029	1060	BV	2202471	111364150	100.00%	44.898%
4	14.714	1674	1706	1717	BV 2	368495	15877092	14.26%	6.401%
5	14.966	1717	1739	1746	VV	2252422	105199290	94.46%	42.413%
6	15.050	1746	1750	1786	VB 4	58943	2624599	2.36%	1.058%
7	15.608	1809	1823	1850	BB	289217	9866783	8.86%	3.978%

Sum of corrected areas: 248035445

PROFILE1.M Wed Oct 05 09:58:08 2016

Library Search Report

Data Path : C:\MSDChem\1\DATA\FAME\
Data File : 30091602.D
Acq On : 30 Sep 2016 12:08
Operator : C009
Sample : 9-230 E
Misc : 1ul
ALS Vial : 1 Sample Multiplier: 1

Search Libraries: C:\Database\wiley7n.l Minimum Quality: 0

Unknown Spectrum: Apex
Integration Events: Chemstation Integrator - AUTOINT1.E

Pk#	RT	Area%	Library/ID	Ref#	CAS#	Qual
1	3.11	0.42	C:\Database\wiley7n.l			
			Dodecanoic acid, methyl ester	136166	000111-82-0	96
			Dodecanoic acid, methyl ester (CAS) $$ Methyl laurate $$ Methyl dode canoate $$ Methyl n-dodecanoate $$ Lauric acid methyl ester $$ Metho lene 2296 $$ Methyl laurinate $$ M ethyl dodecylate $$ Uniphat A40 IN 511 $$ Lauric acid, methyl ester $$ Dodecanoic aci	136165	000111-82-0	94
			Dodecanoic acid, methyl ester (CAS) $$ Methyl laurate $$ Methyl dode canoate $$ Methyl n-dodecanoate $$ Lauric acid methyl ester $$ Metho lene 2296 $$ Methyl laurinate $$ M ethyl dodecylate $$ Uniphat A40 IN 511 $$ Lauric acid, methyl ester $$ Dodecanoic aci	136170	000111-82-0	94
2	5.26	0.84	C:\Database\wiley7n.l			
			Methyl tetradecanoate $$ Tetradeca noic acid, methyl ester $$ Myristi c acid, methyl ester $$ Metholenea t 2495 $$ Methyl myristate $$ Meth yl n-tetradecanoate $$ Uniphat A50	176772	000124-10-7	98
			Tetradecanoic acid, methyl ester (CAS) $$ Methyl myristate $$ Methyl tetradecanoate $$ Methyl n-tetrad ecanoate $$ Myristic acid methyl e ster $$ Uniphat A50 $$ Metholeneat 2495 $$ Myristic acid, methyl est er $$ Tetradecanoic acid methyl es ter $$ MYRISTIC A	176781	000124-10-7	98
			Methyl tetradecanoate	176776	000124-10-7	97
3	9.54	44.90	C:\Database\wiley7n.l			
			Hexadecanoic acid, methyl ester (C AS) $$ Methyl palmitate $$ Methyl hexadecanoate $$ Methyl n-hexadeca noate $$ Uniphat A60 $$ Metholene 2216 $$ Palmitic acid methyl ester $$ Palmitic acid, methyl ester $$ n-Hexadecanoic acid methyl ester $$ PALMITIC ACID-	213911	000112-39-0	99
			Hexadecanoic acid, methyl ester (C AS) $$ Methyl palmitate $$ Methyl hexadecanoate $$ Methyl n-hexadeca noate $$ Uniphat A60 $$ Metholene 2216 $$ Palmitic acid methyl ester $$ Palmitic acid, methyl ester $$ n-Hexadecanoic acid methyl ester $$ PALMITIC ACID-	213895	000112-39-0	97
			Hexadecanoic acid, methyl ester (C AS) $$ Methyl palmitate $$ Methyl hexadecanoate $$ Methyl n-hexadeca	213903	000112-39-0	97

Library Search Report

Data Path : C:\MSDChem\1\DATA\FAME\
Data File : 30091602.D
Acq On : 30 Sep 2016 12:08
Operator : C009
Sample : 9-230 E
Misc : 1ul
ALS Vial : 1 Sample Multiplier: 1

Search Libraries: C:\Database\wiley7n.l Minimum Quality: 0

Unknown Spectrum: Apex
Integration Events: Chemstation Integrator - AUTOINT1.E

Pk#	RT	Area%	Library/ID	Ref#	CAS#	Qual
			noate $$ Uniphat A60 $$ Metholene 2216 $$ Palmitic acid methyl ester $$ Palmitic acid, methyl ester $$ n-Hexadecanoic acid methyl ester $$ PALMITIC ACID-			
4	14.71	6.40	C:\Database\wiley7n.l			
			9,12-Octadecadienoic acid, methyl ester	243170	002462-85-3	99
			8,11-Octadecadienoic acid, methyl ester	243098	056599-58-7	99
			CIS-LINOLEIC ACID METHYL ESTER	243137	000112-63-0	99
5	14.97	42.41	C:\Database\wiley7n.l			
			9-Octadecenoic acid, methyl ester, (E)- $$ Elaidic acid, methyl ester $$ Methyl elaidate $$ Methyl trans-9-octadecenoate $$ (E)-9-Octadecenoic acid methyl ester	245486	001937-62-8	99
			7-Octadecenoic acid, methyl ester	245462	057396-98-2	99
			8-Octadecenoic acid, methyl ester, (E)- (CAS) $$ TRANS-8-OCTADECENOIC METHYL ESTER $$ Methyl trans-8-octadecenoate	245465	026528-50-7	99
6	15.06	1.06	C:\Database\wiley7n.l			
			9-Octadecenoic acid, methyl ester, (E)- $$ Elaidic acid, methyl ester $$ Methyl elaidate $$ Methyl trans-9-octadecenoate $$ (E)-9-Octadecenoic acid methyl ester	245486	001937-62-8	99
			10-Octadecenoic acid, methyl ester	245511	013481-95-3	99
			11-Octadecenoic acid, methyl ester, (Z)- $$ cis-11-Octadecenoic acid methyl ester $$ Methyl cis-octadec-11-enoate $$ cis-Vaccenic acid methyl ester	245513	001937-63-9	99
7	15.61	3.98	C:\Database\wiley7n.l			
			Octadecanoic acid, methyl ester (CAS) $$ Methyl stearate $$ Methyl octadecanoate $$ Methyl n-octadecanoate $$ Stearic acid methyl ester $$ Kemester 9718 $$ Stearic acid, methyl ester $$ n-Octadecanoic acid methyl ester $$ Methyl-octadecanoate $$ Methyl es	247771	000112-61-8	98
			Octadecanoic acid, methyl ester (CAS) $$ Methyl stearate $$ Methyl octadecanoate $$ Methyl n-octadecanoate $$ Stearic acid methyl ester $$ Kemester 9718 $$ Stearic acid, methyl ester $$ n-Octadecanoic acid methyl ester $$ Methyl-octadecanoate $$ Methyl es	247755	000112-61-8	98

Library Search Report

Data Path : C:\MSDChem\1\DATA\FAME\
Data File : 30091602.D
Acq On : 30 Sep 2016 12:08
Operator : C009
Sample : 9-230 E
Misc : 1ul
ALS Vial : 1 Sample Multiplier: 1

Search Libraries: C:\Database\wiley7n.l Minimum Quality: 0

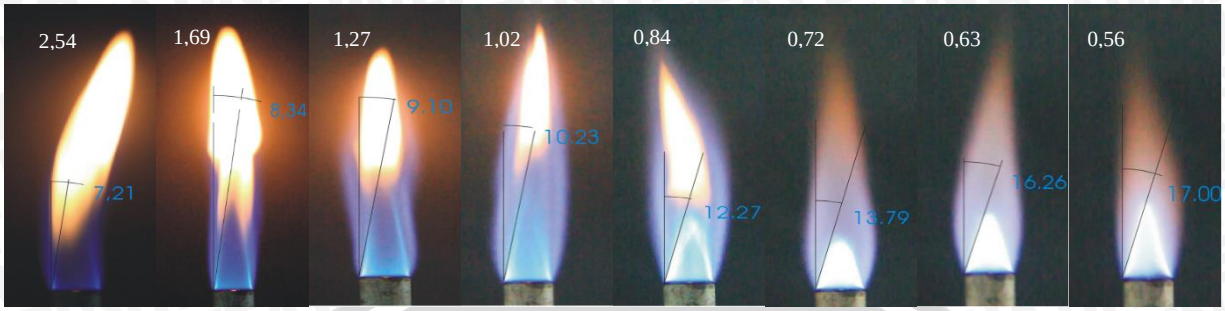
Unknown Spectrum: Apex
Integration Events: Chemstation Integrator - AUTOINT1.E

Pk#	RT	Area%	Library/ID	Ref#	CAS#	Qual
			Octadecanoic acid, methyl ester (C AS) $$ Methyl stearate $$ Methyl octadecanoate $$ Methyl n-octadecanoate $$ Stearic acid methyl ester $$ Kemester 9718 $$ Stearic acid, methyl ester $$ n-Octadecanoic acid methyl ester $$ Methyl-octadecanoate $$ Methyl es	247777	000112-61-8	98

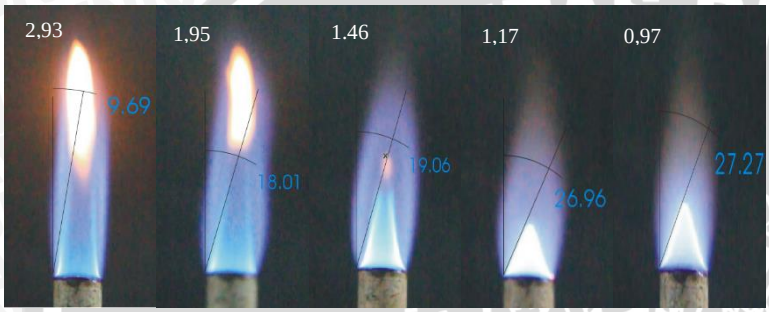
Lampiran 2

Visualisasi Api

Minyak Kelapa Sawit Mentah (*Crude Palm Oil)*



Minyak Kelapa Sawit Non Gliserol



Lampiran 3

Perhitungan Angka Reynolds

Diketahui : Q = 5 l/menit = 0.005 m^3/menit

A = 0,00005541 m^2

Maka, v = Q/A

v = 90,23641 m/menit = 1.5039 m/s

D = 8,4 mm = 0,0084 m

ρ udara = 1,21 kg/m^3

μ (Viskositas dinamis udara) = 1,983 . 10^{-5} Pa.s

Sehingga, Re = ρ.v.D/μ

Re = 1,21 kg/m^3 . 1.5039 m/s . 0,0084 m / 1,983 . 10^{-5} Pa.s

Re = 770,834

Reynolds number 770,834 < 2000 sehingga aliran termasuk dalam aliran laminer.

Lampiran 4

Data Hasil Pengujian Massa Alir dan Massa Jenis Uap Minyak

Jenis Minyak	Massa Alir (kg/menit)	Massa Jenis (kg/m^3)
Mentah	0,00024	3,5
Tanpa Gliserol	0,00028	4,0

Lampiran 5

Tabel Data Hasil Perhitungan

Data Minyak Kelapa Sawit Mentah

KECEPATAN REAKTAN CRUDE						
Qudara (l/min)	(l/min) ke (m3/min)	Qudara (m3/min)	ṁ(g/min)	ρuap (g/m3)	Aburner	Vu
1	10^-3	0.001	0.24	3500	0.0000553896	19.29191452
1.5	10^-3	0.0015	0.24	3500	0.0000553896	28.31887987
2	10^-3	0.002	0.24	3500	0.0000553896	37.34584522
2.5	10^-3	0.0025	0.24	3500	0.0000553896	46.37281057
3	10^-3	0.003	0.24	3500	0.0000553896	55.39977592
3.5	10^-3	0.0035	0.24	3500	0.0000553896	64.42674128
4	10^-3	0.004	0.24	3500	0.0000553896	73.45370663
4.5	10^-3	0.0045	0.24	3500	0.0000553896	82.48067198

KECEPATAN API					
Q udara (l/min)	α	SIN α	Vu	SL	*equivalence ratio (Φ)*
1	7.21	0.125506388	19.29191452	4.035430859	2.542
1.5	9.34	0.162292737	28.31887987	7.659914202	1.695
2	10.1	0.175366726	37.34584522	10.91536435	1.271
2.5	11.23	0.194747951	46.37281057	15.05168311	1.017
3	12.27	0.212518777	55.39977592	19.62248773	0.847
3.5	13.79	0.238363959	64.42674128	25.59502186	0.726
4	16.26	0.27999657	73.45370663	34.27797652	0.635
4.5	17	0.292371705	82.48067198	40.19169112	0.565

Data Minyak Kelapa Sawit Non Gliserol

KECEPATAN REAKTAN NON GLISEROL						
Qudara (l/min)	(l/min) ke (m3/min)	Qudara (m3/min)	ṁ(g/min)	ρuap (g/m3)	Aburner	Vu
0,5	10^-3	0.0005	0.28	4000	0.0000553896	10.2907405
1	10^-3	0.001	0.28	4000	0.0000553896	19.31770585
1.5	10^-3	0.0015	0.28	4000	0.0000553896	28.3446712
2	10^-3	0.002	0.28	4000	0.0000553896	37.37163655
2.5	10^-3	0.0025	0.28	4000	0.0000553896	46.3986019
3	10^-3	0.003	0.28	4000	0.0000553896	55.42556725
3.5	10^-3	0.0035	0.28	4000	0.0000553896	64.45253261
4	10^-3	0.004	0.28	4000	0.0000553896	73.47949796
4.5	10^-3	0.0045	0.28	4000	0.0000553896	82.50646331

KECEPATAN API					
Q udara (l/min)	α	SIN α	Vu	SL	*equivalence ratio (Φ)*
1	9.69	0.168317339	19.31770585	5.41917475	2.93
1.5	18.01	0.30918298	28.3446712	14.60614987	1.953
2	19.06	0.326558121	37.37163655	20.34001899	1.465
2.5	26.96	0.453368349	46.3986019	35.05942925	1.172
3	27.27	0.458184213	55.42556725	42.32519983	0.977

Lampiran 6

Perhitungan Mol

Minyak Kelapa Sawit Mentah

REAKTAN							
REAKTAN	**Rumus kimia**	**Mr**	**Massa (mg)**	**Mol**	**mol*C**	**mol*H**	**mol*O**
Asam Laurat	$C_{12}H_{24}O_2$	200	0.0408	0.000203952	0.002447424	0.004894848	0.000407904
Asam Miristat	$C_{14}H_{28}O_2$	256	0.0816	0.000318675	0.00446145	0.0089229	0.00063735
Asam Palmitat	$C_{16}H_{32}O_2$	256	4.3607	0.017033938	0.272543	0.545086	0.034067875
Asam Linoleat	$C_{18}H_{32}O_2$	280	0.6216	0.002219886	0.039957943	0.071036343	0.004439771
Asam 8 - Oktadekanoat	$C_{19}H_{36}O_2$	296	4.1179	0.013911784	0.264323892	0.500824216	0.027823568
Asam Elaidat	$C_{18}H_{34}O_2$	282	0.1029	0.000365061	0.006571098	0.012412074	0.000730122
Asam Stearat	$C_{18}H_{36}O_2$	284	0.3865	0.001361048	0.024498862	0.048997724	0.002722096
Gliserol	$C_3H_8O_3$	92	0.2880	0.0031304	0.009391304	0.025043478	0.009391304
total			10.0000		0.624194973	1.217217583	0.08021999

PRODUK	**Mol**	**mol*C**	**mol*H**	**mol*O**	**mol*N**
CO_2	0.624194973	0.624194973	0	1.248389946	0
H_2O	0.608608792	0	1.217217583	0.608608792	0
N_2	3.340344045	0	0	0	3.340344045
total		0.624194973	1.217217583	1.856998737	3.340344045

$$i\ (mol(O_2 + 3{,}76N_2)) = \frac{(1.856998737 - 0.08021999)}{2}$$

$$= 0.8883897$$

$j\ (mol(CO_2)) = 0.624194973$

$k\ (mol(H_2O)) = 0.608608792$

$l\ (mol(N_2)) = 3.340344045$

Minyak Kelapa Sawit Non Gliserol

REAKTAN							
REAKTAN	**Rumus kimia**	**Mr**	**Massa (mg)**	**Mol**	**mol*C**	**mol*H**	**mol*O**
Asam Laurat	$C_{12}H_{24}O_2$	200	0.042	0.00021	0.00252	0.00504	0.00042
Asam Miristat	$C_{14}H_{28}O_2$	256	0.084	0.00032	0.00448	0.00896	0.00064
Asam Palmitat	$C_{16}H_{32}O_2$	256	4.49	0.01753	0.28048	0.56096	0.03506
Asam Linoleat	$C_{18}H_{32}O_2$	280	0.64	0.00228	0.04104	0.07296	0.00456
Asam 8 - Oktadekanoat	$C_{19}H_{36}O_2$	296	4.24	0.01432	0.27208	0.51552	0.02864
Asam Elaidat	$C_{18}H_{34}O_2$	282	0.106	0.00037	0.00666	0.01258	0.00074
Asam Stearat	$C_{18}H_{36}O_2$	284	0.398	0.00141	0.02538	0.05076	0.00282
total			10.0000		0.63264	1.22678	0.07288

PRODUK					
PRODUK	**Mol**	**mol*C**	**mol*H**	**mol*O**	**mol*N**
CO_2	0.63264	0.63264	0	1.26528	0
H_2O	0.61339	0	1.22678	0.61339	0
N_2	3.3948852	0	0	0	3.3948852
total		0.63264	1.22678	1.87867	3.3948852

$$h\ (mol(O_2 + 3{,}76N_2)) = \frac{(1.87867 - 0.07288)}{2}$$

$$= 0.902895$$

i ($mol(CO_2)$) = 0.63264

j ($mol(H_2O)$) = 0.61339

k ($mol(N_2)$) = 3.3948852