

# LAMPIRAN 1

## DATA PROPERTIS BIODIESEL KELAPA



ADAN PENGKAJIAN DAN PENERAPAN TEKNOLOGI  
BALAI TERMODINAMIKA, MOTOR DAN PROPULSI

### LABORATORY TEST REPORT

Page 2 of 2

**COMPANY** : S2 MESIN UI      **REPORT NO** : 64/LK/BTMP/XI/07  
**ADDRESS** : FT UI DEPOK      **SAMPLE ID** : C0C0DIESEL  
**DATE SAMPLED** : -      **(WITH SPIRITUS)**  
**DATE RECEIVED** : 08/11/2007      **DATE FINISHED** : 26/11/2007

NO	TEST DESCRIPTION	RESULT	UNIT	METHOD	LIMIT SNI 04-7182-2006
1	Kinematic Viscosity at 40 °C	2.770	cSt	ASTM D 445	2.3 - 6
2	Density at 40° C	0.8566	gr/cm <sup>3</sup>	ASTM D 1298	0.850 - 0.900
3	Total Acid Number (TAN)	0.292	mg KOH/gr	ASTM D 664	< 0.8
4	Flash Point	108	°C	ASTM D 93	> 100
5	Cloud Point	2.7	°C	ASTM D 2500	> 18
6	Pour Point	- 5.3	°C	ASTM D 97	-
7	Water Content	0.02	% vol	ASTM D 2709	< 0.05
8	Total Glycerol	0.2851	% w	FBI A-02-03	< 0.24
9	Free Glycerol	0.0003	% w	FBI A-02-03	< 0.02
10	Saponification Number	259.16	mg KOH/gr	FBI A-03-03	-
11	Ester Content	97.88	% w	Dibitung	> 96.5

Nov 26, 2007  
Chemical Laboratory Coordinator

Siti Yubaidah, ST  
NIP - 680003832

Diloreng mereproduksi sertifikat laporan ini dengan menggunakan file dan gambar foto opsional. Laporan ini berlaku untuk standar internasional. Untuk informasi lebih lanjut, silakan hubungi kami di nomor telepon yang tertera di bagian atas sertifikat ini. Kami tidak bertanggung jawab atas kesalahan atau ketidakakuratan data yang tertera dalam laporan ini. Kami tidak bertanggung jawab atas kerusakan atau kehilangan data yang disebabkan oleh penggunaan perangkat lunak ini.

## LAMPIRAN 2

### DATA PROPERTIS BIODIESEL MINYAK JAGUNG



PERKHAJIAN DAN LAYANAN TEKNOLOGI  
TERKUALITAS, MOTOR DAN PRODUKSI

#### LABORATORY TEST REPORT

Page 1 of 2

COMPANY: HASO SARIJANA (PT) ZONE BIRU/07  
 ADDRESS: Tabung Mesir (20)  
 SAMPLE ID: Biodiesel Minyak Jagung  
 DATE SAMPLED: 11/04/07  
 LOCATION: 13/04/07  
 DATE RECEIVED: 11/04/07  
 DATE FINISHED: 13/04/07

No	Test Description	Standard	Results	Units	Method
1	Viscosity at 40°C	2,3 - 6	4,869	cSt	ASTM D - 445
2	Density at 15°C	0,85 - 0,90	0,8686	g/cm <sup>3</sup>	IP - 365
3	Flash Point	min 100	180	°C	IP - 404
4	Cloud Point	max 18	11	°C	ASTM D - 2500
5	Pour Point	-	- 3	°C	ASTM D - 97
6	Water Content	max 0,05	0,02	% wt	ASTM D - 2709
7	Free Glycerol	max 0,02	0,0135	% wt	ASTM D 6584
8	Total Glycerol	max 0,24	0,3235	% wt	ASTM - D 6584
9	Total Acid Number (TAN)	max 0,8	0,2166	mg KOH/gr	ASTM D - 664
10	Saponification Number	-	201,059	mg KOH/gr	ASTM D - 94
11	Ester Content	min 96,5	99,1569	% wt	Feih: lungan

April 13, 2007  
 Chemical Laboratory Coordinator

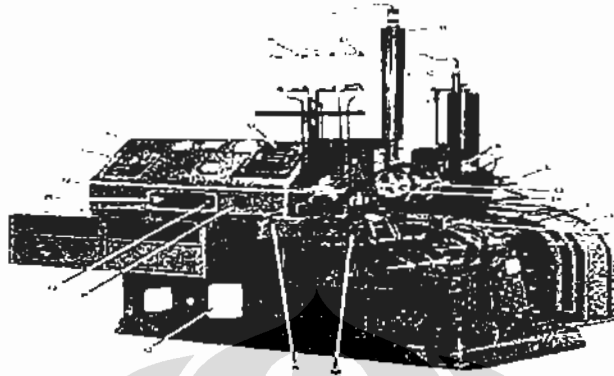
Siti Yubaijah, ST  
 NIP. 800603832

Kawasan HUSPIPEK Gal 210, Serpong - Tangerang 15111 Tel. (021) 7567 519 Fax (021) 7569 534

Ditaring meyakini bahwa sertifikat laporan ini dengan cara apapun adalah dengan tujuan untuk keperluan administratif dan tidak dapat digunakan sebagai pengganti atau sebagai jaminan kualitas produk. Sertifikat ini hanya berlaku untuk keperluan administratif dan tidak dapat digunakan sebagai jaminan kualitas produk. Sertifikat ini hanya berlaku untuk keperluan administratif dan tidak dapat digunakan sebagai jaminan kualitas produk.

### LAMPIRAN 3

## DATA PENGUJIAN CETANE NUMBER



LABORATORIUM PENGUJIAN CETANE NUMBER  
 PT. EMIGAS, CILEDUK BAYU KAY. 109 CIPULIH  
 KEDAYOHAN LAMA  
 JAKARTA SELATAN

### LABORATORIUM TEST REPORT

PENGUJIAN : CETANE NUMBER  
 SAMPEL/DI : SOLAR MURNI, BIODIESEL  
 METODE : ASTM D-613  
 MESIN : CFR WAUKENA ENGINE  
 TANGGAL DITERIMA : 8 APRIL 2008  
 TANGGAL SELESAI : 9 APRIL 2008

NO	URAIAN JENIS BAHAN BAKAR	HASIL	METODE
1	SOLAR MURNI	52,2	ASTM D - 613
2	BIODIESEL KELAPA (100%)	62,0	ASTM D - 613
3	B10 KELAPA	57,1	ASTM D - 613
4	B20 KELAPA	58,1	ASTM D - 613
5	B30 KELAPA	59	ASTM D - 613
6	BIODIESEL JAGUNG (100%)	58,6	ASTM D - 613
7	B10 JAGUNG	53,4	ASTM D - 613
8	B20 JAGUNG	55,8	ASTM D - 613
9	B30 JAGUNG	57,2	ASTM D - 613

JAKARTA, 10 APRIL 2008  
 PELAKSANA,

  
 PRAYOGI

## LAMPIRAN 4

### DATA PENGUJIAN SOLAR MURNI



Laboratorium Termodinamika  
Departemen Teknik, Universitas Indonesia  
Kampus Baru UI, Depok 16424

Test on 22 Maret 2008  
Tested Fuel Solar 100%

#### ENGINE RESEARCH AND TEST BED

MODEL : GWE-80/100-HS-AV  
TYPE : SD-22 (Nissan Motor CO. Ltd)

#### SPECIMEN

Normal Output 47 PS at 3200 rpm  
1 NO of cycle 4 cycle  
2 Displacement (V) 1,567  
3 Eng Cylinder Bore (D) 7,8 cm  
4 Eng Piston Stroke (S) 8,2 cm  
5 NO of Cylinder (n) 4  
6 Compression Ratio 8,2

#### DYNAMOMETER

1 Model EWS - 50  
2 Type WC Eddy Cur. Elec. Dyn  
3 Balance Spring  
4 Torq arm (L) 0,358 m

#### FUEL

1 Specific Weight ( $\rho$ ) 0,83 kg/l  
2 LHV (Solar) 43300 kJ/kg  
3 FUEL CONTENTS (%) C = 86,5  
H = 13,5  
4 Gas Constant (R) 287 J/kg K  
5 AFR<sub>stoc</sub> 14,7246  
6 Fuel Consumption 30 ml

#### TEST CONDITIONS

1 Atmospheric Pressure ( $P_a$ ) 101,325 kPa  
2 Inner diameter of round nozzle (D) 0,636 m


TEST NO.	Set or command		Measurement									
	Throttle Valve Open	Rotational Shaft Speed	Dynamometer Load	Suction Air Temp	Head Across orifice	Fuel Consuming Time	Exhaust Gas Analyzer					
	%	rpm	kgf	°C	mmH <sub>2</sub> O	sec	Opacity					
1	30	1500	5.5	27	14	54.86	9.10					
2	40	1500	24.5	28	14	24.90	20.35					
3	50	1500	29.7	29	14	20.08	22.90					
4	60	1500	29.0	30	14	21.25	25.90					
1	40	1300	26.2	30	11	28.40	16.80					
2	40	1500	25.8	31	14	24.77	15.00					
3	40	1700	12.1	31	17	39.96	10.80					
4	40	1900	4.4	31	22	46.05	8.55					

#### 1. Diesel Engine Performance

TEST NO.	Throttle Valve Open	Engine Speed	Specific Weight of Air	Suction Air Flow Rate	Exhaust Gas Weight Rate	Air Fuel Ratio	Excess Air Factor	Fuel Consumption	Specific Fuel Consumption	Brake Horse Power	Thermal Efficiency
	%	rpm	$\rho_a$	$G_a$	$G_e$	AFR	$\lambda$	FC	SFC	BHP	$\eta_{th}$
	%	rpm	kg/m <sup>3</sup>	kg/s	kg/s	-	-	L/hr	LAW/hr	KW	%
1	30	1500	1.177	0.035	0.0005	76.496	5.195	1.969	0.656	3.002	14.38
2	40	1500	1.173	0.034	0.0010	34.344	2.332	4.338	0.321	13.495	29.33
3	50	1500	1.169	0.034	0.0012	27.396	1.861	5.380	0.329	16.359	28.67
4	60	1500	1.165	0.034	0.0012	28.952	1.966	5.082	0.318	15.974	29.63
1	40	1300	1.165	0.030	0.0009	34.118	2.317	3.803	0.304	12.507	31.00
2	40	1500	1.163	0.035	0.0010	34.323	2.331	4.361	0.307	14.184	30.67
3	40	1700	1.161	0.038	0.0006	60.994	4.142	2.703	0.358	7.554	26.35
4	40	1900	1.161	0.043	0.0005	79.952	5.430	2.346	0.773	3.035	12.20

## LAMPIRAN 5

### DATA PENGUJIAN BIOSOLAR

	Laboratorium Termodinamika	Test on	22 Maret 2008
	Departemen Teknik, Universitas Indonesia	Tested Fuel	BIOSOLAR
	Kampus Baru UI, Depok 16424		
<b>ENGINE RESEARCH AND TEST BED</b>			
MODEL : GWE-80/100-HS-AV TYPE : SD-22 (Nissan Motor CO, Ltd)			
SPECIMEN	DYNAMOMETER	FUEL	
Normal Output 47 PS at 3200 rpm	1 Model EWS - 50	1 Specific Weight ( $\rho$ )	0.83 kg/l
1 NO of cycle 4 cycle	2 Type WC Eddy Cur. Elec. Dyn	2 LHV (Biosolar)	45040 kJ/kg
2 Displacement (V) 1.567	3 Balance Spring	3 FUEL CONTENTS (%)	C = 86.5 H = 13.5
3 Eng Cylinder Bore (D) 7.8 cm	4 Torq arm (L) 0.358 m	4 Gas Constant (R)	287 J/kg K
4 Eng Piston Stroke (S) 8.2 cm	TEST CONDITIONS		
5 NO of Cylinder (n) 4	1 Atmospheric Pressure ( $P_a$ )	101.325 kPa	5 AFR <sub>reference</sub>
6 Compression Ratio 16.2	2 Inner diameter of round nozzle (D)	0.036 m	6 Fuel Consumption 30 mL

TEST NO.	Set or command		Measurement									
	Throttle Valve Open	Rotational Shaft Speed	Dynamometer Load	Suction Air Temp	Head Across orifice	Fuel Consuming Time	Exhaust Gas Analyzer					
	%	rpm	kgf	$T_a$ °C	$h_o$ mmH <sub>2</sub> O	$t$ sec	Opacity					
1	30	1500	4.4	28	15	59.77	7.40					
2	40	1500	23.6	28	15	24.50	16.50					
3	50	1500	27.5	29	12	22.19	17.40					
4	60	1500	29.0	29	13	22.27	18.50					
1	40	1300	26.5	29	9	28.41	11.30					
2	40	1500	26.7	29	14	21.75	11.20					
3	40	1700	12.3	30	18	35.50	8.70					
4	40	1900	4.8	31	22	44.55	6.60					

#### 1. Diesel Engine Performance

TEST NO.	Throttle Valve Open	Engine Speed	Specific Weight of Air	Suction Air Flow Rate	Exhaust Gas Weight Rate	Air Fuel Ratio	Excess Air Factor	Fuel Consumption	Specific Fuel Consumption	Brake Horse Power	Thermal Efficiency
	%	rpm	$\rho_a$	$G_a$	$G_e$	AFR	$\lambda$	FC	SFC	BHP	$\eta_p$
	%	rpm	kg/m <sup>3</sup>	kg/s	kg/s	-	-	L/hr	L/kWh	kW	%
1	30	1500	1.173	0.035	0.0004	84.960	5.770	1.807	0.746	2.424	12.72
2	40	1500	1.173	0.036	0.0010	34.948	2.373	4.408	0.340	12.972	27.91
3	50	1500	1.169	0.032	0.0011	28.544	1.939	4.868	0.322	15.120	29.45
4	60	1500	1.170	0.033	0.0011	29.829	2.026	4.851	0.304	15.974	31.23
1	40	1300	1.171	0.028	0.0009	31.677	2.151	3.802	0.301	12.650	31.55
2	40	1500	1.169	0.035	0.0011	30.227	2.053	4.966	0.338	14.679	28.03
3	40	1700	1.164	0.039	0.0007	55.826	3.791	3.042	0.398	7.647	23.84
4	40	1900	1.161	0.043	0.0006	76.916	5.224	2.424	0.724	3.349	13.10

## LAMPIRAN 6

### DATA PENGUJIAN B10 KELAPA



Laboratorium Termodinamika  
Departemen Teknik, Universitas Indonesia  
Kampus Baru UI, Depok 16424

Test on : 22 Maret 2008

Tested Fuel B10 Kelapa

#### ENGINE RESEARCH AND TEST BED

MODEL : GWE-80/100-HS-AV

TYPE : SD-22 (Nissan Motor CO, Ltd)

SPECIMEN		DYNAMOMETER		FUEL	
Normal Output	47 PS at 3200 rpm	1 Model	EWS - 50	1 Specific Weight ( $\rho$ )	0.83 kg/l
1 NO of cycle	4 cycle	2 Type	WC Eddy Cur. Elec. Dyn	2 LHV (B10)	44720 kJ/kg
2 Displacement (V)	1.567	3 Balance	Spring	3 FUEL CONTENTS (%)	C = 86.5 H = 13.5
3 Eng Cylinder Bore (D)	7.8 cm	4 Torq arm (L)	0.358 m	4 Gas Constant (R)	287 J/kg K
4 Eng Piston Stroke (S)	8.2 cm	<b>TEST CONDITIONS</b>		5 AFR <sub>theoretical</sub>	14.7246
5 NO of Cylinder (n)	4	1 Atmospheric Pressure ( $P_a$ )	101.325 kPa	6 Fuel Consumption	30 ml
6 Compression Ratio	8.2	2 Inner diameter of round nozzle (D)	0.036 m		

TEST NO.	Set or command		Measurement					Exhaust Gas Analyzer			
	Throttle Valve Open	Rotational Shaft Speed	Dynamic Weigh Load	Suction Air Temp	Head Across orifice	Fuel Consuming Time	Opacity				
	%	rpm	kgf	$T_a$ °C	$h_o$ mmH <sub>2</sub> O	$t$ sec					k
1	30	1500	4.4	30	14	59.75	7.30				
2	40	1500	24.1	30	14	23.61	15.30				
3	50	1500	27.9	30	14	21.45	15.45				
4	60	1500	29.2	31	14	20.50	16.80				
1	40	1300	27.0	31	12	26.94	9.10				
2	40	1500	27.3	32	14	21.91	9.60				
3	40	1700	15.1	32	17	31.58	7.20				
4	40	1900	4.7	32	22	45.70	8.50				

#### 1. Diesel Engine Performance

TEST NO.	Throttle Valve Open	Engine Speed	Specific Weight of Air	Suction Air Flow Rate	Exhaust Gas Weight Rate	Air Fuel Ratio	Excess Air Factor	Fuel Consumption	Specific Fuel Consumption	Brake Horse Power	Thermal Efficiency
	%	rpm	$\rho_a$	$G_a$	$G_e$	AFR	$\lambda$	FC	SFC	BHP	$\eta_e$
	%	rpm	kg/m <sup>3</sup>	kg/s	kg/s	-	-	L/hr	L/kW.hr	kW	%
1	30	1500	1.165	0.035	0.0004	82.900	5.630	1.808	0.746	2.424	12.81
2	40	1500	1.165	0.035	0.0011	32.751	2.224	4.575	0.345	13.275	27.71
3	50	1500	1.164	0.034	0.0012	29.212	1.984	5.035	0.328	15.358	29.15
4	60	1500	1.163	0.034	0.0012	27.907	1.895	5.268	0.328	16.084	29.16
1	40	1300	1.161	0.032	0.0009	34.764	2.361	4.009	0.311	12.889	30.71
2	40	1500	1.158	0.034	0.0011	29.746	2.020	4.930	0.328	15.037	29.13
3	40	1700	1.158	0.038	0.0008	47.690	3.239	3.420	0.363	9.426	26.32
4	40	1900	1.158	0.043	0.0005	79.223	5.380	2.363	0.721	3.279	13.25

# LAMPIRAN 7

## DATA PENGUJIAN B20 KELAPA



Laboratorium Termodinamika  
Departemen Teknik, Universitas Indonesia  
Kampus Baru UI, Depok 16424

Test on 22 Maret 2008  
Tested Fuel B 20 Kelapa (Spritus)

### ENGINE RESEARCH AND TEST BED

MODEL : GWE-80100-HS-AV  
TYPE : SD-22 (Nissan Motor CO., Ltd)

SPECIMEN		DYNAMOMETER		FUEL	
Normal Output	47 PS at 3200 rpm	1 Model	EWS - 50	1 Specific Weight ( $\rho$ )	0.83 kg/l
1 NO of cycle	4 cycle	2 Type	WC Eddy Cur. Elec. Dyn	2 LHV (B20)	44140 kJ/kg
2 Displacement (V)	1.567	3 Balance	Spring	3 FUEL CONTENTS (%)	C = 86.5 H = 13.5
3 Eng Cylinder Bore (D)	7.8 cm	4 Torq arm (L)	0.358 m	4 Gas Constant (R)	287 J/kg K
4 Eng Piston Stroke (S)	8.2 cm	TEST CONDITIONS		5 AFR <sub>theoretical</sub>	14.7246
5 NO of Cylinder (n)	4	1 Atmospheric Pressure (P <sub>a</sub> )	101.325 kPa	6 Fuel Consumption	30 mL
6 Compression Ratio	8.2	2 Inner diameter of round nozzle (D)	0.036 m		

TEST NO.	Set or command		Measurement								
	Throttle Valve Open	Rotational Shaft Speed	Dynamometer Load	Suction Air Temp	Heads Across orifice	Fuel Consuming Time	Exhaust Gas Analyzer				
	%	rpm	kgf	°C	mmH <sub>2</sub> O	sec	Opacity				
1	30	1500	5.3	30	10	53.33	7.05				
2	40	1500	24.3	31	14	23.74	12.70				
3	50	1500	28.0	31	13	22.11	10.65				
4	60	1500	29.0	32	13	21.67	13.15				
1	40	1300	26.0	32	11	25.63	8.05				
2	40	1500	26.5	32	14	21.99	8.55				
3	40	1700	12.5	32	17	34.98	6.90				
4	40	1900	3.5	33	24	58.71	7.05				

#### 1. Diesel Engine Performance

TEST NO.	Throttle Valve Open	Engine Speed	Specific Weight of Air	Suction Air Flow Rate	Exhaust Gas Weight Rate	Air Fuel Ratio	Excess Air Factor	Fuel Consumption	Specific Fuel Consumption	Brake Horse Power	Thermal Efficiency
	%	rpm	$\rho_a$	$G_a$	$G_e$	AFR	$\lambda$	FC	SFC	BHP	$\eta_p$
	%	rpm	kg/m <sup>3</sup>	kg/s	kg/s	-	-	L/hr	L/KW hr	KW	%
1	30	1500	1.165	0.029	0.0005	62.529	4.247	2.025	0.700	2.892	13.82
2	40	1500	1.162	0.035	0.0010	32.893	2.234	4.550	0.341	13.357	28.41
3	50	1500	1.161	0.033	0.0011	29.505	2.004	4.886	0.317	15.423	30.65
4	60	1500	1.158	0.033	0.0011	28.871	1.961	4.985	0.312	15.974	31.01
1	40	1300	1.159	0.030	0.0010	30.714	2.086	4.215	0.340	12.412	28.50
2	40	1500	1.158	0.034	0.0011	30.403	2.065	4.912	0.337	14.569	28.70
3	40	1700	1.158	0.038	0.0007	53.298	3.620	3.088	0.396	7.803	24.45
4	40	1900	1.156	0.045	0.0004	105.094	7.137	1.840	0.764	2.407	12.66

# LAMPIRAN 8

## DATA PENGUJIAN B30 KELAPA



Laboratorium Termodinamika  
Departemen Teknik, Universitas Indonesia  
Kampus Baru UI, Depok 16424

Test on 22 Maret 2008

Tested Fuel . B 30 Kelapa (Spritus)

### ENGINE RESEARCH AND TEST BED

MODEL : GWE-80/100-HS-AV  
TYPE : SD-22 (Nissan Motor CO.,Ltd)

SPECIMEN	DYNAMOMETER	FUEL			
Normal Output 47 PS at 3200 rpm	1 Model EW - 100	1 Specific Weight ( $\rho$ ) 0.83 kg/l			
1 NO of cycle 4 cycle	2 Type WC Eddy Cur. Elec. Dyn	2 LHV (B5) 43660 kJ/kg			
2 Displacement (V) 1.567	3 Balance Spring	3 FUEL CONTENTS (%) C = 86.5 H = 13.5			
3 Eng Cylinder Bore (D) 7.8 cm	4 Torq arm (L) 0.358 m	4 Gas Constanta (R) 287 J/kg K			
4 Eng Piston Stroke (S) 8.2 cm	<b>TEST CONDITIONS</b>				
5 NO of Cylinder (n) 4	1 Atmospheric Pressure (P <sub>a</sub> ) 105.325 kPa	5 AFR <sub>reference</sub> 14.7246			
6 Compression Ratio 8.2	2 Inner diameter of round nozzle (D) 0.036 m	6 Fuel Consumption 30 mL			

TEST NO.	Set or command		Measurement								
	Throttle Valve Open	Rotational Shaft Speed	Dynamometer Load	Suction Air Temp	Head Across orifice	Fuel Consuming Time	Exhaust Gas Analyzer				
	%	rpm	kgf	T <sub>a</sub> °C	h <sub>o</sub> mmH <sub>2</sub> O	t sec	Opacity				
							k				
1	30	1500	4.2	30	14	60.69	7.15				
2	40	1500	23.2	30	14	24.35	12.45				
3	50	1500	27.7	30	13	22.86	12.50				
4	60	1500	29.3	31	13	20.90	13.75				
1	40	1300	26.4	30	10	27.14	9.30				
2	40	1500	26.6	31	14	21.74	9.10				
3	40	1700	13.8	30	17	33.30	7.20				
4	40	1900	4.2	30	22	48.24	7.90				

### 1. Diesel Engine Performance

TEST NO.	Throttle Valve Open	Engine Speed	Specific Weight of Air	Suction Air Flow Rate	Exhaust Gas Weight Rate	Air Fuel Ratio	Excess Air Factor	Fuel Consumption	Specific Fuel Consumption	Brake Horse Power	Thermal Efficiency
	%	N	$\rho_a$	G <sub>a</sub>	G <sub>e</sub>	AFR	$\lambda$	FC	SFC	BHP	$\eta_p$
		rpm	kg/m <sup>3</sup>	kg/s	kg/s	-	-	L/hr	L/KW.hr	kW	%
1	30	1500	1.165	0.035	0.0004	84.204	5.719	1.780	0.778	2.286	12.595
2	40	1500	1.165	0.035	0.0010	33.784	2.294	4.435	0.347	12.779	28.251
3	50	1500	1.165	0.033	0.0011	29.970	2.035	4.724	0.310	15.258	31.666
4	60	1500	1.163	0.033	0.0012	27.913	1.896	5.169	0.321	16.111	30.564
1	40	1300	1.164	0.029	0.0009	31.090	2.111	3.979	0.316	12.579	30.994
2	40	1500	1.161	0.034	0.0011	29.728	2.019	4.969	0.339	14.652	28.912
3	40	1700	1.164	0.038	0.0007	50.888	3.456	3.244	0.378	8.584	25.947
4	40	1900	1.165	0.043	0.0005	82.921	5.631	2.239	0.773	2.895	12.680



# LAMPIRAN 9

## DATA PENGUJIAN B10 JAGUNG



Laboratorium Termodinamika  
Departemen Teknik, Universitas Indonesia  
Kampus Baru UI, Depok 16424

Test on : 23 Maret 2008

Tested Fuel : B 10 Jagung (Spritus)

### ENGINE RESEARCH AND TEST BED

MODEL : GWE-80/100-HS-AV

TYPE : SD-22 (Nissan Motor CO., Ltd)

SPECIMEN		DYNAMOMETER		FUEL	
Normal Output	47 PS at 3200 rpm	1 Model	EW - 100	1 Specific Weight ( $\rho$ )	0.83 kg/l
1 NO of cycle	4 cycle	2 Type	WC Eddy Cur. Elec. Dyn	2 LHV (B10)	44520 kJ/kg
2 Displacement (V)	1.567	3 Balance	Spring	3 FUEL CONTENTS (%)	C = 86.5 H = 13.5
3 Eng. Cylinder Bore (D)	7.8 cm	4 Torq arm (L)	0.358 m	4 Gas Constant (R)	287 J/kg K'
4 Eng. Piston Stroke (S)	8.2 cm	<b>TEST CONDITIONS</b>			
5 NO of Cylinder (n)	4	1 Atmospheric Pressure ( $P_a$ )	101.325 kPa	5 AFR <sub>theoretical</sub>	14.7246
6 Compression Ratio	8.2	2 Inner diameter of round nozzle (D)	0.036 m	6 Fuel Consumption	30 mL

TEST NO.	Set or command						Measurement				
	Throttle Valve Open	Rotational Shaft Speed	Cylinder Load	Suction Air Temp	Head Across orifice	Fuel Consuming Time	Exhaust Gas Analyzer				
	%	rpm	kgf	$T_a$ °C	$h_o$ mmH <sub>2</sub> O	t sec	Opacity k				
1	30	1500	3.2	27	14	63.41	9.00				
2	40	1500	24.3	28	14	23.30	15.35				
3	50	1500	28.8	29	15	19.30	12.20				
4	60	1500	29.3	30	13	21.40	14.55				
1	40	1300	27.2	30	10	26.76	10.95				
2	40	1500	26.5	30	14	21.71	9.20				
3	40	1700	12.8	30	18	33.85	9.45				
4	40	1900	4.4	30	22	47.91	7.20				

### 1. Diesel Engine Performance

TEST NO.	Throttle Valve Open	Engine Speed	Specific Weight of Air	Suction Air Flow Rate	Exhaust Gas Weight Rate	Air Fuel Ratio	Excess Air Factor	Fuel Consumption	Specific Fuel Consumption	Brake Horse Power	Thermal Efficiency
	%	N	$\rho_a$	$G_a$	$G_e$	AFR	$\lambda$	FC	SFC	BHP	$\eta_b$
	%	rpm	kg/m <sup>3</sup>	kg/s	kg/s	-	-	L/hr	L/kWh	kW	%
1	30	1500	1.177	0.035	0.0004	88.889	6.037	1.703	0.966	1.763	9.93
2	40	1500	1.174	0.035	0.0011	32.444	2.203	4.636	0.347	13.357	27.64
3	50	1500	1.171	0.036	0.0013	27.779	1.887	5.597	0.353	15.836	27.14
4	60	1500	1.167	0.033	0.0012	28.628	1.944	5.048	0.313	16.111	30.62
1	40	1300	1.165	0.028	0.0009	30.579	2.077	4.037	0.311	12.961	30.80
2	40	1500	1.165	0.035	0.0011	30.115	2.045	4.976	0.341	14.597	28.14
3	40	1700	1.165	0.039	0.0007	52.492	3.565	3.191	0.401	7.959	23.93
4	40	1900	1.165	0.043	0.0005	83.488	5.670	2.254	0.734	3.070	13.06

# LAMPIRAN 10

## DATA PENGUJIAN B20 JAGUNG



Laboratorium Termodinamika  
Departemen Teknik, Universitas Indonesia  
Kampus Baru UI, Depok 16424

Test on : 23 Maret 2008  
Tested Fuel : B 20 Jagung (Spritus)

### ENGINE RESEARCH AND TEST BED

MODEL : GWE-80/100-HS-AV  
TYPE : SD-22 (Nissan Motor CO, Ltd)

SPECIMEN	DYNAMOMETER	FUEL
Normal Output 47 PS at 3200 rpm	1 Model EW - 100	1 Specific Weight ( $\rho$ ) 0.83 kg/l
1 NO of cycle 4 cycle	2 Type WC Eddy Cur. Elec. Dyn	2 LHV (B20) 43740 kJ/kg
2 Displacement (V) 1.567	3 Balance Spring	3 FUEL CONTENTS (%) C = 86.5 H = 13.5
3 Eng. Cylinder Bore (D) 7.8 cm	4 Torq arm (L) 0.358 m	4 Gas Constant (R) 287 J/kg K
4 Eng. Piston Stroke (S) 8.2 cm	<b>TEST CONDITIONS</b>	
5 NO of Cylinder (n) 4	1 Atmospheric Pressure ( $P_a$ ) 101.325 kPa	5 AFR <sub>theoretical</sub> 14.7246
6 Compression Ratio 8.2	2 Inner diameter of round nozzle (D) 0.036 m	6 Fuel Consumption 30 ml

TEST NO.	Set or command		Measurement					Exhaust Gas Analyzer			
	Throttle Valve Open	Rotational Shaft Speed	Dynamometer Load	Suction Air Temp	Head Across orifice	Fuel Consuming Time					
	%	rpm	kgf	$T_a$ °C	$h_o$ mmH <sub>2</sub> O	$t$ sec	Opacity k				
1	30	1500	5.0	30	14	58.77	7.15				
2	40	1500	24.3	30	14	22.71	14.45				
3	50	1500	28.5	30	15	20.34	13.30				
4	60	1500	29.3	30	14	19.78	13.95				
1	40	1300	27.0	31	10	26.03	10.15				
2	40	1500	27.5	31	14	21.06	10.00				
3	40	1700	12.5	31	18	34.83	8.15				
4	40	1900	3.6	31	22	56.80	7.00				

#### 1. Diesel Engine Performance

TEST NO.	Throttle Valve Open	Rotational Shaft Speed	Specific Weight of Air	Suction Air Flow Rate	Exhaust Gas Weight Rate	Air Fuel Ratio	Excess Air Factor	$F_{ex}$ Consumption	Specific Fuel Consumption	Brake Horse Power	Thermal Efficiency
	%	rpm	$\rho_a$	$G_1$	$G_e$	AFR	$\lambda$	FC	SFC	BHP	$\eta_p$
	%	rpm	kg/m <sup>3</sup>	kg/s	kg/s	-	-	L/hr	kg/kWh	kW	%
1	30	1500	1.165	0.035	0.0004	81.534	5.537	1.838	0.667	2.754	14.63
2	40	1500	1.165	0.035	0.0011	31.502	2.139	4.757	0.356	13.357	27.42
3	50	1500	1.165	0.036	0.0012	29.204	1.983	5.311	0.338	15.698	28.96
4	60	1500	1.165	0.035	0.0013	27.439	1.863	5.460	0.339	15.111	28.61
1	40	1300	1.161	0.029	0.0010	30.473	2.070	4.149	0.322	12.889	30.33
2	40	1500	1.160	0.034	0.0012	29.160	1.980	5.138	0.339	15.148	28.84
3	40	1700	1.161	0.039	0.0007	54.697	3.715	3.101	0.397	7.803	24.57
4	40	1900	1.160	0.043	0.0004	98.563	6.694	1.901	0.757	2.512	12.90

# LAMPIRAN 11

## DATA PENGUJIAN B30 JAGUNG



Laboratorium Termodinamika  
Departemen Teknik, Universitas Indonesia  
Kampus Baru UI, Depok 16424

Test on 23 Maret 2008

Tested Fuel B 30 Jagung (Spritus)

### ENGINE RESEARCH AND TEST BED

MODEL : GWE-80/100-HS-AV  
TYPE : SD-22 (Hissan Motor CO., Ltd)

SPECIMEN		DYNAMOMETER		FUEL	
Normal Output	47 PS at 3200 rpm	1 Model	EW - 100	1 Specific Weight ( $\rho$ )	0.83 kg/l
1 NO of cycle	4 cycle	2 Type	WC Eddy Cur. Elec. Dyn	2 LHV (B5)	42660 kJ/kg
2 Displacement (V)	1.567	3 Balance	Spring	3 FUEL CONTENTS (%)	C = 86.5 H = 13.5
3 Eng. Cylinder Bore (D)	7.8 cm	4 Torq arm (L)	0.358 m	4 Gas Constant (R)	287 J/kg K
4 Eng. Piston Stroke (S)	8.2 cm	TEST CONDITIONS		5 $AFR_{theoretical}$	14.7246
5 NO of Cylinder (n)	4	1 Atmospheric Pressure ( $P_a$ )	101.325 kPa	6 Fuel Consumption	30 ml
6 Compression Ratio	8.2	2 Inner diameter of round nozzle (D)	0.036 m		

TEST NO.	Set or command		Measurement					Exhaust Gas Analyzer			
	Throttle Valve Open	Rotational Shaft Speed	Dynamometer Load	Suction Air Temp	Head Across orifice	Fuel Consuming Time					
	%	rpm	W	$T_a$	$h_o$	t	Opacity				
1	30	1500	4.1	30	14	62.01	9.00				
2	40	1500	24.5	30	14	23.24	12.42				
3	50	1500	28.8	31	14	19.98	11.95				
4	60	1500	29.0	31	13	21.02	11.10				
1	40	1300	27.0	31	10	25.77	10.60				
2	40	1500	27.5	32	14	21.06	8.45				
3	40	1700	12.9	32	18	34.41	8.15				
4	40	1900	4.4	32	22	48.03	7.20				

### 1. Diesel Engine Performance

TEST NO.	Throttle Valve Open	Rotational Shaft Speed	Specific Weight of Air	Suction Air Flow Rate	Exhaust Gas Weight Rate	Air Fuel Ratio	Excess Air Factor	$F_{up}$ Consuming	Specific Fuel Consumption	Brake Horse Power	Thermal Efficiency
	%	N	$\rho_a$	$G_a$	$G_e$	AFR	$\lambda$	FC	SFC	BHP	$\eta_{th}$
	%	rpm	kg/m <sup>3</sup>	kg/s	kg/s	-	-	L/hr	L/kWhr	KW	%
1	30	1500	1.165	0.035	0.0004	86.036	5.843	1.742	0.771	2.268	12.89
2	40	1500	1.165	0.035	0.0011	32.237	2.189	4.648	0.344	13.495	28.87
3	50	1500	1.163	0.035	0.0012	27.698	1.881	5.405	0.341	15.864	29.18
4	60	1500	1.161	0.033	0.0012	28.057	1.905	5.138	0.322	15.974	30.91
1	40	1300	1.160	0.029	0.0010	30.140	2.047	4.152	0.325	12.889	30.67
2	40	1500	1.158	0.034	0.0012	29.124	1.978	5.128	0.339	15.148	29.37
3	40	1700	1.158	0.039	0.0007	53.957	3.664	3.139	0.390	8.053	25.51
4	40	1900	1.157	0.043	0.0005	63.228	5.552	2.249	0.732	3.070	13.57

## LAMPIRAN 12

Life Cycle Cost Analysis Pengolahan Biodiesel Processor Jenis Susun Jenis 2 Batch, Kapasitas : 10 Liter						
Uraian	Unit	Qty	Unit Biaya Rp.	Total Biaya Rp.	Tahun	Present Value Rp.
<b>Initial Expenses</b>						
<b>Detail Investasi</b>						
Fiber Glass 1,5 mm	m	1	200,000	200,000	0	200,000
Selang 1/2"	m	2	10,000	20,000	0	20,000
Kaca	m	0,5	15,000	7,500	0	7,500
Valve 1/2"	bh	5	15,000	75,000	0	75,000
Motor DC 12 V 1500 rpm	bh	2	185,000	370,000	0	370,000
Power supply & acc.	bh	1	2,150,000	2,150,000	0	2,150,000
Besi Siku 2 "	m	3,2	45,000	144,000	0	144,000
Ember plastik	bh	2	10,000	20,000	0	20,000
Temperatur swith	hh	2	65,000	130,000	0	130,000
Heater	bh	2	65,000	130,000	0	130,000
Plat besi 2 mm	m	0,5	50,000	25,000	0	25,000
Timbangan	bh	1	200,000	200,000	0	200,000
Gelas Ukur (1 liter)	bh	1	25,000	25,000	0	25,000
Design Service	ls	1	600,000	600,000	0	600,000
Modal Kerja	bl	1	1,000,000	1,000,000	0	1,000,000
						<b>5,096,500</b>
<b>Future Expenses</b>						
<b>1 Biaya Produksi/Operasi</b>						
<b>Biaya Pengolahan</b>						
Listrik	kWh	7	660	1,663,200	5	1,106,104
Air	m <sup>3</sup>	0,01	6,000	21,600	5	14,365
Lain-lain	ls	1	75,000	900,000	5	598,541
						<b>1,719,009</b>
<b>Biaya Bahan Baku</b>						
Minyak Kelapa Mentah/Kasar	ltr	10	6,000	21,600,000	5	14,364,981
Spritus	ltr	2	2,000	1,440,000	5	957,665
NaOH	ltr	0,1	15,000	540,000	5	359,125
						<b>15,681,771</b>
<b>2 Pemasaran</b>						
Biodiesel	ltr	10	9,000	32,400,000	5	21,547,472
Gliserol	ltr	1	750	270,000	5	179,562
						<b>21,727,034</b>
<b>3 Biaya Pemeliharaan dan Perbaikan</b>						
Pengecatan	ks	1	25,000	25,000	5	16,626
Sistem Kelistrikan	ks	1	100,000	100,000	5	66,505
Perbaikan kebocoran	ls	1	50,000	50,000	5	33,252
Lain-lain	ls	1	50,000	50,000	5	33,252
						<b>149,635</b>
<b>4 Biaya Penggantian</b>						
Motor DC 12 V 1500 rpm	bh	2	150,000	300,000	2	254,837
Heater	bh	2	65,000	130,000	2	110,429
Temperatur switch	bh	2	65,000	130,000	2	110,429
Valve 1/2"	bh	5	25,000	125,000	3	97,864
						<b>573,558</b>
<b>5 Biaya Sisa (Residual Value)</b>						
Fiber Glass 1,5 mm	m	1	200,000	40,000	5	26,602
Motor DC 12 V 1500 rpm	bh	2	185,000	74,000	5	49,213
Power supply & acc.	bh	1	2,150,000	430,000	5	285,970
Temperatur swith	bh	2	65,000	26,000	5	17,291
Heater	bh	2	65,000	26,000	5	17,291
						<b>396,367</b>
<b>TOTAL LIFE CYCLE COST ANALYSIS</b>						<b>45,343,875</b>

### LAMPIRAN 13

Life Cycle Cost Analysis Pengolahan Biodiesel Processor Jenis Susun Jenis 3 Batch, Kapasitas : 10 Liter						
Uraian	Satuan	Qty	Blaya Satuan Rp.	Total Blaya Rp.	Tahun (Umur)	Present Value Rp.
<b>Initial Expenses</b>						
<b>Detail Investasi</b>						
Fiber Glass 1,5 cm	m	1.8	200,000	360,000	0	360,000
Selang 1/2"	m	4	10,000	40,000	0	40,000
Kaca	m	0.8	15,000	12,000	0	12,000
Valve 1/2"	bh	9	15,000	135,000	0	135,000
Motor DC 12 V 1500 rpm	bh	3	185,000	555,000	0	555,000
Power Supply & acc.	bh	1	2,150,000	2,150,000	0	2,150,000
Besi Siku 2"	m	4	45,000	180,000	0	180,000
Ember plastik	bh	3	10,000	30,000	0	30,000
Temperatur swicth	bh	2	65,000	130,000	0	130,000
Heater	bh	2	65,000	130,000	0	130,000
Plat besi 2 mm	m	1	50,000	50,000	0	50,000
Timbangan	bh	1	200,000	200,000	0	200,000
Gelas Ukur (1 liter)	bh	1	25,000	25,000	0	25,000
Design Servise	ls	1	650,000	650,000	0	650,000
Modal Kerja	bl	1	1,200,000	1,200,000	0	1,200,000
						<b>5,847,000</b>
<b>Future Expenses</b>						
<b>1 Blaya Operasi/Produksi</b>						
<b>Blaya Pengolahan</b>						
Lstrik	kWh	10.5	660	2,494,800	5	1,659,155
Air	m <sup>3</sup>	0.01	6,000	21,600	5	14,365
Lain-lain	ls	1	75,000	900,000	5	598,541
						<b>2,272,061</b>
<b>Blaya Bahan Baku</b>						
Minyak Kelapa Mentah	litr	10	6,000	21,600,000	5	14,364,981
Spritus	litr	2	2,000	1,440,000	5	957,665
NaOH	kg	0.1	15,000	540,000	5	359,125
						<b>15,681,771</b>
<b>2 Pemasaran</b>						
Biodiesel	litr	10	9,000	32,400,000	5	21,547,472
Gliserol	litr	1	750	270,000	5	179,562
						<b>21,727,034</b>
<b>3 Blaya Pemeliharaan dan Perbaikan</b>						
Pengecatan	ls	1	25,000	25,000	5	16,626
Sistem Kelistrikan	ls	1	100,000	100,000	5	66,505
Perbaikan kebocoran	ls	1	75,000	75,000	5	49,878
Lain-lain	ls	1	50,000	50,000	5	33,252
						<b>166,261</b>
<b>4 Blaya Penggantian</b>						
Motor DC 12 V 1500 rpm	bh	3	150,000	450,000	2	382,255
Heater	bh	2	50,000	100,000	2	84,946
Timer temperatur	bh	1	25,000	25,000	2	21,236
Valve 1/2"	bh	9	25,000	225,000	3	176,154
						<b>664,591</b>
<b>5 Nilai sisa (Residual Value)</b>						
Fiber Glass 1,5 cm	m	1.8	200,000	72,000	5	47,883
Motor DC 12 V 1500 rpm	bh	3	185,000	111,000	5	73,820
Power Supply & acc.	bh	1	2,150,000	430,000	5	285,970
Temperatur swicth	bh	2	65,000	26,000	5	17,291
Heater	bh	2	65,000	26,000	5	17,291
						<b>442,255</b>
<b>TOTAL LIFE CYCLE COST ANALYSIS</b>						<b>46,800,974</b>