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Appendix A Properties of The Chemical Components for Process Simulation

Table A1 The properties of components for hydrogenated biodiesel and SMR-hydrogenated biodiesel processes

Name	Molecular Structure	Component Name	MW ^a kg/kmol	NMP ^b K	NBP ^c K	SG ^d 60 F	TC ^e K	PC ^f kPa	VC ^g m ³ /kmol	ZC ^h	GF ⁱ MJ/kmol	HF ^j MJ/kmol	HC ^k MJ/kmol
Trimyristin	C ₄₅ H ₈₆ O ₆	M-M-M	723.16	403.3	715.2	0.92	993.6	790.9	2.62	0.25	-592.04	-1942.36	-26163.59
Tripalmitin	C ₅₁ H ₉₈ O ₆	P-P-P	807.32	339.0	722.8	0.91	1017.4	753.9	2.96	0.26	-537.08	-2067.16	-29850.74
Tristearin	C ₅₇ H ₁₁₀ O ₆	S-S-S	891.48	328.0	727.8	0.90	1039.1	726.5	3.30	0.27	-482.12	-2191.96	-33537.88
Triolein	C ₅₇ H ₁₀₄ O ₆	O-O-O	885.43	425.5	705.4	0.91	1042.6	728.7	3.27	0.27	-250.76	-1843.96	-33160.44
Trilinolein	C ₅₇ H ₉₈ O ₆	LI-LI-LI	879.38	431.0	687.2	0.92	1046.1	730.9	3.23	0.27	-19.40	-1495.96	-32783.00
Trilinolenin	C ₅₇ H ₉₂ O ₆	LN-LN-LN	873.33	450.0	672.1	0.94	1049.6	733.2	3.20	0.26	-211.96	-1147.96	-32405.55
Hydrogen	H ₂	H2	2.02	13.8	20.3	0.07	33.0	1293.3	0.06	0.30	1E-07	1E-07	-241.84
Tridecane	C ₁₃ H ₂₈	TRIDECAN	184.37	267.7	508.5	0.76	675.8	1722.5	0.77	0.23	57.93	-311.40	-8189.63
Tetradecane	C ₁₄ H ₃₀	TETDECAN	198.40	279.0	526.6	0.76	691.9	1621.2	0.82	0.23	66.23	-332.11	-8804.25
Pentadecane	C ₁₅ H ₃₂	PENDECAN	212.42	283.0	543.7	0.77	706.8	1519.8	0.88	0.22	74.63	-352.62	-9419.06
Hexadecane	C ₁₆ H ₃₄	HXDECANE	226.45	291.3	559.9	0.77	720.6	1418.5	0.93	0.22	82.46	-373.64	-10033.36
Heptadecane	C ₁₇ H ₃₆	HDECCANE	240.48	295.1	575.1	0.78	733.4	1317.2	0.98	0.21	91.16	-393.89	-10648.43
Octadecane	C ₁₈ H ₃₈	OCTDECAN	254.50	301.3	589.8	0.78	745.3	1215.9	1.05	0.20	98.90	-415.09	-11262.56
Water	H ₂ O	H2O	18.02	273.1	373.1	0.99	647.4	22119.	0.05	0.22	-228.79	-242.00	0.00
Propane	C ₃ H ₈	PROPANE	44.10	85.5	231.0	0.50	369.8	4249.5	0.20	0.28	-23.58	-103.86	-2044.21
Methane	CH ₄	METHANE	16.04	90.6	111.6	0.30	190.6	4600.1	0.09	0.28	-50.54	-74.59	-802.45
Carbonmonoxide	CO	CO	28.01	68.1	81.7	0.80	133.0	3495.7	0.09	0.29	-137.27	-110.53	-282.27

- a) MW denotes molecular weight
 b) NMP denotes normal melting point
 c) NBP denotes normal boiling point
 d) SG denotes specific gravity

- e) TC denotes critical temperature
 f) PC denotes critical pressure
 g) VC denotes critical volume

- h) ZC denotes critical compressibility factor
 i) GF denotes Gibbs free energy of formation
 j) HF denotes heat of formation
 k) HC denotes heat of combustion

Table A2 The properties of components for conventional biodiesel process

Name	Molecular Structure	Component Name	MW ^a kg/kmol	NMP ^b K	NBP ^c K	SG ^d K	TC ^e kPa	PC ^f m ³ /kmol	VC ^g	ZC ^h MJ/kmol	GF ⁱ MJ/kmol	HF ^j MJ/kmol
Ditetradecanoyl-glycerol	C ₃₁ H ₆₀ O ₅	M-M-OH	512.80	373.14	661.8	844.24	963.2	1.8474	0.169	-482.62	-1420.88	-18032.35
Dihexadecanoyl-glycerol	C ₃₅ H ₆₈ O ₅	P-P-OH	568.91	384.50	668.7	866.71	897.9	2.0742	0.161	-445.98	-1504.08	-20490.45
Diocadecanoyl-glycerol	C ₃₉ H ₇₆ O ₅	S-S-OH	625.01	395.04	674.0	886.70	848.8	2.3010	0.154	-409.34	-1587.28	-22948.54
Diocadecenoyl-glycerol	C ₃₉ H ₇₂ O ₅	O-O-OH	620.98	399.58	660.5	884.90	852.7	2.2778	0.149	-255.10	-1355.28	-22696.91
Diocadecadienoylglycerol	C ₃₉ H ₆₈ O ₅	LI-LI-OH	616.95	402.00	648.3	883.00	463.7	2.2045	0.066	-161.62	-1171.48	-22397.09
Diocadecatrienoyl-glycerol	C ₃₉ H ₆₄ O ₅	LN-LN-OH	612.92	408.25	638.5	881.24	860.9	2.2314	0.141	-53.38	-89.13	-22193.66
Tetradecanoyl-glycerol	C ₁₇ H ₃₄ O ₄	M-OH-OH	302.45	347.59	631.9	793.41	1584.2	1.0630	0.202	-426.49	-962.12	-9838.38
Hexadecanoyl-glycerol	C ₁₉ H ₃₄ O ₄	P-OH-OH	330.50	354.45	635.6	808.59	1435.7	1.1764	0.194	-408.17	-1003.72	-11067.44
Octadecanoyl-glycerol	C ₂₁ H ₄₂ O ₄	S-OH-OH	358.55	361.00	638.8	822.60	1318.3	1.2898	0.187	-389.85	-1045.32	-12296.48
Octadecenoyl-glycerol	C ₂₁ H ₄₀ O ₄	O-OH-OH	356.54	363.87	631.4	821.32	1327.9	1.2782	0.182	-312.73	-929.32	-12170.67
Octadecadienoyl-glycerol	C ₂₁ H ₃₈ O ₄	LI-OH-OH	354.52	366.69	624.6	820.03	1337.7	1.2666	0.178	-235.61	-813.32	-12044.86
Octadecatrienoyl-glycerol	C ₂₁ H ₃₆ O ₄	LN-OH-OH	352.51	369.46	618.5	818.73	1347.7	1.2550	0.173	-158.49	-697.32	-11919.04
Methyl tetradecanoate	C ₁₅ H ₃₀ O ₂	MEC14H28	242.40	292.15	608.7	736.07	1561.3	0.9004	0.229	-227.47	-670.90	-8858.96
Methyl hexadecanoate	C ₁₇ H ₃₄ O ₂	MEC16H32	270.45	303.15	686.6	760.30	1417.7	1.0138	0.227	-209.15	-712.50	-10088.01
Methyl octadecanoate	C ₁₉ H ₃₈ O ₂	MEC18H36	298.50	312.25	720.0	782.23	1304.0	1.1272	0.226	-190.83	-754.10	-11317.06
Methyl octadecenoate	C ₁₉ H ₃₆ O ₂	MOLEATE	296.49	293.05	617.0	764.00	1280.0	1.0600	0.214	-117.00	-626.00	-11203.34
Methyl octadecadienoate	C ₁₉ H ₃₄ O ₂	MEC18H32	294.47	253.25	636.6	789.36	1322.8	1.1040	0.222	-36.59	-522.94	-11064.58
Methyl octadecatrienoate	C ₁₉ H ₃₂ O ₂	MEC18H30	292.45	296.68	616.7	792.85	1332.5	1.0924	0.220	40.53	-408.54	-10937.18
Methanol	CH ₄ O	METHANOL	32.04	175.47	337.9	512.64	8097.0	0.1180	0.224	-162.32	-200.94	-638.20
Glycerin	C ₃ H ₈ O ₃	GLYCERIN	92.10	291.33	561.0	850.00	7500.0	0.2640	0.280	-447.10	-577.90	-1477.00

Appendix B Mass Balance of Hydrogenated Biodiesel, SMR-Hydrogenated Biodiesel and Biodiesel Processes from PRO/II®

Table B1 Mass balance of hydrogenated biodiesel process from PRO/II®

Stream	103	101	104	201	202	205	206	1302	301	303
Description	Palm Oil	Hydrogen	Rn Mix.	Vap. Mix.	Liq. Product	hydrogenated biodiesel,C3	Waste H ₂ O	Re H ₂	PSA	H ₂ ,CO
Phase	Liquid	Vapor	Mixed	Vapor	Liquid	Mixed	Liquid	Vapor	Mixed	Vapor
Temperature (°C)	30.00	30.00	325.00	45.00	45.00	30.00	30.00	45.00	45.00	45.00
Pressure (psia)	14.70	14.70	514.70	175.00	175.00	17.00	17.00	175.00	175.00	14.70
Mass Rate (kg / h)										
M-M-M	328.71	0	47.76	0	47.76	0	47.76	0	0	0
P-P-P	14664.14	0	2130.76	0	2130.76	0	2130.76	0	0	0
S-S-S	1785.38	0	259.42	0	259.42	0	259.42	0	0	0
O-O-O	16178.60	0	2350.81	0	2350.81	0	2350.81	0	0	0
LI-LI-LI	4780.85	0	694.68	0	694.68	0	694.68	0	0	0
LN-LN-LN	196.52	0	28.56	0	28.56	0	28.56	0	0	0
OLEIC	127.12	0	13.42	0	13.42	0	13.42	0	0	0
H ₂	0	1108.8	184.55	176.57	9.22	9.00	0.22	151.85	24.72	24.72
TRIDECAN	0	0	4.70	0	4.70	4.70	0	0	0	0
TETDECAN	0	0	226.17	0	226.17	226.17	0	0	0	0
PENDECAN	0	0	216.41	0	216.41	216.41	0	0	0	0
HXDECANE	0	0	10315.99	0	10315.98	10315.98	0	0	0	0
HDECANE	0	0	351.38	0	351.38	351.38	0	0	0	0
OCTDECAN	0	0	16655.92	0	16655.92	16655.92	0	0	0	0
H ₂ O	0	0	4108.05	8.53	4099.53	13.44	4086.08	0	8.53	0
PROPANE	0	0	1679.26	419.44	1259.82	1257.71	2.11	0	419.44	0
METHANE	0	0	20.05	18.23	1.81	1.77	0.05	0	18.23	0
CO	0	0	35.18	33.74	1.44	1.43	0.02	0	33.74	33.74
Total Mass Rate (kg / h)	38061.33	1108.8	39323.08	656.52	38667.81	29053.92	9613.89	151.85	504.66	58.46

Table B1 Mass balances of hydrogenated biodiesel process from PRO/II® (cont.)

Stream	304	402	403	402A	402B	102	401	404	405	406
Description	H ₂ O, C1, C3	Propane	Hydrogenated Biodiesel, H ₂ O	Fuel Gas	Water	H ₂	Steam	Hydrogenated Biodiesel	Waste H ₂ O	Waste H ₂ O
Phase	Mixed	Vapor	Liquid	Vapor	Liquid	Vapor	Vapor	Liquid	Liquid	Liquid
Temperature (°C)	45.00	30.23	98.54	30.00	30.00	520.72	148.0	30.00	30.00	36.56
Pressure (psia)	14.70	14.70	14.7	14.7	14.7	514.7	64.70	14.70	14.70	14.7
Mass Rate(kg / h)										
M-M-M	0	0	0	0	0	0	0	0	0	47.76
P-P-P	0	0	0	0	0	0	0	0	0	2130.76
S-S-S	0	0	0	0	0	0	0	0	0	259.42
O-O-O	0	0	0	0	0	0	0	0	0	2350.81
LI-LI-LI	0	0	0	0	0	0	0	0	0	694.68
LN-LN-LN	0	0	0	0	0	0	0	0	0	28.56
OLEIC	0	0	0	0	0	0	0	0	0	13.42
H ₂	0	9.00	0	0	0	1260.65	0	0	0	0.22
TRIDECAN	0	0	4.70	0	0	0	0	4.70	0	0
TETDECAN	0	0	226.17	0	0	0	0	226.17	0	0
PENDECAN	0	0	216.41	0	0	0	0	216.41	0	0
HXDECANE	0	0	10315.97	0	0.01	0	0	10315.97	0	0
HDECANE	0	0	351.38	0	0	0	0	351.38	0	0
OCTDECAN	0	0	16655.91	0	0	0	0	16655.92	0	0
H ₂ O	8.53	25.89	987.54	9.60	24.81	0	1000.0	3.61	983.93	5070.01
PROPANE	419.44	1245.13	12.58	1647.83	16.74	0	0	12.57	0.01	2.12
METHANE	18.23	1.77	0	19.99	0.01	0	0	0	0	0.05
CO	0	1.43	0	1.43	0	0	0	0	0	0.02
Total Mass Rate (kg / h)	446.20	1283.23	28770.67	1687.86	41.58	1260.65	1000.0	27786.74	983.94	10597.82

Table B2 Mass balance of SMR based hydrogen production for hydrogenated biodiesel process from PRO/II®

Stream	501	502	503	504	505	506	507	508	509	510	511	512	513
Description	CH ₄	CH ₄	CH ₄	Rn. Mix	Rn. Mix	Rn. Mix	Rn. Mix	Rn. Mix	Rn. Mix.	Rn. Mix.	Water	Water	Water
Phase	Vapour	Vapour	Vapour	Vapour	Vapour	Vapour	Vapour	Vapour	Vapour	Vapour	Liquid	Liquid	Liquid
Temperature (°C)	298.0	225.0	537.8	856.8	348.9	418.9	196.9	196.9	37.9	37.9	37.9	37.9	25.0
Pressure (psia)	14.7	377.7	377.7	377.7	377.7	377.7	377.7	377.7	308.6	308.6	308.6	308.6	14.7
Mass Rate (kg / h)													
CH ₄	1488.0	1488.0	1488.0	625.7	625.7	625.7	625.7	625.7	0	3.9	0.4	3.5	0
H ₂	0	0	0	1002.8	1002.8	1076.2	1076.2	1120.3	1114.6	3.4	0.3	3.1	0
CO	0	0	0	2550.6	2550.6	1530.3	1530.3	918.2	9.2	2.4	0.2	2.2	0
CO ₂	0	0	0	2593.8	2593.8	4196.6	4196.6	5158.4	50.0	156.5	15.6	140.8	0
H ₂ O	0	0	0	2670.4	2670.4	2012.3	2012.3	1618.6	0.4	1579.8	158.0	1421.8	4895.8
O ₂	0	0	0	0	0	0	0	0	0	0	0	0	0
N ₂	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Rate (kg / h)	1488.0	1488.0	1488.0	9443.3	9443.3	9441.1	9441.1	9441.1	1174.2	1745.9	174.6	1571.3	4895.8
Stream	514	515	516	517	518	519	520	521	522	523	524	525	101A
Description	Water	Water	Water	Water	Water	H ₂	Mix. gas	Methane	Mix. gas	Air	Flue gas	Flue gas	H ₂
Phase	Liquid	Liquid	Liquid	Liquid	Vapour	Vapour	Vapour	Vapour	Vapour	Vapour	Vapour	Vapour	Vapour
Temperature (°C)	25.0	28.0	155.0	222.5	222.5	28.0	30.0	25.0	37.0	25.0	1594.8	1594.8	100.0
Pressure (psia)	377.7	377.7	377.7	377.7	377.7	308.6	19.1	14.7	14.7	14.7	14.7	14.7	514.7
Mass Rate (kg / h)													
CH ₄	0	3.5	3.5	3.5	3.5	0	621.8	106.8	728.6	0	7.3	1.8	0
H ₂	0	3.1	3.1	3.1	3.1	1114.6	2.2	0	2.2	0	2.2	0.6	1114.6
CO	0	2.2	2.2	2.2	2.2	9.2	906.6	0	906.6	0	906.6	226.7	9.2
CO ₂	0	140.8	140.8	140.8	140.8	50.0	4951.9	0	4951.9	0	6930.6	1732.6	50.0
H ₂ O	4895.8	6317.6	6317.6	6317.6	6317.6	0.4	38.4	0	38.4	0	1658.3	414.6	0.4
O ₂	0	0	0	0	0	0	0	0	0	3352.7	475.3	118.8	0
N ₂	0	0	0	0	0	0	0	0	0	11041.0	11041.0	2760.3	0
Total Rate (kg / h)	4895.8	6467.2	6467.2	6467.2	6467.2	1174.2	6521.0	106.8	6627.8	14393.7	21021.3	5255.3	1174.2

Table B3 Mass balance of biodiesel process from PRO/II®

Stream	101	101B	101C	102	201	203	102A	302	204	205	501	103	502
Description	MeOH	MeOH	MeOH	MeOH	Rn. Mix	Rn. Mix	MeOH	Methyl Ester	Rn. Mix.	Glycerin	Methyl Ester	Palm Oil	Waste
Phase	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid
Temperature (°C)	30.0	30.0	30.0	30.0	60.0	60.0	30.0	184.68	60.0	60.0	30.0	30.0	60
Pressure (psia)	14.7	14.7	14.7	14.7	14.7	14.7	14.7	0.25	14.7	14.7	14.7	14.7	14.7
Mass Rate (kg/ h)													
M-M-M	0	0	0	0	0	0	0	0	0	0	0	290.47	0
P-P-P	0	0	0	0	0	0	0	0	0	0	0	11607.5	0
S-S-S	0	0	0	0	0	0	0	0	0	0	0	1279.83	0
O-O-O	0	0	0	0	0	0	0	0	0	0	0	11676.0	0
LI-LI-LI	0	0	0	0	0	0	0	0	0	0	0	3473.87	0
LN-LN-LN	0	0	0	0	0	0	0	0	0	0	0	143.78	0
M-M-OH	0	0	0	0	0	0	0	0	0	0	0	0	0
P-P-OH	0	0	0	0	0	0	0	0	0	0	0	0	0
S-S-OH	0	0	0	0	0	0	0	0	0	0	0	0	0
O-O-OH	0	0	0	0	0	0	0	0	0	0	0	0	0
LI-LI-OH	0	0	0	0	0	0	0	0	0	0	0	0	0
LN-LN-OH	0	0	0	0	0	0	0	0	0	0	0	0	0
LN-LN-OH	0	0	0	0	3.04	6.07	0	5.47	5.47	0.61	0	0	5.47
P-OH-OH	0	0	0	0	118.80	237.59	0	213.84	213.84	23.76	0	0	213.84
S-OH-OH	0	0	0	0	12.87	25.74	0	23.16	23.16	2.57	0	0	23.16
M-OH-OH	0	0	0	0	117.54	235.08	0	211.57	211.57	23.51	0	0	211.57
LI-OH-OH	0	0	0	0	35.01	70.02	0	63.02	63.02	7.00	0	0	63.02
LN-OH-OH	0	0	0	0	1.45	2.90	0	2.61	2.61	0.29	0	0	2.61

Table B3 Mass balance of biodiesel process from PRO/II® (cont.)

Stream	101	101B	101C	102	201	203	102A	302	204	205	501	103	502
Description	MeOH	MeOH	MeOH	MeOH	Rn. Mix	Rn. Mix	MeOH	Methyl Ester	Rn. Mix.	Glycerin	Methyl Ester	Palm Oil	Waste
Phase	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid
Temperature (°C)	30.0	30.0	30.0	30.0	60.0	60.0	30.0	184.68	60.0	60.0	30.0	30.0	60
Pressure (psia)	14.7	14.7	14.7	14.7	14.7	14.7	14.7	0.25	14.7	14.7	14.7	14.7	14.7
Mass Rate(kg / h)													
MEC14H28	0	0	0	0	143.61	287.22	0	281.48	281.48	5.74	281.48	0	0
MEC16H32	0	0	0	0	5735.51	11471.0	0	11241.6	11241.6	229.42	11240.0	0	1.55
MEC18H36	0	0	0	0	632.09	1264.19	0	1238.90	1238.90	25.28	1233.22	0	5.69
MOLEATE	0	0	0	0	5917.85	11835.7	0	11598.9	11598.9	236.71	11552.6	0	46.40
MEC18H32	0	0	0	0	1715.82	3431.63	0	3363.00	3363.00	68.63	3339.97	0	23.04
MEC18H30	0	0	0	0	71.02	142.03	0	139.19	139.19	2.84	135.57	0	3.62
OLEIC	0	0	0	0	0	0	0	0	0	0	0	287.50	0
METHANOL	3684.98	327.96	4955.11	6491.46	8153.11	9814.76	3245.73	15.70	7851.80	1962.95	15.70	0	0
GLYCERIN	0	0	0	0	1466.21	2932.41	0	29.32	29.32	2903.09	29.32	0	0
H2O	0	0	5.66	0	0	0	0	0	0	0	0	0	0
Total Mass Rate (kg / h)	3684.98	327.96	4960.77	6491.46	24123.9	41756.3	3245.73	28427.8	36263.9	5492.41	27827.9	28759.0	599.97

Table B3 Mass balance of biodiesel process from PRO/II® (cont.)

Stream	401	402	102B	107A	202	107B	301	104	303	105	107	108	101A
Description	MeOH	Glycerin	MeOH	Palm Oil	Rn. Mix	Palm Oil	MeOH	Rn. Mix.	MeOH	Glycerin	Palm Oil	MeOH	MeOH
Phase	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid
Temperature (°C)	30.0	212.0	30.0	60.0	60.0	60.0	30.0	60.0	30.0	30.0	60.0	30.0	30.0
Pressure (psia)	0.2	0.25	14.7	14.7	14.7	14.7	0.21	14.7	14.7	14.7	14.7	14.7	14.7
Mass Rate(kg / h)													
MEC14H28	0	5.74	0	0	143.61	0	0	0	0	0	0	0	0
MEC16H32	0	229.42	0	0	5735.5	0	0	0	0	0	0	0	0
MEC18H36	0	25.28	0	0	632.09	0	0	0	0	0	0	0	0
MOLEATE	0	236.71	0	150.89	5917.8	150.89	0	301.78	0	0	301.78	0	0
MEC18H32	0	68.63	0	0	1715.8	0	0	0	0	0	0	0	0
MEC18H30	0	2.84	0	0	71.02	0	0	0	0	0	0	0	0
OLEIC	0	0	0	0	0	0	0	0	0	0	0	0	0
METHANOL	1959.03	3.93	3245.7	0	1661.7	0	7836.1	4922.5	9795.1	0	0	4627.1	3357.0
GLYCERIN	0	2903.1	0	0	1466.2	0	0	0	0	3165.0	0	0	0
H2O	0	0	0	0	0	0	0	24.00	0	0	0	5.6	0
Total Mass Rate (kg / h)	1959.03	3533.4	3245.7	14386.6	17632.4	14386.6	7836.1	33719.7	9795.1	3165.0	28773.2	1160.6	3357.0

Appendix C Comparison of Capital and Manufacturing Costs

Table C1 Comparison of capital and manufacturing costs

Description	Hydrogenated biodiesel	SMR- hydrogenated biodiesel	Renewable Diesel*	Biodiesel	Biodiesel (UOP)*
Year	2010	2010	2005	2010	2005
Capacity (ton product/year)	200,000	200,000	230,700	200,000	320,400
Total update bare module	11.01	11.08	8.95	8.04	56.78
Contingency fee (MUSD)	2.75	2.77	3.32	2.01	21.07
Auxiliary facility cost (MUSD)	4.41	4.43	2.82	3.22	11.61
Fixed capital cost (MUSD)	18.17	18.28	15.09	13.27	89.46
Working capital (MUSD)	3.53	3.53	0.61	2.58	3.89
Total capital investment (MUSD)	21.70	21.83	15.70	15.85	93.35
<i>Direct manufacturing cost (MUSD/year)</i>					
Feed	190.57	190.57	142.91	143.95	307.27
Hydrogen	9.51	-	20.25	-	-
Catalyst and chemicals	0.84	0.90	3.90	0.08	11.78
Methanol	-	-	-	20.34	7.66
Methane	-	2.95	-	-	-
Salary	0.13	0.14	0.09	0.13	1.3
Maintenance	0.91	0.91	0.27	0.66	1.7
Operating supplies	0.36	0.36	0.23	0.27	1.95
Payroll	0.03	0.03	0.04	0.03	0.58
Utilities	3.02	0.78	0.07	7.00	4.64
Subtotal A _{DMC}	205.37	196.68	167.76	174.40	336.88
<i>Indirect manufacturing cost</i>					
Taxes & Insurance	0.55	0.55	0.08	0.40	0.45
Subtotal A _{IMC}	0.55	0.55	0.08	0.40	0.45
Depreciation	1.45	1.46	-	1.06	-
Total manufacturing cost (MUSD/year)	207.63	198.97	167.84	175.15	337.33

(*Bain, R.L., World Biofuels Assessment, 2007.)

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1. Katinhom, N., Jongpatiwut, S., Gani, R., Osuwan, S., and Siemanond, K. (2010, April 22) Comparative Study of Bio-hydrogenated Diesel and Conventional Biodiesel: Technology and Economics. Poster presented at The 1st National Research Symposium on Petroleum, Petrochemicals, and Advanced Materials and the 16th PPC Symposium on Petroleum, Petrochemicals, and Polymers, Bangkok, Thailand.

