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APPENDICES

Appendix A Property of Biodiesel

Table A1 Property of biodiesel (palm oil methyl ester) from the Department of Naval Dockyards

Item	Property, Unit	Test Method	Result
1	Flash point, °C	ASTM D93	122
2	Water and sediment, %vol.	ASTM D2709	traces
3	Viscosity at 40°C, cSt	ASTM D445	4.611
4	Density at 15°C, g/ml	ASTM D4052	0.87863
5	Carbon residue, %wt.	ASTN D4530	0.086
6	Sulfated ash, %wt.	ASTM D874	<0.001
7	Sulfur content, %wt.	ASTM D5453	0.0005
8	Copper strip corrosion, number	ASTM D130	1a
9	Cloud point, °C	ASTM D2500	21
10	Pour point, °C	ASTM D97	9
11	Cetane number	ASTM D613	55.4
12	Heat of Combustion, MJ/kg	ASTM D240	39.6
13	Total acid number, mgKOH/g	ASTM D664	0.29
14	Phosphorus content, ppmwt.	ASTM D4951	n.d.
15	Distillation	ASTM D1160	
	ATE at 90% recovered, °C		358

Appendix B Fuel Property Testing Results

Table B1 Fuel Property Testing Results of Diesohol Emulsions, Diesel, Biodiesel and Ethanol

No.	Ratio			Fuel Properties				
	%D	%B	%E	Density (g/cm ³)	Cetane Index	Flash Point (°C)	Pour Point (°C)	Heat of Combustion (MJ/kg)
1	90	10	0	0.83889	47.99	71	6	44.7
2	90	5	5	0.83134	47.31	17.5	3	44.5
3	90	0	10	0.82681	46.05	14.5	3	43.4
4	85	15	0	0.84167	48.52	73.5	6	44.2
5	85	10	5	0.83339	47.70	14	3	43.7
6	85	5	10	0.83123	46.67	13.5	3	43.6
7	85	0	15	0.82467	45.81	13	3	42.5
8	80	15	5	0.83749	48.66	16	3	43.3
9	80	10	10	0.83314	46.85	15	3	43.5
10	80	5	15	0.82898	46.25	13	3	42.8
Diesel				0.83540	47.64	69	6	45.0
Biodiesel				0.87863	55.40	122	9	39.6
Ethanol				0.79400	5-8	13	-117.3	27.0

Note: D = Diesel

B = Biodiesel

E = Ethanol 99.5%

Appendix C Emission Testing Results and Fuel Consumption Rates

Table C1 Emission Testing Results and Fuel Consumption Rates of Diesohol Emulsions, Diesel and Biodiesel

No.	Ratio			%Load (%)	CO (%vol)	HC (ppm vol)	NOx (ppm vol)	Fuel Consumption Rate (lit/hr)
	%D	%B	%E					
1	90	10	0	100	1.17	44	566	1.14
				60	0.04	12	510	0.94
				30	0.05	11	332	0.49
				0	0.07	16	177	0.36
2	90	5	5	100	0.78	43	504	1.35
				60	0.17	35	380	0.68
				30	0.02	10	250	0.61
				0	0.08	39	127	0.44
3	90	0	10	100	0.88	42	515	1.20
				60	0.14	34	350	0.81
				30	0.12	35	255	0.78
				0	0.11	45	98	0.44
4	85	15	0	100	0.65	28	534	1.34
				60	0.04	9	511	0.65
				30	0.05	8	346	0.63
				0	0.05	12	225	0.47
5	85	10	5	100	1.36	64	497	1.29
				60	0.05	19	452	0.59
				30	0.06	31	260	0.49
				0	0.08	35	136	0.41
6	85	5	10	100	0.87	56	534	1.08
				60	0.05	33	440	0.86
				30	0.07	37	275	0.52
				0	0.09	59	105	0.41
7	85	0	15	100	0.92	69	538	1.03
				60	0.05	40	454	0.78
				30	0.09	56	260	0.54
				0	0.12	88	132	0.48

Table C1 Emission Testing Results and Fuel Consumption Rates of Diesohol Emulsions, Diesel and Biodiesel (continue)

No.	Ratio			%Load (%)	CO (%vol)	HC (ppm vol)	NOx (ppm vol)	Fuel Consumption Rate (lit/hr)
	%D	%B	%E					
8	80	15	5	100	0.61	37	506	1.05
				60	0.09	23	432	0.74
				30	0.07	30	298	0.67
				0	0.06	27	177	0.71
9	80	10	10	100	0.75	82	510	0.96
				60	0.05	47	425	0.58
				30	0.07	51	282	0.52
				0	0.08	64	116	0.43
10	80	5	15	100	0.70	57	504	1.02
				60	0.05	42	404	0.90
				30	0.08	50	276	0.54
				0	0.11	82	100	0.43
Diesel				100	1.75	146	169	1.09
				60	0.04	10	292	0.85
				30	0.04	11	247	0.67
				0	0.08	21	226	0.47
Biodiesel				100	1.64	67	498	1.41
				60	0.03	9	405	0.60
				30	0.05	7	286	0.65
				0	0.06	11	210	0.56

Note: D = Diesel

B = Biodiesel

E = Ethanol 99.5%

Appendix D Specification for Diesel Fuel

Table D1 Specification for diesel fuel in Thailand

Test Items	Limits	Type of Diesel Fuel		Test Method
		High Speed	Low Speed	
1. Specific Gravity at 15.6/15.6 (°C)	Min Max	0.81 0.87	- 0.92	ASTM D1298
2. Cetane Number or Calculated Cetane Index	Min	47	45	ASTM D613 ASTM D976
3. Viscosity (cSt) 3.1 at 40°C 3.2 at 50°C	Min Max Min Max	1.8 4.1 - -	- 8 - 6	ASTM D445
4. Pour Point (°C)	Max	10	16	ASTM D97
5. Sulphur Content (% wt.)	Max	0.035	1.5	ASTM D2622
6. Corrosion	Max	Number1	-	ASTM D130
7. Carbon Residue (% wt.)	Max	0.05	-	ASTM D189
8. Water and Sediment (% vol.)	Max	0.05	0.3	ASTM D2709
9. Ash (% wt.)	Max	0.01	0.02	ASTM D482
10. Flash Point (°C)	Min	52	52	ASTM D93
11. Transformation 90% recovered (°C)	Max	357	-	ASTM D86
12. Color	Min Max	- 4	4.5 7.5	ASTM D1500
13. Lubricity by HFRR (µm)	Max	460	-	CEC F-06-A-96
14. Detergent Additive (if added)	Must be in accordance with DOEB's requirements.			

Note: 1) Equivalent test method may be used but in case of discrepancy test method specified in the above table must be used.

2) This Notification has come into force since 26 January 2004.

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