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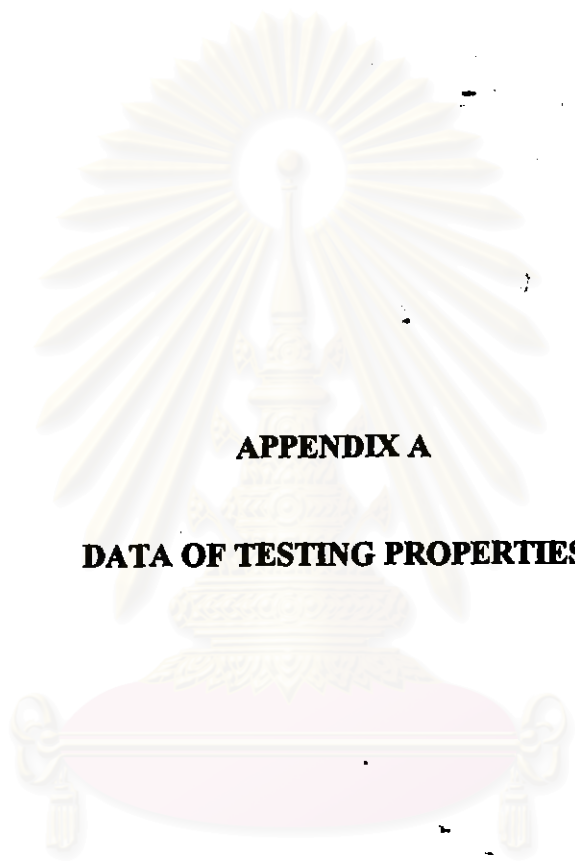


สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย



APPENDIXS

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย



APPENDIX A

DATA OF TESTING PROPERTIES

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

Table A-1 Testing properties of particleboards A.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density	2 hr	density	2 hr.	24 hr.	density	load	density	moiture	MOR	MOE	2-h boil		2-h boil	
	(kg/m ³)	(%)	(kg/m ³)	(%)	(MPa)	(kg/m ³)	(MPa)	(kg/m ³)	(%)	(MPa)	(MPa)	density	load	density	load
												(kg/m ³)	(MPa)	(kg/m ³)	(MPa)
1/1	790.71	4.23	800.21	12.06	38.84	801.06	1.42	802.13	-	18.82	2648.97	763.92	0.26	784.13	7.56
1/2	742.52	4.55	762.11	13.53	43.06	825.74	1.20	786.04	5.22	17.07	2534.69	813.39	0.32	-	-
average	766.62	4.39	781.16	12.80	40.95	813.40	1.31	794.09	5.22	17.95	2591.83	788.66	0.29	784.13	7.56
2/1	735.73	4.61	747.16	15.09	47.16	753.87	1.50	780.35	-	18.39	2757.38	804.18	0.32	820.34	9.16
2/2	788.32	4.40	733.06	18.30	52.87	714.92	1.37	698.70	4.92	13.24	2005.91	783.49	0.38	-	-
average	762.03	4.51	740.11	16.70	50.02	734.40	1.44	739.53	4.92	15.82	2381.65	793.84	0.35	820.34	9.16
3/1	776.02	4.71	768.82	13.67	45.57	803.82	1.36	806.28	-	19.45	2660.61	775.83	0.22	813.91	7.94
3/2	800.68	4.89	773.69	12.81	41.71	823.56	1.42	757.67	4.81	14.86	2146.42	-	-	-	-
average	788.35	4.80	771.26	13.24	43.64	813.69	1.39	781.98	4.81	17.16	2403.52	775.83	0.22	813.91	7.94
4/1	713.00	4.87	764.37	13.73	45.57	755.15	1.51	755.50	-	16.41	2429.78	-	-	-	-
4/2	731.18	4.59	732.70	15.37	48.91	755.48	1.03	727.54	4.68	16.05	2154.52	-	-	-	-
average	722.09	4.73	748.54	14.55	47.24	755.32	1.27	741.52	4.68	16.23	2292.15	-	-	-	-
average	759.77	4.61	760.27	14.32	45.46	779.20	1.35	764.28	4.91	16.79	2417.29	786.11	0.29	806.13	8.22
SD		0.22		1.94	4.36		0.16		0.23	2.10	281.36		0.06		4.17

Table A-2 Testing properties of particleboards B.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density	2 hr	density	2 hr.	24 hr.	density	load	density	moiture	MOR	MOE	2-h boil		2-h boil	
	(kg/m3)	(%)	(kg/m3)	(%)	(MPa)	(kg/m3)	(MPa)	(kg/m3)	(%)	(MPa)	(MPa)	density	load	density	load
												(kg/m3)	(MPa)	(kg/m3)	(MPa)
1/1	779.39	5.18	837.15	11.99	35.39	814.51	1.24	803.96	4.64	19.57	2712.49	780.97	0.16	-	-
1/2	793.07	4.44	844.10	11.53	34.17	779.15	1.07	825.42	4.94	20.75	2813.00	805.63	0.11	-	-
average	786.23	4.81	840.63	11.76	34.78	796.83	1.16	814.69	4.79	20.16	2762.75	793.30	0.14	-	-
2/1	791.82	5.22	730.04	16.71	52.26	753.19	1.08	805.18	4.93	20.98	2913.12	772.52	0.24	-	-
2/2	752.12	5.39	788.83	12.85	40.79	755.16	1.17	820.08	5.06	20.94	2649.55	804.48	0.18	-	-
average	771.97	5.31	759.44	14.78	46.53	754.18	1.13	812.63	5.00	20.96	2781.34	788.50	0.21	-	-
3/1	815.89	5.54	784.29	19.17	49.84	772.65	1.19	810.81	4.62	19.33	2577.57	772.27	0.11	-	-
3/2	826.89	5.83	810.98	18.49	48.78	734.15	1.48	791.01	4.89	18.12	2506.07	742.75	0.38	-	-
average	821.39	5.69	797.64	18.83	49.31	753.40	1.34	800.91	4.76	18.73	2541.82	757.51	0.25	-	-
4/1	798.07	6.49	775.49	19.13	49.14	724.98	0.75	784.77	4.92	17.54	2515.83	774.33	0.16	-	-
4/2	798.07	6.98	776.01	21.37	53.22	724.39	1.18	797.32	5.18	19.83	2740.28	791.48	0.18	-	-
average	798.07	6.74	775.75	20.25	51.18	724.69	0.97	791.05	5.05	18.69	2628.06	782.91	0.17	-	-
average	794.42	5.63	793.36	16.41	45.45	757.27	1.15	804.82	4.90	19.63	2678.49	780.55	0.19	-	-
SD		0.80		3.78	7.57		0.20		0.19	1.29	144.09		0.09		

Table A-8 Testing properties of particleboards C1.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density	2 hr	density	2 hr.	24 hr.	density	load	density	moiture	MOR	MOE	2-h boil		2-h boil	
	(kg/m3)	(%)	(kg/m3)	(%)	(MPa)	(kg/m3)	(MPa)	(kg/m3)	(%)	(MPa)	(MPa)	density	load	density	load
												(kg/m3)	(MPa)	(kg/m3)	(MPa)
1/1	800.44	70.34	696.55	109.50	129.13	807.82	0.32	829.05	4.75	8.58	1499.60	749.92	0.00	722.04	0.00
1/2	747.79	68.75	725.63	106.42	125.02	776.17	0.24	813.09	4.90	7.24	1128.19	770.15	0.00	-	-
average	774.12	69.55	711.09	107.96	127.08	792.00	0.28	821.07	9.65	7.91	1313.90	760.04	0.00	722.04	0.00
2/1	834.29	59.68	743.57	103.77	118.38	778.40	0.28	819.53	4.79	9.09	1484.99	784.86	0.00	756.95	0.00
2/2	751.79	60.12	752.26	102.62	117.32	819.23	0.31	776.64	5.00	6.62	999.73	738.99	0.00	-	-
average	793.04	59.90	747.92	103.20	117.85	798.82	0.30	798.09	9.79	7.86	1242.36	761.93	0.00	756.95	0.00
3/1	818.59	50.63	766.46	92.17	104.42	844.75	0.48	807.30	4.73	9.70	1610.34	857.01	0.00	807.82	0.00
3/2	708.47	48.84	744.87	94.73	107.56	870.18	0.46	765.75	4.86	8.07	1220.83	845.86	0.00	-	-
average	763.53	49.74	755.67	93.45	105.99	857.47	0.47	786.53	9.59	8.89	1415.59	851.44	0.00	807.82	0.00
4/1	715.63	66.75	760.07	101.99	119.29	743.55	0.19	808.40	5.06	7.54	1336.21	641.72	0.00	812.82	0.00
4/2	792.47	71.30	760.36	104.66	119.64	711.58	0.16	827.05	5.29	7.91	1190.06	688.37	0.00	-	-
average	754.05	69.03	760.22	103.33	119.47	727.57	0.18	817.73	10.35	7.73	1263.14	665.05	0.00	812.82	0.00
average	771.18	62.05	743.72	101.98	117.60	793.96	0.31	805.85	9.85	8.09	1308.74	759.61	0.00	774.91	0.00
SD		8.75		5.80	8.20		0.12		0.19	1.00	210.14				

Table A-4 Testing properties of particleboards D2.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density (kg/m ³)	2 hr (%)	density (kg/m ³)	2 hr. (%)	24 hr. (MPa)	density (kg/m ³)	load (MPa)	density (kg/m ³)	moiture (%)	MOR (MPa)	MOE (MPa)	2-h boil		2-h boil	
												density (kg/m ³)	load (MPa)	density (kg/m ³)	load (MPa)
1/1	785.85	35.37	710.72	82.15	96.01	759.27	0.79	812.23	4.37	13.66	2011.97	771.51	0.00	732.38	2.19
1/2	770.38	37.13	746.37	78.38	91.20	720.56	0.58	818.56	4.56	14.77	2083.72	809.78	0.00	-	-
average	778.12	36.25	728.55	80.27	93.61	739.92	0.69	815.40	8.93	14.22	2011.97	790.65	0.00	732.38	2.19
2/1	741.93	40.33	725.93	84.91	98.03	800.75	0.50	829.34	4.44	15.00	2326.57	798.62	0.00	782.15	3.43
2/2	743.00	40.71	813.13	76.70	89.34	787.03	0.64	823.87	4.12	15.17	2161.81	838.33	0.00	-	-
average	742.47	40.52	769.53	80.81	93.69	792.89	0.57	826.61	8.56	15.09	2244.19	818.48	0.00	782.15	3.43
3/1	817.38	41.66	815.55	76.68	88.89	788.51	0.50	783.08	4.58	11.15	1891.26	782.28	0.00	814.92	3.51
3/2	794.96	43.58	769.09	83.35	95.50	694.95	0.31	767.86	4.13	10.02	1681.29	711.71	0.00	-	-
average	806.17	42.62	792.32	80.02	92.20	741.73	0.41	775.47	8.71	10.59	1786.28	747.00	0.00	814.92	3.51
4/1	786.88	38.62	748.50	84.05	95.32	763.31	0.50	811.37	4.43	13.31	1955.59	791.06	0.00	794.36	3.43
4/2	798.25	38.69	769.05	79.96	92.24	714.13	0.33	804.00	4.63	12.60	1893.15	732.09	0.00	-	-
average	792.57	38.66	758.78	82.01	93.78	738.72	0.42	807.69	9.06	12.96	1924.37	761.58	0.00	794.36	3.43
average	779.83	39.51	762.29	80.77	93.32	753.56	0.52	806.29	8.82	13.21	1991.70	779.42	0.00	780.95	3.14
SD		2.61		3.30	3.37		0.16		0.19	1.87	207.72				1.51

Table A-5 Testing properties of particleboards E3.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density (kg/m ³)	2 hr (%)	density (kg/m ³)	2 hr. (%)	24 hr. (MPa)	density (kg/m ³)	load (MPa)	density (kg/m ³)	moiture (%)	MOR (MPa)	MOE (MPa)	2-h boil		2-h boil	
												density (kg/m ³)	load (MPa)	density (kg/m ³)	load (MPa)
1/1	739.39	29.31	829.03	63.21	72.70	808.73	0.89	847.20	4.61	16.48	2513.82	794.51	0.00	814.17	5.42
1/2	691.98	27.05	725.31	73.88	85.99	793.65	0.87	839.23	4.57	18.42	2300.27	764.55	0.00	-	-
average	715.69	28.18	777.17	68.55	79.35	801.19	0.88	843.22	9.18	17.45	2407.05	779.53	0.00	814.17	5.42
2/1	738.69	30.61	734.01	75.22	85.88	762.41	0.54	845.55	4.46	16.63	2500.44	838.50	0.00	783.60	5.28
2/2	815.21	31.80	724.77	76.70	87.66	810.40	0.78	810.65	4.09	15.56	2104.76	803.66	0.00	-	-
average	776.95	31.21	729.39	75.96	86.77	786.41	0.66	828.10	8.55	16.10	2302.60	821.08	0.00	783.60	5.28
3/1	777.13	31.08	711.81	77.90	88.41	781.70	0.64	827.68	4.30	15.05	2278.24	834.21	0.00	770.78	4.34
3/2	795.38	31.52	759.94	74.03	83.72	790.12	0.85	815.09	4.07	15.53	2200.88	840.86	0.00	-	-
average	786.26	31.30	735.88	75.97	86.07	785.91	0.75	821.39	8.37	15.29	2239.56	837.54	0.00	770.78	4.34
4/1	739.27	31.18	737.13	78.74	88.18	836.69	0.80	844.02	4.56	15.83	2218.08	798.78	0.00	764.62	4.27
4/2	733.78	34.29	735.04	77.82	87.64	822.53	0.82	807.00	4.54	14.72	1914.41	810.69	0.00	-	-
average	736.53	32.74	736.09	78.28	87.91	829.61	0.81	825.51	9.10	15.28	2066.25	804.74	0.00	764.62	4.27
average	753.85	30.86	744.63	74.69	85.02	800.78	0.77	829.55	8.80	16.03	2253.86	810.72	0.00	783.29	4.83
SD		2.08		4.98	5.22		0.12		0.22	1.16	197.37				2.22

Table A-6 Testing properties of particleboards F.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density	2 hr	density	2 hr.	24 hr.	density	load	density	moiture	MOR	MOE	2-h boil		2-h boil	
	(kg/m3)	(%)	(kg/m3)	(%)	(MPa)	(kg/m3)	(MPa)	(kg/m3)	(%)	(MPa)	(MPa)	density	load	density	load
												(kg/m3)	(MPa)	(kg/m3)	(MPa)
1/1	833.94	4.72	816.70	13.86	41.12	747.60	1.23	758.86	-	16.40	2242.39	682.14	0.16	830.23	8.60
1/2	827.60	4.71	784.27	15.96	41.97	698.75	1.10	787.48	-	20.42	2582.51	741.54	0.28	-	-
average	830.77	4.72	800.49	14.91	41.55	723.18	1.17	773.17	-	18.41	2412.45	711.84	0.22	830.23	8.60
2/1	798.61	4.53	858.78	11.75	33.87	695.48	1.17	784.63	5.56	18.90	2426.13	788.49	0.25	805.55	8.29
2/2	803.80	4.07	712.88	20.84	50.49	788.53	1.29	737.93	-	15.01	1900.04	819.91	0.36	-	-
average	801.21	4.30	785.83	16.30	42.18	742.01	1.23	761.28	5.56	16.96	2163.09	804.20	0.31	805.55	8.29
3/1	816.85	7.06	865.00	16.80	41.71	672.80	0.89	751.66	5.20	19.50	2362.47	809.02	0.33	761.35	6.49
3/2	823.93	6.70	826.77	15.78	39.70	652.13	0.75	761.65	-	15.68	2109.95	791.43	0.19	-	-
average	820.39	6.88	845.89	16.29	40.71	662.47	0.82	756.66	5.20	17.59	2236.21	800.23	0.26	761.35	6.49
4/1	830.90	7.11	786.03	24.50	48.71	706.20	1.16	799.94	5.72	18.78	2588.73	702.30	0.23	734.43	5.90
4/2	817.20	5.91	794.49	19.08	45.43	638.84	0.96	775.59	-	19.31	2463.96	734.53	0.25	-	-
average	824.05	6.51	790.26	21.79	47.07	672.52	1.06	787.77	5.72	19.05	2526.35	718.42	0.24	734.43	5.90
average	819.10	5.60	805.62	17.32	42.88	700.04	1.07	769.72	5.49	18.00	2334.52	758.67	0.26	782.89	7.32
SD		1.24		4.04	5.28		0.19		0.27	2.00	238.97		0.07		3.47

Table A-7 Testing properties of particleboards G.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density	2 hr	density	2 hr.	24 hr.	density	load	density	moiture	MOR	MOE	2-h boil		2-h boil	
	(kg/m3)	(%)	(kg/m3)	(%)	(MPa)	(kg/m3)	(MPa)	(kg/m3)	(%)	(MPa)	(MPa)	density	load	density	load
												(kg/m3)	(MPa)	(kg/m3)	(MPa)
1/1	728.90	5.02	824.54	12.28	35.43	619.04	0.74	796.93	-	17.38	2517.18	865.21	0.27	794.42	7.48
1/2	856.65	4.32	707.03	20.99	66.13	687.45	1.19	849.83	-	21.69	3132.26	785.23	0.25	-	-
average	792.78	4.67	765.79	16.64	50.78	653.25	0.97	823.38	-	19.54	2824.72	825.22	0.26	794.42	7.48
2/1	831.10	5.96	837.71	14.69	36.18	673.05	0.97	806.69	4.83	19.33	2730.83	821.99	0.22	797.78	8.13
2/2	742.01	6.16	695.53	25.82	68.57	664.70	0.94	819.17	-	20.91	2801.14	865.53	0.29	-	-
average	786.56	6.06	766.62	20.26	52.38	668.88	0.96	812.93	4.83	20.12	2765.99	843.76	0.26	797.78	8.13
3/1	858.79	5.66	821.49	17.15	39.87	731.47	1.35	803.88	5.00	18.70	2427.51	805.77	0.20	784.48	6.69
3/2	721.90	6.07	665.91	27.51	70.89	741.16	1.32	841.75	-	21.22	2971.57	783.38	0.19	-	-
average	790.35	5.87	743.70	22.33	55.38	736.32	1.34	822.82	5.00	19.96	2699.54	794.58	0.20	784.48	6.69
4/1	786.76	6.57	834.40	15.31	39.21	698.64	0.95	767.26	4.81	18.80	2433.88	863.67	0.27	792.47	7.53
4/2	797.13	6.42	869.24	14.25	40.96	736.77	1.11	738.40	-	16.39	2126.77	837.17	0.27	-	-
average	791.95	6.50	851.82	14.78	40.09	717.71	1.03	752.83	4.81	17.60	2280.33	850.42	0.27	792.47	7.53
average	790.41	5.77	781.98	18.50	49.66	694.04	1.07	802.99	4.88	19.30	2642.64	828.49	0.25	792.29	7.46
SD		0.76		5.66	15.79		0.21		0.10	1.88	327.88		0.04		3.37

Table A-8 Testing properties of particleboards H.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density	2 hr	density	2 hr.	24 hr.	density	load	density	moiture	MOR	MOE	density	load	density	load
	(kg/m ³)	(%)	(kg/m ³)	(%)	(MPa)	(kg/m ³)	(MPa)	(kg/m ³)	(%)	(MPa)	(MPa)	(kg/m ³)	(MPa)	(kg/m ³)	(MPa)
1/1	822.87	9.66	812.26	29.87	62.37	794.65	1.10	775.92	-	16.90	2388.23	804.50	0.16	730.04	5.01
1/2	827.18	9.04	837.03	23.04	57.68	828.74	1.29	813.72	-	20.47	2943.93	779.43	0.13	-	-
average	825.03	9.35	824.65	26.46	60.03	811.70	1.20	794.82	-	18.69	2666.08	791.97	0.15	730.04	5.01
2/1	818.46	5.97	829.87	15.52	42.30	795.20	1.18	785.12	5.92	19.11	2565.36	818.66	0.13	795.97	7.18
2/2	833.42	6.01	837.44	17.77	43.68	718.69	0.95	762.08	-	17.16	2447.99	815.13	0.20	-	-
average	825.94	5.99	833.66	16.65	42.99	756.95	1.07	773.60	5.92	18.14	2506.68	816.90	0.17	795.97	7.18
3/1	806.95	8.15	769.52	26.30	62.33	717.18	0.93	812.31	5.58	20.71	2830.51	826.54	0.20	841.10	8.20
3/2	830.78	7.38	769.47	24.06	63.40	751.83	1.06	832.74	-	20.96	2811.18	786.57	0.12	-	-
average	818.87	7.77	769.50	25.18	62.87	734.51	1.00	822.53	5.58	20.84	2820.85	806.56	0.16	841.10	8.20
4/1	776.46	9.93	832.54	27.05	59.80	672.90	0.75	807.96	5.41	19.86	2825.26	847.07	0.19	847.60	9.79
4/2	846.20	8.41	738.62	29.92	72.42	656.99	0.75	817.05	-	21.89	2959.18	779.37	0.17	-	-
average	811.33	9.17	785.58	28.49	66.11	664.95	0.75	812.51	5.41	20.88	2892.22	813.22	0.18	847.60	9.79
average	820.29	8.07	803.34	24.19	58.00	742.02	1.00	800.86	5.64	19.63	2721.46	807.16	0.16	803.68	7.55
SD		1.52		5.28	10.21		0.19		0.26	1.80	222.62		0.03		3.79

Table A-9 Testing properties of particleboards I.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density (kg/m ³)	2 hr (%)	density (kg/m ³)	2 hr. (%)	24 hr. (MPa)	density (kg/m ³)	load (MPa)	density (kg/m ³)	moiture (%)	MOR (MPa)	MOE (MPa)	density (kg/m ³)	load (MPa)	density (kg/m ³)	load (MPa)
1/1	783.61	4.43	769.02	17.58	45.13	686.08	0.90	797.44	8.20	16.86	2292.61	742.96	0.23	746.37	6.40
1/2	780.95	4.24	752.96	16.64	43.49	738.66	1.29	803.62	8.57	16.95	2200.95	743.91	0.28	-	-
average	782.28	4.34	760.99	17.11	44.31	712.37	1.10	800.53	8.39	16.91	2246.78	743.44	0.26	746.37	6.40
2/1	757.30	4.20	745.47	16.60	45.67	742.62	1.21	757.70	8.19	14.25	2084.07	742.36	0.20	758.62	6.88
2/2	783.55	4.44	772.52	14.15	46.65	755.09	1.21	811.58	7.97	17.10	2400.32	770.12	0.20	-	-
average	770.43	4.32	759.00	15.38	46.16	748.86	1.21	784.64	8.08	15.68	2242.20	756.24	0.20	758.62	6.88
3/1	807.10	4.41	732.65	19.58	51.55	728.59	1.30	773.62	8.05	16.99	2082.82	773.14	0.14	746.91	6.53
3/2	799.43	4.65	737.08	20.89	54.25	770.25	1.19	793.35	8.08	17.96	2326.76	788.48	0.29	-	-
average	803.27	4.53	734.87	20.24	52.90	749.42	1.25	783.49	8.07	17.48	2204.79	780.81	0.22	746.91	6.53
4/1	732.84	4.31	757.43	16.13	43.76	769.83	1.26	780.56	8.11	15.76	2284.81	730.12	0.21	787.87	7.25
4/2	786.91	4.16	784.92	13.80	38.64	779.11	1.10	794.86	7.83	16.15	2338.93	779.84	0.31	-	-
average	759.88	4.24	771.18	14.97	41.20	774.47	1.18	787.71	7.97	15.96	2311.87	754.98	0.26	787.87	7.25
average	778.96	4.36	756.51	16.92	46.14	746.28	1.18	789.09	8.13	16.50	2251.41	758.87	0.23	759.94	6.77
SD		0.16		2.43	4.86		0.13		0.22	1.12	117.90		0.06		3.04

Table A-10 Testing properties of particleboards J.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density (kg/m ³)	2 hr (%)	density (kg/m ³)	2 hr. (%)	24 hr. (MPa)	density (kg/m ³)	load (MPa)	density (kg/m ³)	moiture (%)	MOR (MPa)	MOE (MPa)	2-h boil		2-h boil	
												density (kg/m ³)	load (MPa)	density (kg/m ³)	load (MPa)
1/1	697.94	4.39	760.91	15.25	43.43	710.05	1.04	770.68	8.15	14.81	2076.33	748.55	0.21	759.78	6.17
1/2	718.38	3.90	761.44	14.06	38.51	704.39	0.92	760.58	8.35	14.50	1965.67	748.07	0.26	-	-
average	708.16	4.15	761.18	14.66	40.97	707.22	0.98	765.63	8.25	14.66	2021.00	748.31	0.24	759.78	6.17
2/1	716.00	3.59	747.66	14.71	42.71	688.04	0.99	745.58	9.16	12.78	1738.02	718.56	0.19	761.29	6.36
2/2	702.15	3.63	757.67	13.01	38.13	673.00	0.73	776.49	8.73	15.22	2582.61	703.26	0.19	-	-
average	709.08	3.61	752.67	13.86	40.42	680.52	0.86	761.04	8.95	14.00	2160.32	710.91	0.19	761.29	6.36
3/1	674.15	4.26	757.52	14.80	40.08	700.94	0.81	767.31	8.22	13.99	2036.22	713.99	0.19	755.87	6.77
3/2	693.12	4.07	761.94	12.88	37.49	677.01	0.75	759.20	8.23	13.97	1839.59	765.66	0.25	-	-
average	683.64	4.17	759.73	13.84	38.79	688.98	0.78	763.26	8.23	13.98	1937.91	739.83	0.22	755.87	6.77
4/1	718.41	3.64	734.13	13.85	44.95	734.84	1.04	770.58	8.37	16.14	2104.38	752.87	0.17	751.08	5.38
4/2	757.77	3.87	733.24	15.33	42.21	720.80	0.96	760.54	8.36	12.72	1817.72	749.78	0.20	-	-
average	738.09	3.76	733.69	14.59	43.58	727.82	1.00	765.56	8.37	14.43	1961.05	751.33	0.19	751.08	5.38
average	709.74	3.92	751.81	14.24	40.94	701.13	0.91	763.87	8.45	14.27	2020.07	737.59	0.21	757.01	6.17
SD		0.30		0.95	2.76		0.13		0.34	1.17	262.68		0.03		2.81

Table A-11 Testing properties of particleboards K.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density	2 hr	density	2 hr.	24 hr.	density	load	density	moiture	MOR	MOE	2-h boil		2-h boil	
	(kg/m ³)	(%)	(kg/m ³)	(%)	(MPa)	(kg/m ³)	(MPa)	(kg/m ³)	(%)	(MPa)	(MPa)	density	load	density	load
												(kg/m ³)	(MPa)	(kg/m ³)	(MPa)
1/1	788.49	5.77	741.78	22.21	46.60	767.69	1.45	772.71	5.64	17.76	2147.36	773.56	0.32	741.58	6.28
1/2	815.85	6.01	750.56	21.01	52.32	716.59	1.40	804.80	5.44	20.65	2577.43	740.97	0.30	-	-
average	802.17	5.89	746.17	21.61	49.46	742.14	1.43	788.76	5.54	19.21	2362.40	757.27	0.31	741.58	6.28
2/1	775.27	6.58	776.47	20.86	43.78	758.74	1.47	770.49	5.14	20.11	2468.38	693.33	0.24	756.47	7.70
2/2	771.68	6.82	807.51	17.69	38.75	780.32	1.57	753.24	5.25	19.42	2222.62	709.38	0.23	-	-
average	773.48	6.70	791.99	19.28	41.27	769.53	1.52	761.87	5.20	19.77	2345.50	701.36	0.24	756.47	7.70
3/1	730.18	6.38	771.67	21.80	46.44	768.66	1.67	781.65	5.27	14.56	1841.80	782.39	0.30	765.09	7.24
3/2	794.23	6.45	787.67	20.23	43.63	777.00	1.48	715.48	5.36	17.15	2312.65	798.53	0.32	-	-
average	762.21	6.42	779.67	21.02	45.04	772.83	1.58	748.57	5.32	15.86	2077.23	790.46	0.31	765.09	7.24
4/1	749.50	7.06	796.17	19.67	42.02	768.62	1.85	787.45	5.82	19.37	2301.80	771.92	0.29	787.48	7.65
4/2	820.36	7.19	782.26	21.23	45.56	770.09	1.55	764.57	5.83	18.02	2142.32	787.61	0.33	-	-
average	784.93	7.13	789.22	20.45	43.79	769.36	1.70	776.01	5.83	18.70	2222.06	779.77	0.31	787.48	7.65
average	780.70	6.53	776.76	20.59	44.89	763.46	1.56	768.80	5.47	18.38	2251.80	757.21	0.29	762.66	7.22
SD		0.49		1.42	3.96		0.15		0.26	1.96	223.92		0.04		3.28

Table A-12 Testing properties of particleboards L.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density (kg/m ³)	2 hr (%)	density (kg/m ³)	2 hr. (%)	24 hr. (MPa)	density (kg/m ³)	load (MPa)	density (kg/m ³)	moiture (%)	MOR (MPa)	MOE (MPa)	2-h boil		2-h boil	
												density (kg/m ³)	load (MPa)	density (kg/m ³)	load (MPa)
1/1	785.91	6.45	775.67	21.83	45.03	825.00	2.01	720.80	6.11	14.14	1824.81	777.72	0.26	769.44	7.41
1/2	785.96	6.08	834.09	15.86	38.32	796.18	1.81	799.01	5.88	20.25	2604.51	724.24	0.27	-	-
average	785.94	6.27	804.88	18.85	41.68	810.59	1.91	759.91	6.00	17.20	2214.66	750.98	0.27	769.44	7.41
2/1	797.65	6.93	774.14	20.48	48.07	788.66	1.63	740.65	5.93	16.08	1967.54	732.48	0.27	761.23	7.63
2/2	785.40	6.46	811.94	15.99	36.40	778.95	2.04	779.30	5.61	20.95	2551.87	786.99	0.30	-	-
average	791.53	6.70	793.04	18.24	42.24	783.81	1.84	759.98	5.77	18.52	2259.71	759.74	0.29	761.23	7.63
3/1	781.02	6.11	763.21	21.97	45.19	796.85	2.01	748.28	5.64	17.62	2086.04	757.20	0.30	775.73	8.55
3/2	777.88	6.46	823.98	16.06	36.33	780.91	2.16	784.74	5.51	20.31	2551.06	756.28	0.23	-	-
average	779.45	6.29	793.60	19.02	40.76	788.88	2.09	766.51	5.58	18.97	2318.55	756.74	0.27	775.73	8.55
4/1	767.56	5.98	795.47	17.45	40.81	785.54	1.94	771.52	5.77	15.76	2046.18	721.32	0.32	788.07	8.43
4/2	794.09	5.90	838.17	15.52	34.63	801.68	1.91	777.06	5.39	19.29	2306.87	765.42	0.25	-	-
average	780.83	5.94	816.82	16.49	37.72	793.61	1.93	774.29	5.58	17.53	2176.53	743.37	0.29	788.07	8.43
average	784.43	6.30	802.08	18.15	40.60	794.22	1.94	765.17	5.73	18.05	2242.36	752.71	0.28	773.62	8.01
SD		0.34		2.81	4.97		0.16		0.24	2.52	302.18		0.03		3.61

Table A-13 Testing properties of particleboards M.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density	2 hr	density	2 hr.	24 hr.	density	load	density	moiture	MOR	MOE	2-h boil		2-h boil	
	(kg/m3)	(%)	(kg/m3)	(%)	(MPa)	(kg/m3)	(MPa)	(kg/m3)	(%)	(MPa)	(MPa)	density	load	density	load
												(kg/m3)	(MPa)	(kg/m3)	(MPa)
1/1	689.81	4.25	685.45	17.52	50.91	676.11	1.04	717.48	6.31	12.58	1780.81	682.26	0.28	711.01	4.53
1/2	699.44	3.98	707.64	15.71	46.56	668.62	0.95	705.75	5.28	13.95	1984.20	703.35	0.27	-	-
average	694.63	4.12	696.55	16.62	48.74	672.37	1.00	711.62	5.80	13.27	1882.51	692.81	0.28	711.01	4.53
2/1	678.49	3.52	717.90	14.51	44.22	659.89	1.21	701.47	3.48	12.60	1777.50	696.10	0.24	706.91	4.75
2/2	735.24	3.44	656.10	19.35	51.30	688.51	1.05	717.78	7.90	13.73	1981.02	683.03	0.20	-	-
average	706.87	3.48	687.00	16.93	47.76	674.20	1.13	709.63	5.69	13.17	1879.26	689.57	0.22	706.91	4.75
3/1	695.27	3.59	725.74	13.94	43.56	701.96	0.64	667.23	6.03	10.85	1535.75	686.47	0.22	703.35	4.82
3/2	687.64	4.34	690.73	16.30	48.01	702.41	1.43	730.09	5.57	13.78	1988.93	681.84	0.18	-	-
average	691.46	3.97	708.24	15.12	45.79	702.19	1.04	698.66	5.80	12.32	1762.34	684.16	0.20	703.35	4.82
4/1	721.72	5.19	677.34	23.14	61.33	723.81	1.29	667.28	6.34	10.89	1562.83	708.69	0.22	718.43	5.05
4/2	732.38	5.44	742.53	18.71	50.43	684.86	0.91	725.59	5.72	11.96	1849.93	694.67	0.19	-	-
average	727.05	5.32	709.94	20.93	55.88	704.34	1.10	696.44	6.03	11.43	1706.38	701.68	0.21	718.43	5.05
average	705.00	4.22	700.43	17.40	49.54	688.27	1.07	704.08	5.83	12.54	1807.62	692.05	0.23	709.93	4.79
SD		0.76		3.00	5.61		0.25		1.24	1.25	181.81		0.04		2.15

Table A-14 Testing properties of particleboards N.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density	2 hr	density	2 hr.	24 hr.	density	load	density	moiture	MOR	MOE	2-h boil		2-h boil	
	(kg/m3)	(%)	(kg/m3)	(%)	(MPa)	(kg/m3)	(MPa)	(kg/m3)	(%)	(MPa)	(MPa)	density	load	density	load
												(kg/m3)	(MPa)	(kg/m3)	(MPa)
1/1	766.68	4.24	791.78	13.14	35.92	894.33	1.77	838.67	6.71	22.11	2812.05	834.57	0.38	786.70	8.70
1/2	805.21	4.60	844.80	11.63	32.70	892.27	2.52	878.29	6.24	26.44	3448.97	883.83	0.54	-	-
average	785.95	4.42	818.29	12.39	34.31	893.30	2.15	858.48	6.48	24.28	3130.51	859.20	0.46	786.70	8.70
2/1	798.67	4.22	821.78	11.49	32.67	886.88	2.36	801.69	7.55	20.36	2592.21	881.80	0.50	806.83	9.97
2/2	845.45	3.75	838.72	11.19	31.38	834.80	2.14	870.94	7.21	23.76	3293.06	889.21	0.43	-	-
average	822.06	3.99	830.25	11.34	32.03	860.84	2.25	836.32	7.38	22.06	2942.64	885.51	0.47	806.83	9.97
3/1	803.89	4.09	816.58	11.43	33.34	858.73	2.41	817.20	6.76	21.43	2737.18	828.54	0.43	837.80	10.64
3/2	852.11	3.86	799.13	12.71	36.01	849.33	1.93	855.96	6.21	23.23	2961.82	808.93	0.44	-	-
average	828.00	3.98	807.86	12.07	34.68	854.03	2.17	836.58	6.49	22.33	2849.50	818.74	0.44	837.80	10.64
4/1	765.05	5.32	786.71	15.40	38.32	903.84	2.30	827.06	6.78	23.94	2791.11	875.87	0.39	870.06	11.79
4/2	775.22	5.53	837.15	12.76	32.33	905.36	1.29	847.46	6.36	25.42	3158.73	885.00	0.46	-	-
average	770.14	5.43	811.93	14.08	35.33	904.60	1.80	837.26	6.57	24.68	2974.92	880.44	0.43	870.06	11.79
average	801.54	4.45	817.08	12.47	34.08	878.19	2.09	842.16	6.73	23.34	2974.39	860.97	0.45	825.35	10.28
SD		0.66		1.39	2.39		0.41		0.47	2.02	298.37		0.05		4.73

Table A-15 Testing properties of particleboards O.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density	2 hr	density	2 hr.	24 hr.	density	load	density	moiture	MOR	MOE	2-h boil		2-h boil	
	(kg/m ³)	(%)	(kg/m ³)	(%)	(MPa)	(kg/m ³)	(MPa)	(kg/m ³)	(%)	(MPa)	(MPa)	density	load	density	load
												(kg/m ³)	(MPa)	(kg/m ³)	(MPa)
1/1	795.59	4.48	824.58	13.86	34.17	862.89	1.75	847.06	7.13	25.78	3092.92	829.47	0.30	819.85	8.11
1/2	843.81	3.69	841.24	11.66	31.24	879.43	1.70	860.67	6.92	26.43	3452.14	846.26	0.35	-	-
average	819.70	4.09	832.91	12.76	32.71	871.16	1.73	853.87	7.03	26.11	3272.53	837.87	0.33	819.85	8.11
2/1	805.75	4.32	803.13	13.30	36.08	874.07	1.85	810.01	7.19	22.39	2825.82	843.17	0.33	842.54	9.86
2/2	821.95	3.93	884.83	8.53	24.39	895.56	1.33	849.45	6.97	25.59	3231.85	841.76	0.28	-	-
average	813.85	4.13	843.98	10.92	30.24	884.82	1.59	829.73	7.08	23.99	3028.84	842.47	0.31	842.54	9.86
3/1	776.31	3.07	831.99	10.69	30.31	817.26	1.45	817.93	7.25	23.00	2815.89	822.81	0.30	851.66	11.10
3/2	835.20	3.26	835.30	10.11	29.61	861.76	1.34	869.94	7.07	26.51	3344.87	843.45	0.40	-	-
average	805.76	3.17	833.65	10.40	29.96	839.51	1.40	843.94	7.16	24.76	3080.38	833.13	0.35	851.66	11.10
4/1	851.03	3.49	836.82	7.18	28.07	735.91	1.04	884.03	7.50	28.27	3410.79	838.52	0.45	853.66	10.49
4/2	824.81	3.63	802.41	14.33	34.64	773.79	1.39	856.82	7.20	24.45	3316.71	778.97	0.33	-	-
average	837.92	3.56	819.62	10.76	31.36	754.85	1.22	870.43	7.35	26.36	3363.75	808.75	0.39	853.66	10.49
average	819.31	3.73	832.54	11.21	31.06	837.58	1.48	849.49	7.15	25.30	3186.37	830.55	0.34	841.93	9.89
SD		0.49		2.57	3.85		0.27		0.18	1.94	251.04		0.06		4.56

Table A-16 Testing properties of particleboards P.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density	2 hr	density	2 hr.	24 hr.	density	load	density	moiture	MOR	MOE	2-h boil		2-h boil	
	(kg/m ³)	(%)	(kg/m ³)	(%)	(MPa)	(kg/m ³)	(MPa)	(kg/m ³)	(%)	(MPa)	(MPa)	density	load	density	load
												(kg/m ³)	(MPa)	(kg/m ³)	(MPa)
1/1	840.28	3.84	842.99	12.55	32.41	842.48	1.15	788.46	7.83	20.03	2717.50	830.33	0.30	846.78	10.18
1/2	861.43	2.86	829.93	14.07	33.36	826.66	1.17	816.04	7.75	23.62	3058.16	834.24	0.35	-	-
average	850.86	3.35	836.46	13.31	32.89	834.57	1.16	802.25	7.79	21.83	2887.83	832.29	0.33	846.78	10.18
2/1	879.10	3.73	836.01	11.89	34.82	825.05	0.87	820.76	8.07	23.28	2973.06	847.97	0.38	850.70	11.86
2/2	882.87	3.57	799.08	18.10	41.61	798.90	0.96	841.99	8.01	23.53	3149.67	760.33	0.31	-	-
average	880.99	3.65	817.55	15.00	38.22	811.98	0.92	831.38	8.04	23.41	3061.37	804.15	0.35	850.70	11.86
3/1	803.93	3.36	808.38	15.69	38.04	890.93	0.96	820.19	5.91	24.47	3184.20	892.76	0.33	852.21	12.00
3/2	846.26	3.55	827.21	14.81	37.01	847.22	1.13	862.43	8.02	25.26	3390.55	859.28	0.47	-	-
average	825.10	3.46	817.80	15.25	37.53	869.08	1.05	841.31	6.97	24.87	3287.38	876.02	0.40	852.21	12.00
4/1	868.35	4.29	858.04	12.96	32.45	834.43	1.27	846.47	7.91	25.77	3291.84	824.48	0.37	840.96	10.53
4/2	879.96	2.98	814.36	17.99	39.72	846.44	1.20	848.24	7.80	23.72	3126.85	807.88	0.35	-	-
average	874.16	3.64	836.20	15.48	36.09	840.44	1.24	847.36	7.86	24.75	3209.35	816.18	0.36	840.96	10.53
average	857.77	3.52	827.00	14.76	36.18	839.01	1.09	830.57	7.66	23.71	3111.48	832.16	0.36	847.66	11.14
SD		0.46		2.37	3.47		0.14		0.72	1.73	205.15		0.05		5.05

Table A-17 Testing properties of particleboards Q.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density	2 hr	density	2 hr.	24 hr.	density	load	density	moiture	MOR	MOE	2-h boil		2-h boil	
	(kg/m ³)	(%)	(kg/m ³)	(%)	(MPa)	(kg/m ³)	(MPa)	(kg/m ³)	(%)	(MPa)	(MPa)	density	load	density	load
												(kg/m ³)	(MPa)	(kg/m ³)	(MPa)
1/1	760.90	11.56	818.88	29.54	43.68	776.39	1.01	763.02	5.25	20.83	2341.32	804.77	0.32	797.53	8.52
1/2	792.19	11.34	791.65	34.14	51.50	819.90	1.89	776.84	5.23	19.36	2525.12	801.37	0.28	-	-
average	776.55	11.45	805.27	31.84	47.59	798.15	1.45	769.93	5.24	20.10	2433.22	803.07	0.30	797.53	8.52
2/1	820.03	12.13	771.87	38.15	54.98	779.72	1.26	802.61	5.27	20.71	2574.86	799.35	0.23	792.53	8.45
2/2	811.68	11.01	785.01	32.37	54.76	809.49	1.21	785.72	5.09	19.22	2675.51	807.89	0.28	-	-
average	815.86	11.57	778.44	35.26	54.87	794.61	1.24	794.17	5.18	19.97	2625.19	803.62	0.26	792.53	8.45
3/1	736.74	11.86	811.35	30.12	43.47	820.54	1.15	771.97	5.95	18.06	2285.50	827.74	0.33	783.83	8.59
3/2	816.72	14.34	808.23	30.49	49.33	804.15	1.25	767.09	5.55	21.01	2427.66	838.22	0.29	-	-
average	776.73	13.10	809.79	30.31	46.40	812.35	1.20	769.53	5.75	19.54	2356.58	832.98	0.31	783.83	8.59
4/1	739.12	11.63	823.41	30.93	44.77	851.57	1.13	801.69	5.62	21.61	2556.32	839.20	0.30	781.61	7.72
4/2	814.33	12.88	827.59	30.35	42.89	874.18	1.44	774.14	5.38	19.09	2486.54	810.31	0.30	-	-
average	776.73	12.26	825.50	30.64	43.83	862.88	1.29	787.92	5.50	20.35	2521.43	824.76	0.30	781.61	7.72
average	786.46	12.09	804.75	32.01	48.17	816.99	1.29	780.39	5.42	19.99	2484.10	816.11	0.29	788.88	8.32
SD		1.07		2.89	5.13		0.27		0.28	1.22	128.06		0.03		3.74

Table A-18 Testing properties of particleboards R.

piece/ sample number	thickness swelling		water absorption			internal bond		modulus of rupture and elasticity				internal bond		modulus of rupture	
	density (kg/m ³)	2 hr (%)	density (kg/m ³)	2 hr. (%)	24 hr. (MPa)	density (kg/m ³)	load (MPa)	density (kg/m ³)	moiture (%)	MOR (MPa)	MOE (MPa)	density (kg/m ³)	load (MPa)	density (kg/m ³)	load (MPa)
1/1	794.64	16.35	794.98	51.21	58.95	804.91	1.21	762.61	5.77	16.62	1864.54	822.94	0.17	842.57	8.91
1/2	824.96	14.38	822.54	44.48	53.78	775.61	1.03	811.74	5.36	17.87	2358.16	792.95	0.14	-	-
average	809.80	15.37	808.76	47.85	56.37	790.26	1.12	787.18	5.57	17.25	2111.35	807.95	0.16	842.57	8.91
2/1	829.73	15.53	769.37	52.76	61.91	865.39	0.90	823.42	5.28	18.43	2327.84	861.37	0.17	850.96	10.19
2/2	762.89	17.03	818.88	47.26	56.28	874.03	1.48	833.52	5.14	19.72	2545.55	884.71	0.23	-	-
average	796.31	16.28	794.13	50.01	59.10	869.71	1.19	828.47	5.21	19.08	2436.70	873.04	0.20	850.96	10.19
3/1	810.02	15.93	834.19	46.79	55.28	847.59	1.03	810.47	5.17	20.06	2390.60	834.51	0.20	841.57	9.27
3/2	828.34	13.89	790.66	50.88	60.68	874.02	1.26	816.63	5.16	20.50	2461.95	870.20	0.25	-	-
average	819.18	14.91	812.43	48.84	57.98	860.81	1.15	813.55	5.17	20.28	2426.28	852.36	0.23	841.57	9.27
4/1	824.55	13.50	823.71	48.94	57.28	830.47	1.03	841.89	5.48	20.99	2440.52	809.33	0.16	833.51	8.97
4/2	798.65	17.92	816.80	46.63	55.72	853.26	1.13	832.31	5.56	21.06	2692.42	802.07	0.18	-	-
average	811.60	15.71	820.26	47.79	56.50	841.87	1.08	837.10	5.52	21.03	2566.47	805.70	0.17	833.51	8.97
average	809.22	15.57	808.89	48.62	57.49	840.66	1.13	816.57	5.37	19.41	2385.20	834.76	0.19	842.15	9.34
SD		1.55		2.81	2.81		0.18		0.22	1.61	240.29		0.04		4.21



APPENDIX B
BASIC DATA OF THE RUBBER WOOD FLAKES

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

Table B-1 Size Distribution of the Fine Rubber Wood Flakes.

Sample No.	Weight (g)	Particles on test seive (mesh)											
		+20		+40		+60		+80		+100		-100	
		weight (g)	percent	weight (g)	percent	weight (g)	percent	weight (g)	percent	weight (g)	percent	weight (g)	percent
1.	20.00	1.10	5.50	7.52	36.25	5.50	27.55	3.15	15.75	1.16	5.80	1.93	9.65
2.	20.05	1.04	5.18	7.70	38.40	5.01	24.98	3.00	14.96	1.34	6.68	2.04	10.47
3.	20.03	1.11	5.54	7.12	35.54	5.50	27.46	2.90	14.48	1.39	6.94	2.05	10.23
4.	20.03	1.04	5.19	7.39	36.89	5.16	25.76	3.02	15.08	1.54	7.69	2.06	10.28
5.	20.03	1.12	5.59	7.48	37.34	5.16	25.71	3.00	14.98	1.48	7.39	1.97	9.83
Average Size Distributions		5.40		36.88		26.29		15.05		6.90		10.03	

*** SHAKER : RETSCH VS 1000, Time = 10 min, Interval = noncontinuous, amplitude = 70.

Table B-2 Size Distribution of the Coarse Rubber Wood Flakes.

Sample No.	Weight (g)	Particles on test seive (mesh)											
		+5		+12		+20		+40		+60		-60	
		weight (g)	percent	weight (g)	percent	weight (g)	percent	weight (g)	percent	weight (g)	percent	weight (g)	percent
1.	20.05	1.2	5.89	8.7	40.40	7.7	38.40	2.2	10.97	0.3	1.50	0.2	0.99
2.	20.05	2.3	11.47	8.1	40.40	6.5	32.42	2.5	12.46	0.4	1.99	0.2	0.99
3.	20.04	2.2	10.98	8.2	40.92	6.3	31.44	2.8	13.97	0.5	2.50	0.3	1.50
4.	20.03	2.3	11.28	7.8	38.94	6.7	33.45	2.5	12.48	0.4	1.99	0.3	1.49
5.	20.05	2.5	12.46	8.3	41.39	6.5	33.63	2.2	10.97	0.3	1.49	0.3	1.49
Everage Size Distributions		10.47		41.01		33.63		12.17		1.89		1.29	

*** SHAKER : RETSCH VS 1000, Time = 10 min, Interval = noncontinuous, amplitude = 70.

Table B-3 Slenderness ratio of the rubber wood flakes.

Mesh No.	Mesh size mm.	Mesh size average mm.*	Particle thickness mm.*	Particle length mm.*	Slenderness ratio	Screen yield %
Fine flake						
+20	0.850	>0.850	0.541	4.942	9.13	5.40
+40	0.425	0.425-0.850	0.286	2.869	10.03	36.88
+60	0.250	0.250-0.425	0.317	2.029	6.40	26.29
+80	0.180	0.180-0.250	---	---	---	15.05
+100	0.150	0.150-0.180	---	---	---	6.90
-100	<0.150	<0.150	---	---	---	10.03
Coarse flake						
+5	4.00	3.90	1.005	22.162	22.04	10.47
+12	1.70	2.32	0.895	15.741	17.59	41.01
+20	0.850	1.23	0.653	8.688	13.30	33.63
+40	0.425	0.425-0.850	0.292	4.281	14.66	12.17
+60	0.250	0.250-0.425	0.163	2.890	17.78	1.89
-60	<0.250	<0.250	---	---	---	1.29

* Average measured value from 100 particles.

Table B-4 Moisture content distribution of rubber wood flakes raw material.

Sample No.	Particle weight before oven-dry (g)	Particle weight after oven-dry (g)			
		1st time		2nd time	
		weight	percent	weight	percent
1/1	29.80	27.76	7.35	27.76	7.35
1/2	26.85	25.00	7.40	24.99	7.44
2/1	24.84	23.07	7.67	23.08	7.63
2/2	25.91	24.03	7.82	24.03	7.82
3/1	29.29	27.35	7.09	27.37	7.01
3/2	29.95	27.99	7.00	27.97	7.08
4/1	39.43	36.95	6.71	36.93	6.77
4/2	39.20	36.80	6.52	36.73	6.72
5/1	43.19	40.46	6.75	40.40	6.91
5/2	37.81	35.38	6.87	35.42	6.75
Average (%)		7.12		7.15	

*** Moisture content of rubber wood flakes = 7%.

Table B-5 Moisture content of the flakes (2%) before and after pMDI binder spraying.

Sample No.	Particle weight before oven-dry (g)	Particle weight after oven-dry (g)			
		1st time		2nd time	
		weight	percent	weight	percent
Before					
fine 1	45.31	44.18	2.56	44.20	2.51
fine 2	41.95	40.92	2.52	40.95	2.44
coarse 3	31.13	31.31	2.71	30.32	2.67
coarse 4	32.73	31.89	2.73	31.88	2.67

After					
fine 1	32.62	31.07	4.99	31.09	4.92
fine 2	30.27	28.81	5.07	28.83	4.99
coarse 3	23.68	22.56	4.96	22.59	4.83
coarse 4	22.19	21.19	4.72	21.18	4.77

Table B-6 Moisture content of the flakes (7%) before and after pMDI binder spraying.

Sample No.	Particle weight before oven-dry (g)	Particle weight after oven-dry (g)			
		1st time		2nd time	
		weight	percent	weight	percent
Before					
fine 1	24.85	23.27	6.79	23.21	7.07
fine 2	26.22	24.53	6.89	24.51	6.98
coarse 3	43.34	40.60	6.75	40.55	6.88
coarse 4	43.17	40.44	6.75	40.39	6.88

After					
fine 1	34.83	32.50	7.17	32.45	7.33
fine 2	36.05	33.60	7.29	33.56	7.42
coarse 3	41.26	38.61	6.86	38.56	7.00
coarse 4	43.79	40.92	7.01	40.88	7.12

Table B-7 Moisture content of the flakes (12%) before and after pMDI binder spraying.

Sample No.	Particle weight before oven-dry (g)	Particle weight after oven-dry (g)			
		1st time		2nd time	
		weight	percent	weight	percent
Before					
fine 1	22.72	20.43	11.21	20.42	11.26
fine 2	23.74	21.31	11.20	21.29	11.51
coarse 3	21.17	18.82	12.49	18.83	12.43
coarse 4	19.90	17.73	12.24	17.71	12.37
After					
fine 1	33.57	30.43	10.32	30.45	10.25
fine 2	33.97	30.82	10.22	30.83	10.18
coarse 3	36.54	32.70	11.74	32.71	11.71
coarse 4	38.03	33.99	11.89	34.01	11.82

Table B-8 Moisture content of the flakes (17%) before and after pMDI binder spraying.

Sample No.	Particle weight before oven-dry (g)	Particle weight after oven-dry (g)			
		1st time		2nd time	
		weight	percent	weight	percent
Before					
fine 1	24.90	21.55	15.55	21.58	15.38
fine 2	25.69	22.22	15.62	22.24	15.51
coarse 3	19.52	16.52	18.16	16.51	18.23
coarse 4	19.90	16.82	18.31	16.80	18.45
After					
fine 1	36.30	32.22	12.66	32.20	12.73
fine 2	34.00	30.15	12.77	30.14	12.81
coarse 3	28.49	24.61	15.77	24.61	15.77
coarse 4	31.58	27.23	15.98	27.24	15.93

Table B-9 Moisture content of the flakes (22%) before and after pMDI binder spraying.

Sample No.	Particle weight before oven-dry (g)	Particle weight after oven-dry (g)			
		1st time		2nd time	
		weight	percent	weight	percent
Before					
fine 1	21.15	17.64	19.90	17.61	20.10
fine 2	23.74	19.80	19.90	19.78	20.02
coarse 3	23.92	19.33	23.75	18.58	23.87
coarse 4	25.63	20.72	23.70	21.43	23.82

After					
fine 1	37.70	32.37	16.47	32.37	16.47
fine 2	43.86	37.71	16.31	37.72	16.28
coarse 3	37.6	31.02	21.28	31.02	21.28
coarse 4	41.04	33.80	21.42	33.78	21.49

Table B-10 Moisture content of the flakes (7%) before and after phenolic binder spraying.

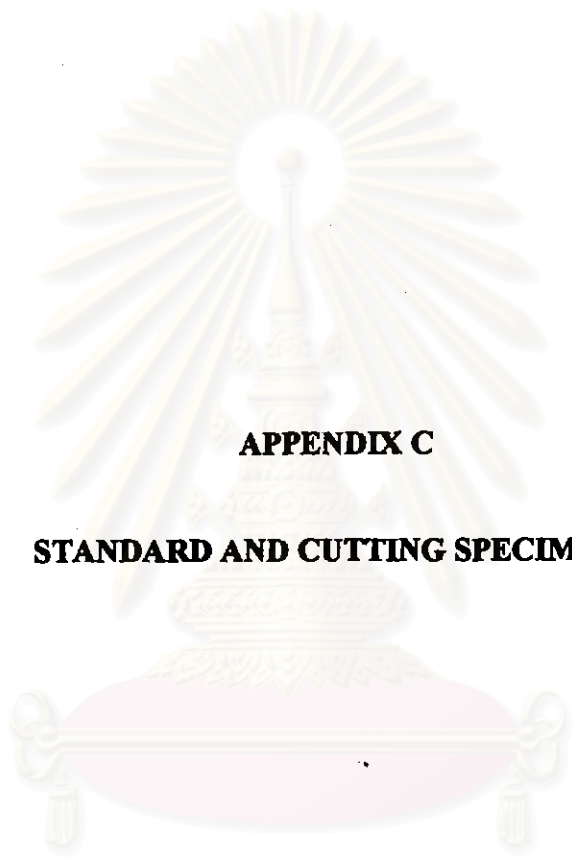
Sample No.	Particle weight before oven-dry (g)	Particle weight after oven-dry (g)			
		1st time		2nd time	
		weight	percent	weight	percent
Before					
fine 1	41.99	39.36	6.68	39.41	6.55
fine 2	43.16	40.45	6.70	40.48	6.62
coarse 3	18.61	17.18	8.32	17.23	8.01
coarse 4	28.59	26.55	7.68	26.55	7.68

After					
fine 1	29.29	26.62	10.03	26.60	10.11
fine 2	29.61	26.91	10.03	26.90	10.07
coarse 3	42.61	37.72	12.96	37.72	12.96
coarse 4	37.81	33.73	12.10	33.69	12.23

Table B-11 Moisture content of the flakes(7%) before and after pMDI and phenolic binders spraying.

Sample No.	Particle weight before oven-dry (g)	Particle weight after oven-dry (g)			
		1st time		2nd time	
		weight	percent	weight	percent
Before					
fine 1	41.99	39.36	6.68	39.41	6.55
fine 2	43.16	40.45	6.70	40.48	6.62
coarse 3	18.61	17.18	8.32	17.23	8.01
coarse 4	28.59	26.55	7.68	26.55	7.68
After					
fine 1	27.43	24.45	12.19	24.51	11.91
fine 2	29.20	26.06	12.05	26.09	11.92
coarse 3	24.47	22.77	7.47	22.81	7.28
coarse 4	33.83	31.46	7.53	31.48	7.47

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APPENDIX C

STANDARD AND CUTTING SPECIMENS

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Standard for Flat Pressed Particleboards

The rubber wooden particleboard products were tested according to following properties. The water absorption (except size of specimen), thickness swelling, internal bond (dry), modulus of rupture (dry), and modulus of Elasticity (dry) were tested according to TIS 867-2532. The internal bond (wet) was tested according to DIN 68763. The modulus of rupture (wet) was tested according to CAN 3-0188.0-M78. The standard values for flat pressed particleboards are as follows:

Table C-1 Standard values for flat pressed particleboards.

Properties	Standard Values	
2-h Water absorption, %	40	(maximum)
24-h Water absorption, %	80	(maximum)
Thickness swelling, %	12	(maximum)
Modulus of rupture, MPa	13.8	(minimum)
Modulus of elasticity, MPa	2000	(minimum)
Internal bond, MPa	0.34	(minimum)
2-h Boil modulus of rupture, MPa	5.60	(minimum)
2-h Boil internal bond, MPa	0.15	(minimum)

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Table C-2 Standard values of various standards.

PROPERTIES	STANDARD										
	TIS 876 2532 ^a	CAN3-0188.3-M82 ^b				ASTM D 1037 ^c	DIN 68763 ^d		JIS A 5908 ^e		
		GU-1	GU-2	GY-1	GY-2 ^f		V20	V100 & V100G ^g	18 Type	13 Type	8 Type ^h
Max. Water Absorption (%)											
2 hours	40	—	—	—	—	—	—	—	—	—	—
24 hours	80	—	—	—	—	—	—	—	—	—	—
Max. Thickness Swelling (%)	12.0	0.75	0.25	0.75	0.25 ⁱ	—	16	12	12	12	12
Min. Modulus of Rupture (MPa)	13.8	17.0	17.0	14.0	14.0	—	18	19	18	13	8
Min. Modulus of Elasticity (GPa)	2.0	3.40	3.40	2.50	2.50	—	—	—	—	—	—
Min. Internal Bond (MPa)	0.34	0.5	0.5	0.5	0.5	—	0.4	—	0.3	0.2	0.15
Min. Modulus of Rupture											
2 hours boiling (MPa)	—	7.0	7.0	5.6	5.6	—	—	—	9.0	6.5	—
Min. Internal Bond											
2 hours boiling (MPa)	—	—	—	—	—	—	—	0.15	—	—	—

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Remark

- * a = Standard for flat pressed particleboards : Medium density.
b = Exterior-bond mat-formed wood particleboards.
c = Standard test methods for evaluating properties of wood-based fiber and particle panel materials.
d = Flat pressed particleboard for use in building construction : Concepts, requirements testing and inspection.
e = Particleboard.
- ** f = Grade U-1 and U-2 are based on the properties of commercial boards accepted by Canadian building authorities for use in site-built construction.
= Grade Y-1 and Y-2 correspond in physical properties to the particleboard specified in the National Particleboard Standard NPA-2-72, Particleboard Decking for the Factory-Built Housing.
g = Type V20 : Board for interior applications, whose binders are resistant to low ambient humidity, such as aminoplastic resins, alkaline hardening phenolic resins and polymer diphenyl methane diisocyanate (pMDI).
= Type V100 : Board whose binders are resistant to high ambient humidity, such as alkaline hardening phenolic resins and polymer diphenyl methane diisocyanate (pMDI).
= Type V100G : Board whose binders are resistant to high ambient humidity, such as alkaline hardening phenolic resins, phenol resorcin resins and polymer diphenyl methane diisocyanate (pMDI), and treated with a preservative against wood-detroying fungi (basidiomycetes).
h = 18 Type : Board whose bending strength shall be 18.0 N/mm^2 (184 kgf/cm^2) or over both lengtwise and widthwise.
= 13 Type : Board whose bending strength shall be 13.0 N/mm^2 (184 kgf/cm^2) or over both lengtwise and widthwise.
= 8 Type : Board whose bending strength shall be 8.0 N/mm^2 (184 kgf/cm^2) or over both lengtwise and widthwise.
- *** i = Devation from nominal maximum \pm devation from panel average (mm).

Table C-3 Standard dimension of specimens of various standards.

STANDARDS	Dimensions of Specimens (mm)					
	Water Absorption	Thickness Swelling	Modulus of Rupture & Modulus of Elasticity	Internal Bond	Modulus of Rupture 2 hs boiling	Internal Bond 2 hs boiling
TIS 876 2532 ^a	300x300	100x100	100x16 times of nominal thickness + 50	50x50	---	---
CAN3-0188.0-M78 ^b	---	150x150	75x24 times of nominal thickness + 50	50x50	75x 24 times of nominal thickness + 50	---
ASTM D 1037 ^c	304x304 or 152x152	304x304 or 152x152	76x24 times of nominal thickness	50x50	---	---
DIN 68763 ^d	---	DIN 52360 and DIN 52364	DIN 52360 and DIN 52362	DIN 52360 and DIN 52362	---	DIN 52360 and DIN 52365
JIS A 5908 ^e	---	50x50	50x15 times of nominal thickness + 50	50x50	50x15 times of nominal thickness + 50	---

Remark

a = Standard for flat pressed particleboards : Medium density.

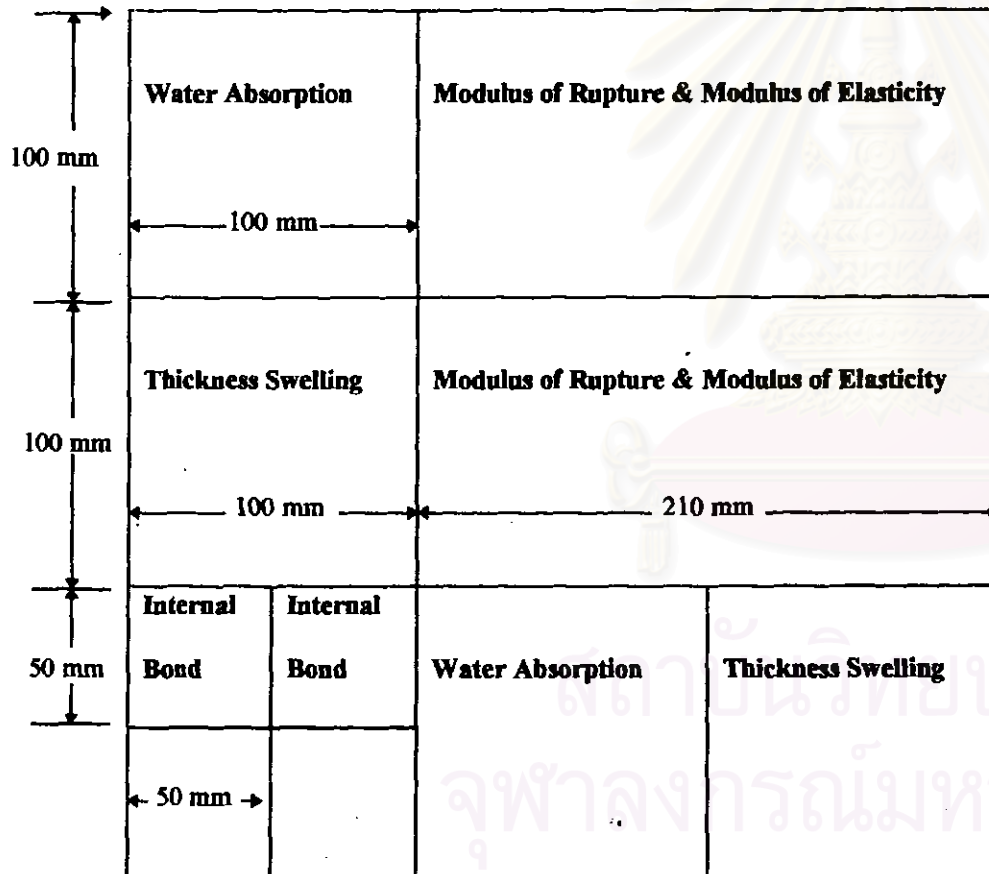
b = Exterior-bond mat-formed wood particleboards.

c = Standard test methods for evaluating properties of wood-based fiber and particle panel materials.

d = Flat pressed particleboard for use in building construction : Concepts, requirements testing and inspection.

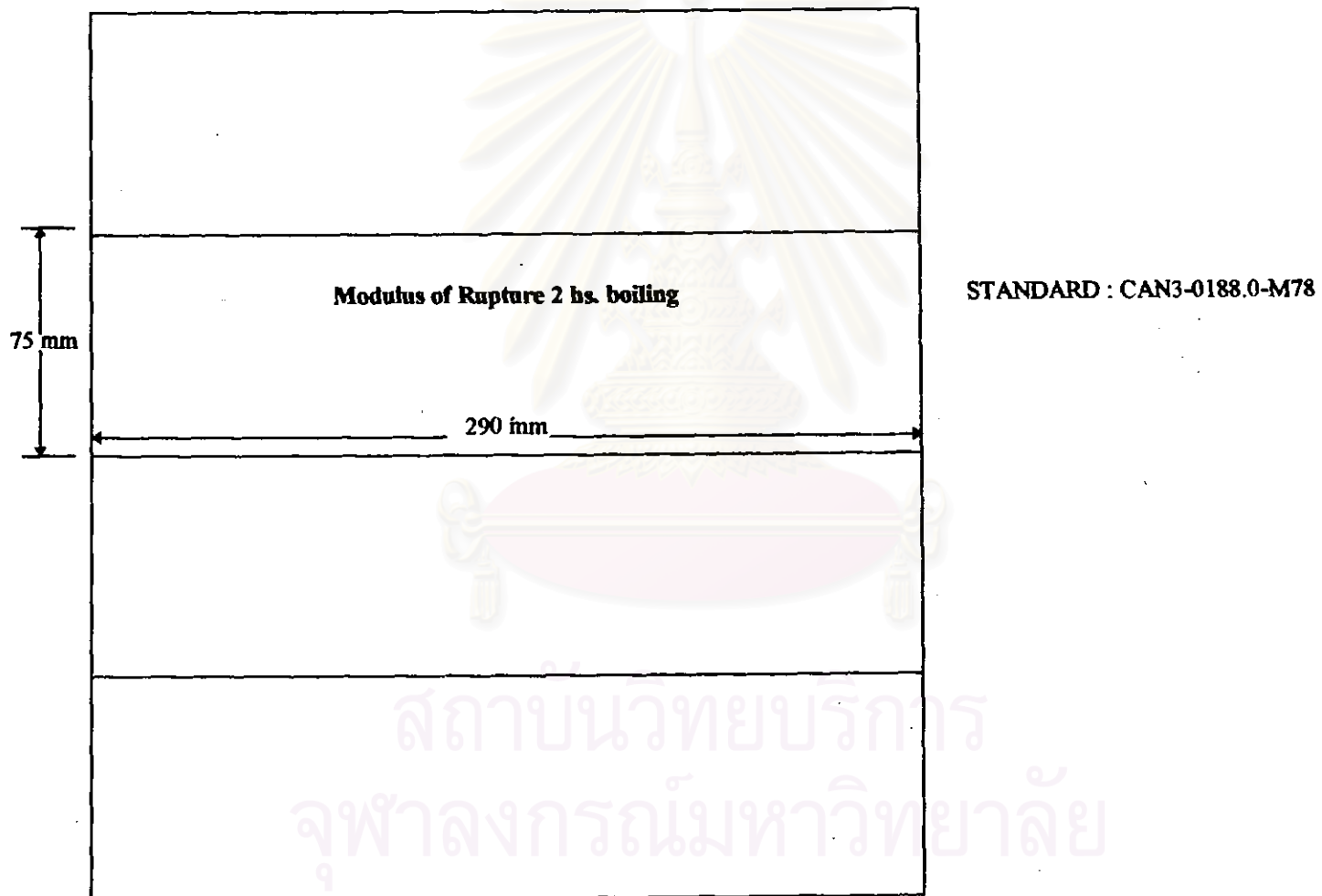
e = Particleboard.

Figure C-1 Diagram of cutting specimens for particleboard of 10 mm thickness.



STANDARD : TIS 876-2532 (except Water Absorption)

Figure C-2 Diagram of cutting specimens for particleboard of 10 mm thickness.



VITA

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