APPENDIX A

Proximate analysis

Table A.1 Protein content in fish protein powder

Sample	Replication	*Protein (%)
Protein powder	1	85.2019
Protein powder	2	84.4076
Protein powder	3	85.1792

*N× 6.25

Table A.2 Moisture content in fish protein powder

Sample	Replication	Moisture (%wb)	Moisture (%db)
Protein powder	1	6.4801	6.9292
Protein powder	2	6.5316	6.9881
Protein powder	3	6.2478	6.6642

Table A.3 Ash in fish protein powder

Sample	Replication	Ash (%)
Protein powder	1	2.7700
Protein powder	2	2.7792
Protein powder	3	2.7917

Table A.4 Fat content in fish protein powder

Sample	Replication	Fat (%)
Protein powder	1	4.2510
Protein powder	2	4.2329
Protein powder	3	4.3665

Table A.5 sieve analysis of fish protein powder for preparation sample

Maximum size present in substantial proportions(µm)	Minimum weight of sample dispatched for testing(g)	% of sample dispatched for testing
1000	0.1	0.20
710	0.09	0.18
500	0.16	0.32
425	0.66	1.32
300	4.18	8.35
180	9.83	19.65
75	15.02	30.02
<75	19.99	39.96

APPENDIX B

Properties of fish protein and Kraft Lignin

Table B.1 TGA of fish protein and Kraft lignin which test temperature from the room temperature (30°C) to 600 °C and the heating rate was 10 °C/min.

	Fish protein		Kraft lignin	
Temperature	**% weight loss**	**DTG (mg/min)**	**% weight loss**	**DTG (mg/min)**
30	99.98	1.15E-05	99.95	-1.87E-04
40	99.93	6.13E-05	99.63	-3.65E-04
50	99.79	-2.59E-04	99.12	-6.79E-04
60	99.54	-2.80E-04	98.49	-5.95E-04
70	99.20	-3.81E-04	97.95	-4.98E-04
80	98.77	-4.77E-04	97.49	-3.43E-04
90	98.25	-5.62E-04	97.24	-1.63E-04
100	97.68	-5.55E-04	97.09	-2.32E-04
110	97.17	-4.48E-04	96.90	-1.19E-04
120	96.77	-3.37E-04	96.75	-1.42E-04
130	96.48	-2.49E-04	96.60	-1.66E-04
140	96.27	-1.81E-04	96.37	-2.56E-04
150	96.11	-1.66E-04	96.12	-3.00E-04
160	95.94	-1.68E-04	95.82	-2.98E-04
170	95.79	-1.44E-04	95.48	-3.14E-04
180	95.61	-2.32E-04	95.17	-4.13E-04
190	95.33	-3.84E-04	94.74	-4.50E-04
200	94.89	-5.90E-04	94.20	-6.75E-04
210	94.24	-6.49E-04	93.55	-5.12E-04
220	93.47	-8.57E-04	92.95	-7.72E-04
230	92.58	-8.69E-04	92.22	-7.11E-04
240	91.61	-1.03E-03	91.45	-8.31E-04
250	90.48	-1.26E-03	90.61	-8.72E-04
260	89.05	-1.65E-03	89.64	-1.11E-03
270	87.28	-1.92E-03	88.50	-1.10E-03
280	85.21	-2.30E-03	87.38	-1.15E-03
290	82.68	-2.84E-03	86.24	-1.21E-03
300	79.48	-3.60E-03	85.00	-1.28E-03
310	75.56	-4.14E-03	83.63	-1.41E-03
320	70.95	-5.28E-03	82.15	-1.56E-03
330	65.17	-5.91E-03	80.54	-1.76E-03
340	59.64	-5.21E-03	78.61	-2.16E-03
350	54.92	-4.32E-03	76.30	-2.36E-03
360	50.88	-3.92E-03	73.81	-2.62E-03
370	47.16	-3.51E-03	71.14	-2.68E-03
380	43.95	-2.99E-03	68.55	-2.49E-03
390	41.24	-2.53E-03	66.27	-2.13E-03
400	38.88	-2.16E-03	64.24	-1.82E-03

Table B.1 TGA of fish protein and Kraft lignin which test temperature from the room temperature (30°C) to 600 °C and the heating rate was 10 °C/min (Continues)

Temperature	Fish protein		Kraft lignin	
	% weight loss	DTG (mg/min)	% weight loss	DTG (mg/min)
410	36.99	-1.70E-03	62.67	-1.41E-03
420	35.48	-1.35E-03	61.44	-1.14E-03
430	34.20	-1.29E-03	60.33	-1.20E-03
440	33.00	-1.08E-03	59.11	-1.10E-03
450	31.98	-9.36E-04	58.03	-1.00E-03
460	31.12	-7.79E-04	57.10	-9.11E-04
470	30.41	-6.57E-04	56.22	-8.61E-04
480	29.82	-5.54E-04	55.43	-8.22E-04
490	29.30	-4.57E-04	54.60	-8.27E-04
500	28.89	-3.46E-04	53.82	-6.97E-04
510	28.54	-3.54E-04	53.06	-8.02E-04
520	28.19	-3.08E-04	52.24	-7.72E-04
530	27.89	-2.94E-04	51.50	-7.29E-04
540	27.65	-1.67E-04	50.87	-6.34E-04
550	27.40	-2.65E-04	50.16	-7.50E-04
560	27.18	-1.90E-04	49.53	-5.70E-04
570	26.92	-2.29E-04	48.78	-6.28E-04
580	26.71	-2.31E-04	48.16	-6.45E-04
590	26.53	-1.93E-04	47.62	-5.62E-04
600	26.31	-2.43E-04	47.00	-7.54E-04

Table B.2 DSC of fish protein was heated first time at 10 ºC/min from 25 to 250 ºC and heated a second time at 10 ºC/min to 250 ºC. Finally the sample was cooled to 25 ºC at 10 ºC/min.

Temperature(ºC)	Replication 1		Replication 2	
	Heating (W/g)	Reheating (W/g)	Heating (W/g)	Reheating (W/g)
25.83	0.10	-0.05	0.11	-0.04
30.50	0.20	0.13	0.18	0.13
35.17	0.21	0.14	0.20	0.15
39.83	0.22	0.14	0.20	0.14
44.50	0.23	0.14	0.21	0.14
49.17	0.23	0.13	0.21	0.13
53.83	0.23	0.13	0.21	0.13

Table B.2 DSC of fish protein was heated first time at 10 ºC/min from 25 to 250 ºC and heated a second time at 10 ºC/min to 250 ºC. Finally the sample was cooled to 25 ºC at 10 ºC/min (Continues)

	Replication 1		Replication 2	
Temperature(ºC)	Heating (W/g)	Reheating (W/g)	Heating (W/g)	Reheating (W/g)
58.50	0.24	0.13	0.22	0.13
63.17	0.25	0.13	0.23	0.13
67.83	0.26	0.13	0.24	0.13
72.50	0.28	0.13	0.26	0.12
77.17	0.30	0.13	0.29	0.12
81.83	0.32	0.14	0.31	0.12
86.50	0.34	0.14	0.33	0.12
91.17	0.36	0.14	0.35	0.12
95.83	0.39	0.14	0.39	0.12
100.50	0.42	0.14	0.41	0.12
105.17	0.45	0.14	0.44	0.12
109.83	0.47	0.14	0.46	0.12
111.00	0.47	0.14	0.46	0.13
115.67	0.49	0.15	0.48	0.13
120.33	0.50	0.15	0.47	0.12
125.00	0.49	0.15	0.45	0.13
129.67	0.48	0.15	0.44	0.13
134.33	0.46	0.15	0.41	0.13
139.00	0.44	0.16	0.39	0.13
143.67	0.41	0.16	0.36	0.13
148.33	0.39	0.16	0.33	0.13
153.00	0.36	0.16	0.30	0.13
157.67	0.33	0.16	0.27	0.13
162.33	0.31	0.17	0.25	0.13
167.00	0.29	0.17	0.24	0.14
171.67	0.27	0.18	0.22	0.14
176.33	0.26	0.19	0.21	0.15
181.00	0.26	0.20	0.21	0.16
185.67	0.27	0.21	0.22	0.16
190.33	0.28	0.21	0.25	0.17
195.00	0.31	0.22	0.27	0.17
199.67	0.36	0.22	0.31	0.18
204.33	0.40	0.22	0.36	0.18
209.00	0.43	0.23	0.38	0.18
213.67	0.45	0.23	0.40	0.18
218.33	0.47	0.24	0.42	0.18
223.00	0.47	0.24	0.42	0.19

Table B.2 DSC of fish protein was heated first time at 10 ºC/min from 25 to 250 ºC and heated a second time at 10 ºC/min to 250 ºC. Finally the sample was cooled to 25 ºC at 10 ºC/min (Continues)

	Replication 1		Replication 2	
Temperature(ºC)	Heating (W/g)	Reheating (W/g)	Heating (W/g)	Reheating (W/g)
227.67	0.47	0.25	0.41	0.20
232.33	0.46	0.26	0.39	0.21
237.00	0.45	0.28	0.38	0.22
241.67	0.45	0.29	0.39	0.24
246.33	0.47	0.32	0.41	0.26
247.50	0.48	0.32	0.42	0.27

Table B.3 DSC of Kraft lignin was heated first time at 10 ºC/min from 25 to 250 ºC and heated a second time at 10 ºC/min to 250 ºC. Finally the sample was cooled to 25 ºC at 10 ºC/min (Continues)

	Replication 1		Replication 2	
Temperature(ºC)	Heating (W/g)	Reheating (W/g)	Heating (W/g)	Reheating (W/g)
25.83	0.11	0.00	0.08	0.01
30.50	0.19	0.13	0.19	0.13
35.17	0.20	0.14	0.20	0.15
39.83	0.20	0.13	0.20	0.15
44.50	0.21	0.13	0.21	0.14
49.17	0.21	0.13	0.21	0.14
53.83	0.22	0.13	0.22	0.14
58.50	0.24	0.13	0.23	0.14
63.17	0.25	0.13	0.25	0.14
67.83	0.27	0.13	0.26	0.14
72.50	0.28	0.14	0.28	0.14
77.17	0.31	0.14	0.30	0.14
81.83	0.33	0.14	0.33	0.14
86.50	0.36	0.14	0.36	0.14
91.17	0.39	0.14	0.38	0.14
95.83	0.41	0.14	0.40	0.14
100.50	0.42	0.14	0.41	0.14
105.17	0.42	0.14	0.40	0.14
109.83	0.40	0.14	0.39	0.14
111.00	0.40	0.14	0.38	0.14
115.67	0.37	0.14	0.35	0.14

Table B.3 DSC of Kraft lignin was heated first time at 10 ºC/min from 25 to 250 ºC and heated a second time at 10 ºC/min to 250 ºC. Finally the sample was cooled to 25 ºC at 10 ºC/min (Continues)

	Replication 1		Replication 2	
Temperature(ºC)	**Heating (W/g)**	**Reheating (W/g)**	**Heating (W/g)**	**Reheating (W/g)**
120.33	0.34	0.14	0.32	0.14
125.00	0.31	0.15	0.29	0.14
129.67	0.28	0.15	0.27	0.14
134.33	0.26	0.15	0.25	0.14
139.00	0.25	0.15	0.24	0.14
143.67	0.25	0.15	0.24	0.14
148.33	0.26	0.16	0.25	0.14
153.00	0.26	0.16	0.25	0.15
157.67	0.27	0.17	0.26	0.15
162.33	0.27	0.17	0.26	0.16
167.00	0.26	0.18	0.25	0.16
171.67	0.26	0.18	0.25	0.17
176.33	0.25	0.19	0.24	0.17
181.00	0.24	0.19	0.23	0.18
185.67	0.23	0.20	0.22	0.18
190.33	0.22	0.20	0.21	0.18
195.00	0.21	0.20	0.20	0.18
199.67	0.20	0.20	0.19	0.18
204.33	0.19	0.20	0.19	0.18
209.00	0.19	0.20	0.19	0.18
213.67	0.18	0.20	0.18	0.18
218.33	0.19	0.20	0.18	0.20
223.00	0.19	0.19	0.18	0.18
227.67	0.19	0.19	0.18	0.17
232.33	0.18	0.19	0.17	0.17
237.00	0.18	0.19	0.15	0.17
241.67	0.16	0.18	0.14	0.17
246.33	0.15	0.18	0.13	0.16
247.50	0.14	0.17	0.12	0.16

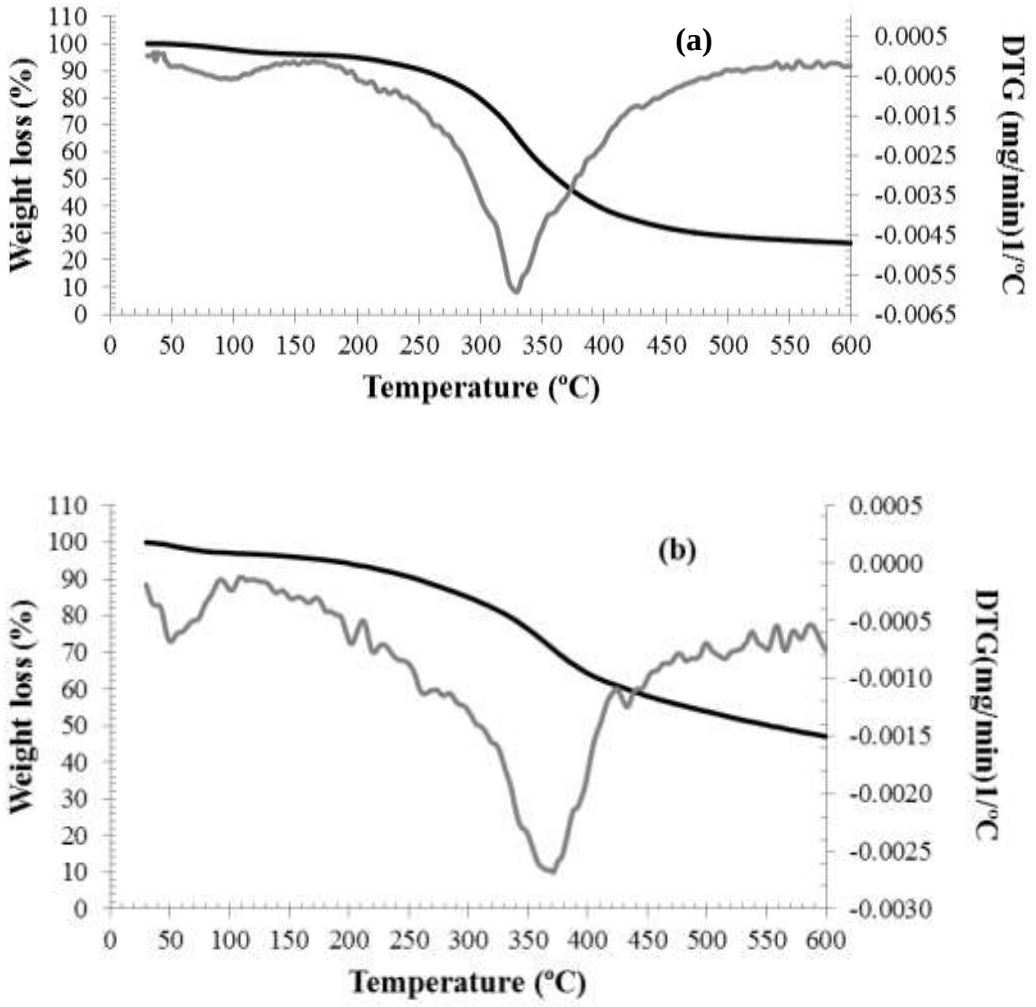

Figure B.1 (—) TG and (—) derivative TG (DTG) curves of Fish protein (a) and Kraft lignin (b) measured at 10°C /min in nitrogen

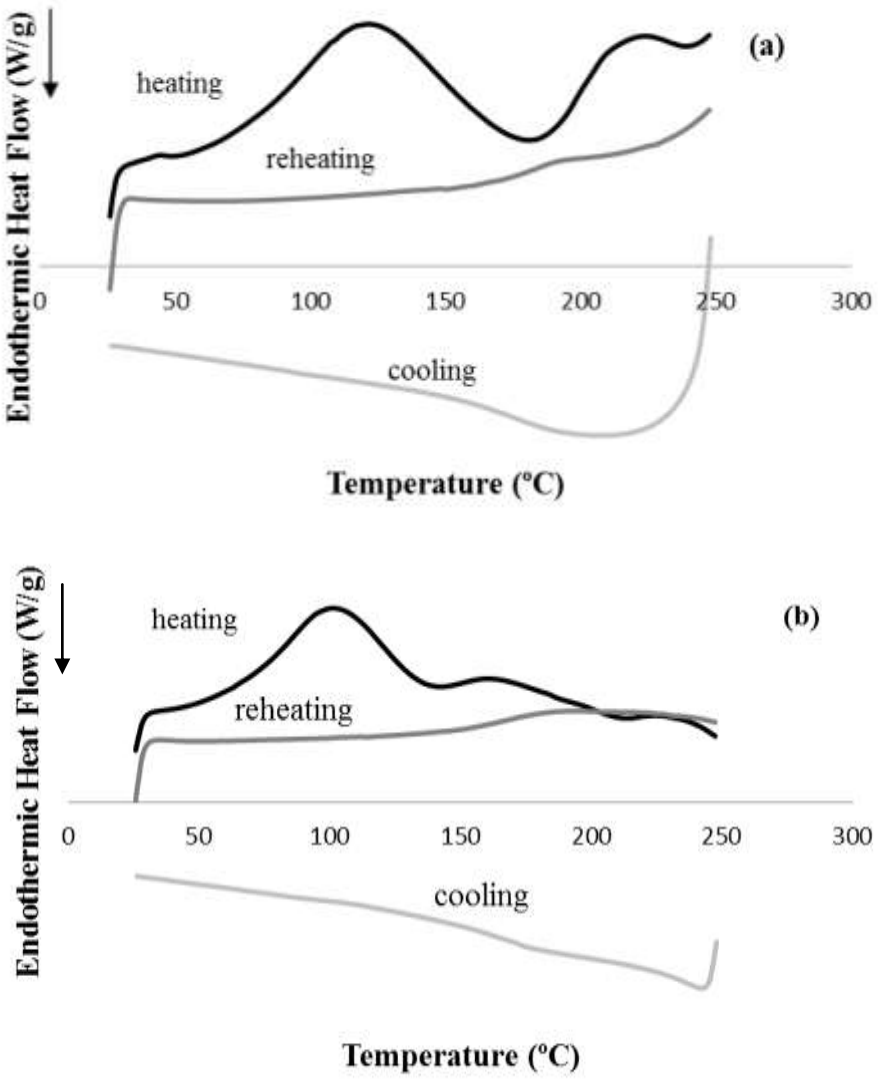

Figure B.2 DSC scan of Fish protein (a), Kraft lignin (b) of biomaterial at 0% RH

APPENDIX C

Rheological Properties of Plasticized fish protein/Kraft Lignin Blend

Table C.1 Shear rate and appearance viscosity of plasticized fish protein/ Kraft lignin mixed blend and die temperature is 140 ^{o}C

Sample	Replication	Shear rate (1/s)	Shear viscosity (Pa.s)
0% KL	1	9.9936	23987
		49.997	6114
		99.994	3568.4
		500	926.21
		999.99	23987
	2	9.9936	20986
		49.997	4564.7
		99.994	2307.3
		500	797.27
		999.99	
20% KL	1	9.9936	11485
		49.997	2435.6
		99.994	1272.8
		500	267.2
		999.99	145.76
	2	9.9936	10902
		49.997	2189
		99.994	1092.8
		500	218.89
		999.99	
40% KL	1	9.9936	6751
		49.997	2085.8
		99.994	941.26
		500	218.89
		999.99	153.09
	2	9.9936	6534.2
		49.997	1645.9
		99.994	671.38
		500	205.9
		999.99	125.6

Table C.1 Shear rate and appearance viscosity of plasticized fish protein/ Kraft lignin mixed blend and die temperature is 140 ^{o}C (Continues)

Sample	Replication	Shear rate (1/s)	Shear viscosity (Pa.s)
60% KL	1	9.9936	3150.5
		49.997	629.74
		99.994	316.54
		500	66.3
		999.99	36.149
	2	9.9936	3067.1
		49.997	613.07
		99.994	306.54
		500	61.637
		999.99	35.649
70% KL	1	9.9936	3033.8
		49.997	606.41
		99.994	303.2
		500	60.637
		999.99	30.319
	2	9.9936	3017.1
		49.997	603.07
		99.994	301.54
		500	60.304
		999.99	30.152

APPENDIX D

Plasticized fish protein/Kraft Lignin Biomaterial
Experiment Data

TableD.1 Dynamic mechanical analysis of 0% KL

Replication 1				Replication 2			
Temp (°C)	**E" (MPa)**	**E' (MPa)**	**Tan δ**	**Temp (°C)**	**E" (MPa)**	**E' (MPa)**	**Tan δ**
-100.5711	407.9459	10704.7931	0.0248	-97.3281	229.5245	6150.4178	0.0311
-95.5711	181.4832	9784.7381	0.0217	-92.3281	194.9366	5896.2823	0.0346
-90.5711	152.7085	9546.0147	0.0219	-87.3281	210.7801	5785.8813	0.0391
-85.5711	232.5351	9257.8490	0.0258	-82.3281	268.3915	5651.8771	0.0450
-80.5711	320.1492	8991.9235	0.0324	-77.3281	295.1092	5455.9933	0.0520
-75.5711	304.0294	8722.5805	0.0410	-72.3281	292.5711	5169.8154	0.0604
-70.5711	438.3701	8141.2384	0.0517	-67.3281	311.6215	4844.9788	0.0718
-65.5711	516.8680	7639.3604	0.0629	-62.3281	390.5231	4527.1866	0.0860
-60.5711	496.3176	7064.6471	0.0723	-57.3281	440.5451	4212.5139	0.0988
-55.5711	526.7814	6513.8580	0.0818	-52.3281	439.7339	3894.5740	0.1080
-50.5711	534.8727	5897.2287	0.0905	-47.3281	401.7409	3556.8531	0.1134
-45.5711	510.4629	5254.2321	0.0981	-42.3281	368.8408	3185.6327	0.1159
-40.5711	481.5853	4666.2130	0.1035	-37.3281	330.5680	2822.8159	0.1147
-35.5711	457.1857	4137.8303	0.1067	-32.3281	286.4351	2541.4131	0.1104
-30.5711	399.9154	3643.8498	0.1064	-27.3281	239.4494	2301.2523	0.1042
-25.5711	332.7921	3248.8627	0.1033	-22.3281	197.5509	2073.3035	0.0978
-20.5711	285.4162	2929.5557	0.0990	-17.3281	167.1647	1878.9314	0.0928
-15.5711	245.2736	2620.4050	0.0947	-12.3281	150.0901	1703.6899	0.0906
-10.5711	214.0372	2365.8330	0.0915	-7.3281	142.9408	1549.5392	0.0904
-5.5711	188.7284	2135.7659	0.0898	-2.3281	135.4391	1447.2237	0.0910
-0.5711	173.5306	1934.1528	0.0896	2.6720	122.2449	1315.1380	0.0922
4.4289	162.0116	1769.6717	0.0904	7.6720	112.1190	1209.1387	0.0937
9.4289	149.9451	1637.1570	0.0916	12.6720	106.2732	1118.0062	0.0961
14.4289	141.1743	1511.7149	0.0931	17.6720	102.7132	1030.0615	0.0992
19.4289	132.5779	1390.5799	0.0951	22.6720	98.1146	943.7028	0.1030
24.4289	125.3597	1282.0020	0.0973	27.6720	93.0046	863.2882	0.1074
29.4289	117.7422	1180.9270	0.1001	32.6720	87.9383	783.4686	0.1127
34.4289	112.4729	1092.4680	0.1034	37.6720	84.0919	713.3656	0.1186
39.4289	108.3397	999.4241	0.1082	42.6720	80.5815	644.8761	0.1259
44.4289	103.3450	912.8543	0.1137	47.6720	77.6289	578.5179	0.1340
49.4289	99.8927	816.0746	0.1214	52.6720	76.0457	524.7561	0.1431
54.4289	95.7209	733.3632	0.1295	57.6720	74.5942	481.4929	0.1534
59.4289	90.4078	649.5503	0.1388	62.6720	72.8519	434.3378	0.1670
64.4289	85.7180	568.7202	0.1507	67.6720	70.6165	391.4052	0.1824
69.4289	80.1376	490.1195	0.1657	72.6720	67.6373	342.1990	0.2012
74.4289	74.7848	413.4467	0.1846	77.6720	64.6053	293.3266	0.2236
79.4289	69.3779	340.4069	0.2071	82.6720	60.2580	242.7431	0.2503
84.4289	63.0770	273.2602	0.2323	87.6720	54.7051	197.0709	0.2779
89.4289	55.8697	215.5729	0.2576	92.6720	48.1818	158.0107	0.3035
94.4289	47.9345	170.4404	0.2788	97.6720	41.1717	126.2042	0.3237
99.4289	40.0199	134.8352	0.2935	102.6720	33.6661	99.1419	0.3367
104.4289	30.6993	101.7945	0.2995	107.6720	27.0011	78.5467	0.3402

TableD.1 Dynamic mechanical analysis of 0% KL (Continues)

Replication 1				Replication 2			
Temp (°C)	**E" (MPa)**	**E' (MPa)**	**Tan δ**	**Temp (°C)**	**E" (MPa)**	**E' (MPa)**	**Tan δ**
109.4289	24.4645	82.4362	0.2955	112.6720	21.1224	62.6158	0.3343
114.4289	19.7040	68.3759	0.2857	117.6720	16.2778	50.6300	0.3197
119.4289	15.4642	57.1959	0.2698	122.6720	12.5256	41.7897	0.2983
124.4289	11.9111	48.3163	0.2475	127.6720	9.6709	35.4736	0.2728
129.4289	9.3332	41.5229	0.2243	132.6720	7.5996	31.1036	0.2462
134.4289	7.2380	36.4254	0.2006	137.6720	6.0875	27.9857	0.2205
139.4289	5.7718	32.9293	0.1785	142.6720	4.9956	25.6816	0.1968
144.4289	4.7703	30.4344	0.1603	147.6720	4.1817	24.0641	0.1766
149.4289	4.1361	28.6372	0.1448	152.6720	3.6644	23.0386	0.1609
154.4289	3.5972	27.0847	0.1300	157.6720	3.3325	22.3771	0.1485
159.4289	3.0440	25.7868	0.1158	162.6720	3.0846	21.8547	0.1385
164.4289	2.5980	25.1746	0.1034	167.6720	2.7951	21.5987	0.1296
169.4289	2.1994	24.8220	0.0932	172.6720	2.5964	21.5409	0.1219
174.4289	2.0501	24.4045	0.0856	177.6720	2.5168	21.5794	0.1156
179.4289	1.9600	23.8404	0.0801	182.6720	2.3856	21.7810	0.1093
184.4289	1.7444	23.2489	0.0744	187.6720	2.2855	22.2257	0.1031
189.4289	1.5966	22.8945	0.0685	192.6720	2.2375	22.7081	0.0967
194.4289	1.3853	22.5202	0.0613	197.6720	2.1100	23.2983	0.0896
199.4289	1.2290	21.8687	0.0533	202.6720	1.8592	23.9200	0.0823
204.4289	0.9453	21.2253	0.0448	207.6720	1.7540	23.9205	0.0757
209.4289	0.6285	19.7136	0.0361	212.6720	1.6595	23.1438	0.0688
214.4289	0.4654	17.0273	0.0276	217.6720	1.3668	21.3614	0.0600
219.4289	0.3010	13.9083	0.0193	222.6720	0.9447	18.7686	0.0487
				227.6720	0.5406	15.1328	0.0359

TableD.2 Dynamic mechanical analysis of 10% KL

Replication 1				Replication 2			
Temp (°C)	**E" (MPa)**	**E' (MPa)**	**Tan δ**	**Temp (°C)**	**E" (MPa)**	**E' (MPa)**	**Tan δ**
-99.0091	454.2947	9754.7669	0.0353	-99.6350	209.6732	6241.1351	0.0309
-94.0091	332.3091	9642.3505	0.0367	-94.6350	225.1035	6157.6951	0.0334
-89.0091	355.7725	9435.2462	0.0409	-89.6350	220.1715	6079.4290	0.0368
-84.0091	448.0455	9063.3591	0.0507	-84.6350	251.6157	5875.8238	0.0439
-79.0091	550.5172	8517.9840	0.0654	-79.6350	310.6484	5685.7527	0.0560
-74.0091	656.4737	7931.5092	0.0846	-74.6350	374.9220	5373.2080	0.0762
-69.0091	790.2771	7194.9244	0.1084	-69.6350	487.6694	4965.7581	0.1038
-64.0091	845.3071	6358.2436	0.1347	-64.6350	602.8599	4419.4865	0.1386
-59.0091	838.5710	5412.4438	0.1640	-59.6350	651.8562	3824.6150	0.1708
-54.0091	833.5751	4456.9464	0.1914	-54.6350	645.8496	3197.3952	0.1962
-49.0091	793.2042	3550.2283	0.2136	-49.6350	584.1481	2659.0461	0.2085
-44.0091	689.5928	2865.6797	0.2217	-44.6350	498.9028	2297.9222	0.2052
-39.0091	563.4193	2515.2705	0.2158	-39.6350	400.6664	2092.3766	0.1896
-34.0091	435.6279	2252.7854	0.1963	-34.6350	301.7423	1939.7944	0.1636
-29.0091	345.4806	2083.3426	0.1719	-29.6350	237.5919	1786.5130	0.1383
-24.0091	276.1923	1935.5517	0.1479	-24.6350	191.0444	1653.8586	0.1191
-19.0091	223.5137	1805.8734	0.1270	-19.6350	158.6938	1530.8011	0.1055
-14.0091	186.2569	1685.1679	0.1126	-14.6350	138.1582	1420.8244	0.0972
-9.0091	161.0902	1572.6028	0.1027	-9.6350	122.7264	1309.9166	0.0931
-4.0091	143.0129	1461.1847	0.0972	-4.6350	111.0538	1202.5527	0.0916
0.9909	129.9788	1356.7756	0.0948	0.3651	102.7323	1101.5058	0.0916
5.9909	119.0168	1252.7600	0.0940	5.3651	94.1634	1014.8085	0.0922
10.9909	109.2968	1163.0200	0.0946	10.3651	86.8349	932.1029	0.0934
15.9909	103.7645	1079.0631	0.0964	15.3651	80.9881	855.9754	0.0955
20.9909	100.0521	999.7913	0.0992	20.3651	77.7510	787.4499	0.0986
25.9909	95.2358	926.2386	0.1022	25.3651	74.4766	729.0898	0.1025
30.9909	90.3677	854.4089	0.1057	30.3651	72.1076	673.7867	0.1068
35.9909	86.4955	794.8201	0.1094	35.3651	70.1253	627.3407	0.1115
40.9909	83.7383	733.0931	0.1141	40.3651	69.2458	588.6794	0.1168
45.9909	80.5177	669.1387	0.1199	45.3651	67.7810	549.5096	0.1217
50.9909	76.8999	604.7469	0.1268	50.3651	65.7849	515.4861	0.1279
55.9909	73.1803	538.0433	0.1354	55.3651	64.0246	473.8450	0.1359
60.9909	69.0237	470.3691	0.1466	60.3651	62.9888	428.1127	0.1473
65.9909	63.8277	391.4524	0.1639	65.3651	61.5393	378.5554	0.1630
70.9909	59.4060	329.6369	0.1822	70.3651	59.7443	328.6807	0.1835
75.9909	54.6064	270.2136	0.2052	75.3651	57.3147	276.9214	0.2094
80.9909	49.3437	215.1236	0.2318	80.3651	54.2781	227.8456	0.2399
85.9909	43.9372	169.9952	0.2579	85.3651	50.3579	184.2310	0.2723
90.9909	37.6692	131.9491	0.2831	90.3651	44.8512	147.4807	0.3035
95.9909	31.2677	102.2591	0.3033	95.3651	38.4548	116.1417	0.3312
100.9909	25.2376	79.1667	0.3164	100.3651	32.1636	90.9793	0.3520
105.9909	19.9450	61.7722	0.3209	105.3651	25.9414	70.4911	0.3644

TableD.2 Dynamic mechanical analysis of 10% KL (Continues)

Replication 1				Replication 2			
Temp (°C)	**E" (MPa)**	**E' (MPa)**	**Tan δ**	**Temp (°C)**	**E" (MPa)**	**E' (MPa)**	**Tan δ**
110.9909	15.3138	48.1698	0.3170	110.3651	20.7459	56.1115	0.3672
115.9909	11.6306	38.1307	0.3058	115.3651	15.9092	44.1290	0.3616
120.9909	8.8239	30.5844	0.2889	120.3651	11.4887	33.1622	0.3454
125.9909	6.7746	25.2913	0.2674	125.3651	8.6466	26.6316	0.3244
130.9909	5.1980	21.1491	0.2416	130.3651	6.6350	22.2381	0.2985
135.9909	3.9362	18.4623	0.2127	135.3651	5.0654	19.1221	0.2680
140.9909	2.9267	16.6576	0.1845	140.3651	3.9600	16.8075	0.2348
145.9909	2.4326	15.2833	0.1606	145.3651	3.0969	14.9210	0.1998
150.9909	2.0595	14.6480	0.1397	150.3651	2.1675	13.4741	0.1607
155.9909	1.7466	14.3209	0.1216	155.3651	1.4471	12.4267	0.1243
160.9909	1.5281	14.2246	0.1056	160.3651	1.0494	11.2347	0.0941
165.9909	1.3426	14.6115	0.0912	165.3651	0.6721	10.2601	0.0715
170.9909	1.1128	14.7739	0.0785	170.3651	0.4620	9.5982	0.0573
175.9909	0.9857	14.5097	0.0682	175.3651	0.4437	9.0275	0.0507
180.9909	0.8644	14.3644	0.0600	180.3651	0.4634	8.8238	0.0462
185.9909	0.7574	14.3612	0.0542	185.3651	0.4392	8.7690	0.0389
190.9909	0.7228	14.2960	0.0499	190.3651	0.2881	8.7070	0.0250
195.9909	0.6899	14.4098	0.0465	195.3651	-0.0321	9.6708	0.0050

TableD.3 Dynamic mechanical analysis of 20% KL

Replication 1				Replication 2			
Temp (^{o}C)	E" (MPa)	E' (MPa)	Tan δ	Temp (^{o}C)	E" (MPa)	E' (MPa)	Tan δ
-100.4342	209.8395	8108.8158	0.0218	-100.1311	31.0523	6236.2296	0.0062
-95.4342	201.9851	7961.8970	0.0246	-95.1311	82.1664	6193.7561	0.0120
-90.4342	203.0507	7789.1998	0.0283	-90.1311	99.7236	6237.1708	0.0176
-85.4342	249.0162	7537.7694	0.0343	-85.1311	158.5169	6116.0547	0.0245
-80.4342	310.8197	7289.2706	0.0423	-80.1311	184.0893	5877.6354	0.0330
-75.4342	358.2434	6952.3010	0.0520	-75.1311	243.3107	5607.9993	0.0440
-70.4342	413.0913	6492.3134	0.0631	-70.1311	289.0564	5297.6542	0.0580
-65.4342	442.7074	5973.9507	0.0736	-65.1311	350.8239	5030.3666	0.0752
-60.4342	453.3164	5535.0254	0.0834	-60.1311	425.9393	4580.0729	0.0923
-55.4342	471.0708	5040.2736	0.0931	-55.1311	480.8361	4169.3335	0.1073
-50.4342	454.8984	4521.1214	0.1006	-50.1311	439.3588	3735.4292	0.1154
-45.4342	430.3207	4035.5594	0.1051	-45.1311	380.8575	3248.5875	0.1170
-40.4342	391.6319	3598.9725	0.1062	-40.1311	328.3535	2890.0043	0.1136
-35.4342	330.0125	3232.6052	0.1037	-35.1311	283.8005	2620.8348	0.1073
-30.4342	285.8311	2886.9487	0.0992	-30.1311	230.2059	2359.3426	0.0985
-25.4342	250.5471	2634.7002	0.0936	-25.1311	185.8942	2129.5086	0.0887
-20.4342	211.6464	2438.3686	0.0879	-20.1311	157.1020	1971.7090	0.0808
-15.4342	183.2868	2259.4546	0.0825	-15.1311	134.7950	1835.6376	0.0748
-10.4342	165.6630	2110.3529	0.0788	-10.1311	122.1063	1719.2081	0.0712
-5.4342	148.7680	1959.1055	0.0761	-5.1311	114.5919	1612.4285	0.0692
-0.4342	138.4812	1838.0009	0.0747	-0.1311	100.9125	1507.9997	0.0682
4.5658	127.7545	1719.8924	0.0741	4.8689	97.1844	1408.7045	0.0685
9.5658	118.7762	1619.7581	0.0746	9.8689	91.6377	1319.4684	0.0699
14.5658	116.2423	1525.9832	0.0761	14.8689	89.3203	1230.4478	0.0724
19.5658	114.0577	1433.1287	0.0786	19.8689	87.8748	1143.0250	0.0756
24.5658	110.0908	1344.5986	0.0816	24.8689	84.5318	1069.3936	0.0792
29.5658	106.8410	1260.5607	0.0849	29.8689	81.8373	985.2487	0.0841
34.5658	105.5446	1177.8126	0.0893	34.8689	82.4555	914.1320	0.0904
39.5658	104.9616	1089.9710	0.0954	39.8689	82.4381	838.8389	0.0978
44.5658	102.8600	1007.5222	0.1026	44.8689	81.7541	767.9137	0.1062
49.5658	103.3081	923.7793	0.1133	49.8689	82.0246	706.3051	0.1167
54.5658	106.8509	817.7927	0.1306	54.8689	82.2961	641.5993	0.1281
59.5658	105.1690	713.0300	0.1492	59.8689	82.5855	583.7935	0.1393
64.5658	104.0351	608.0662	0.1712	64.8689	82.1077	524.8770	0.1549
69.5658	99.7294	504.2086	0.1956	69.8689	79.5952	461.6895	0.1727
74.5658	90.3216	407.1562	0.2209	74.8689	76.0944	396.1130	0.1948
79.5658	79.8362	323.4729	0.2475	79.8689	72.7891	330.1319	0.2239
84.5658	68.2906	251.8064	0.2765	84.8689	68.2540	262.7007	0.2620
89.5658	58.8020	191.6753	0.3073	89.8689	61.3958	201.7807	0.3056
94.5658	49.7202	147.0101	0.3372	94.8689	52.9177	150.7063	0.3512
99.5658	40.5816	111.9333	0.3658	99.8689	43.8023	111.3095	0.3948
104.5658	32.4866	84.7199	0.3881	104.8689	35.4332	82.5008	0.4310

TableD.3 Dynamic mechanical analysis of 20% KL (Continues)

Replication 1				Replication 2			
Temp (°C)	**E" (MPa)**	**E' (MPa)**	**Tan δ**	**Temp (°C)**	**E" (MPa)**	**E' (MPa)**	**Tan δ**
109.5658	25.9351	65.4887	0.3990	109.8689	27.8209	60.6097	0.4581
114.5658	19.9347	48.0875	0.3945	114.8689	20.9117	43.5004	0.4700
119.5658	14.3293	36.4051	0.3654	119.8689	15.3635	32.4608	0.4591
124.5658	8.8930	28.6339	0.3141	124.8689	10.6871	24.4757	0.4275
129.5658	5.4464	22.4074	0.2551	129.8689	7.3341	19.2298	0.3811
134.5658	3.4447	18.7564	0.1984	134.8689	5.1192	15.9804	0.3280
139.5658	2.3258	16.8753	0.1500	139.8689	3.6759	13.7933	0.2748
144.5658	1.8164	16.3989	0.1113	144.8689	2.7363	12.4200	0.2266
149.5658	1.3382	16.3200	0.0830	149.8689	2.1537	11.7575	0.1885
154.5658	0.9450	15.9397	0.0625	154.8689	1.7648	11.3453	0.1598
159.5658	0.8327	15.8728	0.0485	159.8689	1.4986	11.1101	0.1390
164.5658	0.6995	16.0337	0.0390	164.8689	1.4066	11.1414	0.1236
169.5658	0.5453	16.2222	0.0325	169.8689	1.3379	11.2413	0.1089
174.5658	0.4531	16.3497	0.0290	174.8689	1.2026	11.5955	0.0911
179.5658	0.4121	16.6132	0.0293	179.8689	0.7503	12.6191	0.0703
184.5658	0.5224	17.0340	0.0332	184.8689	0.5806	13.1874	0.0538
189.5658	0.8072	18.1940	0.0398	189.8689	0.8216	14.3482	0.0446
194.5658	0.9555	19.3457	0.0465	194.8689	0.6073	14.1174	0.0383
199.5658	1.0224	20.2995	0.0529	199.8689	0.5164	14.1438	0.0332

TableD.4 Dynamic mechanical analysis of 30% KL

Replication 1				Replication 2			
Temp (^{o}C)	E" (MPa)	E' (MPa)	Tan δ	Temp (^{o}C)	E" (MPa)	E' (MPa)	Tan δ
-97.8487	226.0312	7793.7108	0.0278	-100.5068	120.6208	3612.9450	0.0341
-92.8487	218.9929	7513.8952	0.0310	-95.5068	137.6622	3597.0439	0.0378
-87.8487	310.5820	7354.3381	0.0358	-90.5068	165.8441	3569.3214	0.0471
-82.8487	267.3531	7215.2479	0.0407	-85.5068	181.4504	3511.9761	0.0512
-77.8487	358.4414	6942.4267	0.0488	-80.5068	209.2151	3436.3508	0.0613
-72.8487	359.1851	6544.7025	0.0617	-75.5068	239.6068	3329.3944	0.0715
-67.8487	466.5868	6134.9739	0.0798	-70.5068	295.1724	3211.7060	0.0916
-62.8487	573.5058	5571.4156	0.1008	-65.5068	365.0344	2994.0020	0.1219
-57.8487	597.4722	4973.7032	0.1199	-60.5068	417.4380	2655.1444	0.1584
-52.8487	594.5879	4280.5755	0.1337	-55.5068	421.2553	2254.1120	0.1871
-47.8487	532.4984	3693.2824	0.1398	-50.5068	385.0662	1890.9158	0.2033
-42.8487	439.2100	3208.4725	0.1386	-45.5068	329.5194	1593.6977	0.2064
-37.8487	376.1036	2824.1932	0.1325	-40.5068	275.4854	1396.0514	0.1973
-32.8487	308.4366	2521.8240	0.1226	-35.5068	223.1734	1244.9462	0.1788
-27.8487	252.0560	2292.1556	0.1114	-30.5068	176.7984	1120.3629	0.1578
-22.8487	211.0922	2119.8974	0.1008	-25.5068	142.2818	1020.5252	0.1394
-17.8487	177.6490	1970.3281	0.0914	-20.5068	118.8064	941.8238	0.1263
-12.8487	155.5919	1855.4039	0.0837	-15.5068	102.4851	875.7337	0.1170
-7.8487	138.2556	1769.5229	0.0782	-10.5068	91.3212	816.6153	0.1119
-2.8487	125.6021	1683.2094	0.0743	-5.5068	83.4723	760.1630	0.1098
2.1513	113.9342	1607.1525	0.0719	-0.5068	77.9188	706.7802	0.1103
7.1513	108.5260	1540.4906	0.0712	4.4932	73.5731	655.2581	0.1123
12.1513	106.8644	1473.3929	0.0714	9.4932	70.2230	608.1125	0.1155
17.1513	103.2034	1417.8228	0.0719	14.4932	67.3273	563.4619	0.1196
22.1513	98.9881	1362.3678	0.0723	19.4932	64.4040	522.1662	0.1234
27.1513	94.6162	1306.3301	0.0730	24.4932	61.7307	482.8459	0.1277
32.1513	91.6479	1244.1763	0.0742	29.4932	59.8125	448.7049	0.1333
37.1513	91.0060	1179.6487	0.0765	34.4932	57.9082	423.5437	0.1368
42.1513	88.6471	1112.3538	0.0795	39.4932	56.0339	400.4416	0.1400
47.1513	86.9629	1047.0840	0.0833	44.4932	54.4319	377.4967	0.1439
52.1513	87.3225	976.5566	0.0886	49.4932	53.5680	357.5865	0.1501
57.1513	86.7992	909.4132	0.0949	54.4932	51.8405	336.1216	0.1542
62.1513	87.5183	839.4277	0.1037	59.4932	50.1433	312.4077	0.1604
67.1513	89.1766	741.5337	0.1192	64.4932	48.5248	288.5680	0.1683
72.1513	89.3550	646.3990	0.1386	69.4932	46.5114	264.7038	0.1756
77.1513	88.5344	544.1239	0.1655	74.4932	44.7583	238.9349	0.1872
82.1513	86.5704	442.0864	0.1998	79.4932	43.7112	213.7537	0.2046
87.1513	82.2249	341.3135	0.2442	84.4932	42.6809	187.8051	0.2273
92.1513	75.3683	255.4593	0.2966	89.4932	41.3543	159.9638	0.2578
97.1513	65.8520	187.5553	0.3515	94.4932	39.8312	132.3248	0.3010
102.1513	54.7671	135.9658	0.4023	99.4932	36.9551	103.4450	0.3603
107.1513	43.4430	97.3705	0.4444	104.4932	30.7065	72.7655	0.4233

TableD.4 Dynamic mechanical analysis of 30% KL (Continues)

Replication 1				Replication 2			
Temp (°C)	**E" (MPa)**	**E' (MPa)**	**Tan δ**	**Temp (°C)**	**E" (MPa)**	**E' (MPa)**	**Tan δ**
112.1513	32.6298	68.6183	0.4726	109.4932	21.7223	45.2395	0.4785
117.1513	23.1036	47.0512	0.4825	114.4932	14.3260	28.9779	0.4920
122.1513	15.6064	32.4974	0.4704	119.4932	8.6476	19.5479	0.4405
127.1513	10.4593	23.6813	0.4388	124.4932	4.2980	14.8682	0.2855
132.1513	7.1287	18.1555	0.3935	129.4932	1.7200	11.6482	0.1481
137.1513	4.9988	14.8237	0.3423	134.4932	0.3957	9.2205	0.0459
142.1513	3.7132	12.9550	0.2931	139.4932	-0.1639	7.8372	-0.0187
147.1513	2.8310	11.5657	0.2490	144.4932	-0.3404	6.9984	-0.0474
152.1513	2.2435	10.6639	0.2123	149.4932	-0.3540	6.3416	-0.0529
157.1513	1.8328	10.0858	0.1821	154.4932	-0.4138	5.8149	-0.0697
162.1513	1.4723	9.5687	0.1561	159.4932	-0.5050	5.5843	-0.0925
167.1513	1.2928	9.3498	0.1356	164.4932	-0.5135	5.4276	-0.0957
172.1513	1.1420	9.2621	0.1163	169.4932	-0.4679	5.4941	-0.0829
177.1513	0.9213	9.2773	0.0972	174.4932	-0.4996	5.5122	-0.0905
182.1513	0.6794	9.5708	0.0798	179.4932	-0.5428	5.4095	-0.1015
187.1513	0.5963	9.6065	0.0675	184.4932	-0.5330	5.4490	-0.0972
192.1513	0.5989	9.5494	0.0591	189.4932	-0.5218	5.5078	-0.0940
197.1513	0.5229	9.4047	0.0519	194.4932	-0.5135	5.5372	-0.0943
				199.4932	-0.4521	5.5669	-0.0786

TableD.5 Dynamic mechanical analysis of 40% KL

Replication 1				Replication 2			
Temp (^{o}C)	E" (MPa)	E' (MPa)	Tan δ	Temp (^{o}C)	E" (MPa)	E' (MPa)	Tan δ
-98.6643	-76.9132	9958.7352	-0.0035	-96.4494	224.9945	9874.0010	0.0222
-93.6643	93.6071	9522.1173	0.0033	-91.4494	269.1362	10028.2186	0.0239
-88.6643	46.3206	9413.7944	0.0077	-86.4494	225.2035	10085.2615	0.0273
-83.6643	99.6417	9376.8667	0.0129	-81.4494	335.5575	9569.2891	0.0374
-78.6643	221.1178	8826.7584	0.0219	-76.4494	544.4080	9361.4625	0.0499
-73.6643	211.7462	8507.5424	0.0341	-71.4494	526.0073	8938.6553	0.0626
-68.6643	400.1305	7748.7775	0.0508	-66.4494	614.4343	8368.0893	0.0783
-63.6643	513.7631	7092.1066	0.0684	-61.4494	692.0278	7621.5406	0.0971
-58.6643	533.0381	6303.6227	0.0856	-56.4494	773.9019	6632.2138	0.1160
-53.6643	554.9663	5446.1223	0.0980	-51.4494	797.4027	5777.6382	0.1289
-48.6643	487.4788	4710.8956	0.1040	-46.4494	696.6841	4999.3696	0.1320
-43.6643	439.1188	4099.6696	0.1039	-41.4494	534.7091	4357.7680	0.1267
-38.6643	361.0034	3613.4517	0.0980	-36.4494	440.1599	3824.4316	0.1157
-33.6643	275.4048	3217.6416	0.0885	-31.4494	343.9450	3361.9666	0.1013
-28.6643	229.4734	2960.9782	0.0782	-26.4494	253.4591	3028.7313	0.0867
-23.6643	187.1753	2743.1903	0.0691	-21.4494	199.7053	2829.9906	0.0763
-18.6643	158.2722	2559.5045	0.0624	-16.4494	190.6060	2666.0173	0.0698
-13.6643	137.0253	2413.1013	0.0582	-11.4494	166.3808	2513.9331	0.0655
-8.6643	129.2813	2284.2346	0.0562	-6.4494	149.4240	2377.5410	0.0630
-3.6643	122.1021	2167.8393	0.0556	-1.4494	140.4074	2237.3337	0.0614
1.3357	115.6395	2056.0670	0.0553	3.5506	129.5365	2103.3661	0.0603
6.3357	106.7229	1951.9412	0.0553	8.5506	116.7644	1988.4216	0.0597
11.3357	101.0593	1843.0188	0.0560	13.5506	111.0806	1892.0314	0.0604
16.3357	101.1479	1746.4017	0.0576	18.5506	114.9470	1809.9550	0.0627
21.3357	101.5787	1649.1536	0.0597	23.5506	114.6188	1722.2551	0.0657
26.3357	96.6707	1556.5991	0.0620	28.5506	113.3310	1630.8712	0.0688
31.3357	92.0406	1471.7091	0.0653	33.5506	110.3627	1540.2732	0.0718
36.3357	97.0341	1375.6464	0.0706	38.5506	107.5852	1433.3802	0.0755
41.3357	100.7822	1306.4176	0.0761	43.5506	106.3755	1337.4204	0.0801
46.3357	102.0983	1205.5310	0.0851	48.5506	107.5190	1262.7275	0.0853
51.3357	107.2244	1116.3935	0.0919	53.5506	109.6845	1173.1239	0.0933
56.3357	103.5355	1045.3230	0.0980	58.5506	111.0389	1083.7877	0.1009
61.3357	99.3638	955.3699	0.1073	63.5506	111.4571	996.6844	0.1109
66.3357	104.6158	850.1736	0.1215	68.5506	111.2328	896.3580	0.1227
71.3357	105.8829	739.7647	0.1412	73.5506	110.2163	781.4008	0.1392
76.3357	103.7450	608.7122	0.1712	78.5506	108.4187	657.2104	0.1640
81.3357	98.8965	474.1110	0.2127	83.5506	105.9908	528.7739	0.2022
86.3357	91.3647	350.6395	0.2660	88.5506	99.2559	400.6539	0.2593
91.3357	82.8290	254.2849	0.3312	93.5506	90.8342	287.2933	0.3349
96.3357	72.2440	179.8052	0.4075	98.5506	78.6371	190.8015	0.4247
101.3357	58.8412	123.1508	0.4827	103.5506	60.9812	116.0802	0.5153
106.3357	46.2250	85.1780	0.5368	108.5506	41.1497	68.9464	0.5769

TableD.5 Dynamic mechanical analysis of 40% KL (Continues)

Replication 1				Replication 2			
Temp (°C)	**E" (MPa)**	**E' (MPa)**	**Tan δ**	**Temp (°C)**	**E" (MPa)**	**E' (MPa)**	**Tan δ**
111.3357	31.1414	52.9705	0.5745	113.5506	26.0303	41.9746	0.5920
116.3357	18.8882	31.8952	0.5710	118.5506	15.4665	26.5568	0.5563
121.3357	11.0357	20.5885	0.5248	123.5506	8.3097	17.3421	0.4598
126.3357	6.3842	14.6093	0.4371	128.5506	4.3804	12.4315	0.3340
131.3357	3.6825	10.8128	0.3238	133.5506	1.7216	10.0760	0.1980
136.3357	1.7797	8.6566	0.2019	138.5506	0.1616	8.6562	0.0764
141.3357	0.3428	7.5568	0.0825	143.5506	-0.3056	7.4790	-0.0084
146.3357	-0.2417	6.5376	-0.0062	148.5506	-0.3876	6.8562	-0.0562
151.3357	-0.4738	6.0150	-0.0629	153.5506	-0.4053	6.2568	-0.0751
156.3357	-0.4773	5.6501	-0.0886	158.5506	-0.4635	6.0329	-0.0784
161.3357	-0.4348	5.3565	-0.0976	163.5506	-0.3563	6.0324	-0.0737
166.3357	-0.4748	5.0469	-0.0999	168.5506	-0.3778	6.0511	-0.0696
171.3357	-0.4669	4.8327	-0.1000	173.5506	-0.4128	6.0405	-0.0680
176.3357	-0.4491	4.8616	-0.1003	178.5506	-0.3847	5.8163	-0.0690
181.3357	-0.4944	4.7674	-0.1020	183.5506	-0.3991	5.8481	-0.0729
186.3357	-0.4965	4.6874	-0.1036	188.5506	-0.4841	5.6698	-0.0783
191.3357	-0.5011	4.6954	-0.1042	193.5506	-0.4847	5.6914	-0.0819
196.3357	-0.4993	4.8490	-0.1039	198.5506	-0.4609	5.6983	-0.0836

TableD.6 Dynamic mechanical analysis of 50% KL

Replication 1				Replication 2			
Temp (°C)	**E" (MPa)**	**E' (MPa)**	**Tan δ**	**Temp (°C)**	**E" (MPa)**	**E' (MPa)**	**Tan δ**
-97.5985	83.6829	4452.4631	0.0192	-101.2998	78.1847	471.2311	0.1670
-92.5985	96.5617	4387.0503	0.0210	-96.2998	73.4777	466.0081	0.1573
-87.5985	106.2159	4372.8228	0.0242	-91.2998	69.8431	464.3586	0.1498
-82.5985	130.7447	4287.1851	0.0307	-86.2998	66.9508	465.4104	0.1443
-77.5985	181.9770	4150.2441	0.0421	-81.2998	64.6414	462.3163	0.1398
-72.5985	220.1283	3930.6032	0.0616	-76.2998	63.7804	456.0631	0.1407
-67.5985	322.1618	3677.5782	0.0920	-71.2998	66.0366	448.7668	0.1471
-62.5985	423.5704	3265.1547	0.1264	-66.2998	76.8293	433.8397	0.1695
-57.5985	437.8641	2804.1294	0.1524	-61.2998	95.9613	413.2416	0.2244
-52.5985	395.5369	2405.3779	0.1654	-56.2998	101.7477	422.9709	0.3880
-47.5985	350.2243	2076.7948	0.1658	-51.2998	76.3257	494.4549	0.3815
-42.5985	281.9735	1818.1309	0.1550	-46.2998	60.5219	523.7858	0.3227
-37.5985	215.6194	1573.1257	0.1381	-41.2998	60.7630	513.3140	0.3383
-32.5985	166.3999	1400.7063	0.1201	-36.2998	62.9995	575.1753	0.3504
-27.5985	134.3051	1279.6506	0.1050	-31.2998	52.2649	490.6219	0.3216
-22.5985	109.9990	1179.9794	0.0932	-26.2998	41.6848	393.1173	0.2857
-17.5985	93.6371	1099.7031	0.0854	-21.2998	42.3817	365.7931	0.2611
-12.5985	83.4607	1038.4411	0.0810	-16.2998	43.1885	341.0240	0.2614
-7.5985	77.8865	977.2024	0.0796	-11.2998	38.4402	330.9692	0.2467
-2.5985	75.1125	920.9775	0.0799	-6.2998	35.2028	328.4898	0.2462
2.4015	70.0091	878.1721	0.0807	-1.2998	34.0512	326.8949	0.2613
7.4015	69.2249	843.4792	0.0825	3.7002	36.2078	321.5990	0.2975
12.4015	69.2671	807.4618	0.0844	8.7002	40.1103	312.0501	0.3125
17.4015	67.2175	783.2575	0.0851	13.7002	43.7591	316.2427	0.3213
22.4015	63.6003	755.5500	0.0852	18.7002	43.2666	387.6149	0.2901
27.4015	62.2950	725.3539	0.0864	23.7002	37.2902	413.4243	0.1801
32.4015	62.0919	689.2339	0.0892	28.7002	31.2472	413.0024	0.0968
37.4015	60.0651	655.5918	0.0922	33.7002	27.7736	406.5058	0.0655
42.4015	59.4591	617.3779	0.0956	38.7002	26.4739	406.4943	0.0650
47.4015	57.1775	582.1900	0.0991	43.7002	26.1403	405.8967	0.0644
52.4015	57.1927	549.1167	0.1039	48.7002	26.4539	403.7995	0.0657
57.4015	56.6623	515.0570	0.1097	53.7002	26.9053	401.4561	0.0671
62.4015	55.6331	477.7400	0.1163	58.7002	27.4080	397.7470	0.0688
67.4015	54.6228	428.2710	0.1266	63.7002	28.3660	390.4808	0.0725
72.4015	53.7395	382.1275	0.1392	68.7002	30.0550	377.0901	0.0798
77.4015	53.4409	335.7862	0.1583	73.7002	32.6381	358.6013	0.0909
82.4015	53.4423	283.0087	0.1900	78.7002	36.3091	331.2634	0.1103
87.4015	53.8634	225.4511	0.2422	83.7002	40.9989	295.4113	0.1369
92.4015	52.7862	166.3795	0.3217	88.7002	47.4196	252.0792	0.1895
97.4015	49.4774	118.3956	0.4238	93.7002	52.0429	197.7951	0.2611
102.4015	44.3680	85.1594	0.5317	98.7002	53.5442	144.8652	0.3723
107.4015	35.3720	56.4035	0.6301	103.7002	47.7802	97.5904	0.5083

TableD.6 Dynamic mechanical analysis of 50% KL (Continues)

Replication 1				Replication 2			
Temp (°C)	**E" (MPa)**	**E' (MPa)**	**Tan δ**	**Temp (°C)**	**E" (MPa)**	**E' (MPa)**	**Tan δ**
112.4015	24.6419	34.1804	0.6848	108.7002	32.6512	55.0486	0.5883
117.4015	14.5922	21.2607	0.6609	113.7002	15.8193	27.8157	0.5224
122.4015	7.5078	13.2260	0.5608	118.7002	5.7234	16.9200	0.3230
127.4015	3.8381	9.3886	0.4212	123.7002	1.0886	12.4365	0.0996
132.4015	1.9099	7.3988	0.2728	128.7002	-0.4551	10.3046	-0.0281
137.4015	0.8108	6.2065	0.1370	133.7002	-0.6407	9.1076	-0.0567
142.4015	0.1598	5.3424	0.0357	138.7002	-0.5327	8.5140	-0.0571
147.4015	-0.2023	4.6781	-0.0318	143.7002	-0.4784	8.3057	-0.0576
152.4015	-0.2693	4.4365	-0.0634	148.7002	-0.4747	8.0692	-0.0598
157.4015	-0.2938	4.2935	-0.0763	153.7002	-0.4762	7.9256	-0.0607
162.4015	-0.3149	4.1380	-0.0822	158.7002	-0.4689	7.8233	-0.0596
167.4015	-0.4405	4.4918	-0.0859	163.7002	-0.4709	7.8235	-0.0600
172.4015	-0.6645	4.2864	-0.0884	168.7002	-0.4799	7.8188	-0.0617
177.4015	5.6278	-5.7572	-0.0839	173.7002	-0.4825	7.8096	-0.0619
182.4015	-6.1469	33.3415	-0.0573	178.7002	-0.4823	7.7639	-0.0624
				183.7002	-0.4816	7.8878	-0.0611
				188.7002	-0.4814	7.8701	-0.0612
				193.7002	-0.4814	7.7770	-0.0622
				198.7002	-0.4809	8.0703	-0.0596

TableD.7 Dynamic mechanical analysis of 60% KL

Replication 1				Replication 2			
Temp (^{o}C)	E" (MPa)	E' (MPa)	Tan δ	Temp (^{o}C)	E" (MPa)	E' (MPa)	Tan δ
-98.0074	16.0869	292.5690	0.0074	-100.1836	16.9417	255.5562	0.0324
-93.0074	7.2203	405.8817	0.0030	-95.1836	14.0251	449.2802	0.0291
-88.0074	1.9007	380.4251	0.0005	-90.1836	13.1101	702.5515	0.0163
-83.0074	1.9558	379.7830	0.0007	-85.1836	12.9245	730.0235	0.0112
-78.0074	2.3773	382.3405	0.0012	-80.1836	14.2367	763.3134	0.0131
-73.0074	2.3119	380.1314	0.0014	-75.1836	5.7274	667.2986	0.0087
-68.0074	2.4975	396.0374	0.0021	-70.1836	45.4151	727.9990	0.0077
-63.0074	2.6714	397.7680	0.0029	-65.1836	145.0843	1376.9750	0.0395
-58.0074	2.7094	361.5151	0.0048	-60.1836	60.7680	757.4496	0.0520
-53.0074	3.5687	319.3480	0.0101	-55.1836	57.9897	458.3669	0.1115
-48.0074	6.3617	271.7028	0.0200	-50.1836	94.7891	372.6322	0.2159
-43.0074	7.6243	247.9399	0.0219	-45.1836	94.4092	323.1644	0.2841
-38.0074	5.8275	231.8143	0.0206	-40.1836	80.5211	294.6190	0.3319
-33.0074	4.6764	232.5994	0.0222	-35.1836	60.5638	318.8590	0.2461
-28.0074	4.9353	264.4604	0.0259	-30.1836	44.7494	322.3895	0.1590
-23.0074	4.8295	238.1308	0.0277	-25.1836	36.9864	320.5222	0.1270
-18.0074	3.8709	238.8690	0.0222	-20.1836	33.5743	325.3858	0.1100
-13.0074	3.7836	280.3816	0.0198	-15.1836	31.0666	308.4518	0.1001
-8.0074	4.4388	274.5480	0.0236	-10.1836	27.0235	297.8288	0.0892
-3.0074	4.5932	243.2485	0.0266	-5.1836	23.3325	286.9880	0.0817
1.9926	2.7205	258.6938	0.0100	-0.1836	19.7159	278.4577	0.0704
6.9926	1.6489	260.6026	0.0061	4.8164	16.4751	269.3753	0.0625
11.9926	1.8632	256.6558	0.0068	9.8164	13.7813	263.0207	0.0520
16.9926	2.9087	252.2766	0.0124	14.8164	11.8000	257.5458	0.0463
21.9926	3.0225	249.3421	0.0113	19.8164	9.4959	253.2355	0.0382
26.9926	3.6330	245.3107	0.0150	24.8164	7.8012	249.6663	0.0291
31.9926	3.5811	242.2584	0.0154	29.8164	7.4086	245.9232	0.0317
36.9926	2.6457	239.3499	0.0101	34.8164	7.2816	242.3855	0.0303
41.9926	2.9864	235.9490	0.0131	39.8164	7.0276	238.6025	0.0307
46.9926	3.6922	229.5845	0.0159	44.8164	6.1323	235.6689	0.0236
51.9926	4.1212	225.7847	0.0188	49.8164	7.1603	233.7793	0.0317
56.9926	4.3956	222.1617	0.0193	54.8164	6.3557	232.4953	0.0230
61.9926	5.4424	215.7051	0.0255	59.8164	6.6850	230.0209	0.0289
66.9926	6.7527	207.8076	0.0323	64.8164	8.2082	227.7703	0.0360
71.9926	9.2614	197.6031	0.0468	69.8164	10.8367	224.3211	0.0476
76.9926	13.6365	185.4971	0.0738	74.8164	14.5466	218.5287	0.0656
81.9926	19.8564	171.9059	0.1138	79.8164	18.6142	209.3170	0.0904
86.9926	28.9525	154.9456	0.1841	84.8164	23.2386	198.0046	0.1152
91.9926	37.6284	128.2261	0.2986	89.8164	32.3378	181.2038	0.1787
96.9926	37.6170	89.2990	0.4323	94.8164	41.6314	153.7945	0.2678
101.9926	27.1970	50.1274	0.5422	99.8164	42.2238	105.4738	0.4140
106.9926	15.0920	24.9190	0.5787	104.8164	28.9860	51.6965	0.5700

TableD.7 Dynamic mechanical analysis of 60% KL (Continues)

Replication 1				Replication 2			
Temp (°C)	**E" (MPa)**	**E' (MPa)**	**Tan δ**	**Temp (°C)**	**E" (MPa)**	**E' (MPa)**	**Tan δ**
111.9926	6.3380	12.9484	0.4512	109.8164	12.3742	20.6599	0.5548
116.9926	1.6057	8.4433	0.1958	114.8164	2.7833	10.4904	0.2512
121.9926	-0.1922	6.7548	-0.0109	119.8164	-0.3009	7.9272	-0.0175
126.9926	-0.4921	5.9336	-0.0660	124.8164	-0.5756	7.1171	-0.0622
131.9926	-0.4113	5.6373	-0.0653	129.8164	-0.4649	6.6577	-0.0674
136.9926	-0.3581	5.5994	-0.0636	134.8164	-0.4395	6.5338	-0.0678
141.9926	-0.3495	5.4825	-0.0652	139.8164	-0.4445	6.3294	-0.0706
				144.8164	-0.4468	6.2448	-0.0720
				149.8164	-0.4462	6.3567	-0.0701
				154.8164	-0.4462	6.3830	-0.0704
				159.8164	-0.4463	6.3664	-0.0698
				164.8164	-0.4464	6.3074	-0.0707
				169.8164	-0.4465	6.2840	-0.0714
				174.8164	-0.4463	6.3671	-0.0703
				179.8164	-0.4461	6.4725	-0.0687
				184.8164	-0.4466	6.3509	-0.0701
				189.8164	-0.4464	6.2550	-0.0721
				194.8164	-0.4454	6.5355	-0.0674
				199.8164	-0.4458	6.3900	-0.0707

TableD.8 Dynamic mechanical analysis of 70% KL

Replication 1				Replication 2			
Temp (°C)	**E" (MPa)**	**E' (MPa)**	**Tan δ**	**Temp (°C)**	**E" (MPa)**	**E' (MPa)**	**Tan δ**
-99.9792	3.0981	266.3446	0.0270	-96.9104	2.4402	62.0470	0.0840
-94.9792	4.1763	268.4244	0.0331	-91.9104	4.3942	126.9498	0.0740
-89.9792	4.7065	263.6253	0.0329	-86.9104	1.4385	79.2069	0.0666
-84.9792	5.8546	239.6177	0.0395	-81.9104	2.2406	89.8585	0.0644
-79.9792	6.9850	238.5228	0.0452	-76.9104	2.5122	94.1701	0.0634
-74.9792	7.7779	233.3661	0.0521	-71.9104	3.3378	104.0405	0.0614
-69.9792	7.6400	236.7747	0.0484	-66.9104	2.3712	95.3206	0.0579
-64.9792	10.2823	228.3686	0.0633	-61.9104	2.0099	80.6172	0.0563
-59.9792	15.9981	211.0122	0.0845	-56.9104	2.5997	84.8410	0.0595
-54.9792	22.5518	189.3831	0.1149	-51.9104	2.9496	81.5394	0.0692
-49.9792	29.2561	196.5819	0.1600	-46.9104	5.2131	67.7361	0.0853
-44.9792	34.2183	222.7759	0.1724	-41.9104	7.3380	55.4364	0.1020
-39.9792	33.5246	211.6993	0.1625	-36.9104	7.3321	51.5959	0.1117
-34.9792	27.0386	191.3115	0.1385	-31.9104	6.5619	53.1800	0.1136
-29.9792	19.8407	176.9422	0.1096	-26.9104	5.9345	69.2983	0.1065
-24.9792	14.6438	166.0735	0.0875	-21.9104	5.4886	66.5376	0.0964
-19.9792	14.5622	166.3863	0.0868	-16.9104	4.9815	60.8835	0.0850
-14.9792	8.4859	151.2677	0.0565	-11.9104	4.1002	60.1537	0.0749
-9.9792	6.7223	146.5197	0.0460	-6.9104	3.3602	54.7848	0.0695
-4.9792	5.2273	142.2543	0.0365	-1.9104	3.7223	54.3890	0.0673
0.0208	4.2722	139.0077	0.0308	3.0896	3.3264	53.7909	0.0640
5.0208	3.6754	136.4828	0.0269	8.0896	2.9040	51.8983	0.0621
10.0208	3.2531	134.6175	0.0245	13.0896	2.7061	55.5725	0.0625
15.0208	2.7810	132.4873	0.0207	18.0896	3.1841	51.4712	0.0650
20.0208	2.5673	131.3138	0.0188	23.0896	2.6994	50.6977	0.0644
25.0208	2.5912	130.3802	0.0201	28.0896	2.3970	49.4350	0.0635
30.0208	2.5562	129.2825	0.0206	33.0896	2.5416	48.7626	0.0623
35.0208	2.4117	128.1568	0.0176	38.0896	2.2922	51.5175	0.0595
40.0208	2.5035	127.2222	0.0199	43.0896	2.2968	51.8213	0.0578
45.0208	2.5988	126.8493	0.0208	48.0896	2.2625	54.6783	0.0561
50.0208	2.6204	126.8320	0.0206	53.0896	2.2347	53.2290	0.0564
55.0208	2.6191	127.0107	0.0209	58.0896	2.4069	51.2986	0.0587
60.0208	2.6112	126.4859	0.0203	63.0896	2.7884	52.9277	0.0614
65.0208	2.9532	125.5870	0.0241	68.0896	3.1431	50.2648	0.0654
70.0208	3.8583	123.5631	0.0312	73.0896	2.6179	53.2663	0.0682
75.0208	5.8646	120.8365	0.0483	78.0896	4.3906	53.2708	0.0790
80.0208	9.6332	117.4664	0.0811	83.0896	5.4254	52.9584	0.0997
85.0208	15.5906	112.2864	0.1308	88.0896	7.5483	51.7905	0.1523
90.0208	23.0138	100.9107	0.2255	93.0896	11.7119	48.3509	0.2648
95.0208	26.6227	76.6761	0.3798	98.0896	15.6037	35.4469	0.4289
100.0208	22.3032	43.5691	0.5607	103.0896	14.9103	20.4893	0.5689
105.0208	13.6893	19.4973	0.6570	108.0896	9.3012	10.5251	0.6463

TableD.8 Dynamic mechanical analysis of 70% KL (Continues)

Replication 1				Replication 2			
Temp (°C)	**E" (MPa)**	**E' (MPa)**	**Tan δ**	**Temp (°C)**	**E" (MPa)**	**E' (MPa)**	**Tan δ**
110.0208	5.2711	7.6492	0.4741	113.0896	4.7862	8.1479	0.7026
115.0208	0.6864	4.5524	0.0951	118.0896	-8.3840	42.6094	0.6685
120.0208	-0.6662	4.1752	-0.0739	123.0896	20.0548	-84.8557	0.3857
125.0208	-0.6162	4.1041	-0.0752	128.0896	455.8393	-1311.6961	0.0148
130.0208	-0.3817	4.0824	-0.0673	133.0896	1138.8753	-2229.0993	-0.1664
135.0208	-0.2686	4.1862	-0.0649	138.0896	391.8862	-1485.2643	0.0347
140.0208	-0.2542	4.2518	-0.0640	143.0896	145.8111	-929.4668	0.8926
145.0208	-0.2637	4.1780	-0.0657	148.0896	2495.2241	-973.6373	2.0998
150.0208	-0.2719	4.1230	-0.0667	153.0896	748.8276	-591.1647	1.5869
155.0208	-0.2743	4.1669	-0.0655	158.0896	2904.4193	1289.5856	0.5961
160.0208	-0.2744	4.1493	-0.0659	163.0896	3675.5161	304.3809	-0.0039
165.0208	-0.2741	4.0737	-0.0676	168.0896	387.3826	-1005.5719	-0.1446
170.0208	-0.2739	4.0735	-0.0675	173.0896	74.1700	-1179.1157	-0.1058
175.0208	-0.2738	4.0924	-0.0670	178.0896	177.4747	-1186.7553	-0.0632
180.0208	-0.2737	4.1220	-0.0665	183.0896	151.6880	-1249.3602	-0.0386
185.0208	-0.2737	4.1688	-0.0657	188.0896	264.7328	-585.2894	0.0034
190.0208	-0.2737	4.1727	-0.0656	193.0896	1347.8985	236.0133	0.0591
195.0208	-0.2738	4.0908	-0.0671	198.0896	1530.4367	-406.4425	0.0501

Table D.9 FT-IR spectrum of plasticized fish protein/ Kraft lignin biomaterial

Wave number (1/cm)	% Transmittance									
	0% KL		20% KL		40% KL		60% KL		70% KL	
	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2
4000	65.00	64.81	67.88	64.52	69.97	69.97	69.89	69.95	69.99	69.94
3980	65.00	64.82	67.85	64.51	69.98	69.93	69.87	69.91	69.95	69.95
3960	64.98	64.83	67.87	64.50	69.99	69.95	69.93	69.96	69.98	69.97
3940	64.94	64.81	67.87	64.49	69.97	69.94	69.92	69.97	69.98	69.95
3920	64.92	64.79	67.88	64.48	69.97	69.94	69.88	69.98	69.97	69.95
3900	64.92	64.79	67.89	64.50	69.97	69.93	69.83	69.98	69.99	69.96
3880	64.90	64.77	67.87	64.50	69.97	69.97	69.91	69.96	69.99	69.97
3860	64.84	64.74	67.81	64.49	69.96	69.95	69.95	69.94	69.98	69.96
3840	64.75	64.71	67.72	64.47	69.94	69.93	69.96	69.91	69.99	69.96
3820	64.67	64.67	67.59	64.43	69.90	69.90	69.95	69.89	69.99	69.96
3800	64.58	64.59	67.41	64.36	69.82	69.83	69.90	69.87	69.99	69.96
3780	64.36	64.43	67.20	64.21	69.67	69.73	69.87	69.80	69.98	69.99
3760	63.85	64.11	66.87	63.92	69.40	69.45	69.65	69.63	69.98	69.94
3740	63.23	63.66	66.44	63.52	69.03	69.06	69.31	69.36	69.93	69.83
3720	62.68	63.22	65.91	63.10	68.62	68.70	69.00	69.05	69.75	69.65
3700	62.01	62.53	65.11	62.51	67.98	68.04	68.33	68.46	69.36	69.23
3680	60.62	61.05	63.59	61.15	66.50	66.53	66.55	66.91	68.19	68.03
3660	58.90	59.40	61.56	59.41	64.46	64.26	63.57	64.35	65.97	65.87
3640	56.23	56.74	58.44	56.53	61.16	60.72	59.14	60.38	62.41	62.38
3620	52.79	53.23	54.51	52.75	56.97	56.29	54.07	55.70	58.06	58.11
3600	48.90	49.02	49.83	48.18	51.81	51.16	48.48	50.28	52.75	52.94
3580	44.69	44.59	44.96	43.43	46.38	45.72	42.84	44.64	46.93	47.33
3560	40.54	40.36	40.33	38.97	41.20	40.52	37.79	39.40	41.22	41.81
3540	36.74	36.45	36.18	35.02	36.62	35.95	33.61	34.92	36.15	36.84
3520	33.02	32.68	32.40	31.38	32.58	32.03	30.16	31.13	31.93	32.61
3500	29.58	29.22	29.02	28.11	29.06	28.68	27.32	28.00	28.55	29.15
3480	26.61	26.22	26.09	25.31	26.10	25.93	25.01	25.45	25.91	26.36
3460	24.03	23.63	23.60	22.90	23.56	23.62	23.04	23.28	23.73	24.01
3440	21.99	21.64	21.71	21.13	21.64	21.88	21.53	21.61	22.06	22.18
3420	20.69	20.47	20.56	20.23	20.51	20.76	20.58	20.58	20.92	20.94
3400	20.18	20.12	20.13	20.17	20.12	20.20	20.15	20.14	20.26	20.24
3380	20.27	20.48	20.35	20.85	20.47	20.24	20.29	20.32	20.16	20.20
3360	20.91	21.49	21.23	22.33	21.56	20.80	20.98	21.12	20.54	20.74
3340	21.61	22.54	22.32	23.99	22.91	21.62	21.92	22.21	21.25	21.62
3320	22.07	23.35	23.35	25.48	24.23	22.51	22.95	23.40	22.17	22.73
3300	22.57	24.13	24.40	26.82	25.49	23.44	23.97	24.57	23.17	23.90
3280	23.67	25.40	25.77	28.28	26.85	24.59	25.02	25.75	24.26	25.12
3260	25.89	27.58	27.67	30.16	28.49	26.13	26.16	27.00	25.41	26.39
3240	28.44	30.05	29.81	32.26	30.32	27.88	27.42	28.40	26.69	27.78
3220	30.60	32.19	31.80	34.26	32.17	29.64	28.76	29.91	28.14	29.33
3200	32.63	34.18	33.73	36.20	34.01	31.44	30.17	31.47	29.73	30.99
3180	34.92	36.42	35.87	38.27	36.02	33.45	31.69	33.14	31.45	32.76
3160	37.38	38.79	38.13	40.39	38.13	35.62	33.30	34.88	33.29	34.62
3140	39.63	40.95	40.26	42.35	40.17	37.73	34.92	36.62	35.19	36.51

Table D.9 FT-IR spectrum of plasticized fish protein/ Kraft lignin biomaterial (Continues)

Wave number (1/cm)	% Transmittance									
	0% KL		20% KL		40% KL		60% KL		70% KL	
	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2
3120	41.30	42.54	42.04	43.96	41.99	39.64	36.49	38.29	37.07	38.37
3100	42.12	43.33	43.27	45.10	43.49	41.24	38.03	39.94	39.08	40.34
3080	42.45	43.64	44.02	45.82	44.57	42.42	39.37	41.40	40.96	42.17
3060	43.27	44.41	44.93	46.68	45.63	43.62	40.59	42.71	42.59	43.77
3040	45.25	46.24	46.57	48.14	47.13	45.26	41.92	44.10	44.10	45.22
3020	46.82	47.76	47.94	49.30	48.34	46.57	42.89	45.08	45.07	46.14
3000	47.84	48.75	48.80	50.06	49.09	47.39	43.54	45.72	45.69	46.74
2980	44.73	45.89	46.54	48.13	47.55	45.67	42.74	45.00	45.10	46.16
2960	38.96	40.66	41.48	43.57	42.62	40.49	38.62	40.67	40.34	41.59
2940	37.24	39.14	39.58	41.81	40.24	38.08	36.20	38.01	37.17	38.52
2920	37.15	39.15	40.49	42.54	41.43	39.43	37.54	39.42	39.06	40.40
2900	42.38	43.99	43.86	45.76	44.17	42.32	39.44	41.46	41.21	42.50
2880	42.27	43.93	43.48	45.49	43.69	41.86	38.90	40.90	40.55	41.87
2860	44.24	45.86	45.88	47.57	46.14	44.53	41.22	43.29	43.34	44.59
2840	48.98	50.22	49.23	50.61	48.62	47.27	42.99	45.06	45.08	46.28
2820	51.82	52.85	52.04	53.12	51.72	50.60	46.13	48.20	48.65	49.69
2800	53.79	54.68	53.96	54.80	53.73	52.74	48.29	50.33	50.97	51.89
2780	55.28	56.09	55.39	56.05	55.17	54.29	49.90	51.88	52.60	53.45
2760	56.56	57.28	56.53	57.04	56.25	55.44	51.08	53.02	53.77	54.55
2740	57.67	58.33	57.49	57.89	57.12	56.38	52.01	53.90	54.65	55.40
2720	58.80	59.41	58.52	58.79	58.06	57.40	53.05	54.88	55.61	56.31
2700	59.73	60.30	59.45	59.60	58.98	58.39	54.13	55.88	56.62	57.26
2680	60.27	60.83	60.03	60.11	59.61	59.05	54.91	56.62	57.36	57.97
2660	60.77	61.34	60.51	60.54	60.09	59.57	55.52	57.19	57.92	58.50
2640	61.39	61.95	61.06	61.02	60.57	60.08	56.09	57.72	58.39	58.95
2620	62.13	62.65	61.74	61.62	61.21	60.77	56.88	58.44	59.07	59.60
2600	62.90	63.39	62.49	62.27	61.89	61.51	57.71	59.19	59.76	60.26
2580	63.51	63.99	63.18	62.87	62.57	62.24	58.59	59.97	60.50	60.97
2560	63.95	64.42	63.72	63.36	63.17	62.87	59.40	60.71	61.21	61.65
2540	64.33	64.86	64.22	63.80	63.73	63.45	60.17	61.42	61.90	62.30
2520	64.68	65.32	64.65	64.18	64.22	63.97	60.89	62.06	62.53	62.89
2500	65.13	65.85	65.14	64.63	64.74	64.52	61.62	62.72	63.15	63.49
2480	65.78	66.43	65.69	65.22	65.30	65.12	62.41	63.41	63.80	64.11
2460	66.45	67.02	66.28	65.83	65.90	65.75	63.25	64.15	64.48	64.76
2440	67.08	67.58	66.86	66.44	66.51	66.40	64.14	64.92	65.20	65.45
2420	67.69	68.11	67.43	67.03	67.11	67.03	65.01	65.67	65.89	66.11
2400	68.20	68.56	67.93	67.57	67.66	67.61	65.85	66.40	66.57	66.75
2380	68.60	68.88	68.34	68.01	68.12	68.07	66.59	67.05	67.20	67.32
2360	68.81	69.10	68.65	68.33	68.43	68.40	67.17	67.55	67.66	67.70
2340	69.00	69.28	68.90	68.60	68.69	68.69	67.64	67.95	68.04	68.05
2320	69.20	69.43	69.12	68.85	68.89	68.96	68.03	68.22	68.34	68.36
2300	69.48	69.62	69.37	69.14	69.19	69.23	68.41	68.60	68.69	68.73
2280	69.74	69.81	69.65	69.44	69.50	69.52	68.90	69.06	69.09	69.12
2260	69.91	69.95	69.85	69.68	69.73	69.76	69.34	69.45	69.46	69.46

Table D.9 FT-IR spectrum of plasticized fish protein/ Kraft lignin biomaterial (Continues)

Wave number (1/cm)	% Transmittance									
	0% KL		20% KL		40% KL		60% KL		70% KL	
	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2
2240	69.98	70.00	69.96	69.84	69.88	69.91	69.64	69.71	69.73	69.71
2220	70.00	70.00	70.00	69.94	69.96	69.98	69.83	69.88	69.91	69.87
2200	69.99	69.98	69.99	69.98	69.96	69.98	69.90	69.95	70.00	69.95
2180	69.94	69.93	69.94	69.93	69.90	69.91	69.83	69.90	69.98	69.92
2160	69.84	69.84	69.83	69.83	69.80	69.80	69.69	69.79	69.88	69.82
2140	69.75	69.75	69.73	69.74	69.73	69.71	69.59	69.71	69.80	69.75
2120	69.67	69.67	69.64	69.66	69.64	69.63	69.48	69.62	69.71	69.67
2100	69.63	69.62	69.56	69.58	69.56	69.55	69.35	69.51	69.60	69.57
2080	69.61	69.59	69.47	69.49	69.42	69.41	69.10	69.30	69.39	69.38
2060	69.67	69.65	69.48	69.48	69.37	69.38	68.90	69.13	69.19	69.21
2040	69.79	69.77	69.66	69.63	69.57	69.59	69.22	69.37	69.42	69.43
2020	69.91	69.89	69.85	69.80	69.79	69.81	69.60	69.69	69.72	69.71
2000	69.98	69.97	69.96	69.93	69.93	69.96	69.88	69.92	69.96	69.93
1980	69.95	69.96	69.94	69.94	69.92	69.95	69.87	69.90	69.96	69.93
1960	69.93	69.96	69.94	69.95	69.89	69.94	69.81	69.85	69.91	69.88
1940	69.89	69.97	69.98	69.99	69.92	69.98	69.86	69.89	69.95	69.91
1920	69.70	69.89	69.92	69.95	69.93	69.92	69.85	69.97	69.96	69.92
1900	69.31	69.50	69.66	69.82	69.85	69.78	69.82	69.92	69.95	69.89
1880	68.82	69.04	69.35	69.64	69.70	69.60	69.72	69.87	69.92	69.85
1860	68.18	68.43	68.93	69.37	69.50	69.38	69.61	69.79	69.89	69.83
1840	67.24	67.58	68.32	68.93	69.17	69.11	69.52	69.70	69.93	69.91
1820	66.08	66.46	67.44	68.25	68.60	68.46	69.10	69.40	69.81	69.83
1800	64.47	65.02	66.15	67.18	67.46	67.37	67.83	68.28	69.07	69.13
1780	62.31	62.95	64.16	65.49	65.51	65.28	65.02	65.95	67.03	67.18
1760	58.75	59.69	61.11	62.77	62.71	62.44	61.85	63.15	64.51	64.74
1740	53.01	54.41	56.27	58.32	58.18	57.73	57.22	59.17	61.24	61.59
1720	48.54	49.63	51.72	54.35	53.82	52.79	52.78	55.30	57.68	58.25
1700	37.95	39.13	43.47	47.24	47.77	46.16	48.76	51.66	54.84	55.62
1680	27.00	28.88	33.61	38.26	39.18	36.72	43.59	47.19	53.22	54.03
1660	21.57	23.75	28.31	33.25	33.97	31.17	40.02	43.98	51.85	52.62
1640	22.81	24.70	29.71	33.77	35.30	32.62	40.43	43.77	51.06	51.75
1620	32.84	34.50	38.78	41.50	42.27	39.93	41.98	44.23	47.63	48.58
1600	42.19	43.01	43.32	46.66	43.32	41.21	39.18	41.35	41.09	42.54
1580	39.18	40.37	42.88	46.94	45.59	43.22	43.56	46.17	47.52	48.77
1560	33.82	35.80	39.54	44.26	44.58	41.88	46.73	50.25	55.37	56.21
1540	30.43	32.82	36.97	42.01	42.33	39.51	45.08	48.75	55.05	55.94
1520	34.49	36.23	37.72	42.43	38.32	35.65	34.91	37.04	35.97	37.62
1500	43.65	44.32	43.95	48.13	43.38	41.12	38.79	41.11	40.27	41.87
1480	50.33	50.79	48.31	51.99	47.06	45.11	41.01	43.47	42.77	44.21
1460	44.67	45.73	42.48	46.54	40.71	38.44	34.94	37.06	35.13	36.70
1440	44.60	45.57	43.03	47.12	42.20	40.02	36.85	39.22	37.90	39.37
1420	44.50	45.58	42.30	46.54	41.16	38.81	35.42	37.54	35.76	37.28
1400	41.22	42.68	41.57	46.00	41.78	39.25	36.93	39.01	37.67	39.20
1380	45.75	46.79	44.41	48.61	43.48	41.26	38.15	40.30	39.28	40.88

Table D.9 FT-IR spectrum of plasticized fish protein/ Kraft lignin biomaterial (Continues)

Wave number (1/cm)	% Transmittance									
	0% KL		20% KL		40% KL		60% KL		70% KL	
	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2
1360	50.13	51.04	47.07	51.03	45.29	43.33	39.27	41.42	40.35	41.97
1340	50.26	51.11	47.38	51.40	46.10	43.88	39.96	42.14	41.33	42.98
1320	49.81	50.60	46.85	51.02	45.55	43.38	39.51	41.71	40.61	42.29
1300	50.55	51.22	46.53	50.74	44.29	42.16	37.81	39.88	38.08	39.84
1280	50.96	51.49	44.42	48.72	40.04	37.82	33.14	34.69	31.55	33.38
1260	50.22	50.48	44.22	48.51	39.92	37.70	33.06	34.57	31.59	33.46
1240	47.75	47.73	44.08	48.38	41.14	38.90	34.77	36.58	34.27	36.13
1220	49.39	48.76	44.21	48.34	40.09	38.06	33.34	34.94	32.30	34.15
1200	52.51	51.00	47.07	51.05	42.84	41.03	35.42	37.26	35.19	37.06
1180	55.03	52.44	50.52	54.43	47.02	45.22	39.53	41.75	40.43	42.24
1160	55.24	51.94	50.26	54.26	46.61	44.76	38.91	41.04	39.11	40.94
1140	55.86	51.72	49.67	53.83	45.60	43.66	37.33	39.33	36.76	38.60
1120	44.24	41.35	41.42	46.04	39.04	36.69	32.44	34.29	31.76	33.54
1100	43.43	39.93	41.34	45.96	39.49	37.30	32.78	34.76	32.85	34.68
1080	45.22	41.92	43.07	47.63	41.30	39.24	34.38	36.39	34.59	36.42
1060	38.60	37.28	37.58	42.52	36.55	34.29	30.94	32.78	30.99	32.78
1040	34.88	34.49	32.92	38.15	30.81	28.50	25.58	26.89	24.50	26.00
1020	47.02	45.30	42.30	47.43	38.32	36.67	30.12	32.16	30.55	32.36
1000	52.56	50.41	48.46	53.57	45.90	44.39	36.95	39.51	38.99	40.73
980	55.90	53.74	51.24	56.42	48.67	47.33	39.30	42.04	41.80	43.49
960	62.66	59.90	57.31	62.39	54.17	53.14	44.15	46.95	46.91	48.43
940	64.10	61.68	59.23	64.21	56.98	55.83	47.99	50.67	50.75	52.12
920	59.89	58.61	54.83	60.15	52.82	51.41	44.02	46.77	46.78	48.33
900	64.86	63.13	59.57	64.76	57.37	56.39	48.79	51.37	51.73	52.98
880	65.98	64.36	60.34	65.64	58.26	57.14	50.16	52.64	52.70	53.87
860	61.31	60.38	54.89	60.58	52.37	50.81	43.61	46.15	45.80	47.23
840	63.01	61.90	57.03	62.56	54.66	53.21	45.72	48.34	48.48	49.73
820	63.67	62.41	57.54	62.81	54.84	53.34	45.84	48.37	48.23	49.55
800	62.68	61.24	57.37	62.63	55.36	53.81	46.77	49.29	49.49	50.69
780	60.21	59.27	55.85	61.23	54.63	52.96	46.64	49.18	49.61	50.82
760	58.25	57.61	54.53	60.21	53.99	52.19	46.54	49.11	49.78	50.97
740	55.54	55.23	52.54	58.38	52.49	50.54	45.47	48.03	48.90	50.09
720	53.07	53.07	50.90	56.86	51.32	49.33	44.74	47.28	48.42	49.60
700	50.09	50.36	48.59	54.75	49.45	47.35	43.37	45.98	47.34	48.55
680	48.32	48.58	46.46	52.78	47.19	45.04	41.06	43.72	44.92	46.16
660	48.11	48.24	46.00	52.34	46.55	44.48	40.32	43.02	44.30	45.50
640	48.18	48.24	45.85	52.03	46.03	44.19	39.62	42.25	43.49	44.70
620	47.57	47.48	44.66	50.74	44.06	42.31	37.48	40.11	41.16	42.44
600	47.14	46.91	44.74	50.57	44.80	43.32	38.53	41.12	42.86	44.01
580	47.29	46.87	44.49	50.23	44.42	42.99	38.08	40.74	42.63	43.72
560	47.00	46.45	43.82	49.62	43.47	42.09	36.87	39.64	41.35	42.56
540	47.80	47.17	44.50	50.25	44.03	42.87	37.28	40.06	42.08	43.23
520	48.53	47.88	45.38	50.81	44.84	43.86	37.83	40.65	42.90	44.04
500	48.89	48.30	45.90	51.15	45.07	44.36	38.24	40.89	43.19	44.18

Table D.9 FT-IR spectrum of plasticized fish protein/ Kraft lignin biomaterial (Continues)

Wave number (1/cm)	% Transmittance									
	0% KL		20% KL		40% KL		60% KL		70% KL	
	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2
480	49.22	48.53	45.96	51.46	45.46	44.97	38.59	40.81	43.47	44.33
460	50.64	49.68	47.35	52.52	46.60	46.20	39.16	41.64	44.34	45.21
440	52.25	51.85	48.77	53.83	47.67	47.60	39.94	42.53	45.50	46.22
420	53.37	53.56	49.64	54.71	48.54	48.61	40.54	43.31	46.24	47.11
400	53.68	55.82	48.98	55.51	49.02	48.83	40.92	44.47	46.66	47.95

Table D.10 Mechanical properties of plasticized fish protein/ Kraft lignin biomaterial at 100 ºC

Sample	**Young (MPa)**	**Tensile strength (MPa)**	**Elongation at break (%)**
0% KL	35.872	2.055	10.270
	19.890	0.993	7.095
	22.961	1.456	20.995
	23.124	1.342	24.234
	24.332	1.762	25.012
	21.439	1.181	30.325
	42.303	2.601	31.432
	22.438	1.042	30.542
10% KL	29.879	3.508	15.695
	20.351	2.439	15.795
	24.797	3.089	21.195
	32.493	3.248	14.695
	29.953	2.989	24.873
	31.181	3.233	23.986
	32.410	2.490	22.974
	33.639	3.017	30.865
20% KL	36.969	3.227	20.395
	39.842	4.480	14.820
	32.460	4.875	18.195
	26.908	4.326	23.595
	50.324	4.840	18.620
	45.203	4.754	23.987
	41.874	4.103	26.972
30% KL	45.732	5.448	15.120
	37.229	5.505	23.170
	43.584	3.758	20.070
40% KL	40.667	3.821	10.020
	26.008	3.568	15.320
	27.807	3.643	11.270
	27.005	3.347	11.345
	29.267	3.642	12.895
50% KL	18.674	1.248	7.070
	18.007	1.158	5.170

Table D.11 Mechanical properties of plasticized fish protein/ Kraft lignin biomaterial at 130 ºC

Sample	Young (MPa)	Tensile strength (MPa)	Elongation at break (%)
0% KL	25.639	1.505	8.545
	28.875	2.318	14.770
	25.989	1.337	8.245
	31.101	2.153	11.995
10% KL	40.190	3.713	10.945
	36.797	3.191	11.295
	43.093	3.138	11.045
	40.634	3.101	10.095
20% KL	58.861	4.727	10.370
	48.782	3.574	9.020
	61.172	3.680	6.995
	86.396	4.447	6.170
	75.163	5.471	10.520
30% KL	60.583	5.123	10.020
	63.717	4.906	6.295
	71.588	5.508	10.370
	72.400	5.565	7.245
40% KL	66.206	4.487	8.645
	60.826	3.412	5.195
	68.934	3.902	6.895
	62.414	2.911	5.145
50% KL	8.631	0.336	1.870
	16.283	0.225	0.370
	1.156	0.060	1.370
	-2.851	0.114	0.170

Table D.12 Water absorption of plasticized fish protein/ Kraft lignin biomaterial at 100 ºC

Fiber content	Replication	Water absorption (%)
0 % KL	1	59.14
	2	58.10
	3	54.17
	4	55.05
10 % KL	1	56.88
	2	54.68
	3	53.80
	4	55.49
20 % KL	1	43.53
	2	41.55
	3	41.25
	4	43.26
30 % KL	1	42.21
	2	42.81
	3	41.37
	4	42.25
40 % KL	1	33.28
	2	33.55
	3	33.56
	4	32.95
50 % KL	1	30.64
	2	33.77
	3	32.91
	4	32.81
60 % KL	1	31.07
	2	32.25
	3	31.40
	4	33.26
70 % KL	1	30.44
	2	31.51
	3	30.15
	4	31.16

Table D.13 Water absorption of plasticized fish protein/ Kraft lignin biomaterial at 130 ºC

Fiber content	Replication	Water absorption (%)
0 % KL	1	55.91
	2	53.84
	3	54.25
	4	54.96
10 % KL	1	50.53
	2	51.66
	3	51.24
	4	49.68
20 % KL	1	41.26
	2	38.55
	3	40.68
	4	42.56
30 % KL	1	36.35
	2	35.47
	3	35.48
	4	35.46
40 % KL	1	32.09
	2	32.39
	3	33.36
	4	33.20
50 % KL	1	32.53
	2	32.18
	3	30.95
	4	32.03
60 % KL	1	30.99
	2	30.53
	3	31.53
	4	30.24
70 % KL	1	30.43
	2	29.42
	3	29.42
	4	29.92

APPENDIX E
Statistic analysis

Table E.1 ANOVA table of water absorption of biomaterial at 100ºC

Water absorption

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	3053.274	7	436.182	283.669	.000
Within Groups	36.903	24	1.538		
Total	3090.177	31			

	KL	N	Subset for alpha = .05			
			1	2	3	4
Duncan(a)	70.00	4	30.8150			
	60.00	4	31.9950	31.9950		
	50.00	4	32.5325	32.5325		
	40.00	4		33.3350		
	30.00	4			42.1600	
	20.00	4			42.3975	
	10.00	4				55.2125
	.00	4				56.6150
	Sig.		.075	.161	.789	.123

Means for groups in homogeneous subsets are displayed.

Table E.2 ANOVA table of water absorption of biomaterial at 130ºC

Water absorption

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2553.588	7	364.798	489.910	.000
Within Groups	17.871	24	.745		
Total	2571.459	31			

	KL	N	Subset for alpha = .05						
			1	2	3	4	5	6	7
Duncan(a)	70.00	4	29.7998						
	60.00	4	30.8199	30.8199					
	50.00	4		31.9208	31.9208				
	40.00	4			32.7608				
	30.00	4				35.6930			
	20.00	4					40.7629		
	10.00	4						50.7805	
	.00	4							54.7403
	Sig.		.108	.084	.181	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

Table E.3 ANOVA table of Young's modulus of biomaterial at 100 ºC

Young's modulus

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1333.342	5	266.668	6.276	.001
Within Groups	1147.316	27	42.493		
Total	2480.658	32			

	KL	N	Subset for alpha = .05			
			1	2	3	4
Duncan(a,b)	50.00	2	18.3405			
	.00	8	26.5449	26.5449		
	10.00	8		29.3379		
	40.00	5		30.1508	30.1508	
	20.00	7			39.0829	39.0829
	30.00	3				42.1817
	Sig.		.079	.457	.057	.496

Means for groups in homogeneous subsets are displayed.

Table E.4 ANOVA table of Tensile strength of biomaterial at 100 ºC

Tensile strength

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	48.754	5	9.751	36.439	.000
Within Groups	7.225	27	.268		
Total	55.979	32			

	KL	N	Subset for alpha = .05		
			1	2	3
Duncan(a,b)	50.00	2	1.2030		
	.00	8	1.5540		
	10.00	8		3.0016	
	40.00	5		3.6042	
	20.00	7			4.3721
	30.00	3			4.9037
	Sig.		.334	.103	.148

Means for groups in homogeneous subsets are displayed.

Table E.5 ANOVA table of elongation at break of biomaterial 100 ºC

Elongation at break

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	730.167	5	146.033	4.030	.007
Within Groups	978.495	27	36.241		
Total	1708.662	32			

	KL	N	Subset for alpha = .05		
			1	2	3
Duncan(a,b)	50.00	2	6.1200		
	40.00	5	12.1700	12.1700	
	30.00	3		19.4533	19.4533
	20.00	7		20.9406	20.9406
	10.00	8		21.2598	21.2598
	.00	8			22.4881
	Sig.		.156	.053	.512

Means for groups in homogeneous subsets are displayed.

Table E.6 ANOVA table of Young's modulus of biomaterial at 130 ºC

Young's modulus

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	13082.422	5	2616.484	39.218	.000
Within Groups	1267.605	19	66.716		
Total	14350.027	24			

	KL	N	Subset for alpha = .05			
			1	2	3	4
Duncan(a,b)	50.00	4	5.8048			
	.00	4		27.9010		
	10.00	4			40.1785	
	40.00	4				64.5950
	20.00	5				66.0748
	30.00	4				67.0720
	Sig.		1.000	1.000	1.000	.685

Means for groups in homogeneous subsets are displayed.

Table E.7 ANOVA table of Tensile strength of biomaterial at 130 ºC

Tensile strength

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	69.004	5	13.801	51.416	.000
Within Groups	5.100	19	.268		
Total	74.103	24			

	KL	N	Subset for alpha = .05				
			1	2	3	4	5
Duncan(a,b)	50.00	4	.1838				
	.00	4		1.8283			
	10.00	4			3.2858		
	40.00	4			3.6780	3.6780	
	20.00	5				4.3798	
	30.00	4					5.2755
	Sig.		1.000	1.000	.290	.066	1.000

Means for groups in homogeneous subsets are displayed.

Table E.8 ANOVA table of elongation at break of biomaterial 130 ºC

Elongation at break

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	275.395	5	55.079	15.489	.000
Within Groups	67.564	19	3.556		
Total	342.959	24			

	KL	N	Subset for alpha = .05		
			1	2	3
Duncan(a,b)	50.00	4	.9450		
	40.00	4		6.4700	
	30.00	4		8.4825	8.4825
	20.00	5		8.6150	8.6150
	10.00	4			10.8450
	.00	4			10.8887
	Sig.		1.000	.137	.107

Means for groups in homogeneous subsets are displayed.

Table E.9 ANOVA table of storage modulus (E') of biomaterial

Storage modulus

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1000.656	7	142.951	25.622	.000
Within Groups	44.634	8	5.579		
Total	1045.290	15			

	KL	N	Subset for alpha = .05				
			1	2	3	4	5
Duncan(a)	70.00	2	3.4275				
	60.00	2	5.9269	5.9269			
	50.00	2	7.1025	7.1025			
	40.00	2	8.0647	8.0647			
	30.00	2		10.6793	10.6793		
	20.00	2			15.2568	15.2568	
	10.00	2				16.9420	
	.00	2					29.7163
	Sig.		.102	.095	.089	.496	1.000

Means for groups in homogeneous subsets are displayed.

Table E.10 ANOVA table of Tan δ peak high of biomaterial

Tan δ peak high

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.344	7	.049	16.318	.000
Within Groups	.027	9	.003		
Total	.371	16			

	KL	N	Subset for alpha = .05				
			1	2	3	4	5
Duncan(a,b)	.00	2	.3199				
	10.00	2	.3441				
	20.00	2	.4349	.4349			
	30.00	2		.4880	.4880		
	40.00	2			.5857	.5857	
	60.00	2			.5922	.5922	
	50.00	2				.6385	.6385
	70.00	3					.7358
	Sig.		.070	.349	.096	.372	.103

Means for groups in homogeneous subsets are displayed.

Table E.11 ANOVA table of Glass transition temperature of biomaterial

Glass transition temperature

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	166.175	7	23.739	2.543	.097
Within Groups	84.007	9	9.334		
Total	250.182	16			

	KL	N	Subset for alpha = .05		
			1	2	3
Duncan(a,b)	.00	2	105.5004		
	60.00	2	106.6045	106.6045	
	10.00	2	107.7780	107.7780	107.7780
	70.00	3	109.6424	109.6424	109.6424
	50.00	2	111.3008	111.3008	111.3008
	40.00	2		113.0432	113.0432
	20.00	2		113.0673	113.0673
	30.00	2			115.1222
	Sig.		.107	.079	.052

Means for groups in homogeneous subsets are displayed.

Table E.12 ANOVA table of consistency (K) of biomaterial

Consistency (K)

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	215305826 52.600	4	53826456663.150	53.763	.000
Within Groups	5005873 11.000	5	100117462.200		
Total	220311699 63.600	9			

	KL	N	Subset for alpha = .05		
			1	2	3
Duncan(a)	60.00	2	28458.5000		
	70.00	2	30235.0000		
	40.00	2	47726.5000		
	20.00	2		105266.0000	
	.00	2			145693.0000
	Sig.		.120	1.000	1.000

Means for groups in homogeneous subsets are displayed.

Table E.13 ANOVA table of power law index (n) of biomaterial

Power law index

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.047	4	.012	42.107	.000
Within Groups	.001	5	.000		
Total	.049	9			

	KL	N	Subset for alpha = .05	
			1	2
Duncan(a)	70.00	2	.0000	
	20.00	2	.0250	
	60.00	2	.0250	
	40.00	2		.1450
	.00	2		.1650
	Sig.		.206	.286

Means for groups in homogeneous subsets are displayed.

Table E.14 ANOVA table of soluble protein of biomaterial

Soluble protein

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	4347.213	4	1086.803	50.216	.000
Within Groups	216.426	10	21.643		
Total	4563.639	14			

	KL	N	Subset for alpha = .05		
			1	2	3
Duncan(a)	0.00	3	18.1607		
	20.00	3	21.1877	21.1877	
	40.00	3	22.7010	22.7010	
	60.00	3		27.9977	
	FP	3			64.3187
	Sig.		.280	.117	1.000

Means for groups in homogeneous subsets are displayed.

Table E.15 ANOVA table of insoluble protein of biomaterial

Insoluble protein

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	469.312	4	117.328	12.117	.001
Within Groups	96.829	10	9.683		
Total	566.141	14			

	KL	N	Subset for alpha = .05	
			1	2
Duncan(a)	0.00	3	8.3227	
	60.00	3	9.0810	
	20.00	3	10.9717	
	40.00	3	11.5387	
	FP	3		23.6473
	Sig.		.265	1.000

Means for groups in homogeneous subsets are displayed.