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APPENDICES

Appendix A Analysis composition in marl by XRF

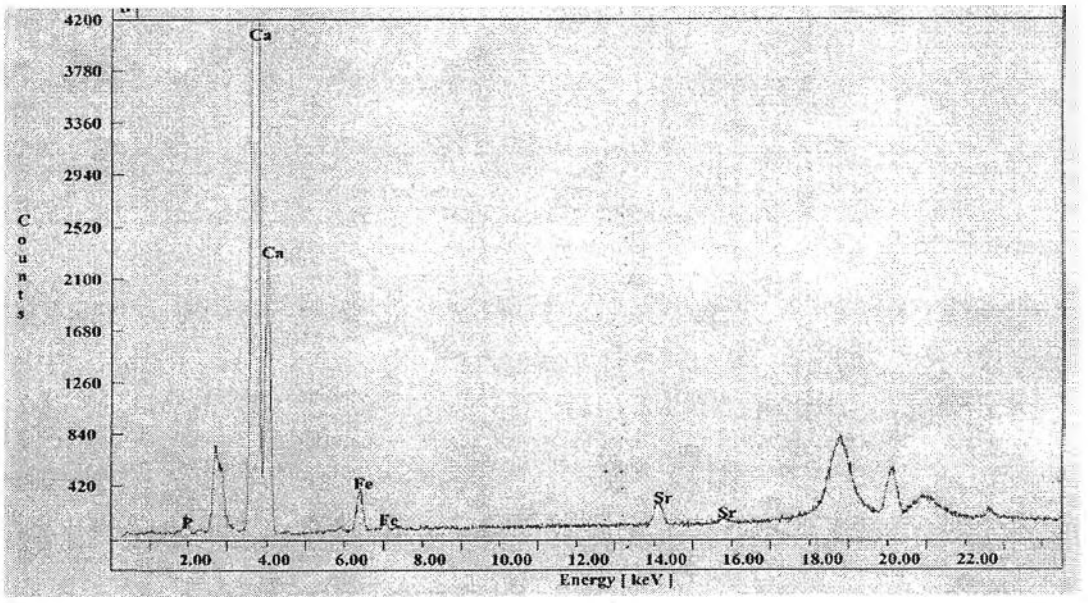

Figure A1 X-ray fluorescence spectrum of marl or Din-so-pong.

Table A1 The composition analysis of marl or Din-so-pong by XRF

Element	Wt%	Atomic%
P	0.7698	1.00
Ca	96.3481	97.13
Fe	2.0270	1.47
Sr	0.8550	0.39
Total	**100.00**	**100.00**

Appendix B Surface area of marl analysis by BET.

This is a step to find out the needed amounts of silane are able to reach the surface of the marl. It is found by performing surface area analysis using Brunauer-Emmett-Teller (BET) and Barrett Toyner Halenda (BJH) methods. This anslyser was performed on a Quantachrome / Autosorb-1, Thermo Finnigan / Sorptomatic 1990 with the outgas temp at 150°C and the outgas time 2 h.

Table B1 The surface area of marl

No. analysis	Surface area(m^2/g)
1	4.17
2	2.39
3	2.93
Average	**3.16**

For the filler treatment (Leong *et al.*, 2005)

The required amount of silane was calculate with this equation;

$$\text{Amount of silane (g)} = \frac{[\text{Amount of filler (g)} \times \text{Surface area of filler } (m^2/g)]}{\text{Minimum coating area of silane coupling agent (ws)}} \quad (5)$$

With the minimum coating of the type of silane used was 353 ws. So the amount of silane needed for 100 g marl is 0.90 g or silane concentration is 1 wt% filler.

Appendix C Proton Nuclear Magnetic Resonance (NMR) spectra of silk sericin protein.

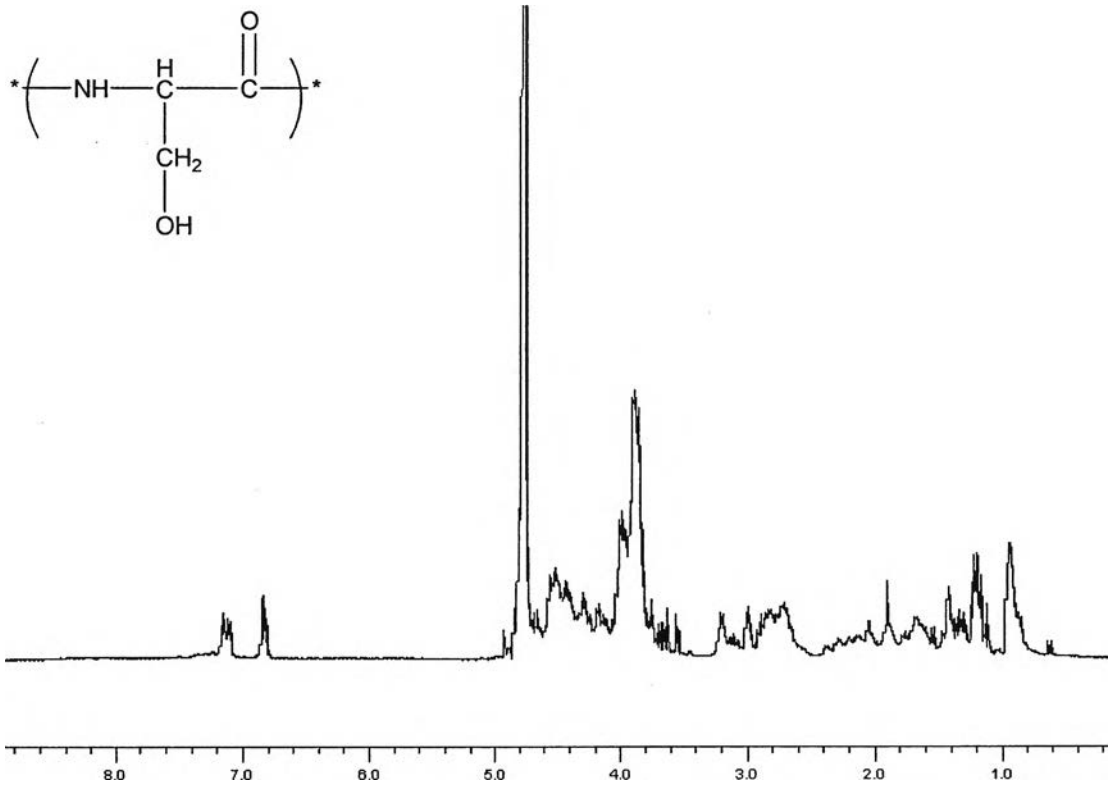

Figure C1 ^{1}H NMR spectra of silk sericin protein in D_2O.

*(**Note** an asterisk for both sides of sericin prefered to 18 amino acids, i.e. serine; glycine;, tyrosine; glutamine.)*

Appendix D Mechanical properties

Table D1 Impact strength of polybenzoxazine–marl composites as a function of marl contents

Marl content (wt%)	Impact strength (kJ/m^2)					Average	SD
0	1.3	1.3	1.1	1.2	-	1.2	0.1
10	1.4	1.8	1.8	2.0	-	1.6	0.3
20	2.2	2.3	2.1	2.2	1.9	2.2	0.2
30	2.9	3.0	4.2	3.6	-	3.4	0.7
40	1.5	2.7	1.5	2.1	-	2.0	0.6
50	1.4	1.2	1.3	1.1	-	1.3	0.1
20-Sailane	2.2	2.5	2.4	2.2	2.3	2.3	0.1
20-Stearic acid	2.6	2.4	2.3	2.3	2.1	2.3	0.2

Table D2 Impact strength of polybenzoxazine biocomposites as a function of graft copolymer–silane modified-surface marl contents

Graft copolymer content (wt%)	Impact strength (kJ/m^2)					Average	SD
10	1.0	1.6	1.1	1.2	1.2	1.2	0.2
20	3.7	3.9	3.5	3.7	3.8	3.7	0.2
30	2.8	2.1	2.3	2.4	2.4	2.4	0.3
40	1.7	1.5	1.4	1.7	1.6	1.7	0.4
50	1.6	1.2	1.2	1.4	1.5	1.5	0.5

Table D3 Flexural properties of PBZ composites as a function of marl contents

Marl content (wt%)	Flexural Strain (%)				Average	SD
0	2.5	1.4	2.3	-	2.1	0.6
10	4.1	3.3	6.1	-	4.5	1.4
20	6.4	7.4	5.5	-	6.4	0.9
30	5.0	4.3	3.8	3.9	4.2	0.5
40	4.7	4.3	4.3	4.7	4.5	0.2
50	3.5	3.1	1.8	-	2.8	0.9
20-Sailane	5.8	5.7	2.5	-	4.7	1.8
20-Stearic acid	5.1	4.6	5.0	-	4.9	0.2

Marl content (wt%)	Flexural Stress (MPa)				Average	SD
0	18.0	10.8	11.2	-	13.4	4.1
10	15.2	9.8	18.4	-	14.5	4.4
20	15.8	17.3	15.3	-	16.1	1.0
30	18.0	22.5	21.1	18.6	19.9	1.9
40	27.8	27.8	26.4	27.6	27.4	0.6
50	32.7	31.4	20.4	-	28.2	6.6
20-Sailane	22.5	26.6	15.6	-	21.6	5.6
20-Stearic acid	25.9	25.9	25.7	-	25.9	0.1

Marl content (wt%)	Flexural modulus (MPa)				Average	SD
0	541.0	540.0	500.0	-	527.0	23.4
10	399.0	294.0	426.0	-	373.0	69.7
20	201.0	326.0	393.0	-	306.7	97.5
30	549.0	667.0	654.0	569.0	596.8	59.0
40	795.0	785.0	774.0	809.0	790.8	14.9
50	1148.0	1062.0	1175.0	-	1128.3	59.0
20-Sailane	562.6	573.7	653.0	-	596.4	49.3
20-Stearic acid	604.9	617.4	572.8	-	598.6	23.0

Table D4 Flexural properties of polybenzoxazine biocomposites as a function of graft copolymer–silane modified-surface marl contents

Graft copolymer content (wt%)	Flexural Strain (%)					Average	SD
10	1.6	1.8	1.5	0.7	1.2	1.4	0.4
20	2.9	3.1	3.4	4.2	2.8	3.3	0.6
30	2.8	2.9	2.2	3.0	2.9	2.8	0.3
40	2.5	2.4	3.2	3.7	2.2	2.8	0.7
50	0.8	1.4	1.1	1.0	0.7	1.0	0.3

Graft copolymer content (wt%)	Flexural Stress (MPa)					Average	SD
10	9.4	13.1	11.8	4.4	5.7	8.9	3.8
20	18.97	13.52	17.63	20.71	11.17	16.4	4.0
30	28.0	22.7	31.9	20.1	25.6	25.7	4.6
40	29.7	32.7	26.8	18.6	25.8	26.7	5.3
50	27.4	25.1	31.0	32.0	27.7	28.6	2.8

Graft copolymer content (wt%)	Flexural modulus (MPa)					Average	SD
10	776.0	1055.0	1090.0	1066.0	823.0	962.0	149.8
20	571.0	898.0	1331.0	750.0	920.0	894.0	281.8
30	1287.0	1286.0	1323.0	1238.0	1775.0	1381.8	221.9
40	1447.0	1461.0	1710.0	1508.0	978.0	1420.8	269.1
50	1801.0	1422.0	1794.0	1897.0	1767.0	1732.6	178.6

Appendix E Dynamic Mechanical Analysis (DMA) of polybenzoxazine–marl composites as a function of marl contents.

Table E1 DMA of the synthesized polybenzoxazine (0% marl)

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-100.70	81.12	2945.09	0.03
-99.70	80.84	2944.72	0.03
-98.70	80.60	2944.26	0.03
-97.70	80.38	2943.51	0.03
-96.70	80.22	2942.46	0.03
-95.70	80.13	2940.97	0.03
-94.70	80.11	2939.07	0.03
-93.70	80.19	2936.68	0.03
-92.70	80.31	2934.39	0.03
-91.70	80.49	2931.45	0.03
-90.70	80.67	2928.29	0.03
-89.70	80.82	2925.00	0.03
-88.70	80.94	2921.73	0.03
-87.70	81.02	2918.40	0.03
-86.70	81.05	2915.65	0.03
-85.70	81.04	2912.55	0.03
-84.70	80.98	2909.26	0.03
-83.70	80.88	2906.05	0.03
-82.70	80.69	2902.00	0.03
-81.70	80.40	2897.22	0.03
-80.70	80.19	2894.11	0.03
-79.70	79.93	2890.10	0.03
-78.70	79.63	2885.04	0.03
-77.70	79.43	2881.19	0.03
-76.70	79.30	2877.26	0.03
-75.70	79.21	2872.76	0.03
-74.70	79.19	2869.06	0.03
-73.70	79.23	2864.18	0.03
-72.70	79.34	2858.99	0.03
-71.70	79.48	2854.77	0.03
-70.70	79.64	2850.96	0.03
-69.70	79.85	2846.54	0.03
-68.70	80.07	2841.79	0.03
-66.70	80.36	2833.78	0.03
-65.70	80.53	2828.52	0.03
-64.70	80.67	2824.05	0.03
-63.70	80.77	2820.74	0.03
-62.70	80.91	2816.03	0.03
-61.70	81.06	2811.85	0.03
-60.70	81.23	2807.27	0.03
-59.70	81.45	2802.32	0.03
-58.70	81.67	2797.85	0.03
-57.70	82.03	2792.07	0.03
-56.70	82.35	2787.57	0.03
-55.70	82.66	2783.19	0.03
-54.70	82.99	2778.29	0.03
-53.70	83.33	2772.56	0.03
-52.70	83.60	2767.84	0.03
-51.70	83.93	2762.46	0.03
-50.70	84.28	2757.37	0.03
-49.70	84.69	2751.77	0.03
-48.70	85.05	2747.32	0.03
-47.70	85.47	2742.45	0.03
-46.70	86.01	2736.63	0.03
-45.70	86.64	2729.81	0.03
-44.70	87.09	2724.79	0.03
-43.70	87.62	2718.42	0.03
-42.70	88.10	2712.27	0.03
-41.70	88.61	2705.31	0.03
-40.70	89.06	2698.85	0.03
-39.70	89.54	2691.95	0.03
-38.70	90.07	2684.42	0.03
-37.70	90.58	2677.54	0.03
-36.70	91.15	2670.48	0.03
-35.70	91.74	2663.68	0.03
-34.70	92.39	2656.60	0.03

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-32.70	93.87	2641.19	0.04
-31.70	94.60	2633.61	0.04
-30.70	95.25	2626.78	0.04
-29.70	95.89	2619.92	0.04
-28.70	96.62	2611.91	0.04
-27.70	97.38	2603.05	0.04
-26.70	97.95	2596.04	0.04
-25.70	98.67	2586.45	0.04
-24.70	99.25	2578.39	0.04
-23.70	99.83	2569.98	0.04
-22.70	100.41	2561.16	0.04
-21.70	100.99	2552.31	0.04
-20.70	101.54	2543.85	0.04
-19.70	102.10	2535.28	0.04
-18.70	102.83	2523.64	0.04
-17.70	103.46	2513.68	0.04
-16.70	104.17	2503.01	0.04
-15.70	104.75	2494.53	0.04
-14.70	105.56	2483.03	0.04
-13.70	106.24	2473.29	0.04
-12.70	107.04	2461.82	0.04
-11.70	107.91	2448.90	0.04
-10.70	108.57	2438.79	0.04
-9.70	109.26	2427.47	0.05
-8.70	110.01	2414.06	0.05
-7.70	110.64	2401.77	0.05
-6.70	111.27	2388.66	0.05
-5.70	111.81	2376.90	0.05
-4.70	112.47	2362.41	0.05
-3.70	112.92	2352.23	0.05
-2.70	113.49	2339.20	0.05
-1.70	114.13	2323.89	0.05
-0.70	114.70	2310.29	0.05
0.30	115.25	2296.97	0.05
1.30	115.89	2280.78	0.05
2.30	116.43	2266.68	0.05
3.30	117.02	2250.96	0.05
4.30	117.46	2238.95	0.05
5.30	118.01	2223.31	0.05

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
7.30	119.12	2191.03	0.05
8.30	119.52	2178.82	0.05
9.30	120.17	2157.78	0.06
10.30	120.54	2144.70	0.06
11.30	120.91	2129.11	0.06
12.30	121.19	2114.27	0.06
13.30	121.43	2097.32	0.06
14.30	121.59	2079.36	0.06
15.30	121.66	2066.77	0.06
16.30	121.72	2045.81	0.06
17.30	121.76	2030.70	0.06
18.30	121.81	2013.80	0.06
19.30	121.87	2000.02	0.06
20.30	122.01	1981.89	0.06
21.30	122.20	1966.45	0.06
22.30	122.95	1933.16	0.06
23.30	123.46	1917.91	0.06
24.30	124.34	1897.17	0.07
25.30	125.13	1881.95	0.07
26.30	126.28	1863.02	0.07
27.30	127.05	1851.84	0.07
28.30	128.42	1833.97	0.07
29.30	130.11	1814.49	0.07
30.30	132.52	1789.99	0.07
31.30	134.48	1771.61	0.08
32.30	136.72	1751.76	0.08
33.30	138.89	1733.44	0.08
34.30	141.23	1714.40	0.08
35.30	143.58	1695.93	0.08
36.30	145.98	1677.44	0.09
37.30	148.43	1658.53	0.09
38.30	150.78	1640.24	0.09
39.30	153.29	1620.48	0.09
40.30	155.49	1603.05	0.10
41.30	157.86	1584.25	0.10
42.30	160.32	1564.83	0.10
43.30	162.65	1546.73	0.11
44.30	165.16	1527.53	0.11
45.30	167.53	1509.98	0.11

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
47.30	172.88	1472.62	0.12
48.30	175.63	1454.22	0.12
49.30	178.67	1434.38	0.12
50.30	181.34	1417.32	0.13
51.30	184.51	1397.49	0.13
52.30	187.31	1380.12	0.14
53.30	190.54	1360.39	0.14
54.30	193.63	1341.62	0.14
55.30	196.88	1322.08	0.15
56.30	200.21	1302.21	0.15
57.30	203.42	1283.41	0.16
58.30	207.02	1262.52	0.16
59.30	210.20	1244.27	0.17
60.30	213.79	1223.72	0.17
61.30	217.31	1203.29	0.18
62.30	220.84	1182.27	0.19
63.30	224.44	1160.00	0.19
64.30	227.68	1138.94	0.20
65.30	231.23	1114.49	0.21
66.30	234.21	1092.66	0.21
67.30	237.59	1066.40	0.22
68.30	240.52	1042.22	0.23
69.30	243.51	1016.40	0.24
70.30	246.28	991.45	0.25
71.30	249.14	964.60	0.26
72.30	252.09	935.86	0.27
73.30	254.43	912.40	0.28
74.30	257.22	883.48	0.29
75.30	259.44	859.67	0.30
76.30	261.83	833.12	0.31
77.30	263.93	808.64	0.33
78.30	265.96	783.72	0.34
79.30	267.88	758.44	0.35
80.30	269.38	737.16	0.37
81.30	270.93	713.04	0.38
82.30	271.99	694.54	0.39
83.30	273.08	672.57	0.41
84.30	273.78	655.57	0.42
85.30	274.41	635.81	0.43

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
87.30	274.96	600.83	0.46
88.30	274.90	583.39	0.47
89.30	274.63	568.03	0.48
90.30	274.02	550.83	0.50
91.30	273.22	535.98	0.51
92.30	272.10	520.73	0.52
93.30	270.69	505.83	0.54
94.30	269.01	491.34	0.55
95.30	267.02	476.94	0.56
96.30	264.95	463.91	0.57
97.30	262.27	449.16	0.58
98.30	259.73	436.78	0.59
99.30	256.61	423.18	0.61
100.30	253.41	410.70	0.62
101.30	249.97	398.60	0.63
102.30	245.88	385.60	0.64
103.30	241.73	373.75	0.64
104.30	236.61	360.58	0.65
105.30	231.70	349.24	0.66
106.30	225.63	336.67	0.67
107.30	219.68	325.63	0.68
108.30	212.25	313.37	0.68
109.30	203.18	300.14	0.69
110.30	195.24	289.77	0.68
111.30	185.01	277.65	0.68
112.30	174.76	266.56	0.67
113.30	162.53	254.29	0.65
114.30	150.73	243.22	0.63
115.30	137.72	231.65	0.60
116.30	125.60	221.33	0.57
117.30	112.96	210.91	0.54
118.30	99.59	200.16	0.50
119.30	88.28	191.18	0.45
120.30	76.09	181.50	0.40
121.30	66.15	173.46	0.35
122.30	56.92	165.68	0.30
123.30	49.06	158.57	0.26
124.30	43.00	152.51	0.24
125.30	37.96	146.77	0.23

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
127.30	31.17	136.69	0.23
128.30	29.20	132.59	0.24
129.30	27.56	128.29	0.24
130.30	26.37	124.31	0.23
131.30	25.47	120.60	0.23
132.30	24.62	116.55	0.23
133.30	24.00	113.45	0.23
134.30	23.31	110.06	0.23
135.30	22.66	107.10	0.22
136.30	21.88	103.94	0.22
137.30	21.08	101.02	0.22
138.30	20.26	98.32	0.21
139.30	19.31	95.40	0.21
140.30	18.40	92.74	0.20
141.30	17.33	89.63	0.20
142.30	16.32	86.56	0.20
143.30	15.31	83.23	0.19
144.30	14.31	79.49	0.18
145.30	13.38	75.35	0.18
146.30	12.39	70.03	0.18
147.30	11.72	65.46	0.17
148.30	11.21	60.79	0.17

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
150.30	11.07	54.61	0.16
151.30	11.78	56.12	0.16
152.30	12.79	61.67	0.16
153.30	14.88	77.69	0.16
154.30	17.29	100.29	0.15
155.30	20.83	138.68	0.14
156.30	25.00	189.34	0.13
157.30	29.85	253.76	0.11
158.30	35.31	331.21	0.10
159.30	40.55	408.93	0.11
160.30	46.09	492.81	0.13
161.30	49.46	546.12	0.14
162.30	51.23	580.63	0.14
163.30	51.42	596.11	0.12
164.30	50.13	586.11	0.10
165.30	47.15	546.42	0.09
166.30	43.98	502.12	0.08
167.30	39.93	447.60	0.08
168.30	36.28	404.51	0.08
169.30	33.60	382.47	0.07
170.30	31.55	380.29	0.06
171.30	30.50	394.87	0.06
172.30	29.93	425.99	0.07

Table E2 DMA of the 10 wt% marl–polybenzoxazine composite

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-97.93	120.05	3703.23	0.03
-96.93	119.28	3716.68	0.03
-95.93	119.11	3720.41	0.03
-94.93	118.54	3727.61	0.03
-93.93	117.90	3731.69	0.03
-92.93	117.31	3734.51	0.03
-91.93	116.84	3735.52	0.03
-90.93	116.20	3735.19	0.03
-89.93	115.30	3733.95	0.03
-88.93	114.15	3731.71	0.03
-87.93	113.09	3728.56	0.03
-86.93	112.55	3725.11	0.03
-85.93	112.31	3720.96	0.03
-84.93	112.17	3715.55	0.03
-83.93	111.98	3711.29	0.03
-82.93	111.56	3704.52	0.03
-81.93	111.45	3698.04	0.03
-80.93	111.55	3690.68	0.03
-79.93	111.58	3683.58	0.03
-78.93	111.48	3674.66	0.03
-77.93	111.42	3667.81	0.03
-76.93	111.42	3658.17	0.03
-75.93	111.51	3648.98	0.03
-74.93	111.58	3640.20	0.03
-73.93	111.73	3629.18	0.03
-72.93	111.92	3621.30	0.03
-71.93	112.24	3613.23	0.03
-70.93	112.66	3602.73	0.03
-69.93	112.94	3594.53	0.03
-68.93	113.23	3586.83	0.03
-67.93	113.84	3574.39	0.03
-66.93	114.11	3566.72	0.03
-65.93	114.28	3556.12	0.03
-64.93	114.55	3545.07	0.03
-63.93	114.82	3537.33	0.03
-62.93	115.34	3525.80	0.03
-61.93	116.03	3514.65	0.03

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-59.93	117.76	3492.84	0.03
-58.93	118.44	3483.29	0.03
-57.93	119.03	3472.72	0.03
-56.93	119.91	3459.96	0.03
-55.93	120.93	3449.92	0.04
-54.93	122.21	3438.05	0.04
-53.93	123.23	3427.35	0.04
-52.93	124.22	3416.42	0.04
-51.93	125.18	3405.42	0.04
-50.93	126.50	3391.69	0.04
-49.93	127.48	3382.29	0.04
-48.93	128.56	3370.86	0.04
-47.93	129.33	3358.68	0.04
-46.93	129.77	3349.10	0.04
-45.93	130.76	3334.44	0.04
-44.93	131.57	3326.39	0.04
-43.93	132.92	3314.08	0.04
-42.93	134.10	3302.61	0.04
-41.93	135.11	3291.08	0.04
-40.93	136.02	3277.47	0.04
-39.93	136.66	3267.88	0.04
-38.93	137.56	3258.87	0.04
-37.93	139.13	3246.73	0.04
-36.93	141.61	3231.62	0.04
-35.93	143.46	3221.45	0.04
-34.93	144.85	3212.95	0.05
-33.93	146.56	3200.05	0.05
-32.93	147.75	3189.65	0.05
-31.93	149.05	3179.32	0.05
-30.93	151.06	3164.98	0.05
-29.93	152.12	3157.26	0.05
-28.93	153.66	3144.67	0.05
-27.93	155.38	3130.17	0.05
-26.93	156.97	3118.68	0.05
-25.93	158.36	3109.76	0.05
-24.93	160.79	3094.10	0.05
-23.93	161.88	3085.92	0.05

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-21.93	164.76	3063.20	0.05
-20.93	165.87	3055.40	0.05
-19.93	167.92	3041.98	0.06
-18.93	169.27	3032.82	0.06
-17.93	170.45	3025.04	0.06
-16.93	172.39	3013.93	0.06
-15.93	174.17	3004.92	0.06
-14.93	176.45	2993.72	0.06
-13.93	180.24	2974.46	0.06
-12.93	180.27	2974.60	0.06
-11.93	183.20	2961.24	0.06
-10.93	184.69	2953.78	0.06
-9.93	186.39	2944.61	0.06
-8.93	188.60	2933.64	0.06
-7.93	190.41	2925.55	0.07
-6.93	192.85	2914.52	0.07
-5.93	194.76	2905.43	0.07
-4.93	197.02	2894.52	0.07
-3.93	198.67	2885.75	0.07
-2.93	199.95	2878.42	0.07
-1.93	201.89	2867.21	0.07
-0.93	203.60	2857.65	0.07
0.07	205.84	2845.59	0.07
1.07	206.78	2840.75	0.07
2.07	210.44	2825.38	0.07
3.07	212.60	2815.78	0.08
4.07	214.21	2807.66	0.08
5.07	208.98	2842.26	0.07
6.07	217.12	2789.26	0.08
7.07	218.46	2781.04	0.08
8.07	220.31	2771.11	0.08
9.07	222.03	2761.19	0.08
10.07	223.03	2753.95	0.08
11.07	224.13	2744.71	0.08
12.07	225.07	2736.74	0.08
13.07	226.62	2726.15	0.08
14.07	228.03	2718.02	0.08
15.07	229.38	2710.46	0.08
16.07	231.15	2701.09	0.09

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
18.07	234.22	2684.40	0.09
19.07	235.75	2675.66	0.09
20.07	237.52	2666.29	0.09
21.07	239.09	2659.00	0.09
22.07	240.95	2650.83	0.09
23.07	243.01	2641.39	0.09
24.07	245.05	2631.41	0.09
25.07	246.72	2623.00	0.09
26.07	248.73	2612.98	0.10
27.07	250.39	2605.01	0.10
28.07	252.10	2597.16	0.10
29.07	254.32	2587.13	0.10
30.07	256.89	2576.74	0.10
31.07	259.17	2568.71	0.10
32.07	262.53	2557.72	0.10
33.07	265.23	2549.37	0.10
34.07	268.13	2540.29	0.11
35.07	270.76	2530.17	0.11
36.07	272.95	2520.34	0.11
37.07	274.73	2511.80	0.11
38.07	277.04	2501.74	0.11
39.07	280.35	2490.08	0.11
40.07	283.44	2480.10	0.11
41.07	286.05	2471.01	0.12
42.07	289.38	2457.89	0.12
43.07	291.69	2448.84	0.12
44.07	294.06	2439.76	0.12
45.07	297.26	2428.19	0.12
46.07	299.63	2419.70	0.12
47.07	303.48	2404.12	0.13
48.07	306.10	2392.36	0.13
49.07	308.55	2381.73	0.13
50.07	310.67	2372.92	0.13
51.07	313.08	2363.45	0.13
52.07	316.15	2351.54	0.13
53.07	318.91	2340.69	0.14
54.07	322.72	2325.74	0.14
55.07	325.91	2313.23	0.14
56.07	329.57	2298.49	0.14

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
58.07	335.36	2275.49	0.15
59.07	338.62	2263.44	0.15
60.07	342.19	2250.87	0.15
61.07	346.03	2238.06	0.15
62.07	349.88	2224.74	0.16
63.07	353.44	2211.40	0.16
64.07	356.97	2198.41	0.16
65.07	361.03	2184.15	0.17
66.07	364.70	2170.70	0.17
67.07	368.46	2155.79	0.17
68.07	372.14	2141.13	0.17
69.07	376.21	2125.82	0.18
70.07	380.65	2109.24	0.18
71.07	384.44	2093.54	0.18
72.07	388.64	2074.79	0.19
73.07	392.38	2058.59	0.19
74.07	397.10	2038.72	0.19
75.07	401.52	2019.76	0.20
76.07	406.22	1998.59	0.20
77.07	410.77	1977.28	0.21
78.07	415.37	1955.32	0.21
79.07	420.26	1930.44	0.22
80.07	424.39	1908.37	0.22
81.07	429.39	1880.70	0.23
82.07	433.73	1855.39	0.23
83.07	438.93	1824.49	0.24
84.07	443.73	1795.76	0.25
85.07	448.79	1764.93	0.25
86.07	454.24	1729.70	0.26
87.07	458.67	1698.36	0.27
88.07	463.61	1661.27	0.28
89.07	467.90	1629.31	0.29
90.07	473.25	1591.19	0.30
91.07	478.38	1555.96	0.31
92.07	483.67	1519.85	0.32
93.07	488.94	1483.03	0.33
94.07	493.58	1450.12	0.34
95.07	499.10	1411.19	0.35
96.07	503.47	1378.43	0.37

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
98.07	511.57	1310.81	0.39
99.07	515.36	1277.45	0.40
100.07	518.89	1245.02	0.42
101.07	522.02	1215.52	0.43
102.07	525.27	1182.99	0.44
103.07	527.74	1157.77	0.46
104.07	530.82	1127.55	0.47
105.07	533.38	1101.68	0.48
106.07	535.70	1074.86	0.50
107.07	537.63	1046.92	0.51
108.07	538.85	1023.39	0.53
109.07	539.91	997.39	0.54
110.07	540.76	976.43	0.55
111.07	541.78	950.48	0.57
112.07	542.26	930.64	0.58
113.07	542.28	906.98	0.60
114.07	541.80	886.22	0.61
115.07	540.60	864.35	0.63
116.07	538.31	840.77	0.64
117.07	535.68	821.06	0.65
118.07	531.77	798.17	0.67
119.07	527.72	779.29	0.68
120.07	522.18	757.80	0.69
121.07	515.91	737.14	0.70
122.07	509.08	717.80	0.71
123.07	499.60	694.77	0.72
124.07	491.08	677.08	0.72
125.07	478.44	654.45	0.73
126.07	466.26	635.20	0.73
127.07	450.85	612.87	0.73
128.07	435.82	592.24	0.74
129.07	421.03	572.39	0.74
130.07	404.57	550.73	0.74
131.07	390.01	532.22	0.73
132.07	372.18	510.76	0.73
133.07	355.66	491.84	0.72
134.07	338.36	472.58	0.72
135.07	319.25	451.58	0.71
136.07	303.20	434.09	0.70

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
138.07	266.99	395.67	0.67
139.07	246.69	375.27	0.66
140.07	227.71	356.98	0.64
141.07	207.06	337.83	0.61
142.07	184.37	317.76	0.58
143.07	166.34	302.49	0.55
144.07	146.25	285.95	0.51
145.07	128.39	271.55	0.47
146.07	108.75	256.00	0.43
147.07	92.71	243.39	0.38
148.07	77.10	231.05	0.33
149.07	63.32	219.63	0.29
150.07	53.57	210.67	0.25
151.07	45.03	201.05	0.22
152.07	40.21	193.64	0.21
153.07	36.80	185.68	0.20
154.07	35.02	179.16	0.20

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
156.07	32.81	167.11	0.20
157.07	32.13	163.22	0.20
158.07	31.28	158.75	0.20
159.07	30.53	155.22	0.20
160.07	29.66	151.56	0.20
161.07	28.81	148.20	0.19
162.07	27.96	144.83	0.19
163.07	27.31	142.18	0.19
164.07	26.77	139.96	0.19
165.07	26.21	137.86	0.19
166.07	25.58	135.94	0.19
167.07	24.87	134.33	0.19
168.07	23.80	133.09	0.18
169.07	22.79	132.67	0.18
170.07	21.11	132.63	0.16
171.07	19.26	132.95	0.15
172.07	17.36	133.45	0.13
173.07	15.33	134.10	0.11

Table E3 DMA of the 20 wt% marl–polybenzoxazine composite

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-98.56	62.52	2182.23	0.03
-97.56	62.15	2188.08	0.03
-96.56	61.81	2190.97	0.03
-95.56	61.44	2192.50	0.03
-94.56	60.89	2193.38	0.03
-93.56	60.39	2193.24	0.03
-92.56	59.96	2192.63	0.03
-91.56	59.42	2191.39	0.03
-90.56	58.91	2189.73	0.03
-89.56	58.53	2188.18	0.03
-88.56	57.87	2185.09	0.03
-87.56	57.36	2182.43	0.03
-86.56	56.84	2179.63	0.03
-85.56	56.23	2176.07	0.03
-84.56	55.61	2172.14	0.03
-83.56	55.17	2169.18	0.03
-82.56	54.45	2163.88	0.03
-81.56	53.97	2160.18	0.03
-80.56	53.53	2156.61	0.02
-79.56	52.88	2151.19	0.02
-78.56	52.40	2146.90	0.02
-77.56	51.95	2142.72	0.02
-76.56	51.34	2136.78	0.02
-75.56	50.89	2132.11	0.02
-74.56	50.57	2128.62	0.02
-73.56	50.14	2123.83	0.02
-72.56	49.72	2118.80	0.02
-71.56	49.31	2113.64	0.02
-70.56	49.00	2109.67	0.02
-69.56	48.67	2105.47	0.02
-68.56	48.26	2100.14	0.02
-67.56	47.89	2095.50	0.02
-66.56	47.45	2090.08	0.02
-65.56	47.07	2085.48	0.02
-64.56	46.71	2081.04	0.02
-63.56	46.37	2076.77	0.02
-62.56	45.96	2071.17	0.02
-60.56	45.34	2061.51	0.02
-59.56	45.11	2057.49	0.02
-58.56	44.88	2053.27	0.02
-57.56	44.60	2047.39	0.02
-56.56	44.39	2042.52	0.02
-55.56	44.25	2038.56	0.02
-54.56	44.08	2033.24	0.02
-53.56	43.95	2028.13	0.02
-52.56	43.83	2023.39	0.02
-51.56	43.74	2018.37	0.02
-50.56	43.65	2013.24	0.02
-49.56	43.59	2008.25	0.02
-48.56	43.52	2002.98	0.02
-47.56	43.47	1998.55	0.02
-46.56	43.43	1993.61	0.02
-45.56	43.41	1987.92	0.02
-44.56	43.43	1983.55	0.02
-43.56	43.49	1979.11	0.02
-42.56	43.61	1973.93	0.02
-41.56	43.77	1968.84	0.02
-40.56	43.96	1963.81	0.02
-39.56	44.15	1959.42	0.02
-38.56	44.36	1954.72	0.02
-37.56	44.62	1949.51	0.02
-36.56	44.83	1945.56	0.02
-35.56	45.09	1940.57	0.02
-34.56	45.30	1936.13	0.02
-33.56	45.49	1931.66	0.02
-32.56	45.69	1926.77	0.02
-31.56	45.86	1922.48	0.02
-30.56	46.05	1917.48	0.02
-29.56	46.21	1913.40	0.02
-28.56	46.42	1908.54	0.02
-27.56	46.61	1903.78	0.02
-26.56	46.77	1898.83	0.02
-25.56	46.91	1893.65	0.02
-24.56	46.97	1890.77	0.02

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-22.56	47.16	1881.51	0.02
-21.56	47.29	1875.65	0.03
-20.56	47.36	1871.78	0.03
-19.56	47.44	1868.12	0.03
-18.56	47.53	1862.95	0.03
-17.56	47.59	1858.34	0.03
-16.56	47.65	1853.81	0.03
-15.56	47.68	1849.31	0.03
-14.56	47.72	1845.26	0.03
-13.56	47.76	1840.92	0.03
-12.56	47.81	1836.53	0.03
-11.56	47.86	1832.81	0.03
-10.56	47.92	1828.35	0.03
-9.56	48.01	1823.54	0.03
-8.56	48.10	1819.35	0.03
-7.56	48.21	1814.65	0.03
-6.56	48.28	1810.88	0.03
-5.56	48.36	1805.88	0.03
-4.56	48.41	1801.69	0.03
-3.56	48.46	1796.46	0.03
-2.56	48.52	1792.15	0.03
-1.56	48.60	1788.18	0.03
-0.56	48.70	1784.08	0.03
0.44	48.82	1779.64	0.03
1.44	48.95	1775.13	0.03
2.44	49.05	1771.50	0.03
3.44	49.19	1767.05	0.03
4.44	49.31	1763.39	0.03
5.44	49.45	1759.82	0.03
6.44	49.67	1755.30	0.03
7.44	49.91	1751.46	0.03
8.44	50.15	1748.33	0.03
9.44	50.55	1743.98	0.03
10.44	50.93	1740.45	0.03
11.44	51.43	1736.34	0.03
12.44	51.93	1732.43	0.03
13.44	52.37	1729.11	0.03
14.44	52.98	1724.78	0.03
15.44	53.62	1720.22	0.03

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
17.44	54.66	1712.21	0.03
18.44	55.05	1708.91	0.03
19.44	55.49	1704.90	0.03
20.44	56.00	1700.20	0.03
21.44	56.41	1696.30	0.03
22.44	56.83	1692.40	0.03
23.44	57.24	1688.71	0.03
24.44	57.62	1685.38	0.03
25.44	58.14	1681.02	0.03
26.44	58.87	1675.21	0.04
27.44	59.22	1672.52	0.04
28.44	59.79	1668.35	0.04
29.44	60.28	1664.89	0.04
30.44	61.11	1659.52	0.04
31.44	61.71	1655.96	0.04
32.44	62.37	1652.32	0.04
33.44	63.03	1648.86	0.04
34.44	63.74	1645.24	0.04
35.44	64.47	1641.54	0.04
36.44	65.20	1637.87	0.04
37.44	65.97	1633.95	0.04
38.44	66.68	1630.32	0.04
39.44	67.48	1626.22	0.04
40.44	68.20	1622.53	0.04
41.44	68.96	1618.65	0.04
42.44	69.73	1614.73	0.04
43.44	70.44	1611.24	0.04
44.44	71.25	1607.34	0.04
45.44	71.98	1603.99	0.04
46.44	72.83	1600.32	0.05
47.44	73.67	1596.77	0.05
48.44	74.56	1593.12	0.05
49.44	75.50	1589.34	0.05
50.44	76.41	1585.76	0.05
51.44	77.46	1581.81	0.05
52.44	78.49	1578.02	0.05
53.44	79.65	1573.89	0.05
54.44	80.70	1570.19	0.05
55.44	81.87	1566.13	0.05

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
57.44	84.18	1557.96	0.05
58.44	85.35	1553.70	0.06
59.44	86.35	1549.87	0.06
60.44	87.43	1545.51	0.06
61.44	88.34	1541.67	0.06
62.44	89.36	1537.17	0.06
63.44	90.31	1532.83	0.06
64.44	91.26	1528.44	0.06
65.44	92.31	1523.59	0.06
66.44	93.32	1518.99	0.06
67.44	94.48	1513.89	0.06
68.44	95.57	1509.28	0.06
69.44	96.79	1504.34	0.06
70.44	98.00	1499.57	0.07
71.44	99.28	1494.54	0.07
72.44	100.55	1489.47	0.07
73.44	101.79	1484.34	0.07
74.44	103.08	1478.63	0.07
75.44	104.17	1473.51	0.07
76.44	105.30	1467.80	0.07
77.44	106.34	1462.27	0.07
78.44	107.42	1456.27	0.07
79.44	108.49	1450.30	0.07
80.44	109.59	1444.23	0.08
81.44	110.87	1437.25	0.08
82.44	111.97	1431.45	0.08
83.44	113.26	1424.70	0.08
84.44	114.38	1418.87	0.08
85.44	115.73	1411.99	0.08
86.44	116.96	1405.77	0.08
87.44	118.33	1398.82	0.08
88.44	119.78	1391.46	0.09
89.44	120.99	1385.24	0.09
90.44	122.46	1377.61	0.09
91.44	123.69	1371.31	0.09
92.44	125.20	1363.65	0.09
93.44	126.53	1356.92	0.09
94.44	128.01	1349.42	0.10
95.44	129.40	1342.25	0.10

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
97.44	132.09	1328.09	0.10
98.44	133.32	1321.61	0.10
99.44	134.85	1313.51	0.10
100.44	136.18	1306.70	0.10
101.44	137.71	1299.09	0.11
102.44	139.21	1291.92	0.11
103.44	140.75	1284.63	0.11
104.44	142.45	1276.67	0.11
105.44	143.80	1270.27	0.11
106.44	145.52	1262.16	0.12
107.44	146.92	1255.55	0.12
108.44	148.52	1248.07	0.12
109.44	150.01	1241.07	0.12
110.44	151.47	1234.16	0.12
111.44	153.11	1226.44	0.12
112.44	154.50	1219.83	0.13
113.44	156.07	1212.38	0.13
114.44	157.43	1205.78	0.13
115.44	159.02	1197.88	0.13
116.44	160.52	1190.11	0.14
117.44	161.90	1182.64	0.14
118.44	163.38	1174.33	0.14
119.44	164.61	1167.14	0.14
120.44	166.06	1158.45	0.14
121.44	167.24	1151.33	0.14
122.44	168.74	1142.13	0.15
123.44	170.08	1133.86	0.15
124.44	171.55	1124.72	0.15
125.44	173.06	1115.06	0.16
126.44	174.50	1105.70	0.16
127.44	176.01	1095.48	0.16
128.44	177.41	1085.70	0.16
129.44	178.89	1074.90	0.17
130.44	180.33	1063.99	0.17
131.44	181.68	1053.50	0.17
132.44	183.42	1039.57	0.18
133.44	184.61	1029.81	0.18
134.44	186.36	1014.89	0.18
135.44	187.75	1002.60	0.19

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
137.44	190.84	973.07	0.20
138.44	192.19	958.79	0.20
139.44	193.84	939.87	0.21
140.44	194.98	925.48	0.21
141.44	196.45	904.49	0.22
142.44	197.53	886.45	0.22
143.44	198.64	863.51	0.23
144.44	199.30	845.61	0.24
145.44	199.78	826.63	0.24
146.44	200.05	802.83	0.25
147.44	200.00	786.31	0.25
148.44	199.55	762.18	0.26
149.44	198.83	743.12	0.27
150.44	197.72	723.11	0.27
151.44	195.91	700.09	0.28
152.44	193.87	680.07	0.29

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
154.44	187.67	635.81	0.30
155.44	183.63	613.73	0.30
156.44	178.97	591.90	0.30
157.44	172.59	566.18	0.31
158.44	165.04	539.86	0.31
159.44	158.91	520.77	0.31
160.44	150.36	496.54	0.30
161.44	143.36	478.32	0.30
162.44	134.39	456.51	0.29
163.44	125.63	436.53	0.29
164.44	117.26	418.36	0.28
165.44	107.77	398.59	0.26
166.44	100.69	384.23	0.25
167.44	91.83	366.60	0.24
168.44	84.25	351.71	0.23
169.44	76.30	336.17	0.23
170.44	67.82	319.61	0.22

Table E4 DMA of the 30 wt% marl–polybenzoxazine composite

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-98.38	145.13	3623.66	0.04
-97.38	144.99	3634.31	0.04
-96.38	144.72	3646.37	0.04
-95.38	144.49	3652.65	0.04
-94.38	144.18	3658.43	0.04
-93.38	143.64	3665.05	0.04
-92.38	143.29	3667.83	0.04
-91.38	142.76	3670.70	0.04
-90.38	142.20	3672.35	0.04
-89.38	141.77	3672.81	0.04
-88.38	141.13	3672.21	0.04
-87.38	140.73	3671.11	0.04
-86.38	140.38	3669.53	0.04
-85.38	140.01	3666.80	0.04
-84.38	139.77	3663.78	0.04
-83.38	139.66	3661.69	0.04
-82.38	139.47	3657.25	0.04
-81.38	139.30	3652.80	0.04
-80.38	139.11	3648.19	0.04
-79.38	138.84	3642.12	0.04
-78.38	138.57	3636.25	0.04
-77.38	138.27	3629.82	0.04
-76.38	137.95	3622.76	0.04
-75.38	137.64	3615.58	0.04
-74.38	137.36	3608.27	0.04
-73.38	137.11	3600.36	0.04
-72.38	136.95	3592.45	0.04
-71.38	136.84	3584.99	0.04
-70.38	136.77	3577.15	0.04
-69.38	136.72	3567.66	0.04
-68.38	136.68	3557.81	0.04
-67.38	136.64	3548.88	0.04
-66.38	136.57	3539.42	0.04
-65.38	136.48	3531.04	0.04
-64.38	136.36	3520.71	0.04
-63.38	136.25	3511.18	0.04
-62.38	136.13	3500.52	0.04

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-60.38	135.93	3481.30	0.04
-59.38	135.81	3468.98	0.04
-58.38	135.72	3458.68	0.04
-57.38	135.67	3449.01	0.04
-56.38	135.63	3437.94	0.04
-55.38	135.64	3429.16	0.04
-54.38	135.71	3417.00	0.04
-53.38	135.84	3407.20	0.04
-52.38	136.10	3394.71	0.04
-51.38	136.34	3385.72	0.04
-50.38	136.76	3373.63	0.04
-49.38	137.17	3363.81	0.04
-48.38	137.65	3353.72	0.04
-47.38	138.02	3346.40	0.04
-46.38	138.77	3332.34	0.04
-45.38	139.27	3323.46	0.04
-44.38	139.70	3315.96	0.04
-43.38	140.41	3303.22	0.04
-42.38	140.91	3293.15	0.04
-41.38	141.33	3282.94	0.04
-40.38	141.67	3272.54	0.04
-39.38	141.96	3262.13	0.04
-38.38	142.25	3248.38	0.04
-37.38	142.36	3241.27	0.04
-36.38	142.54	3229.05	0.04
-35.38	142.68	3219.12	0.04
-34.38	142.83	3209.94	0.04
-33.38	143.12	3194.84	0.04
-32.38	143.29	3188.26	0.04
-31.38	143.58	3178.12	0.05
-30.38	143.98	3166.78	0.05
-29.38	144.40	3156.55	0.05
-28.38	144.90	3145.34	0.05
-27.38	145.28	3137.10	0.05
-26.38	145.74	3127.24	0.05
-25.38	146.22	3116.26	0.05
-24.38	146.63	3106.19	0.05

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-22.38	147.44	3083.92	0.05
-21.38	147.72	3076.10	0.05
-20.38	148.21	3062.79	0.05
-19.38	148.48	3055.43	0.05
-18.38	148.86	3044.84	0.05
-17.38	149.16	3036.21	0.05
-16.38	149.52	3025.00	0.05
-15.38	149.83	3015.55	0.05
-14.38	150.14	3006.76	0.05
-13.38	150.49	2997.85	0.05
-12.38	150.96	2987.49	0.05
-11.38	151.34	2979.67	0.05
-10.38	151.88	2969.18	0.05
-9.38	152.45	2958.11	0.05
-8.38	152.88	2948.97	0.05
-7.38	153.20	2941.37	0.05
-6.38	153.49	2932.95	0.05
-5.38	153.76	2922.54	0.05
-4.38	153.92	2913.42	0.05
-3.38	154.02	2903.97	0.05
-2.38	154.06	2893.33	0.05
-1.38	154.06	2885.37	0.05
-0.38	154.07	2875.52	0.05
0.62	154.07	2864.58	0.05
1.62	154.09	2856.86	0.05
2.62	154.12	2849.15	0.05
3.62	154.17	2839.39	0.05
4.62	154.21	2831.06	0.05
5.62	154.24	2821.36	0.05
6.62	154.27	2813.16	0.05
7.62	154.29	2805.85	0.05
8.62	154.34	2796.66	0.06
9.62	154.39	2788.62	0.06
10.62	154.46	2780.90	0.06
11.62	154.57	2770.75	0.06
12.62	154.67	2762.77	0.06
13.62	154.79	2754.32	0.06
14.62	154.92	2746.50	0.06
15.62	155.07	2738.03	0.06

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
17.62	155.36	2722.66	0.06
18.62	155.55	2714.52	0.06
19.62	155.72	2707.29	0.06
20.62	155.92	2699.97	0.06
21.62	156.12	2692.92	0.06
22.62	156.34	2685.51	0.06
23.62	156.58	2677.90	0.06
24.62	156.79	2671.26	0.06
25.62	157.06	2662.25	0.06
26.62	157.27	2654.79	0.06
27.62	157.44	2647.55	0.06
28.62	157.62	2639.06	0.06
29.62	157.80	2629.53	0.06
30.62	157.94	2622.08	0.06
31.62	158.11	2613.17	0.06
32.62	158.27	2605.60	0.06
33.62	158.45	2597.55	0.06
34.62	158.68	2588.08	0.06
35.62	158.90	2579.00	0.06
36.62	159.12	2569.13	0.06
37.62	159.33	2559.57	0.06
38.62	159.54	2550.49	0.06
39.62	159.80	2540.38	0.06
40.62	160.20	2527.52	0.06
41.62	160.58	2517.76	0.06
42.62	160.93	2509.62	0.06
43.62	161.43	2499.42	0.06
44.62	161.93	2490.24	0.07
45.62	162.59	2479.22	0.07
46.62	163.33	2467.94	0.07
47.62	163.90	2459.65	0.07
48.62	164.62	2449.49	0.07
49.62	165.34	2439.31	0.07
50.62	165.92	2430.93	0.07
51.62	166.68	2419.80	0.07
52.62	167.32	2410.06	0.07
53.62	168.08	2398.54	0.07
54.62	168.84	2386.88	0.07
55.62	169.55	2375.99	0.07

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
57.62	170.93	2354.59	0.07
58.62	171.66	2343.29	0.07
59.62	172.33	2332.80	0.07
60.62	173.16	2320.08	0.07
61.62	173.88	2309.10	0.08
62.62	174.74	2296.16	0.08
63.62	175.53	2284.27	0.08
64.62	176.40	2271.61	0.08
65.62	177.26	2259.13	0.08
66.62	178.16	2246.28	0.08
67.62	179.14	2232.41	0.08
68.62	180.04	2219.61	0.08
69.62	181.13	2204.41	0.08
70.62	182.12	2190.79	0.08
71.62	183.34	2174.45	0.08
72.62	184.52	2159.14	0.09
73.62	185.89	2142.30	0.09
74.62	187.46	2124.04	0.09
75.62	188.87	2108.59	0.09
76.62	190.87	2087.88	0.09
77.62	192.58	2071.13	0.09
78.62	194.79	2050.29	0.09
79.62	197.10	2029.01	0.10
80.62	199.50	2007.27	0.10
81.62	202.14	1983.27	0.10
82.62	204.56	1961.13	0.10
83.62	207.53	1933.62	0.11
84.62	210.03	1910.02	0.11
85.62	212.97	1881.55	0.11
86.62	215.66	1854.84	0.12
87.62	218.75	1822.99	0.12
88.62	221.68	1791.55	0.12
89.62	224.53	1759.91	0.13
90.62	227.77	1722.66	0.13
91.62	230.22	1693.67	0.14
92.62	233.33	1655.83	0.14
93.62	235.85	1624.13	0.15
94.62	238.71	1587.24	0.15
95.62	241.42	1551.36	0.16

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
97.62	246.47	1481.59	0.17
98.62	248.73	1448.98	0.17
99.62	251.13	1413.42	0.18
100.62	253.23	1381.38	0.18
101.62	255.28	1349.34	0.19
102.62	257.16	1319.53	0.19
103.62	259.12	1287.97	0.20
104.62	261.01	1256.94	0.21
105.62	262.55	1230.93	0.21
106.62	264.35	1198.95	0.22
107.62	265.73	1172.40	0.23
108.62	267.18	1141.43	0.23
109.62	268.27	1114.77	0.24
110.62	269.25	1085.29	0.25
111.62	269.97	1056.37	0.26
112.62	270.37	1030.24	0.26
113.62	270.53	999.96	0.27
114.62	270.39	976.37	0.28
115.62	269.88	946.70	0.29
116.62	269.13	920.88	0.29
117.62	268.03	894.09	0.30
118.62	266.56	867.01	0.31
119.62	265.00	843.80	0.31
120.62	262.64	815.02	0.32
121.62	260.53	793.42	0.33
122.62	257.52	767.16	0.34
123.62	254.85	746.82	0.34
124.62	251.13	722.09	0.35
125.62	247.10	698.55	0.35
126.62	243.13	677.91	0.36
127.62	237.70	652.80	0.36
128.62	233.28	634.39	0.37
129.62	226.92	610.24	0.37
130.62	221.41	591.14	0.37
131.62	214.63	569.37	0.38
132.62	207.69	548.69	0.38
133.62	200.83	529.58	0.38
134.62	192.49	507.83	0.38
135.62	185.84	491.42	0.38

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
137.62	168.88	452.76	0.37
138.62	160.83	435.69	0.37
139.62	151.79	417.29	0.36
140.62	143.61	401.23	0.36
141.62	134.02	383.01	0.35
142.62	126.32	368.77	0.34
143.62	117.63	352.99	0.33
144.62	109.70	338.83	0.32
145.62	101.96	325.17	0.31
146.62	93.99	311.19	0.30
147.62	87.41	299.67	0.29
148.62	79.78	286.17	0.28
149.62	74.50	276.65	0.26
150.62	69.21	266.81	0.25
151.62	64.39	257.35	0.24
152.62	60.58	249.24	0.24
153.62	56.54	239.51	0.23

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
155.62	51.85	225.55	0.23
156.62	50.01	218.86	0.23
157.62	48.33	211.99	0.23
158.62	47.08	206.40	0.23
159.62	45.89	200.82	0.23
160.62	44.64	194.77	0.23
161.62	43.83	190.85	0.23
162.62	42.86	186.12	0.23
163.62	42.02	182.13	0.23
164.62	41.13	178.01	0.23
165.62	40.12	173.60	0.23
166.62	39.39	170.52	0.23
167.62	38.45	166.72	0.23
168.62	37.67	163.68	0.23
169.62	36.73	160.16	0.23
170.62	35.97	157.36	0.23
171.62	35.16	154.38	0.23

Table E5 DMA of the 40 wt% marl–polybenzoxazine composite

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-97.51	129.57	3628.09	0.04
-96.51	129.13	3621.71	0.04
-95.51	128.79	3616.38	0.04
-94.51	128.13	3604.10	0.04
-93.51	127.63	3592.67	0.04
-92.51	127.12	3579.23	0.04
-91.51	126.71	3567.99	0.04
-90.51	126.19	3553.83	0.04
-89.51	125.79	3542.86	0.04
-88.51	124.91	3518.79	0.04
-87.51	124.37	3503.49	0.04
-86.51	123.95	3491.25	0.04
-85.51	123.44	3476.26	0.04
-84.51	122.78	3457.53	0.04
-83.51	122.47	3449.05	0.04
-82.51	121.87	3432.91	0.04
-81.51	121.34	3419.06	0.04
-80.51	120.67	3402.05	0.04
-79.51	120.16	3389.45	0.04
-78.51	119.52	3373.63	0.04
-77.51	118.98	3360.05	0.04
-76.51	118.43	3346.04	0.04
-75.51	117.93	3333.09	0.04
-74.51	117.33	3317.69	0.04
-73.51	116.51	3296.49	0.04
-72.51	116.17	3288.06	0.04
-71.51	115.50	3271.67	0.04
-70.51	114.92	3257.60	0.04
-69.51	114.31	3242.60	0.04
-68.51	113.65	3226.59	0.04
-67.51	112.90	3207.72	0.04
-66.51	112.39	3194.60	0.04
-65.51	111.67	3175.38	0.04
-64.51	111.24	3162.99	0.04
-63.51	110.80	3149.70	0.04
-62.51	110.34	3135.31	0.04
-61.51	109.89	3121.51	0.04
-59.51	108.85	3092.42	0.04
-58.51	108.34	3079.71	0.04
-57.51	107.74	3065.33	0.04
-56.51	107.09	3050.39	0.04
-55.51	106.55	3037.98	0.04
-54.51	106.01	3025.74	0.03
-53.51	105.49	3013.75	0.03
-52.51	105.00	3002.30	0.03
-51.51	104.41	2988.51	0.03
-50.51	103.83	2974.94	0.03
-49.51	103.28	2962.35	0.03
-48.51	102.76	2950.17	0.03
-47.51	102.28	2938.66	0.03
-46.51	101.68	2924.55	0.03
-45.51	101.10	2911.34	0.03
-44.51	100.55	2899.60	0.03
-43.51	99.97	2887.70	0.03
-42.51	99.49	2878.10	0.03
-41.51	98.80	2864.25	0.03
-40.51	98.22	2852.08	0.03
-39.51	97.71	2840.76	0.03
-38.51	97.11	2827.12	0.03
-37.51	96.55	2814.56	0.03
-36.51	96.07	2804.00	0.03
-35.51	95.52	2791.72	0.03
-34.51	94.92	2778.71	0.03
-33.51	94.34	2766.61	0.03
-32.51	93.89	2757.58	0.03
-31.51	93.37	2747.66	0.03
-30.51	92.68	2735.01	0.03
-29.51	92.12	2725.17	0.03
-28.51	91.55	2714.97	0.03
-27.51	90.92	2703.69	0.03
-26.51	90.33	2692.77	0.03
-25.51	89.79	2682.77	0.03
-24.51	89.18	2671.35	0.03
-23.51	88.67	2661.23	0.03

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-21.51	87.63	2640.57	0.03
-20.51	87.06	2629.46	0.03
-19.51	86.57	2620.41	0.03
-18.51	85.90	2608.25	0.03
-17.51	85.41	2599.24	0.03
-16.51	84.93	2589.81	0.03
-15.51	84.44	2579.53	0.03
-14.51	83.97	2569.24	0.03
-13.51	83.54	2560.00	0.03
-12.51	83.05	2550.45	0.03
-11.51	82.55	2541.28	0.03
-10.51	81.95	2530.86	0.03
-9.51	81.48	2522.78	0.03
-8.51	80.99	2514.03	0.03
-7.51	80.44	2503.74	0.03
-6.51	80.07	2496.10	0.03
-5.51	79.66	2486.30	0.03
-4.51	79.37	2478.69	0.03
-3.51	79.07	2468.97	0.03
-2.51	78.83	2459.28	0.03
-1.51	78.69	2451.56	0.03
-0.51	78.59	2442.31	0.03
0.49	78.60	2433.29	0.03
1.49	78.72	2424.62	0.03
2.49	78.99	2415.42	0.03
3.49	79.39	2406.65	0.03
4.49	79.76	2400.22	0.03
5.49	80.33	2392.27	0.03
6.49	81.00	2384.27	0.03
7.49	81.73	2376.49	0.03
8.49	82.48	2369.41	0.03
9.49	83.39	2361.41	0.04
10.49	84.37	2353.47	0.04
11.49	85.29	2346.36	0.04
12.49	86.17	2339.72	0.04
13.49	87.21	2332.14	0.04
14.49	88.16	2325.32	0.04
15.49	88.95	2319.79	0.04
16.49	89.99	2312.43	0.04

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
17.49	90.94	2305.50	0.04
18.49	91.82	2299.09	0.04
19.49	92.66	2293.10	0.04
20.49	93.75	2285.74	0.04
21.49	94.60	2280.38	0.04
22.49	95.44	2275.32	0.04
23.49	96.47	2269.29	0.04
24.49	97.50	2263.59	0.04
25.49	99.06	2255.41	0.04
26.49	100.16	2250.06	0.04
27.49	101.97	2241.73	0.05
28.49	103.28	2235.97	0.05
29.49	104.95	2228.68	0.05
30.49	106.51	2221.90	0.05
31.49	107.79	2216.27	0.05
32.49	109.07	2210.55	0.05
33.49	110.35	2204.64	0.05
34.49	111.57	2198.88	0.05
35.49	113.11	2191.33	0.05
36.49	114.62	2183.79	0.05
37.49	116.23	2175.69	0.05
38.49	117.72	2168.29	0.05
39.49	119.32	2160.67	0.06
40.49	120.92	2153.49	0.06
41.49	122.65	2146.20	0.06
42.49	124.39	2139.23	0.06
43.49	126.17	2132.23	0.06
44.49	128.06	2124.72	0.06
45.49	129.71	2117.94	0.06
46.49	131.49	2110.36	0.06
47.49	133.04	2103.53	0.06
48.49	134.73	2095.80	0.06
49.49	136.39	2088.08	0.07
50.49	138.07	2080.28	0.07
51.49	139.86	2072.12	0.07
52.49	141.51	2064.74	0.07
53.49	143.39	2056.49	0.07
54.49	145.24	2048.39	0.07
55.49	147.19	2039.86	0.07

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
56.49	149.06	2031.56	0.07
57.49	150.90	2023.34	0.07
58.49	152.90	2014.28	0.08
59.49	154.74	2005.67	0.08
60.49	156.66	1996.41	0.08
61.49	158.43	1987.63	0.08
62.49	160.33	1978.11	0.08
63.49	162.24	1968.60	0.08
64.49	164.16	1959.05	0.08
65.49	166.32	1948.44	0.09
66.49	168.23	1939.03	0.09
67.49	170.52	1927.83	0.09
68.49	172.46	1918.32	0.09
69.49	174.85	1906.64	0.09
70.49	177.12	1895.60	0.09
71.49	179.48	1884.23	0.10
72.49	182.04	1872.10	0.10
73.49	184.61	1860.09	0.10
74.49	187.48	1846.67	0.10
75.49	189.92	1835.21	0.10
76.49	192.89	1821.13	0.11
77.49	195.51	1808.57	0.11
78.49	198.48	1794.13	0.11
79.49	201.27	1780.32	0.11
80.49	204.21	1765.49	0.12
81.49	207.37	1749.29	0.12
82.49	210.19	1734.64	0.12
83.49	213.59	1716.85	0.12
84.49	216.61	1701.09	0.13
85.49	220.25	1681.94	0.13
86.49	223.70	1663.79	0.13
87.49	227.35	1644.61	0.14
88.49	231.12	1624.76	0.14
89.49	234.98	1604.37	0.15
90.49	239.46	1580.65	0.15
91.49	243.42	1559.51	0.16
92.49	248.16	1533.80	0.16
93.49	252.34	1510.58	0.17
94.49	256.98	1484.11	0.17

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
95.49	261.73	1455.99	0.18
96.49	265.85	1430.53	0.19
97.49	270.58	1399.90	0.19
98.49	274.35	1374.13	0.20
99.49	278.51	1344.18	0.21
100.49	282.17	1316.22	0.21
101.49	285.89	1285.84	0.22
102.49	289.30	1255.91	0.23
103.49	292.13	1228.97	0.24
104.49	295.02	1198.64	0.25
105.49	297.12	1173.86	0.25
106.49	299.16	1145.35	0.26
107.49	300.53	1121.59	0.27
108.49	301.58	1096.30	0.28
109.49	302.15	1071.16	0.28
110.49	302.20	1047.71	0.29
111.49	301.66	1022.36	0.30
112.49	300.72	1001.56	0.30
113.49	298.88	975.61	0.31
114.49	296.84	954.97	0.31
115.49	293.69	930.33	0.31
116.49	290.35	909.26	0.32
117.49	286.07	886.67	0.32
118.49	280.74	863.04	0.32
119.49	275.26	842.35	0.33
120.49	267.47	817.24	0.33
121.49	260.59	798.06	0.33
122.49	250.99	774.49	0.33
123.49	241.01	752.66	0.33
124.49	231.07	732.79	0.32
125.49	219.29	710.88	0.31
126.49	208.77	692.18	0.29
127.49	197.16	671.80	0.28
128.49	188.63	656.66	0.28
129.49	178.93	638.85	0.27
130.49	170.85	623.35	0.27
131.49	163.35	608.33	0.27
132.49	156.17	593.40	0.27
133.49	149.81	579.79	0.26

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
134.49	142.73	564.30	0.26
135.49	137.38	552.39	0.25
136.49	130.83	537.64	0.25
137.49	125.04	524.43	0.24
138.49	119.91	512.60	0.24
139.49	114.15	499.17	0.23
140.49	109.71	488.65	0.23
141.49	104.19	475.22	0.22
142.49	100.01	464.68	0.21
143.49	95.48	452.72	0.21
144.49	91.84	442.55	0.20
145.49	88.55	432.66	0.20
146.49	85.47	422.51	0.20
147.49	83.17	414.16	0.20
148.49	80.90	404.89	0.20
149.49	79.23	397.31	0.20
150.49	77.56	388.93	0.20
151.49	76.13	381.17	0.20

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
152.49	74.94	374.38	0.20
153.49	73.56	366.40	0.20
154.49	72.54	360.44	0.20
155.49	71.28	353.25	0.20
156.49	70.11	346.75	0.20
157.49	69.05	341.12	0.20
158.49	67.85	334.94	0.20
159.49	66.80	329.71	0.20
160.49	65.54	323.68	0.20
161.49	64.59	319.25	0.20
162.49	63.40	313.89	0.20
163.49	62.44	309.66	0.20
164.49	61.40	305.18	0.20
165.49	60.33	300.69	0.20
166.49	59.40	296.86	0.20
167.49	58.35	292.57	0.20
168.49	57.49	289.05	0.20
169.49	56.54	285.23	0.20
170.49	55.62	281.53	0.20

Table E6 DMA of the 50 wt% marl–polybenzoxazine composite

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-99.98	188.86	4360.39	0.04
-98.98	187.84	4369.86	0.04
-97.98	186.85	4378.54	0.04
-96.98	185.92	4385.40	0.04
-95.98	185.10	4389.87	0.04
-94.98	184.16	4392.84	0.04
-93.98	183.23	4393.54	0.04
-92.98	182.52	4392.74	0.04
-91.98	181.54	4390.00	0.04
-90.98	180.64	4386.02	0.04
-89.98	179.83	4381.34	0.04
-88.98	178.90	4374.82	0.04
-87.98	177.92	4366.65	0.04
-86.98	177.12	4359.12	0.04
-85.98	176.17	4349.13	0.04
-84.98	175.36	4340.18	0.04
-83.98	174.43	4329.45	0.04
-82.98	173.55	4318.56	0.04
-81.98	172.92	4310.31	0.04
-80.98	172.01	4297.52	0.04
-79.98	171.24	4285.55	0.04
-78.98	170.55	4273.97	0.04
-77.98	169.85	4260.32	0.04
-76.98	169.31	4248.12	0.04
-75.98	168.77	4233.62	0.04
-74.98	168.28	4218.88	0.04
-73.98	167.92	4207.63	0.04
-72.98	167.46	4193.43	0.04
-71.98	167.04	4180.18	0.04
-70.98	166.56	4164.84	0.04
-69.98	166.21	4153.30	0.04
-68.98	165.71	4138.21	0.04
-67.98	165.22	4124.61	0.04
-66.98	164.66	4110.79	0.04
-65.98	164.13	4098.19	0.04
-64.98	163.51	4084.09	0.04
-63.98	162.93	4071.01	0.04
-62.98	162.33	4057.03	0.04
-61.98	161.79	4043.43	0.04
-60.98	161.22	4029.07	0.04
-59.98	160.67	4015.38	0.04
-58.98	160.00	3999.25	0.04
-57.98	159.63	3990.67	0.04
-56.98	159.01	3976.49	0.04
-55.98	158.43	3964.09	0.04
-54.98	157.68	3949.77	0.04
-53.98	157.12	3940.30	0.04
-52.98	156.02	3923.56	0.04
-51.98	155.16	3911.50	0.04
-50.98	154.32	3900.30	0.04
-49.98	153.35	3887.57	0.04
-48.98	152.22	3872.81	0.04
-47.98	151.24	3859.74	0.04
-46.98	150.32	3847.01	0.04
-45.98	149.45	3834.32	0.04
-44.98	148.55	3820.63	0.04
-43.98	147.80	3808.44	0.04
-42.98	147.01	3794.95	0.04
-41.98	146.30	3782.14	0.04
-40.98	145.74	3771.87	0.04
-39.98	145.06	3758.81	0.04
-38.98	144.38	3744.74	0.04
-37.98	143.89	3732.94	0.04
-36.98	143.51	3721.96	0.04
-35.98	143.17	3709.35	0.04
-34.98	142.94	3697.73	0.04
-33.98	142.80	3687.40	0.04
-32.98	142.71	3673.27	0.04
-31.98	142.70	3663.85	0.04
-30.98	142.76	3651.51	0.04

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-29.98	142.86	3639.86	0.04
-28.98	142.98	3629.83	0.04
-27.98	143.17	3617.21	0.04
-26.98	143.40	3605.71	0.04
-25.98	143.66	3594.91	0.04
-24.98	144.00	3582.54	0.04
-23.98	144.27	3572.89	0.04
-22.98	144.57	3560.97	0.04
-21.98	144.75	3551.06	0.04
-20.98	144.85	3541.36	0.04
-19.98	144.88	3529.69	0.04
-18.98	144.83	3521.18	0.04
-17.98	144.72	3510.17	0.04
-16.98	144.60	3501.35	0.04
-15.98	144.48	3492.31	0.04
-14.98	144.34	3480.58	0.04
-13.98	144.24	3470.73	0.04
-12.98	144.16	3460.73	0.04
-11.98	144.11	3451.10	0.04
-10.98	144.08	3441.75	0.04
-9.98	144.07	3431.18	0.04
-8.98	144.07	3420.93	0.04
-7.98	144.07	3411.29	0.04
-6.98	144.05	3403.72	0.04
-5.98	144.01	3391.43	0.04
-4.98	143.97	3383.86	0.04
-3.98	143.95	3373.95	0.04
-2.98	144.00	3364.74	0.04
-1.98	144.11	3357.01	0.04
-0.98	144.42	3345.85	0.04
0.02	144.72	3338.62	0.04
1.02	145.17	3329.67	0.04
2.02	145.69	3320.58	0.04
3.02	146.19	3312.53	0.04
4.02	146.73	3304.03	0.04
5.02	147.23	3296.30	0.04
6.02	147.68	3288.72	0.04

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
7.02	148.17	3279.31	0.05
8.02	148.45	3272.79	0.05
9.02	148.76	3264.83	0.05
10.02	149.02	3257.91	0.05
11.02	149.39	3249.25	0.05
12.02	149.76	3241.86	0.05
13.02	150.29	3232.50	0.05
14.02	150.68	3226.14	0.05
15.02	151.15	3219.05	0.05
16.02	151.83	3209.86	0.05
17.02	152.38	3202.61	0.05
18.02	152.91	3195.63	0.05
19.02	153.42	3188.32	0.05
20.02	153.91	3180.21	0.05
21.02	154.25	3173.04	0.05
22.02	154.51	3165.87	0.05
23.02	154.77	3157.24	0.05
24.02	154.94	3150.11	0.05
25.02	155.11	3142.52	0.05
26.02	155.32	3133.25	0.05
27.02	155.54	3124.68	0.05
28.02	155.83	3115.47	0.05
29.02	156.21	3105.74	0.05
30.02	156.67	3096.28	0.05
31.02	157.17	3087.69	0.05
32.02	157.85	3077.67	0.05
33.02	158.63	3067.07	0.05
34.02	159.20	3059.98	0.05
35.02	159.95	3051.23	0.05
36.02	160.81	3041.98	0.05
37.02	161.79	3032.13	0.05
38.02	162.69	3023.51	0.05
39.02	163.64	3015.07	0.05
40.02	164.78	3006.05	0.06
41.02	166.03	2997.14	0.06
42.02	167.48	2987.82	0.06
43.02	168.90	2979.34	0.06

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
44.02	170.58	2969.82	0.06
45.02	172.65	2958.70	0.06
46.02	175.36	2944.56	0.06
47.02	177.53	2933.35	0.06
48.02	179.18	2924.72	0.06
49.02	180.97	2915.23	0.06
50.02	182.21	2908.50	0.06
51.02	184.09	2898.20	0.06
52.02	185.43	2890.93	0.06
53.02	187.29	2880.91	0.06
54.02	189.08	2871.47	0.07
55.02	191.22	2860.42	0.07
56.02	193.16	2850.57	0.07
57.02	195.28	2839.77	0.07
58.02	199.23	2819.22	0.07
59.02	201.02	2809.43	0.07
60.02	202.86	2799.02	0.07
61.02	204.73	2788.11	0.07
62.02	206.63	2776.71	0.07
63.02	208.74	2764.13	0.08
64.02	210.72	2752.49	0.08
65.02	212.90	2739.99	0.08
66.02	214.97	2728.18	0.08
67.02	217.20	2715.26	0.08
68.02	219.44	2701.94	0.08
69.02	221.74	2687.71	0.08
70.02	223.85	2674.06	0.08
71.02	225.97	2659.83	0.08
72.02	228.16	2644.54	0.09
73.02	230.18	2630.13	0.09
74.02	232.54	2613.30	0.09
75.02	234.71	2597.96	0.09
76.02	237.22	2580.46	0.09
77.02	239.75	2562.91	0.09
78.02	242.25	2545.45	0.10
79.02	245.21	2524.70	0.10
80.02	247.57	2508.04	0.10

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
81.02	250.59	2486.69	0.10
82.02	253.43	2466.72	0.10
83.02	256.70	2443.74	0.11
84.02	259.92	2421.08	0.11
85.02	263.06	2398.95	0.11
86.02	266.96	2371.64	0.11
87.02	270.21	2348.99	0.12
88.02	274.24	2321.15	0.12
89.02	278.12	2294.51	0.12
90.02	282.37	2265.42	0.13
91.02	286.81	2235.14	0.13
92.02	291.30	2204.28	0.14
93.02	296.14	2170.54	0.14
94.02	300.56	2139.33	0.14
95.02	305.73	2102.42	0.15
96.02	310.26	2069.62	0.15
97.02	315.36	2032.31	0.16
98.02	320.12	1996.84	0.16
99.02	324.95	1959.94	0.17
100.02	329.59	1923.21	0.17
101.02	333.61	1889.53	0.18
102.02	337.54	1853.67	0.18
103.02	340.57	1822.59	0.18
104.02	343.56	1786.15	0.19
105.02	345.54	1755.37	0.19
106.02	347.11	1721.43	0.20
107.02	347.98	1688.38	0.20
108.02	348.23	1657.56	0.21
109.02	347.89	1622.95	0.21
110.02	347.20	1596.14	0.22
111.02	345.91	1563.62	0.22
112.02	344.49	1536.67	0.22
113.02	342.56	1506.19	0.23
114.02	340.37	1475.94	0.23
115.02	338.32	1449.87	0.23
116.02	335.74	1419.21	0.24
117.02	333.61	1395.23	0.24

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
118.02	330.82	1365.24	0.24
119.02	328.35	1339.97	0.25
120.02	325.43	1311.24	0.25
121.02	322.70	1285.55	0.25
122.02	319.79	1259.52	0.26
123.02	316.39	1230.68	0.26
124.02	313.77	1209.81	0.26
125.02	310.00	1181.40	0.26
126.02	306.78	1158.73	0.27
127.02	302.82	1132.51	0.27
128.02	298.92	1108.46	0.27
129.02	294.99	1085.67	0.27
130.02	290.12	1059.18	0.27
131.02	286.23	1039.24	0.28
132.02	281.28	1015.05	0.28
133.02	276.44	992.49	0.28
134.02	271.57	970.57	0.28
135.02	266.08	946.82	0.28
136.02	261.22	926.50	0.28
137.02	255.44	903.15	0.28
138.02	250.63	884.32	0.28
139.02	244.72	861.76	0.28
140.02	239.36	841.89	0.28
141.02	233.96	822.32	0.28
142.02	228.08	801.62	0.28
143.02	223.09	784.45	0.28
144.02	216.82	763.37	0.28
145.02	212.50	749.17	0.28

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
146.02	206.24	728.96	0.28
147.02	201.01	712.47	0.28
148.02	195.76	696.25	0.28
149.02	190.31	679.77	0.28
150.02	185.27	664.92	0.28
151.02	179.13	647.37	0.27
152.02	174.55	634.61	0.27
153.02	168.90	619.27	0.27
154.02	163.38	604.61	0.27
155.02	158.23	591.24	0.27
156.02	152.14	575.79	0.26
157.02	148.03	565.51	0.26
158.02	142.31	551.46	0.26
159.02	137.79	540.49	0.25
160.02	132.61	528.05	0.25
161.02	127.33	515.55	0.25
162.02	122.92	505.22	0.24
163.02	118.14	494.18	0.24
164.02	114.10	484.98	0.24
165.02	109.21	474.00	0.23
166.02	105.10	464.88	0.23
167.02	101.05	456.02	0.22
168.02	96.92	447.15	0.22
169.02	93.44	439.80	0.21
170.02	89.14	430.89	0.21
171.02	85.72	423.90	0.21
172.02	82.02	416.36	0.20

Table E7 DMA of the 20 wt% silane modified-surface marl–polybenzoxazine composite

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-99.57	143.15	3777.21	0.04
-98.57	142.62	3781.72	0.04
-97.57	140.55	3797.50	0.04
-96.57	139.45	3803.72	0.04
-95.57	138.76	3806.63	0.04
-94.57	137.16	3810.52	0.04
-93.57	136.22	3811.14	0.04
-92.57	134.73	3809.99	0.04
-91.57	133.99	3808.49	0.04
-90.57	132.68	3804.50	0.03
-89.57	132.12	3802.21	0.03
-88.57	131.19	3797.54	0.03
-87.57	130.21	3791.21	0.03
-86.57	129.33	3784.17	0.03
-85.57	128.29	3773.89	0.03
-84.57	127.71	3767.13	0.03
-83.57	127.18	3759.94	0.03
-82.57	126.73	3752.76	0.03
-81.57	126.31	3744.96	0.03
-80.57	125.84	3735.02	0.03
-79.57	125.43	3725.18	0.03
-78.57	125.09	3715.81	0.03
-77.57	124.73	3706.29	0.03
-76.57	124.46	3699.21	0.03
-75.57	124.02	3688.94	0.03
-74.57	123.60	3679.30	0.03
-73.57	123.17	3669.42	0.03
-72.57	122.82	3661.58	0.03
-71.57	122.52	3654.65	0.03
-70.57	122.00	3641.86	0.03
-69.57	121.69	3633.18	0.03
-68.57	121.37	3623.61	0.03
-67.57	121.09	3613.22	0.03
-66.57	120.90	3604.04	0.03
-65.57	120.69	3592.93	0.03
-64.57	120.51	3583.08	0.03
-63.57	120.33	3574.29	0.03
-62.57	120.07	3563.26	0.03
-61.57	119.88	3555.25	0.03
-60.57	119.65	3545.69	0.03
-59.57	119.62	3544.18	0.03
-58.57	119.19	3526.81	0.03
-57.57	118.90	3516.19	0.03
-56.57	118.63	3506.20	0.03
-55.57	118.41	3497.37	0.03
-54.57	118.21	3488.46	0.03
-53.57	118.03	3479.11	0.03
-52.57	117.90	3470.56	0.03
-51.57	117.75	3458.93	0.03
-50.57	117.66	3450.08	0.03
-49.57	117.56	3441.40	0.03
-48.57	117.46	3431.68	0.03
-47.57	117.33	3421.74	0.03
-46.57	117.21	3414.13	0.03
-45.57	116.98	3402.60	0.03
-44.57	116.79	3395.33	0.03
-43.57	116.46	3384.65	0.03
-42.57	116.10	3375.04	0.03
-41.57	115.69	3365.59	0.03
-40.57	115.32	3357.30	0.03
-39.57	114.73	3344.85	0.03
-38.57	114.34	3336.61	0.03
-37.57	113.86	3326.40	0.03
-36.57	113.46	3317.90	0.03
-35.57	113.07	3308.95	0.03
-34.57	112.69	3299.06	0.03
-33.57	112.37	3289.12	0.03
-32.57	112.74	3307.47	0.03

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-31.57	112.04	3273.47	0.03
-30.57	111.91	3264.19	0.03
-29.57	111.83	3255.48	0.03
-28.57	111.80	3248.60	0.03
-27.57	111.79	3238.32	0.03
-26.57	111.81	3229.24	0.03
-25.57	111.83	3221.32	0.03
-24.57	111.86	3213.65	0.03
-23.57	111.88	3206.49	0.03
-22.57	111.91	3197.21	0.04
-21.57	111.93	3190.34	0.04
-20.57	111.93	3181.04	0.04
-19.57	111.90	3171.08	0.04
-18.57	111.87	3166.02	0.04
-17.57	111.80	3156.04	0.04
-16.57	111.73	3149.93	0.04
-15.57	111.56	3140.67	0.04
-14.57	111.40	3134.43	0.04
-13.57	111.08	3124.56	0.04
-12.57	110.80	3116.60	0.04
-11.57	110.56	3109.30	0.04
-10.57	110.35	3102.40	0.04
-9.57	110.12	3094.53	0.04
-8.57	109.83	3085.85	0.04
-7.57	109.43	3075.70	0.04
-6.57	108.75	3060.55	0.04
-5.57	108.24	3051.01	0.04
-4.57	107.81	3043.70	0.04
-3.57	107.37	3036.73	0.04
-2.57	106.85	3029.25	0.04
-1.57	106.39	3022.85	0.04
-0.57	105.80	3015.08	0.04
0.43	105.32	3008.91	0.03
1.43	104.69	3001.59	0.03
2.43	104.13	2995.57	0.03
3.43	103.51	2989.45	0.03
4.43	102.87	2983.51	0.03

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
5.43	102.15	2976.99	0.03
6.43	101.66	2972.57	0.03
7.43	100.90	2965.95	0.03
8.43	100.13	2959.62	0.03
9.43	99.48	2954.55	0.03
10.43	98.83	2949.70	0.03
11.43	98.21	2945.07	0.03
12.43	97.54	2939.70	0.03
13.43	97.00	2934.36	0.03
14.43	96.65	2929.15	0.03
15.43	96.52	2923.47	0.03
16.43	96.59	2918.95	0.03
17.43	96.82	2913.62	0.03
18.43	97.30	2906.99	0.03
19.43	97.85	2901.41	0.03
20.43	98.40	2896.70	0.03
21.43	98.98	2892.18	0.03
22.43	99.81	2886.15	0.03
23.43	100.41	2881.90	0.03
24.43	100.85	2878.99	0.04
25.43	102.36	2869.37	0.04
26.43	103.26	2864.07	0.04
27.43	104.17	2858.90	0.04
28.43	105.27	2852.72	0.04
29.43	106.19	2847.56	0.04
30.43	107.00	2842.68	0.04
31.43	107.70	2838.00	0.04
32.43	108.34	2832.93	0.04
33.43	108.85	2828.19	0.04
34.43	109.32	2823.22	0.04
35.43	109.82	2817.49	0.04
36.43	110.27	2811.89	0.04
37.43	110.76	2805.79	0.04
38.43	111.16	2800.90	0.04
39.43	111.66	2795.13	0.04
40.43	111.97	2791.71	0.04
41.43	112.62	2785.13	0.04

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
42.43	113.26	2779.22	0.04
43.43	113.78	2774.73	0.04
44.43	114.47	2769.30	0.04
45.43	115.07	2764.90	0.04
46.43	115.92	2759.18	0.04
47.43	116.79	2753.76	0.04
48.43	117.79	2748.01	0.04
49.43	118.84	2742.40	0.04
50.43	119.98	2736.67	0.04
51.43	121.29	2730.41	0.04
52.43	122.52	2724.84	0.04
53.43	123.96	2718.66	0.05
54.43	125.42	2712.77	0.05
55.43	127.00	2706.78	0.05
56.43	128.60	2700.92	0.05
57.43	130.26	2695.03	0.05
58.43	132.21	2688.20	0.05
59.43	133.95	2682.16	0.05
60.43	136.08	2674.83	0.05
61.43	138.04	2668.21	0.05
62.43	140.43	2660.30	0.05
63.43	142.73	2652.87	0.05
64.43	145.06	2645.34	0.05
65.43	147.53	2637.08	0.06
66.43	149.66	2629.53	0.06
67.43	152.00	2620.53	0.06
68.43	153.84	2612.79	0.06
69.43	155.95	2602.97	0.06
70.43	157.75	2593.81	0.06
71.43	159.54	2583.99	0.06
72.43	161.23	2574.19	0.06
73.43	162.90	2564.18	0.06
74.43	164.81	2552.58	0.06
75.43	166.32	2543.39	0.07
76.43	168.29	2531.50	0.07
77.43	170.14	2520.63	0.07
78.43	172.36	2507.81	0.07

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
79.43	174.59	2495.00	0.07
80.43	176.87	2481.68	0.07
81.43	179.40	2466.78	0.07
82.43	181.57	2453.85	0.07
83.43	184.11	2438.54	0.08
84.43	186.25	2425.60	0.08
85.43	188.94	2409.31	0.08
86.43	191.62	2393.30	0.08
87.43	194.30	2377.46	0.08
88.43	197.47	2358.97	0.08
89.43	200.35	2342.25	0.09
90.43	203.67	2322.96	0.09
91.43	206.51	2306.31	0.09
92.43	209.96	2286.15	0.09
93.43	213.24	2266.98	0.09
94.43	216.86	2245.98	0.10
95.43	220.55	2224.70	0.10
96.43	223.95	2205.33	0.10
97.43	228.00	2182.49	0.10
98.43	231.47	2163.13	0.11
99.43	235.80	2139.03	0.11
100.43	239.48	2118.55	0.11
101.43	243.60	2095.52	0.12
102.43	247.53	2073.52	0.12
103.43	251.64	2050.46	0.12
104.43	256.11	2025.16	0.13
105.43	259.68	2004.94	0.13
106.43	264.01	1980.22	0.13
107.43	267.88	1957.85	0.14
108.43	271.92	1934.08	0.14
109.43	275.65	1911.58	0.14
110.43	279.49	1887.77	0.15
111.43	283.66	1861.02	0.15
112.43	286.93	1839.43	0.16
113.43	290.78	1813.46	0.16
114.43	293.91	1791.96	0.16
115.43	297.56	1766.52	0.17

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
116.43	301.21	1740.77	0.17
117.43	304.56	1716.96	0.18
118.43	308.51	1688.74	0.18
119.43	311.58	1666.71	0.19
120.43	315.58	1637.75	0.19
121.43	318.66	1615.00	0.20
122.43	322.51	1586.06	0.20
123.43	326.02	1558.93	0.21
124.43	329.48	1531.70	0.22
125.43	333.46	1499.51	0.22
126.43	336.29	1475.93	0.23
127.43	340.04	1443.98	0.24
128.43	343.03	1417.76	0.24
129.43	346.59	1385.30	0.25
130.43	349.62	1356.13	0.26
131.43	352.54	1325.98	0.27
132.43	355.49	1292.57	0.27
133.43	357.75	1263.84	0.28
134.43	360.18	1227.50	0.29
135.43	361.75	1198.22	0.30
136.43	363.09	1163.40	0.31
137.43	363.79	1129.04	0.32
138.43	363.83	1097.37	0.33
139.43	363.05	1060.80	0.34
140.43	361.60	1029.42	0.35
141.43	358.85	991.92	0.36
142.43	355.79	961.80	0.37
143.43	351.08	925.57	0.38
144.43	345.11	888.52	0.39
145.43	339.39	858.23	0.40
146.43	331.03	819.81	0.40
147.43	324.42	792.76	0.41
148.43	315.13	758.46	0.42
149.43	306.19	728.56	0.42
150.43	296.36	698.47	0.42
151.43	285.68	668.48	0.43
152.43	275.53	642.16	0.43

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
153.43	263.13	612.48	0.43
154.43	252.65	589.17	0.43
155.43	239.15	561.22	0.43
156.43	226.19	536.15	0.42
157.43	211.61	509.67	0.42
158.43	194.68	480.77	0.40
159.43	180.71	458.14	0.39
160.43	160.29	426.71	0.37
161.43	144.99	404.18	0.35
162.43	128.70	380.90	0.33
163.43	114.31	360.69	0.31
164.43	103.71	345.80	0.29
165.43	90.46	326.67	0.27
166.43	82.84	315.09	0.26
167.43	73.98	300.74	0.24
168.43	67.63	289.40	0.23
169.43	62.55	279.15	0.22
170.43	58.04	268.57	0.22
171.43	55.14	260.51	0.21
172.43	52.45	251.61	0.21
173.43	50.93	245.60	0.21
174.43	49.65	239.73	0.21
175.43	48.85	235.60	0.21
176.43	48.15	231.61	0.21
177.43	47.25	225.85	0.21
178.43	46.57	221.25	0.22
179.43	45.87	216.54	0.22
180.43	45.26	212.78	0.22
181.43	44.58	209.17	0.22
182.43	43.78	205.61	0.22
183.43	43.12	203.20	0.21
184.43	42.25	200.63	0.21
185.43	41.51	198.83	0.21
186.43	40.75	197.24	0.21
187.43	39.77	195.46	0.20
188.43	38.76	193.74	0.20
189.43	37.76	191.96	0.20

Temp. (°C)	E' (MPa)	E'' (MPa)	tan ô
190.43	36.82	190.06	0.19
191.43	35.98	188.11	0.19
192.43	35.26	186.19	0.19
193.43	34.63	184.29	0.19
194.43	34.03	182.35	0.18

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
195.43	33.43	180.29	0.18
196.43	32.78	177.93	0.18
197.43	32.33	176.21	0.18
198.43	31.86	174.36	0.18
199.43	31.42	172.58	0.18

Table E8 DMA of the 20 wt% stearic acid modified-surface marl–polybenzoxazine composite

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-99.39	50.26	1705.90	0.03
-98.39	49.43	1708.78	0.03
-97.39	49.16	1709.55	0.03
-96.39	48.69	1710.41	0.03
-95.39	48.25	1710.28	0.03
-94.39	48.12	1709.78	0.03
-93.39	47.97	1708.89	0.03
-92.39	47.69	1706.44	0.03
-91.39	47.38	1703.21	0.03
-90.39	47.26	1700.59	0.03
-89.39	47.14	1697.44	0.03
-88.39	46.77	1692.43	0.03
-87.39	46.54	1690.32	0.03
-86.39	46.06	1686.55	0.03
-85.39	45.41	1681.85	0.03
-84.39	44.73	1677.13	0.03
-83.39	44.25	1673.71	0.03
-82.39	43.41	1666.99	0.03
-81.39	42.68	1660.38	0.03
-80.39	42.42	1657.75	0.03
-79.39	42.00	1653.04	0.03
-78.39	41.57	1648.06	0.03
-77.39	41.25	1644.25	0.03
-76.39	40.96	1641.11	0.02
-75.39	40.24	1634.83	0.02
-74.39	39.86	1631.90	0.02
-73.39	39.31	1627.32	0.02
-72.39	38.86	1623.03	0.02
-71.39	38.50	1619.84	0.02
-70.39	37.75	1614.08	0.02
-69.39	37.22	1610.01	0.02
-68.39	36.69	1605.90	0.02
-67.39	36.11	1601.55	0.02
-66.39	35.42	1596.86	0.02

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-65.39	34.95	1593.58	0.02
-64.39	34.38	1588.97	0.02
-63.39	34.16	1586.88	0.02
-62.39	33.78	1582.66	0.02
-61.39	33.52	1578.86	0.02
-60.39	33.29	1574.58	0.02
-59.39	33.06	1570.80	0.02
-58.39	32.84	1567.35	0.02
-57.39	32.58	1563.44	0.02
-56.39	32.36	1559.56	0.02
-55.39	32.25	1557.17	0.02
-54.39	31.98	1552.76	0.02
-53.39	31.73	1549.65	0.02
-52.39	31.43	1546.08	0.02
-51.39	31.18	1542.54	0.02
-50.39	30.94	1538.98	0.02
-49.39	30.72	1535.51	0.02
-48.39	30.49	1532.14	0.02
-47.39	30.29	1529.41	0.02
-46.39	29.97	1524.68	0.02
-45.39	29.81	1521.45	0.02
-44.39	29.70	1518.34	0.02
-43.39	29.57	1514.57	0.02
-42.39	29.49	1511.59	0.02
-41.39	29.46	1507.32	0.02
-40.39	29.43	1504.86	0.02
-39.39	29.28	1500.79	0.02
-38.39	29.14	1498.16	0.02
-37.39	28.99	1493.88	0.02
-36.39	28.98	1490.94	0.02
-35.39	29.04	1487.71	0.02
-34.39	29.13	1484.51	0.02
-33.39	29.19	1481.75	0.02
-32.39	29.20	1478.17	0.02

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-31.39	29.17	1475.09	0.02
-30.39	29.14	1471.72	0.02
-29.39	29.20	1468.98	0.02
-28.39	29.31	1465.01	0.02
-27.39	29.34	1462.32	0.02
-26.39	29.30	1458.24	0.02
-25.39	29.25	1455.64	0.02
-24.39	29.20	1452.54	0.02
-23.39	29.20	1448.44	0.02
-22.39	29.26	1445.87	0.02
-21.39	29.39	1442.69	0.02
-20.39	29.59	1439.24	0.02
-19.39	29.72	1436.43	0.02
-18.39	29.89	1432.43	0.02
-17.39	30.02	1429.59	0.02
-16.39	30.14	1425.98	0.02
-15.39	30.15	1422.58	0.02
-14.39	30.09	1419.26	0.02
-13.39	30.04	1416.47	0.02
-12.39	30.09	1413.13	0.02
-11.39	30.19	1410.83	0.02
-10.39	30.36	1407.64	0.02
-9.39	30.58	1403.87	0.02
-8.39	30.76	1400.77	0.02
-7.39	30.87	1397.86	0.02
-6.39	30.93	1395.38	0.02
-5.39	30.97	1392.70	0.02
-4.39	31.04	1389.12	0.02
-3.39	31.10	1385.99	0.02
-2.39	31.14	1383.39	0.02
-1.39	31.13	1380.27	0.02
-0.39	31.08	1377.78	0.02
0.61	30.98	1374.37	0.02
1.61	30.94	1371.79	0.02
2.61	30.83	1368.04	0.02
3.61	30.66	1365.06	0.02
4.61	30.45	1361.80	0.02

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
6.61	30.23	1356.10	0.02
7.61	30.17	1352.14	0.02
8.61	30.17	1349.08	0.02
9.61	30.10	1345.65	0.02
10.61	29.97	1342.72	0.02
11.61	29.75	1339.34	0.02
12.61	29.40	1335.78	0.02
13.61	29.14	1333.11	0.02
14.61	28.87	1329.83	0.02
15.61	28.67	1327.29	0.02
16.61	28.45	1324.34	0.02
17.61	28.29	1321.72	0.02
18.61	28.12	1317.79	0.02
19.61	28.02	1314.95	0.02
20.61	27.88	1311.51	0.02
21.61	27.74	1309.08	0.02
22.61	27.56	1306.98	0.02
23.61	27.17	1303.69	0.02
24.61	26.85	1301.11	0.02
25.61	26.62	1298.73	0.02
26.61	26.43	1296.30	0.02
27.61	26.28	1293.82	0.02
28.61	26.16	1291.22	0.02
29.61	26.05	1288.51	0.02
30.61	25.95	1285.48	0.02
31.61	25.90	1281.67	0.02
32.61	25.89	1278.44	0.02
33.61	25.90	1275.66	0.02
34.61	25.91	1272.44	0.02
35.61	25.85	1268.62	0.02
36.61	25.77	1264.99	0.02
37.61	25.69	1261.16	0.02
38.61	25.65	1258.41	0.02
39.61	25.62	1255.35	0.02
40.61	25.61	1252.38	0.02
41.61	25.55	1248.40	0.02
42.61	25.44	1244.45	0.02

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
43.61	25.35	1240.45	0.02
44.61	25.36	1236.55	0.02
45.61	25.62	1229.21	0.02
46.61	25.83	1225.65	0.02
47.61	26.05	1222.29	0.02
48.61	26.30	1217.90	0.02
49.61	26.45	1215.10	0.02
50.61	26.73	1210.64	0.02
51.61	27.12	1206.47	0.02
52.61	27.91	1200.49	0.02
53.61	28.60	1195.71	0.02
54.61	29.18	1191.65	0.02
55.61	29.79	1187.46	0.03
56.61	30.35	1183.33	0.03
57.61	30.94	1179.13	0.03
58.61	31.54	1175.33	0.03
59.61	32.31	1171.31	0.03
60.61	33.28	1166.98	0.03
61.61	34.10	1163.44	0.03
62.61	35.00	1159.20	0.03
63.61	35.75	1155.12	0.03
64.61	36.39	1151.04	0.03
65.61	36.89	1147.33	0.03
66.61	37.36	1143.46	0.03
67.61	37.88	1138.93	0.03
68.61	38.33	1135.12	0.03
69.61	38.90	1130.47	0.03
70.61	39.34	1126.59	0.03
71.61	39.85	1121.94	0.04
72.61	40.36	1117.65	0.04
73.61	40.99	1113.02	0.04
74.61	41.75	1108.36	0.04
75.61	42.56	1104.02	0.04
76.61	43.53	1099.11	0.04
77.61	44.40	1094.82	0.04
78.61	45.39	1089.70	0.04
79.61	46.21	1085.13	0.04

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
80.61	47.02	1080.17	0.04
81.61	47.74	1075.43	0.04
82.61	48.37	1070.72	0.05
83.61	49.00	1065.66	0.05
84.61	49.55	1061.17	0.05
85.61	50.21	1056.20	0.05
86.61	50.87	1051.61	0.05
87.61	51.59	1046.58	0.05
88.61	52.25	1041.50	0.05
89.61	52.85	1036.95	0.05
90.61	53.62	1031.20	0.05
91.61	54.26	1026.66	0.05
92.61	55.12	1021.24	0.05
93.61	56.00	1016.35	0.06
94.61	57.05	1010.87	0.06
95.61	57.98	1005.82	0.06
96.61	58.83	1000.77	0.06
97.61	59.65	994.89	0.06
98.61	60.18	990.39	0.06
99.61	60.87	984.35	0.06
100.61	61.48	979.46	0.06
101.61	62.25	973.77	0.06
102.61	63.03	968.50	0.07
103.61	63.92	963.17	0.07
104.61	64.96	957.38	0.07
105.61	65.84	952.48	0.07
106.61	66.87	946.43	0.07
107.61	67.57	941.70	0.07
108.61	68.30	936.18	0.07
109.61	68.93	931.01	0.07
110.61	69.64	925.65	0.08
111.61	70.43	920.07	0.08
112.61	71.19	914.78	0.08
113.61	72.08	908.47	0.08
114.61	72.83	903.28	0.08
115.61	73.72	896.91	0.08
116.61	74.43	891.34	0.08

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
117.61	75.09	885.52	0.08
118.61	75.74	879.52	0.09
119.61	76.30	873.91	0.09
120.61	76.89	867.14	0.09
121.61	77.37	861.62	0.09
122.61	77.97	855.42	0.09
123.61	78.52	850.06	0.09
124.61	79.26	843.56	0.09
125.61	80.09	837.21	0.10
126.61	80.85	831.79	0.10
127.61	81.82	824.86	0.10
128.61	82.59	819.27	0.10
129.61	83.55	811.94	0.10
130.61	84.34	805.64	0.10
131.61	85.24	798.43	0.11
132.61	86.20	791.22	0.11
133.61	87.20	784.25	0.11
134.61	88.41	775.42	0.11
135.61	89.21	768.80	0.12
136.61	90.21	759.66	0.12
137.61	91.08	751.48	0.12
138.61	92.05	742.56	0.12
139.61	93.11	732.12	0.13
140.61	93.83	724.11	0.13
141.61	94.64	713.69	0.13
142.61	95.25	704.98	0.13
143.61	96.03	693.62	0.14
144.61	96.78	682.71	0.14
145.61	97.39	672.22	0.15
146.61	97.82	659.65	0.15
147.61	97.90	650.05	0.15
148.61	97.76	637.29	0.15
149.61	97.50	626.65	0.16
150.61	97.07	613.54	0.16
151.61	96.60	601.91	0.16
152.61	96.05	590.60	0.16
153.61	95.30	577.61	0.17

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
154.61	94.60	567.35	0.17
155.61	93.62	554.80	0.17
156.61	92.67	543.80	0.17
157.61	91.41	530.83	0.17
158.61	90.13	519.00	0.17
159.61	88.82	508.28	0.17
160.61	86.61	493.50	0.18
161.61	84.80	483.54	0.18
162.61	81.78	469.30	0.17
163.61	78.83	457.28	0.17
164.61	75.69	445.67	0.17
165.61	71.67	431.84	0.17
166.61	68.87	422.54	0.16
167.61	64.92	409.44	0.16
168.61	62.28	399.97	0.16
169.61	59.44	387.82	0.15
170.61	57.51	375.65	0.15
171.61	56.59	365.00	0.16
172.61	56.16	351.85	0.16
173.61	56.08	342.44	0.16
174.61	56.02	333.99	0.17
175.61	55.95	328.68	0.17
176.61	55.82	321.79	0.17
177.61	55.61	313.39	0.18
178.61	55.43	307.75	0.18
179.61	55.11	299.62	0.18
180.61	54.71	292.09	0.19
181.61	54.13	283.36	0.19
182.61	53.60	276.34	0.19
183.61	53.03	269.57	0.20
184.61	52.23	261.06	0.20
185.61	51.71	255.75	0.20
186.61	50.92	247.87	0.21
187.61	50.36	242.45	0.21
188.61	49.65	236.11	0.21
189.61	48.86	229.59	0.21
190.61	48.21	224.61	0.21

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
191.61	47.29	217.96	0.22
192.61	46.62	213.30	0.22
193.61	45.86	208.11	0.22
194.61	45.13	203.10	0.22

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
195.61	44.42	198.24	0.22
196.61	43.72	193.34	0.23
197.61	43.18	189.51	0.23
198.61	42.49	184.51	0.23

Appendix F Dynamic Mechanical Analysis (DMA) of polybenzoxazine biocomposites as a function of graft copolymer added modified-surface marl contents.

Table F1 DMA of the 10 wt% graft copolymer filled with marl–polybenzoxazine composite

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-100.80	55.05	1665.38	0.03
-99.80	55.07	1664.60	0.03
-98.80	55.09	1663.84	0.03
-97.80	55.13	1662.47	0.03
-96.80	55.21	1660.43	0.03
-95.80	55.28	1658.73	0.03
-94.80	55.40	1656.12	0.03
-93.80	55.58	1652.81	0.03
-92.80	55.71	1650.49	0.03
-91.80	55.90	1647.15	0.03
-90.80	56.12	1643.32	0.03
-89.80	56.42	1638.40	0.03
-88.80	56.65	1634.59	0.03
-87.80	56.91	1630.32	0.03
-86.80	57.16	1626.28	0.04
-85.80	57.41	1622.21	0.04
-84.80	57.72	1616.70	0.04
-83.80	57.91	1612.92	0.04
-82.80	58.15	1607.68	0.04
-81.80	58.36	1601.94	0.04
-80.80	58.46	1598.24	0.04
-79.80	58.58	1592.52	0.04
-78.80	58.62	1587.50	0.04
-77.80	58.63	1583.20	0.04
-76.80	58.59	1577.56	0.04
-75.80	58.52	1572.53	0.04
-74.80	58.42	1567.94	0.04
-73.80	58.29	1562.95	0.04
-72.80	58.12	1557.36	0.04
-71.80	57.94	1552.67	0.04
-70.80	57.73	1547.92	0.04
-69.80	57.48	1542.88	0.04
-68.80	57.26	1538.85	0.04
-67.80	56.98	1534.13	0.04
-66.80	56.63	1528.94	0.04
-65.80	56.33	1524.86	0.04
-64.80	55.99	1520.39	0.04
-63.80	55.67	1516.18	0.04
-62.80	55.35	1512.07	0.04
-61.80	55.04	1508.02	0.04
-60.80	54.75	1504.16	0.04
-59.80	54.48	1500.53	0.04
-58.80	54.18	1496.25	0.04
-57.80	53.94	1492.50	0.04
-56.80	53.74	1489.06	0.04
-55.80	53.56	1485.43	0.04
-54.80	53.40	1482.03	0.04
-53.80	53.25	1478.30	0.04
-52.80	53.15	1475.33	0.04
-51.80	53.05	1471.67	0.04
-50.80	52.98	1467.99	0.04
-49.80	52.94	1464.72	0.04
-48.80	52.93	1461.37	0.04
-47.80	52.95	1458.27	0.04
-46.80	53.00	1455.25	0.04
-45.80	53.10	1451.50	0.04
-44.80	53.19	1449.14	0.04
-43.80	53.33	1445.83	0.04
-42.80	53.47	1442.98	0.04
-41.80	53.63	1440.08	0.04

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-40.80	53.84	1436.85	0.04
-39.80	54.02	1434.27	0.04
-38.80	54.28	1430.87	0.04
-37.80	54.51	1428.32	0.04
-36.80	54.75	1425.87	0.04
-35.80	55.12	1422.43	0.04
-34.80	55.46	1419.59	0.04
-33.80	55.81	1416.71	0.04
-32.80	56.18	1413.81	0.04
-31.80	56.51	1411.39	0.04
-30.80	56.94	1408.43	0.04
-29.80	57.29	1406.19	0.04
-28.80	57.81	1403.12	0.04
-27.80	58.26	1400.59	0.04
-26.80	58.31	1400.27	0.04
-25.80	59.28	1395.29	0.04
-24.80	59.74	1392.95	0.04
-23.80	60.34	1389.84	0.04
-22.80	60.82	1387.26	0.04
-21.80	61.44	1383.84	0.04
-20.80	61.95	1380.95	0.04
-19.80	62.41	1378.29	0.05
-18.80	62.95	1375.24	0.05
-17.80	63.37	1372.88	0.05
-16.80	63.90	1370.09	0.05
-15.80	64.46	1367.18	0.05
-14.80	65.07	1364.14	0.05
-13.80	65.51	1361.91	0.05
-12.80	66.12	1358.88	0.05
-11.80	66.53	1356.86	0.05
-10.80	67.13	1353.88	0.05
-9.80	67.42	1352.44	0.05
-8.80	68.09	1349.22	0.05
-7.80	68.72	1346.40	0.05
-6.80	69.30	1343.92	0.05
-5.80	69.97	1341.17	0.05
-4.80	70.72	1338.14	0.05

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-3.80	71.40	1335.50	0.05
-2.80	71.97	1333.32	0.05
-1.80	72.76	1330.27	0.05
-0.80	73.51	1327.37	0.06
0.20	74.24	1324.55	0.06
1.20	74.96	1321.77	0.06
2.20	75.90	1318.02	0.06
3.20	76.69	1314.78	0.06
4.20	77.21	1312.58	0.06
5.20	77.97	1309.27	0.06
6.20	78.58	1306.55	0.06
7.20	79.20	1303.81	0.06
8.20	80.11	1299.83	0.06
9.20	80.71	1297.30	0.06
10.20	81.40	1294.40	0.06
11.20	82.24	1290.90	0.06
12.20	82.94	1288.04	0.06
13.20	83.73	1284.93	0.07
14.20	84.55	1281.84	0.07
15.20	85.54	1278.18	0.07
16.20	86.31	1275.38	0.07
17.20	87.16	1272.28	0.07
18.20	88.08	1268.91	0.07
19.20	88.91	1265.80	0.07
20.20	89.88	1262.08	0.07
21.20	90.52	1259.54	0.07
22.20	91.45	1255.77	0.07
23.20	92.08	1253.16	0.07
24.20	92.94	1249.56	0.07
25.20	93.83	1245.87	0.08
26.20	94.50	1243.04	0.08
27.20	95.35	1239.48	0.08
28.20	96.49	1234.76	0.08
29.20	97.06	1232.43	0.08
30.20	98.05	1228.34	0.08
31.20	98.94	1224.72	0.08
32.20	99.89	1220.89	0.08

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
33.20	100.86	1216.94	0.08
34.20	101.64	1213.78	0.08
35.20	102.77	1209.08	0.08
36.20	103.65	1205.40	0.09
37.20	104.58	1201.58	0.09
38.20	105.48	1197.89	0.09
39.20	106.84	1192.51	0.09
40.20	107.79	1188.83	0.09
41.20	109.11	1183.65	0.09
42.20	110.15	1179.53	0.09
43.20	111.15	1175.50	0.09
44.20	112.03	1171.97	0.10
45.20	113.09	1167.69	0.10
46.20	114.83	1160.82	0.10
47.20	115.81	1156.89	0.10
48.20	116.54	1153.86	0.10
49.20	117.38	1150.30	0.10
50.20	118.64	1144.75	0.10
51.20	119.60	1140.42	0.10
52.20	121.70	1130.57	0.11
53.20	122.78	1125.31	0.11
54.20	123.76	1120.43	0.11
55.20	124.74	1115.49	0.11
56.20	125.81	1110.08	0.11
57.20	126.66	1105.81	0.11
58.20	127.67	1100.73	0.12
59.20	128.54	1096.40	0.12
60.20	129.52	1091.50	0.12
61.20	130.39	1087.15	0.12
62.20	131.33	1082.46	0.12
63.20	132.33	1077.57	0.12
64.20	133.16	1073.49	0.12
65.20	134.21	1068.46	0.13
66.20	135.11	1064.12	0.13
67.20	136.12	1059.20	0.13
68.20	137.07	1054.54	0.13
69.20	138.05	1049.72	0.13

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
70.20	139.02	1044.90	0.13
71.20	139.92	1040.34	0.13
72.20	140.90	1035.36	0.14
73.20	141.70	1031.21	0.14
74.20	142.64	1026.20	0.14
75.20	143.51	1021.59	0.14
76.20	144.47	1016.59	0.14
77.20	145.41	1011.79	0.14
78.20	146.31	1007.37	0.15
79.20	147.37	1002.29	0.15
80.20	148.29	998.02	0.15
81.20	149.34	993.31	0.15
82.20	150.26	989.23	0.15
83.20	151.31	984.69	0.15
84.20	152.32	980.33	0.16
85.20	153.32	976.06	0.16
86.20	154.38	971.54	0.16
87.20	155.33	967.56	0.16
88.20	156.50	962.66	0.16
89.20	157.39	958.95	0.16
90.20	158.47	954.44	0.17
91.20	159.43	950.38	0.17
92.20	160.38	946.31	0.17
93.20	161.35	942.05	0.17
94.20	162.22	938.22	0.17
95.20	163.21	933.85	0.17
96.20	163.99	930.41	0.18
97.20	164.94	926.32	0.18
98.20	165.73	922.97	0.18
99.20	166.59	919.31	0.18
100.20	167.52	915.37	0.18
101.20	168.31	911.90	0.18
102.20	169.20	907.95	0.19
103.20	169.93	904.69	0.19
104.20	170.80	900.84	0.19
105.20	171.54	897.60	0.19
106.20	172.34	894.16	0.19

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
107.20	173.14	890.82	0.19
108.20	173.92	887.66	0.20
109.20	174.82	884.03	0.20
110.20	175.55	881.10	0.20
111.20	176.42	877.55	0.20
112.20	177.14	874.51	0.20
113.20	177.98	870.89	0.20
114.20	178.73	867.61	0.21
115.20	179.49	864.18	0.21
116.20	180.34	860.33	0.21
117.20	181.01	857.32	0.21
118.20	181.87	853.50	0.21
119.20	182.58	850.50	0.21
120.20	183.46	846.93	0.22
121.20	184.28	843.79	0.22
122.20	185.15	840.55	0.22
123.20	186.09	837.15	0.22
124.20	186.98	834.02	0.22
125.20	187.99	830.38	0.23
126.20	188.81	827.37	0.23
127.20	189.76	823.69	0.23
128.20	190.54	820.45	0.23
129.20	191.38	816.81	0.23
130.20	192.16	813.19	0.24
131.20	192.90	809.67	0.24
132.20	193.76	805.52	0.24
133.20	194.45	802.26	0.24
134.20	195.36	798.08	0.24
135.20	196.17	794.48	0.25
136.20	196.99	790.91	0.25
137.20	197.93	786.91	0.25
138.20	198.80	783.30	0.25
139.20	199.80	779.18	0.26
140.20	200.61	775.81	0.26
141.20	201.60	771.59	0.26
142.20	202.50	767.67	0.26
143.20	203.42	763.51	0.27

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
144.20	204.44	758.69	0.27
145.20	205.26	754.69	0.27
146.20	206.25	749.76	0.28
147.20	207.17	745.13	0.28
148.20	208.21	739.88	0.28
149.20	209.28	734.44	0.28
150.20	210.31	729.14	0.29
151.20	211.41	723.49	0.29
152.20	212.32	718.77	0.30
153.20	213.51	712.62	0.30
154.20	214.57	707.09	0.30
155.20	215.68	701.26	0.31
156.20	216.88	694.74	0.31
157.20	217.85	689.31	0.32
158.20	219.05	682.33	0.32
159.20	219.94	677.03	0.32
160.20	221.03	670.34	0.33
161.20	222.13	663.39	0.33
162.20	223.14	656.86	0.34
163.20	224.34	649.08	0.35
164.20	225.36	642.40	0.35
165.20	226.62	634.09	0.36
166.20	227.69	627.08	0.36
167.20	229.02	618.30	0.37
168.20	230.39	609.14	0.38
169.20	231.49	601.53	0.38
170.20	233.09	589.97	0.39
171.20	236.39	557.51	0.42
172.20	236.87	545.66	0.43
173.20	236.85	536.23	0.44
174.20	236.48	527.37	0.45
175.20	235.94	520.77	0.46
176.20	234.81	511.58	0.46
177.20	231.94	496.53	0.47
178.20	228.89	485.14	0.48
179.20	224.15	471.33	0.48
180.20	218.61	458.20	0.48

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
181.20	211.70	444.26	0.48
182.20	203.35	429.61	0.48
183.20	195.69	417.57	0.47
184.20	184.63	401.76	0.46
185.20	175.27	389.45	0.45
186.20	163.13	374.50	0.43
187.20	151.00	360.43	0.41
188.20	138.95	347.06	0.39
189.20	126.32	333.50	0.37

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
190.20	110.52	316.92	0.33
191.20	93.92	299.57	0.30
192.20	83.53	288.50	0.27
193.20	73.87	277.86	0.25
194.20	64.64	267.17	0.23
195.20	58.69	259.90	0.22
196.20	50.81	249.74	0.21
197.20	45.69	242.84	0.20
198.20	39.35	234.12	0.20

Table F2 DMA of the 20 wt% graft copolymer filled with marl–polybenzoxazine composite

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-100.01	92.78	3666.27	0.03
-99.01	91.55	3670.72	0.02
-98.01	90.16	3675.41	0.02
-97.01	89.01	3678.51	0.02
-96.01	87.93	3680.40	0.02
-95.01	86.95	3681.04	0.02
-94.01	85.74	3680.02	0.02
-93.01	85.08	3678.37	0.02
-92.01	84.39	3675.74	0.02
-91.01	83.54	3671.15	0.02
-90.01	82.94	3667.12	0.02
-89.01	82.28	3661.95	0.02
-88.01	81.60	3656.02	0.02
-87.01	81.03	3650.28	0.02
-86.01	80.53	3644.33	0.02
-85.01	80.08	3637.77	0.02
-84.01	79.70	3631.08	0.02
-83.01	79.38	3624.16	0.02
-82.01	79.08	3617.59	0.02
-81.01	78.76	3610.93	0.02
-80.01	78.38	3603.46	0.02
-79.01	77.99	3596.07	0.02
-78.01	77.66	3590.16	0.02
-77.01	77.13	3580.90	0.02
-76.01	76.67	3573.20	0.02
-75.01	76.18	3565.48	0.02
-74.01	75.65	3557.43	0.02
-73.01	75.03	3548.23	0.02
-72.01	74.62	3541.79	0.02
-71.01	74.12	3533.23	0.02
-70.01	73.68	3525.23	0.02
-69.01	73.25	3517.04	0.02
-68.01	72.91	3510.10	0.02
-67.01	72.52	3501.30	0.02

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-66.01	72.27	3495.21	0.02
-65.01	71.95	3486.67	0.02
-64.01	71.70	3478.77	0.02
-63.01	71.46	3470.10	0.02
-62.01	71.29	3462.46	0.02
-61.01	71.14	3453.62	0.02
-60.01	71.05	3446.19	0.02
-59.01	71.00	3436.90	0.02
-58.01	71.00	3430.16	0.02
-57.01	71.07	3420.32	0.02
-56.01	71.18	3412.21	0.02
-55.01	71.34	3404.76	0.02
-54.01	71.60	3395.90	0.02
-53.01	71.90	3388.32	0.02
-52.01	72.32	3379.59	0.02
-51.01	72.78	3371.86	0.02
-50.01	73.40	3362.79	0.02
-49.01	74.17	3352.57	0.02
-48.01	74.91	3343.46	0.02
-47.01	75.67	3334.54	0.02
-46.01	76.52	3324.70	0.02
-45.01	77.33	3315.36	0.02
-44.01	78.14	3305.90	0.02
-43.01	79.04	3295.17	0.02
-42.01	79.79	3285.92	0.02
-41.01	80.57	3275.79	0.02
-40.01	81.42	3264.62	0.02
-39.01	82.20	3254.35	0.03
-38.01	83.00	3243.91	0.03
-37.01	83.81	3233.26	0.03
-36.01	84.63	3222.15	0.03
-35.01	85.37	3211.56	0.03
-34.01	86.08	3200.78	0.03
-33.01	86.92	3187.50	0.03

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-32.01	87.63	3176.12	0.03
-31.01	88.22	3166.29	0.03
-30.01	89.19	3149.97	0.03
-29.01	89.73	3140.68	0.03
-28.01	90.52	3127.73	0.03
-27.01	91.43	3113.26	0.03
-26.01	92.10	3102.94	0.03
-25.01	92.84	3091.99	0.03
-24.01	93.95	3076.12	0.03
-23.01	94.90	3062.55	0.03
-22.01	95.96	3047.36	0.03
-21.01	96.78	3035.60	0.03
-20.01	98.03	3017.24	0.03
-19.01	98.97	3003.25	0.03
-18.01	99.86	2989.55	0.03
-17.01	100.86	2973.50	0.03
-16.01	101.77	2958.01	0.03
-15.01	102.53	2944.37	0.03
-14.01	103.27	2929.71	0.04
-13.01	103.87	2916.91	0.04
-12.01	104.62	2899.32	0.04
-11.01	105.30	2881.20	0.04
-10.01	105.77	2866.82	0.04
-9.01	106.28	2849.06	0.04
-8.01	106.65	2834.90	0.04
-7.01	107.08	2817.38	0.04
-6.01	107.45	2801.42	0.04
-5.01	107.90	2782.05	0.04
-4.01	108.32	2764.59	0.04
-3.01	108.67	2749.79	0.04
-2.01	109.12	2731.76	0.04
-1.01	109.47	2718.41	0.04
-0.01	109.97	2699.49	0.04
0.99	110.36	2685.32	0.04
1.99	110.80	2668.63	0.04
2.99	111.21	2653.11	0.04
3.99	111.72	2631.81	0.04

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
4.99	111.99	2619.81	0.04
5.99	112.41	2599.40	0.04
6.99	112.71	2583.64	0.04
7.99	113.04	2564.52	0.04
8.99	113.29	2547.09	0.04
9.99	113.51	2528.22	0.04
10.99	113.62	2516.39	0.05
11.99	113.72	2495.24	0.05
12.99	113.74	2477.69	0.05
13.99	113.72	2461.82	0.05
14.99	113.66	2443.46	0.05
15.99	113.55	2424.05	0.05
16.99	113.46	2411.04	0.05
17.99	113.30	2391.14	0.05
18.99	113.13	2373.99	0.05
19.99	112.91	2354.68	0.05
20.99	112.70	2338.97	0.05
21.99	112.43	2322.25	0.05
22.99	112.05	2303.08	0.05
23.99	111.70	2287.90	0.05
24.99	111.25	2269.81	0.05
25.99	110.75	2251.15	0.05
26.99	110.34	2236.13	0.05
27.99	109.82	2217.88	0.05
28.99	109.35	2201.57	0.05
29.99	108.87	2185.23	0.05
30.99	108.35	2168.24	0.05
31.99	107.74	2149.82	0.05
32.99	107.20	2134.30	0.05
33.99	106.33	2111.68	0.05
34.99	105.58	2093.98	0.05
35.99	104.97	2080.16	0.05
36.99	104.13	2061.84	0.05
37.99	103.31	2044.35	0.05
38.99	102.02	2017.30	0.05
39.99	101.34	2003.09	0.05
40.99	100.17	1978.89	0.05

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
41.99	99.65	1968.02	0.05
42.99	98.55	1945.22	0.05
43.99	97.13	1915.59	0.05
44.99	96.17	1894.69	0.05
45.99	95.70	1883.58	0.05
46.99	94.98	1863.80	0.05
47.99	94.49	1846.72	0.05
48.99	94.10	1824.17	0.05
49.99	94.03	1804.32	0.05
50.99	94.31	1782.57	0.05
51.99	94.81	1764.79	0.05
52.99	95.63	1745.49	0.05
53.99	97.05	1720.99	0.06
54.99	98.38	1702.64	0.06
55.99	100.19	1681.27	0.06
56.99	101.90	1663.27	0.06
57.99	104.00	1642.83	0.06
58.99	105.96	1624.48	0.07
59.99	108.09	1604.98	0.07
60.99	110.20	1585.55	0.07
61.99	112.34	1565.66	0.07
62.99	114.54	1544.92	0.07
63.99	116.50	1526.28	0.08
64.99	118.86	1503.52	0.08
65.99	120.87	1484.16	0.08
66.99	123.25	1461.20	0.08
67.99	125.47	1440.12	0.09
68.99	127.82	1418.12	0.09
69.99	130.44	1394.04	0.09
70.99	132.84	1372.23	0.10
71.99	135.63	1346.88	0.10
72.99	138.08	1324.39	0.10
73.99	140.81	1298.85	0.11
74.99	143.41	1273.85	0.11
75.99	145.93	1248.93	0.12
76.99	148.60	1221.54	0.12
77.99	151.06	1195.48	0.13

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
78.99	153.88	1164.99	0.13
79.99	156.10	1140.46	0.14
80.99	158.56	1112.47	0.14
81.99	160.86	1085.51	0.15
82.99	163.34	1055.38	0.15
83.99	165.62	1026.59	0.16
84.99	167.76	998.71	0.17
85.99	169.99	968.23	0.18
86.99	171.72	943.22	0.18
87.99	173.58	913.90	0.19
88.99	175.01	888.75	0.20
89.99	176.32	862.29	0.20
90.99	177.32	837.61	0.21
91.99	178.12	811.71	0.22
92.99	178.63	785.60	0.23
93.99	178.79	766.62	0.23
94.99	178.70	741.24	0.24
95.99	178.35	720.37	0.25
96.99	177.65	697.69	0.25
97.99	176.62	675.71	0.26
98.99	175.38	656.10	0.27
99.99	173.65	634.43	0.27
100.99	171.94	616.91	0.28
101.99	169.60	596.58	0.28
102.99	167.39	579.90	0.29
103.99	164.61	561.50	0.29
104.99	161.89	545.55	0.30
105.99	158.59	528.33	0.30
106.99	154.88	511.16	0.30
107.99	151.24	496.09	0.31
108.99	146.49	478.57	0.31
109.99	142.38	464.94	0.31
110.99	136.96	448.83	0.31
111.99	131.84	435.15	0.31
112.99	125.51	419.83	0.30
113.99	118.99	405.49	0.30
114.99	112.80	392.94	0.29

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
115.99	104.58	377.40	0.28
116.99	98.41	366.36	0.27
117.99	90.20	352.13	0.25
118.99	83.90	341.35	0.24
119.99	76.84	329.14	0.23
120.99	70.27	317.33	0.22
121.99	65.04	307.29	0.21
122.99	60.00	296.58	0.20
123.99	56.31	287.70	0.19
124.99	52.82	278.02	0.19
125.99	50.40	270.12	0.19
126.99	48.15	261.42	0.18
127.99	46.61	254.28	0.19
128.99	45.27	246.96	0.19
129.99	44.06	239.20	0.19
130.99	43.21	233.09	0.19
131.99	42.23	225.42	0.19
132.99	41.50	219.51	0.19
133.99	40.63	212.67	0.19
134.99	39.76	206.01	0.20
135.99	39.01	200.70	0.20
136.99	38.09	194.45	0.20
137.99	37.24	189.02	0.20
138.99	36.24	183.05	0.20
139.99	35.34	177.88	0.20
140.99	34.41	172.83	0.20
141.99	33.50	168.05	0.20
142.99	32.60	163.51	0.20
143.99	31.67	158.94	0.20

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
144.99	30.80	154.79	0.20
145.99	29.82	150.24	0.20
146.99	28.96	146.27	0.20
147.99	28.15	142.66	0.20
148.99	27.31	138.98	0.20
149.99	26.55	135.69	0.20
150.99	25.68	132.02	0.19
151.99	24.91	128.86	0.19
152.99	24.16	125.83	0.19
153.99	23.39	122.79	0.19
154.99	22.61	119.73	0.19
155.99	21.70	116.23	0.19
156.99	20.87	113.10	0.18
157.99	19.91	109.51	0.18
158.99	19.20	106.91	0.18
159.99	18.71	105.15	0.18
160.99	18.32	103.77	0.18
161.99	17.98	102.56	0.17
162.99	17.58	101.13	0.17
163.99	17.12	99.57	0.17
164.99	16.64	97.98	0.17
165.99	16.19	96.55	0.17
166.99	15.77	95.29	0.17
167.99	15.26	93.81	0.16
168.99	14.84	92.68	0.16
169.99	14.29	91.21	0.16
170.99	13.87	90.14	0.15
171.99	13.44	89.01	0.15

Table F3 DMA of the 30 wt% graft copolymer filled with marl–polybenzoxazine composite

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-98.66	30.10	1404.99	0.02
-97.66	29.59	1406.54	0.02
-96.66	28.94	1408.27	0.02
-95.66	28.64	1408.71	0.02
-94.66	28.28	1408.49	0.02
-93.66	28.15	1407.79	0.02
-92.66	28.06	1406.36	0.02
-91.66	28.08	1404.22	0.02
-90.66	28.19	1401.62	0.02
-89.66	28.31	1399.46	0.02
-88.66	28.53	1396.21	0.02
-87.66	28.81	1392.71	0.02
-86.66	29.07	1389.68	0.02
-85.66	29.40	1386.24	0.02
-84.66	29.67	1383.30	0.02
-83.66	29.96	1380.26	0.02
-82.66	30.33	1375.92	0.02
-81.66	30.56	1372.94	0.02
-80.66	30.81	1369.15	0.02
-79.66	31.03	1365.01	0.02
-78.66	31.23	1360.77	0.02
-77.66	31.35	1357.46	0.02
-76.66	31.47	1353.55	0.02
-75.66	31.57	1348.40	0.02
-74.66	31.60	1344.79	0.02
-73.66	31.60	1340.83	0.02
-72.66	31.58	1337.60	0.02
-71.66	31.50	1333.43	0.02
-70.66	31.35	1328.66	0.02
-69.66	31.15	1324.16	0.02
-68.66	30.93	1320.26	0.02
-67.66	30.69	1316.86	0.02
-66.66	30.38	1313.08	0.02
-65.66	29.96	1308.69	0.02

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-64.66	29.61	1305.37	0.02
-63.66	29.14	1301.38	0.02
-62.66	28.71	1297.92	0.02
-61.66	28.30	1294.88	0.02
-60.66	27.89	1291.97	0.02
-59.66	27.30	1287.93	0.02
-58.66	26.78	1284.61	0.02
-57.66	26.26	1281.43	0.02
-56.66	25.75	1278.44	0.02
-55.66	25.28	1275.76	0.02
-54.66	24.74	1272.80	0.02
-53.66	24.30	1270.37	0.02
-52.66	23.85	1267.94	0.02
-51.66	23.37	1265.43	0.02
-50.66	22.78	1262.36	0.02
-49.66	22.28	1259.82	0.02
-48.66	21.87	1257.70	0.02
-47.66	21.32	1254.95	0.02
-46.66	20.82	1252.40	0.02
-45.66	20.35	1249.94	0.02
-44.66	20.00	1248.04	0.02
-43.66	19.63	1246.02	0.02
-42.66	19.15	1243.33	0.02
-41.66	18.79	1241.22	0.02
-40.66	18.45	1239.24	0.01
-39.66	18.16	1237.42	0.01
-38.66	17.79	1234.92	0.01
-37.66	17.38	1231.85	0.01
-36.66	17.28	1230.99	0.01
-35.66	17.05	1228.89	0.01
-34.66	16.90	1227.41	0.01
-33.66	16.64	1224.63	0.01
-32.66	16.46	1222.54	0.01
-31.66	16.31	1220.72	0.01

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-30.66	16.20	1219.27	0.01
-29.66	16.02	1216.87	0.01
-28.66	15.93	1215.56	0.01
-27.66	15.81	1213.37	0.01
-26.66	15.72	1211.05	0.01
-25.66	15.69	1209.76	0.01
-24.66	15.66	1207.96	0.01
-23.66	15.63	1205.44	0.01
-22.66	15.63	1204.33	0.01
-21.66	15.63	1202.24	0.01
-20.66	15.65	1200.30	0.01
-19.66	15.67	1198.65	0.01
-18.66	15.70	1196.71	0.01
-17.66	15.72	1195.47	0.01
-16.66	15.74	1193.58	0.01
-15.66	15.76	1192.16	0.01
-14.66	15.77	1190.34	0.01
-13.66	15.80	1187.82	0.01
-12.66	15.82	1186.19	0.01
-11.66	15.85	1184.29	0.01
-10.66	15.89	1182.74	0.01
-9.66	15.96	1180.36	0.01
-8.66	16.02	1178.61	0.01
-7.66	16.09	1176.79	0.01
-6.66	16.17	1174.84	0.01
-5.66	16.27	1172.75	0.01
-4.66	16.41	1170.17	0.01
-3.66	16.50	1168.50	0.01
-2.66	16.63	1166.10	0.01
-1.66	16.72	1164.46	0.01
-0.66	16.85	1162.19	0.01
0.34	17.01	1159.68	0.01
1.34	17.15	1157.44	0.01
2.34	17.30	1155.38	0.01
3.34	17.50	1152.69	0.02
4.34	17.68	1150.64	0.02
5.34	13.74	1191.51	0.01

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
6.34	18.17	1145.51	0.02
7.34	18.44	1143.02	0.02
8.34	18.66	1140.98	0.02
9.34	18.95	1138.43	0.02
10.34	19.20	1136.31	0.02
11.34	19.57	1133.13	0.02
12.34	19.93	1130.28	0.02
13.34	20.22	1128.00	0.02
14.34	20.68	1124.59	0.02
15.34	21.11	1121.48	0.02
16.34	21.50	1118.74	0.02
17.34	21.79	1116.77	0.02
18.34	22.45	1112.33	0.02
19.34	22.79	1110.10	0.02
20.34	23.27	1106.97	0.02
21.34	23.89	1103.03	0.02
22.34	19.97	1127.12	0.02
23.34	24.69	1098.11	0.02
24.34	25.41	1093.94	0.02
25.34	25.94	1090.91	0.02
26.34	26.71	1086.71	0.02
27.34	27.32	1083.42	0.03
28.34	28.12	1079.28	0.03
29.34	28.86	1075.55	0.03
30.34	29.71	1071.20	0.03
31.34	30.43	1067.44	0.03
32.34	31.22	1063.26	0.03
33.34	31.99	1058.94	0.03
34.34	32.61	1055.35	0.03
35.34	33.33	1051.00	0.03
36.34	34.09	1046.30	0.03
37.34	34.75	1042.22	0.03
38.34	35.57	1037.21	0.03
39.34	36.05	1034.29	0.03
40.34	36.93	1029.10	0.04
41.34	37.76	1024.30	0.04
42.34	38.90	1017.79	0.04

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
43.34	39.92	1012.06	0.04
44.34	41.40	1003.70	0.04
45.34	42.16	999.30	0.04
46.34	42.93	994.88	0.04
47.34	43.77	989.98	0.04
48.34	45.19	981.66	0.05
49.34	46.30	975.18	0.05
50.34	47.10	970.51	0.05
51.34	48.17	964.34	0.05
52.34	50.29	952.07	0.05
53.34	51.46	945.12	0.05
54.34	52.52	938.75	0.06
55.34	53.68	931.74	0.06
56.34	54.80	924.94	0.06
57.34	55.84	918.59	0.06
58.34	57.00	911.59	0.06
59.34	58.04	905.34	0.06
60.34	59.21	898.18	0.07
61.34	60.21	891.91	0.07
62.34	61.32	884.81	0.07
63.34	62.32	878.12	0.07
64.34	63.35	871.02	0.07
65.34	64.34	864.06	0.07
66.34	65.25	857.58	0.08
67.34	66.28	850.17	0.08
68.34	67.18	843.42	0.08
69.34	68.15	836.03	0.08
70.34	69.07	828.83	0.08
71.34	69.91	822.24	0.08
72.34	70.77	815.59	0.09
73.34	71.55	809.58	0.09
74.34	72.54	802.16	0.09
75.34	73.34	796.21	0.09
76.34	74.32	789.09	0.09
77.34	75.20	782.63	0.10
78.34	76.05	776.46	0.10
79.34	76.96	769.85	0.10

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
80.34	77.80	763.73	0.10
81.34	78.70	756.99	0.10
82.34	79.40	751.65	0.11
83.34	80.21	745.30	0.11
84.34	80.91	739.68	0.11
85.34	81.64	733.79	0.11
86.34	82.36	727.85	0.11
87.34	83.00	722.65	0.11
88.34	83.71	716.94	0.12
89.34	84.33	712.11	0.12
90.34	85.07	706.45	0.12
91.34	85.66	701.95	0.12
92.34	86.35	696.65	0.12
93.34	86.94	692.17	0.13
94.34	87.54	687.57	0.13
95.34	88.17	682.65	0.13
96.34	88.75	678.11	0.13
97.34	89.37	673.17	0.13
98.34	89.84	669.40	0.13
99.34	90.45	664.44	0.14
100.34	90.96	660.19	0.14
101.34	91.46	655.83	0.14
102.34	91.95	651.31	0.14
103.34	92.37	647.19	0.14
104.34	92.83	642.44	0.14
105.34	93.18	638.54	0.15
106.34	93.59	633.78	0.15
107.34	93.94	629.55	0.15
108.34	94.31	625.00	0.15
109.34	94.70	620.07	0.15
110.34	95.00	616.10	0.15
111.34	95.36	611.22	0.16
112.34	95.65	607.25	0.16
113.34	96.01	602.31	0.16
114.34	96.33	597.94	0.16
115.34	96.69	593.13	0.16
116.34	97.05	588.17	0.16

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
117.34	97.37	583.73	0.17
118.34	97.79	577.81	0.17
119.34	98.09	573.36	0.17
120.34	98.48	567.32	0.17
121.34	98.78	562.37	0.18
122.34	99.11	556.56	0.18
123.34	99.41	550.52	0.18
124.34	99.65	544.85	0.18
125.34	99.90	537.80	0.19
126.34	100.02	532.90	0.19
127.34	100.12	526.16	0.19
128.34	100.14	520.86	0.19
129.34	100.10	513.93	0.19
130.34	99.98	507.19	0.20
131.34	99.78	500.48	0.20
132.34	99.47	492.76	0.20
133.34	99.15	486.51	0.20
134.34	98.63	478.09	0.21
135.34	98.12	471.09	0.21
136.34	97.48	463.41	0.21
137.34	96.76	455.63	0.21
138.34	96.00	448.33	0.21
139.34	95.02	439.69	0.22
140.34	94.10	432.40	0.22
141.34	92.89	423.52	0.22
142.34	91.73	415.66	0.22
143.34	90.43	407.51	0.22
144.34	88.97	398.93	0.22

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
145.34	87.54	391.07	0.22
146.34	85.70	381.62	0.22
147.34	84.11	374.03	0.22
148.34	82.07	364.87	0.23
149.34	80.05	356.38	0.23
150.34	77.99	348.22	0.23
151.34	75.36	338.48	0.22
152.34	73.30	331.22	0.22
153.34	70.55	322.03	0.22
154.34	68.21	314.48	0.22
155.34	65.41	305.73	0.22
156.34	62.54	296.90	0.21
157.34	60.09	289.31	0.21
158.34	57.21	280.16	0.20
159.34	54.94	272.63	0.20
160.34	52.60	264.20	0.19
161.34	50.87	257.30	0.19
162.34	49.14	249.42	0.19
163.34	47.76	241.94	0.19
164.34	46.68	234.95	0.20
165.34	45.70	227.21	0.20
166.34	45.12	221.71	0.21
167.34	44.47	214.38	0.21
168.34	43.96	207.71	0.22
169.34	43.45	200.34	0.22
170.34	42.92	192.17	0.23
171.34	42.46	184.83	0.23

Table F4 DMA of the 40 wt% graft copolymer filled with marl–polybenzoxazine composite

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-98.87	117.30	3745.66	0.03
-97.87	115.44	3742.23	0.03
-96.87	114.13	3740.44	0.03
-95.87	112.76	3739.18	0.03
-94.87	111.45	3738.33	0.03
-93.87	110.18	3737.70	0.03
-92.87	109.06	3737.30	0.03
-91.87	108.02	3737.09	0.03
-90.87	107.13	3737.10	0.03
-89.87	106.18	3737.45	0.03
-88.87	105.63	3737.86	0.03
-87.87	104.68	3738.97	0.03
-86.87	104.09	3739.84	0.03
-85.87	103.46	3740.89	0.03
-84.87	102.89	3742.00	0.03
-83.87	102.57	3742.79	0.03
-82.87	102.25	3743.82	0.03
-81.87	102.06	3744.80	0.03
-80.87	101.94	3745.84	0.03
-79.87	101.89	3746.69	0.03
-78.87	101.87	3747.87	0.03
-77.87	101.91	3748.76	0.03
-76.87	102.02	3749.67	0.03
-75.87	102.25	3750.38	0.03
-74.87	102.46	3750.67	0.03
-73.87	102.85	3750.93	0.03
-72.87	103.27	3751.01	0.03
-71.87	103.70	3750.95	0.03
-70.87	104.24	3750.73	0.03
-69.87	104.81	3750.35	0.03
-68.87	105.26	3749.97	0.03
-67.87	106.05	3749.07	0.03
-66.87	106.65	3748.14	0.03
-65.87	107.36	3746.82	0.03

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-64.87	108.11	3745.25	0.03
-63.87	109.16	3742.83	0.03
-62.87	110.17	3740.32	0.03
-61.87	111.50	3736.95	0.03
-60.87	112.76	3733.77	0.03
-59.87	114.08	3730.42	0.03
-58.87	115.38	3727.08	0.03
-57.87	116.91	3722.99	0.03
-56.87	118.49	3718.60	0.03
-55.87	120.32	3713.25	0.03
-54.87	122.27	3707.14	0.03
-53.87	124.01	3701.31	0.03
-52.87	126.05	3694.11	0.03
-51.87	127.97	3687.11	0.03
-50.87	129.97	3679.55	0.04
-49.87	131.94	3671.91	0.04
-48.87	134.43	3661.93	0.04
-47.87	136.20	3654.54	0.04
-46.87	138.49	3644.69	0.04
-45.87	140.92	3633.86	0.04
-44.87	143.02	3624.23	0.04
-43.87	145.84	3610.84	0.04
-42.87	148.19	3599.23	0.04
-41.87	150.15	3589.25	0.04
-40.87	152.67	3576.04	0.04
-39.87	155.05	3563.23	0.04
-38.87	157.85	3547.67	0.04
-37.87	160.79	3530.63	0.05
-36.87	163.10	3516.76	0.05
-35.87	165.79	3500.14	0.05
-34.87	168.17	3484.96	0.05
-33.87	171.18	3465.34	0.05
-32.87	174.37	3443.98	0.05
-31.87	177.33	3423.44	0.05

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-30.87	180.09	3403.51	0.05
-29.87	182.82	3382.93	0.05
-28.87	186.28	3355.41	0.06
-27.87	188.63	3335.49	0.06
-26.87	190.64	3317.61	0.06
-25.87	193.29	3292.59	0.06
-24.87	196.37	3261.37	0.06
-23.87	198.55	3237.61	0.06
-22.87	200.90	3210.16	0.06
-21.87	203.72	3174.67	0.06
-20.87	205.54	3149.53	0.07
-19.87	207.51	3119.92	0.07
-18.87	209.31	3090.03	0.07
-17.87	210.54	3067.66	0.07
-16.87	211.98	3039.44	0.07
-15.87	213.68	3003.06	0.07
-14.87	214.98	2972.79	0.07
-13.87	216.34	2937.75	0.07
-12.87	218.21	2882.25	0.08
-11.87	218.72	2864.29	0.08
-10.87	219.25	2845.32	0.08
-9.87	220.20	2806.77	0.08
-8.87	214.35	3137.28	0.07
-7.87	218.19	2924.47	0.07
-6.87	222.00	2706.11	0.08
-5.87	222.35	2677.90	0.08
-4.87	222.75	2639.02	0.08
-3.87	222.90	2621.92	0.09
-2.87	223.26	2561.49	0.09
-1.87	223.31	2540.13	0.09
-0.87	223.24	2492.18	0.09
0.13	223.08	2464.99	0.09
1.13	222.75	2432.35	0.09
2.13	222.50	2413.52	0.09
3.13	221.80	2371.05	0.09
4.13	221.04	2333.89	0.09
5.13	220.27	2301.02	0.10

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
6.13	219.36	2266.71	0.10
7.13	218.62	2241.92	0.10
8.13	217.76	2216.09	0.10
9.13	216.58	2184.03	0.10
10.13	214.79	2141.04	0.10
11.13	213.25	2108.62	0.10
12.13	211.60	2077.78	0.10
13.13	209.98	2050.25	0.10
14.13	207.86	2017.42	0.10
15.13	205.33	1981.65	0.10
16.13	203.06	1951.95	0.10
17.13	200.61	1921.54	0.10
18.13	197.71	1886.88	0.10
19.13	194.86	1853.46	0.11
20.13	192.02	1820.38	0.11
21.13	189.39	1789.62	0.11
22.13	186.40	1754.25	0.11
23.13	183.66	1721.74	0.11
24.13	180.99	1689.97	0.11
25.13	178.53	1660.80	0.11
26.13	175.02	1619.82	0.11
27.13	172.47	1590.85	0.11
28.13	169.25	1555.55	0.11
29.13	166.06	1522.04	0.11
30.13	162.59	1487.28	0.11
31.13	159.27	1455.47	0.11
32.13	156.26	1427.68	0.11
33.13	152.40	1392.97	0.11
34.13	149.27	1365.24	0.11
35.13	146.03	1336.45	0.11
36.13	144.01	1318.43	0.11
37.13	140.16	1283.80	0.11
38.13	137.17	1256.28	0.11
39.13	134.91	1235.06	0.11
40.13	132.02	1207.02	0.11
41.13	128.02	1165.63	0.11
42.13	126.12	1144.04	0.11

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
43.13	124.41	1123.13	0.11
44.13	122.66	1099.10	0.11
45.13	120.62	1065.39	0.11
46.13	119.79	1048.72	0.11
47.13	118.80	1024.48	0.12
48.13	117.91	996.70	0.12
49.13	117.52	980.31	0.12
50.13	117.16	960.95	0.12
51.13	116.90	941.81	0.12
52.13	116.69	918.07	0.13
53.13	116.58	879.42	0.13
54.13	116.61	858.71	0.14
55.13	116.70	839.61	0.14
56.13	116.84	817.17	0.14
57.13	117.01	798.79	0.15
58.13	117.23	777.94	0.15
59.13	117.46	759.31	0.15
60.13	117.75	739.27	0.16
61.13	118.02	721.65	0.16
62.13	118.34	702.84	0.17
63.13	118.67	684.04	0.17
64.13	118.97	667.82	0.18
65.13	119.31	649.50	0.18
66.13	119.60	633.70	0.19
67.13	119.91	615.94	0.19
68.13	120.19	599.36	0.20
69.13	120.43	582.81	0.21
70.13	120.64	565.78	0.21
71.13	120.79	550.39	0.22
72.13	120.89	532.27	0.23
73.13	120.92	518.64	0.23
74.13	120.90	501.68	0.24
75.13	120.81	486.85	0.25
76.13	120.63	471.11	0.26
77.13	120.37	455.96	0.26
78.13	120.02	441.80	0.27
79.13	119.53	427.04	0.28

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
80.13	118.92	413.25	0.29
81.13	118.15	399.49	0.30
82.13	117.27	387.00	0.30
83.13	116.17	374.20	0.31
84.13	114.86	361.44	0.32
85.13	113.42	349.63	0.32
86.13	111.54	336.51	0.33
87.13	109.74	325.67	0.34
88.13	107.44	313.67	0.34
89.13	105.38	304.23	0.35
90.13	102.75	293.51	0.35
91.13	100.21	284.17	0.35
92.13	97.30	274.40	0.35
93.13	94.05	264.28	0.35
94.13	91.38	256.44	0.36
95.13	88.00	247.02	0.36
96.13	85.14	239.38	0.35
97.13	81.96	231.29	0.35
98.13	78.89	223.84	0.35
99.13	75.63	216.31	0.35
100.13	72.20	208.79	0.35
101.13	69.20	202.54	0.34
102.13	65.35	194.97	0.34
103.13	62.35	189.39	0.33
104.13	58.35	182.33	0.32
105.13	55.11	176.88	0.31
106.13	51.43	170.90	0.30
107.13	47.56	164.81	0.29
108.13	44.16	159.52	0.27
109.13	40.36	153.59	0.26
110.13	37.55	149.10	0.25
111.13	34.18	143.52	0.23
112.13	31.73	139.21	0.22
113.13	29.29	134.55	0.21
114.13	27.41	130.60	0.21
115.13	25.68	126.52	0.20
116.13	24.13	122.34	0.20

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
117.13	23.05	119.02	0.19
118.13	21.94	115.14	0.19
119.13	21.15	112.04	0.19
120.13	20.35	108.67	0.19
121.13	19.67	105.62	0.19
122.13	18.99	102.46	0.19
123.13	18.30	99.23	0.19
124.13	17.68	96.31	0.19
125.13	17.05	93.41	0.18
126.13	16.52	91.03	0.18
127.13	15.92	88.38	0.18
128.13	15.37	86.05	0.18
129.13	14.83	83.77	0.18
130.13	14.30	81.57	0.18
131.13	13.78	79.46	0.17
132.13	13.25	77.33	0.17
133.13	12.82	75.64	0.17
134.13	12.31	73.63	0.17
135.13	11.84	71.86	0.16
136.13	11.43	70.30	0.16
137.13	11.00	68.72	0.16
138.13	10.61	67.28	0.16
139.13	10.17	65.69	0.15
140.13	9.83	64.46	0.15
141.13	9.47	63.17	0.15
142.13	9.14	61.99	0.15
143.13	8.81	60.83	0.14
144.13	8.49	59.67	0.14

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
145.13	8.21	58.63	0.14
146.13	7.90	57.49	0.14
147.13	7.65	56.55	0.14
148.13	7.42	55.68	0.13
149.13	7.16	54.71	0.13
150.13	6.94	53.91	0.13
151.13	6.71	53.10	0.13
152.13	6.52	52.44	0.12
153.13	6.31	51.73	0.12
154.13	6.16	51.23	0.12
155.13	6.00	50.68	0.12
156.13	5.84	50.15	0.12
157.13	5.69	49.65	0.11
158.13	5.53	49.09	0.11
159.13	5.38	48.56	0.11
160.13	5.22	47.99	0.11
161.13	5.05	47.41	0.11
162.13	4.89	46.87	0.11
163.13	4.67	46.20	0.10
164.13	4.51	45.78	0.10
165.13	4.29	45.29	0.09
166.13	4.10	44.93	0.09
167.13	3.91	44.60	0.09
168.13	3.72	44.34	0.08
169.13	3.56	44.17	0.08
170.13	3.37	43.98	0.08
171.13	3.19	43.83	0.07

Table F5 DMA of the 50 wt% graft copolymer filled with marl–polybenzoxazine composite

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-99.57	50.18	2403.76	0.02
-98.57	48.78	2410.84	0.02
-97.57	47.78	2415.41	0.02
-96.57	47.00	2418.44	0.02
-95.57	46.53	2419.85	0.02
-94.57	46.10	2420.58	0.02
-93.57	45.64	2420.43	0.02
-92.57	45.46	2419.94	0.02
-91.57	45.24	2418.56	0.02
-90.57	45.16	2416.89	0.02
-89.57	45.14	2415.08	0.02
-88.57	45.18	2412.89	0.02
-87.57	45.29	2409.98	0.02
-86.57	45.38	2407.93	0.02
-85.57	45.55	2404.32	0.02
-84.57	45.75	2400.75	0.02
-83.57	45.89	2398.37	0.02
-82.57	46.11	2394.90	0.02
-81.57	46.38	2391.03	0.02
-80.57	46.64	2387.42	0.02
-79.57	46.99	2382.79	0.02
-78.57	47.23	2379.59	0.02
-77.57	47.61	2374.71	0.02
-76.57	47.96	2370.16	0.02
-75.57	48.29	2365.59	0.02
-74.57	48.62	2360.71	0.02
-73.57	48.87	2356.62	0.02
-72.57	49.06	2352.83	0.02
-71.57	49.27	2348.01	0.02
-70.57	49.39	2344.24	0.02
-69.57	49.51	2339.86	0.02
-68.57	49.60	2334.66	0.02
-67.57	49.64	2330.27	0.02
-66.57	49.66	2324.34	0.02

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-65.57	49.65	2319.98	0.02
-64.57	49.62	2315.03	0.02
-63.57	49.58	2310.77	0.02
-62.57	49.52	2305.62	0.02
-61.57	49.42	2301.00	0.02
-60.57	49.32	2297.07	0.02
-59.57	49.18	2292.73	0.02
-58.57	48.96	2287.37	0.02
-57.57	48.83	2284.69	0.02
-56.57	48.49	2279.21	0.02
-55.57	48.21	2275.73	0.02
-54.57	47.86	2271.87	0.02
-53.57	47.47	2267.99	0.02
-52.57	47.04	2263.94	0.02
-51.57	46.65	2260.20	0.02
-50.57	46.21	2255.77	0.02
-49.57	45.87	2252.14	0.02
-48.57	45.55	2248.46	0.02
-47.57	45.27	2245.25	0.02
-46.57	44.93	2240.94	0.02
-45.57	44.72	2238.19	0.02
-44.57	44.46	2234.54	0.02
-43.57	44.16	2230.03	0.02
-42.57	43.98	2227.10	0.02
-41.57	43.77	2223.80	0.02
-40.57	43.54	2219.77	0.02
-39.57	43.39	2216.82	0.02
-38.57	43.22	2212.99	0.02
-37.57	43.09	2209.26	0.02
-36.57	43.00	2206.39	0.02
-35.57	42.89	2202.11	0.02
-34.57	42.83	2198.92	0.02
-33.57	42.80	2195.77	0.02
-32.57	42.80	2192.97	0.02

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
-31.57	42.82	2189.25	0.02
-30.57	42.88	2185.31	0.02
-29.57	42.96	2181.52	0.02
-28.57	43.05	2178.25	0.02
-27.57	43.17	2174.16	0.02
-26.57	43.30	2170.69	0.02
-25.57	43.49	2166.82	0.02
-24.57	43.75	2162.66	0.02
-23.57	43.99	2159.43	0.02
-22.57	44.34	2155.44	0.02
-21.57	44.77	2151.10	0.02
-20.57	45.08	2148.20	0.02
-19.57	45.57	2143.98	0.02
-18.57	46.15	2139.22	0.02
-17.57	46.68	2135.01	0.02
-16.57	47.28	2130.29	0.02
-15.57	47.98	2124.86	0.02
-14.57	48.54	2120.62	0.02
-13.57	49.35	2114.51	0.02
-12.57	50.05	2109.27	0.02
-11.57	50.67	2104.63	0.02
-10.57	51.47	2098.71	0.02
-9.57	52.26	2092.97	0.02
-8.57	52.96	2087.86	0.03
-7.57	53.72	2082.12	0.03
-6.57	54.60	2075.35	0.03
-5.57	55.21	2070.62	0.03
-4.57	56.20	2062.79	0.03
-3.57	56.97	2056.52	0.03
-2.57	57.85	2049.31	0.03
-1.57	58.65	2042.53	0.03
-0.57	59.62	2034.03	0.03
0.43	60.35	2027.37	0.03
1.43	61.36	2017.93	0.03
2.43	62.18	2009.82	0.03
3.43	63.10	2000.42	0.03
4.43	64.00	1991.28	0.03

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
5.43	64.90	1982.45	0.03
6.43	65.97	1972.16	0.03
7.43	67.13	1961.35	0.03
8.43	68.78	1945.92	0.04
9.43	69.49	1939.17	0.04
10.43	70.78	1926.61	0.04
11.43	71.53	1919.15	0.04
12.43	72.80	1906.27	0.04
13.43	74.32	1890.88	0.04
14.43	75.35	1880.41	0.04
15.43	76.25	1871.15	0.04
16.43	77.64	1856.83	0.04
17.43	79.47	1837.49	0.04
18.43	80.97	1821.17	0.04
19.43	82.60	1802.92	0.05
20.43	84.24	1783.99	0.05
21.43	86.10	1761.86	0.05
22.43	87.77	1741.14	0.05
23.43	89.14	1723.60	0.05
24.43	90.84	1701.27	0.05
25.43	91.68	1690.17	0.05
26.43	93.48	1666.33	0.06
27.43	95.01	1646.30	0.06
28.43	96.47	1627.22	0.06
29.43	98.28	1604.16	0.06
30.43	99.34	1590.79	0.06
31.43	103.91	1534.90	0.07
32.43	105.79	1512.66	0.07
33.43	107.78	1489.14	0.07
34.43	110.27	1459.67	0.08
35.43	112.06	1438.03	0.08
36.43	113.82	1416.21	0.08
37.43	116.23	1384.78	0.08
38.43	118.11	1358.19	0.09
39.43	119.82	1331.60	0.09
40.43	121.23	1307.06	0.09
41.43	122.47	1282.02	0.10

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
42.43	123.50	1257.09	0.10
43.43	124.27	1233.76	0.10
44.43	124.89	1208.84	0.10
45.43	125.28	1186.50	0.11
46.43	125.55	1162.20	0.11
47.43	125.67	1140.09	0.11
48.43	125.69	1117.65	0.11
49.43	125.63	1096.22	0.11
50.43	125.52	1076.20	0.12
51.43	125.36	1054.05	0.12
52.43	125.20	1034.22	0.12
53.43	125.00	1012.57	0.12
54.43	124.80	992.62	0.13
55.43	124.58	971.67	0.13
56.43	124.38	952.02	0.13
57.43	124.18	932.69	0.13
58.43	123.99	912.24	0.14
59.43	123.85	895.17	0.14
60.43	123.69	874.23	0.14
61.43	123.58	856.36	0.14
62.43	123.46	837.16	0.15
63.43	123.35	819.26	0.15
64.43	123.23	801.77	0.15
65.43	123.08	783.79	0.16
66.43	122.91	766.79	0.16
67.43	122.68	748.82	0.16
68.43	122.44	733.65	0.17
69.43	122.09	716.34	0.17
70.43	121.71	701.04	0.17
71.43	121.27	686.22	0.18
72.43	120.70	670.13	0.18
73.43	120.14	656.39	0.18
74.43	119.44	641.02	0.19
75.43	118.78	627.95	0.19
76.43	118.01	614.41	0.19
77.43	117.24	602.21	0.19
78.43	116.40	590.03	0.20

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
79.43	115.48	577.97	0.20
80.43	114.55	566.74	0.20
81.43	113.48	554.98	0.20
82.43	112.50	545.02	0.21
83.43	111.31	533.93	0.21
84.43	110.23	524.47	0.21
85.43	108.92	513.79	0.21
86.43	107.69	504.28	0.21
87.43	106.37	494.77	0.21
88.43	104.93	484.94	0.22
89.43	103.75	477.42	0.22
90.43	102.22	468.14	0.22
91.43	100.89	460.55	0.22
92.43	99.33	452.03	0.22
93.43	97.80	444.11	0.22
94.43	96.21	436.29	0.22
95.43	94.55	428.48	0.22
96.43	92.93	421.19	0.22
97.43	90.97	412.81	0.22
98.43	89.42	406.47	0.22
99.43	87.33	398.35	0.22
100.43	85.43	391.36	0.22
101.43	83.53	384.64	0.22
102.43	81.38	377.38	0.22
103.43	79.40	370.89	0.21
104.43	77.01	363.27	0.21
105.43	75.14	357.42	0.21
106.43	72.82	350.24	0.21
107.43	70.77	343.90	0.21
108.43	68.51	336.83	0.20
109.43	66.56	330.57	0.20
110.43	64.54	323.85	0.20
111.43	62.58	316.97	0.20
112.43	60.94	310.86	0.20
113.43	59.18	303.70	0.19
114.43	57.96	298.28	0.19
115.43	56.55	291.28	0.19

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
116.43	55.43	284.93	0.19
117.43	54.46	278.62	0.20
118.43	53.49	271.52	0.20
119.43	52.81	265.86	0.20
120.43	52.05	259.01	0.20
121.43	51.49	253.46	0.20
122.43	50.85	246.81	0.21
123.43	50.30	240.79	0.21
124.43	49.77	234.70	0.21
125.43	49.24	228.64	0.22
126.43	48.76	223.14	0.22
127.43	48.20	216.82	0.22
128.43	47.72	211.75	0.23
129.43	47.12	205.82	0.23
130.43	46.54	200.56	0.23
131.43	45.88	195.14	0.24
132.43	45.07	189.11	0.24
133.43	44.33	184.04	0.24
134.43	43.38	177.86	0.24
135.43	42.56	172.76	0.25
136.43	41.66	167.33	0.25
137.43	40.73	161.93	0.25
138.43	39.88	157.17	0.25
139.43	38.93	151.95	0.26
140.43	38.08	147.43	0.26
141.43	37.10	142.28	0.26
142.43	36.30	138.21	0.26
143.43	35.28	133.10	0.27

Temp. (°C)	E' (MPa)	E'' (MPa)	tan δ
144.43	34.37	128.69	0.27
145.43	33.47	124.42	0.27
146.43	32.43	119.61	0.27
147.43	31.65	116.14	0.27
148.43	30.64	111.72	0.27
149.43	29.69	107.77	0.28
150.43	28.86	104.42	0.28
151.43	27.93	100.79	0.28
152.43	27.05	97.47	0.28
153.43	26.05	93.80	0.28
154.43	25.21	90.78	0.28
155.43	24.22	87.29	0.28
156.43	23.38	84.44	0.28
157.43	22.53	81.59	0.28
158.43	21.60	78.55	0.28
159.43	20.81	76.03	0.27
160.43	19.89	73.20	0.27
161.43	19.07	70.74	0.27
162.43	18.16	68.14	0.27
163.43	17.30	65.79	0.26
164.43	16.48	63.64	0.26
165.43	15.63	61.49	0.25
166.43	14.76	59.37	0.25
167.43	13.88	57.30	0.24
168.43	13.23	55.80	0.24
169.43	12.48	54.11	0.23
170.43	11.66	52.28	0.23

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Publications:

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Proceedings:

1. Vachirapatama, N.; Mahajaroensiri, J.; and Visessanguan, W. (2007, 18–20 October) Identification and Determination of Seven Synthetic Dyes in Foodstuffs and Soft Drinks on Monolithic C18 Column by High Performance Liquid Chromatography. Proceedings of the 33rd Congress on Science and Technology of Thailand, Bangkok, Thailand.
2. Mahajaroensiri, J.; Chaisuwan, T.; and Magaraphan, R. (2009, January 13-16) Effects of Marl on Thermal and Mechanical Properties of Polybenzoxazine Composites: Synthesis and Characterization. Proceedings of the 2nd Pure and Applied Chemistry International Conference (PACCON 2009), Pitsanuloke, Thailand.
3. Mahajaroensiri, J.; Chaisuwan, T.; and Magaraphan, R. (2009, February 24-27) Hardening of Silk Sericin-g-PLA/Marl Biocomposite by Polybenzoxazine. Proceedings of the 7th Global Plastics Environmental Conference (GPEC 2009), Orlando, Florida, USA.

4. Mahajaroensiri, J.; Chaisuwan, T.; and Magaraphan, R. (2009, April 24) Biocompatible Hybrid Composite Derived from Silk Sericin-g-PLA, Marl, and Polybenzoxazine. Proceedings of the 15th PPC Symposium on Petroleum, Petrochems, and Polymers, Sasa Patasala Buliding, Bangkok, Thailand.

Presentations:

1. Vachirapatama, N.; Mahajaroensiri, J.; and Visessanguan, W. (2007, 18–20 October) Identification and Determination of Seven Synthetic Dyes in Foodstuffs and Soft Drinks on Monolithic C18 Column by High Performance Liquid Chromatography. Paper presented at 33rd Congress on Science and Technology of Thailand, Bangkok, Thailand.
2. Mahajaroensiri, J.; Chaisuwan, T.; and Magaraphan, R. (2009, January 13-16) Effects of Marl on Thermal and Mechanical Properties of Polybenzoxazine Composites: Synthesis and Characterization. Paper presented at 2nd Pure and Applied Chemistry International Conference (PACCON 2009), Pitsanuloke, Thailand.
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4. Mahajaroensiri, J.; Chaisuwan, T.; and Magaraphan, R. (2009, April 24) Biocompatible Hybrid Composite Derived from Silk Sericin-g-PLA, Marl, and Polybenzoxazine. Poster presented at 15th PPC Symposium on Petroleum, Petrochems, and Polymers, Sasa Patasala Buliding, Bangkok, Thailand.