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APPENDICES

Appendix A

Swelling Ratio

Table A1 Swelling ratio of chitosan/PAA hydrogel film as a function of concentration of aqueous NaCl solution at room temperature.

CS:PAA 1:1												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	4.23	0.48	4.23	1.02	6.55	1.08	7.96	2.39	8.94	0.95	14.80	3.08
25	32.89	2.00	32.89	3.10	35.25	2.03	37.02	1.89	35.07	2.90	38.70	0.49
40	36.97	0.56	36.97	0.84	39.89	0.59	41.74	1.27	42.00	1.40	43.39	1.34
55	37.98	1.30	37.98	1.17	40.40	0.95	42.35	0.69	42.85	0.60	45.19	2.61
70	38.22	2.50	38.22	0.92	41.13	1.60	41.94	0.67	44.22	0.82	44.15	1.72
85	36.69	2.50	36.69	0.70	41.40	2.35	43.03	1.39	43.06	0.51	45.19	2.02
100	37.89	1.14	37.89	0.35	39.18	0.75	43.57	0.69	43.46	1.50	45.19	1.27
115	37.02	1.43	37.02	1.54	39.45	2.35	42.65	0.49	42.74	2.13	44.92	1.98
130	37.72	1.80	37.72	0.92	39.41	0.26	41.63	0.75	43.27	1.03	44.41	1.27
145	36.22	2.23	36.22	1.78	39.16	1.21	40.41	1.06	41.12	1.59	42.08	1.36
Equilibrium swelling ratio (%)	33.53	0.60	36.52	0.75	38.67	0.95	42.39	1.03	43.50	0.95	45.44	1.12

CS:PAA 2:1												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	30.00	1.44	32.19	0.53	26.74	13.16	36.14	1.33	35.02	2.54	40.30	0.47
25	36.79	1.15	39.37	0.62	40.19	4.10	42.76	0.49	44.38	1.56	46.74	1.13
40	36.67	0.88	39.62	0.60	40.95	1.44	43.00	2.95	44.86	1.47	47.26	0.80
55	36.11	1.76	38.54	1.54	40.31	2.53	43.56	0.32	45.67	0.45	47.26	0.80
70	33.76	1.93	38.83	1.07	40.80	2.50	43.81	0.99	45.65	0.74	46.51	0.36
85	33.68	3.04	38.80	1.35	39.49	1.66	42.54	0.55	44.89	0.33	45.99	0.81
100	33.80	1.17	38.55	0.92	40.76	2.14	42.29	0.96	44.38	0.33	46.22	1.30
115	33.01	1.22	36.94	1.57	40.33	2.79	43.74	1.44	42.87	1.56	44.73	2.19
130	34.04	1.48	36.44	1.78	39.13	0.62	41.46	1.57	43.89	0.78	45.23	1.86
Equilibrium swelling ratio (%)	34.07	0.97	38.02	0.96	40.14	0.62	42.90	0.87	44.56	0.99	45.99	0.83

Table A1 (continued) Swelling ratio of chitosan/PAA hydrogel film as a function of concentration of aqueous NaCl solution at room temperature.

CS:PAA 3:1												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	99.95	25.70	91.91	6.05	89.08	3.47	83.19	7.52	83.31	2.85	84.30	5.82
25	120.85	9.63	104.99	3.58	98.31	1.51	93.81	3.19	94.15	5.76	94.28	3.84
40	120.85	9.63	104.97	3.25	99.94	1.36	95.53	2.90	96.72	5.04	94.32	4.36
55	121.28	8.34	106.25	2.38	101.27	2.19	95.94	4.00	97.94	3.56	94.66	4.06
70	122.56	6.47	107.16	3.14	102.53	2.20	95.91	3.63	96.26	4.44	93.55	3.39
85	117.87	6.41	107.13	3.46	102.77	2.57	95.39	5.08	98.83	3.82	93.93	3.17
100	116.60	5.90	107.58	3.20	102.23	4.70	96.00	2.75	97.93	2.56	94.73	2.50
115	115.75	4.51	110.17	2.07	103.62	3.81	95.39	5.08	97.90	2.55	94.32	4.36
130	111.93	5.21	108.89	2.55	103.62	3.81	95.86	4.61	97.93	2.56	94.32	4.36
Equilibrium swelling ratio (%)	117.66	3.87	107.86	1.42	102.67	0.89	95.75	0.28	97.80	0.83	94.25	0.45

CS:PAA 4:1												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	105.17	2.00	98.35	3.75	95.06	6.90	96.07	2.52	87.48	11.51	91.22	4.41
25	120.03	5.75	109.24	1.36	97.76	6.75	98.33	3.89	95.72	2.84	94.66	0.82
40	117.77	4.20	109.91	1.90	101.95	4.94	99.66	1.63	94.60	2.24	95.03	1.87
55	115.84	3.55	108.98	0.46	102.58	5.96	100.73	1.27	96.08	2.23	95.80	0.78
70	115.18	4.73	110.67	1.05	102.66	4.83	99.34	3.15	95.36	3.46	95.05	0.71
85	112.60	2.79	109.63	1.08	102.62	5.66	97.93	2.69	96.10	1.57	93.51	2.46
100	110.65	5.06	108.43	3.54	101.15	5.39	97.97	3.71	95.01	2.22	95.06	1.75
115	109.68	4.16	109.26	1.08	100.77	5.19	97.97	4.46	94.63	1.88	91.98	2.43
130	108.06	5.30	108.88	2.56	100.82	5.05	98.26	1.15	95.37	1.61	93.89	1.84
145	106.77	3.45	109.53	2.49	100.81	4.41	98.91	2.18	92.47	2.91	91.16	3.91
Equilibrium swelling ratio (%)	111.26	3.45	109.34	0.71	101.63	0.93	98.73	1.03	95.00	1.24	93.78	1.71

Table A1 (continued) Swelling ratio of chitosan/PAA hydrogel film as a function of concentration of aqueous NaCl solution at room temperature.

CS:PAA 5:1												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	163.84	2.40	130.48	3.05	124.16	2.55	116.46	3.79	113.89	6.60	107.33	0.71
25	171.59	2.08	140.71	2.23	127.17	2.14	118.64	2.79	117.08	4.10	109.21	0.50
40	170.89	3.08	141.26	2.66	126.67	2.17	117.44	1.70	116.11	2.66	107.33	0.71
55	168.79	5.78	143.03	3.27	126.00	2.56	119.30	1.40	116.81	3.26	108.85	0.15
70	167.69	5.73	142.12	3.40	127.07	1.57	118.14	2.31	117.82	2.28	108.74	2.10
85	164.77	5.73	143.54	4.68	126.00	1.50	117.00	3.12	116.17	3.68	110.43	0.85
100	162.92	4.88	143.52	4.61	125.59	1.80	118.44	3.60	115.13	1.81	109.48	2.73
115	159.98	4.13	143.54	4.68	127.88	2.00	115.53	3.30	116.19	1.81	108.38	1.91
130	158.51	3.82	143.54	4.68	123.76	0.66	116.66	2.57	116.40	2.96	108.84	0.96
145	157.05	4.58	142.72	6.92	123.86	2.97	118.37	4.79	115.20	3.35	109.16	1.37
Equilibrium swelling ratio (%)	162.82	4.53	143.15	0.56	125.74	1.53	117.63	1.29	116.25	0.93	109.13	0.67

CS:PAA:B 3:1:0.05												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	70.51	0.42	65.28	1.80	63.98	0.83	62.67	2.02	63.65	4.89	64.68	2.05
25	77.96	1.60	72.72	3.98	69.66	0.45	68.12	1.11	65.88	5.32	64.85	1.55
40	76.12	1.75	73.25	4.60	66.63	2.35	66.65	1.73	65.26	6.58	65.40	2.03
55	71.30	2.74	71.92	3.70	68.13	2.53	65.79	3.23	65.62	5.68	65.73	1.48
70	68.58	2.65	73.21	5.44	67.24	1.84	64.99	1.49	64.01	5.22	65.34	2.78
85	67.89	2.07	71.70	2.48	66.62	2.71	64.97	1.89	61.78	3.43	64.24	1.82
100	67.03	1.33	71.13	2.92	65.72	3.10	64.65	2.25	63.67	5.23	63.45	1.59
115	65.15	1.07	69.78	2.26	66.33	1.87	65.21	2.06	63.33	6.63	63.45	0.34
130	63.34	0.54	69.44	3.46	66.00	3.68	63.81	0.80	61.10	4.88	62.15	3.56
145	61.77	0.20	67.51	3.49	66.05	1.07	64.70	1.87	62.05	5.77	60.18	1.69
Equilibrium swelling ratio (%)	66.44	3.26	70.67	1.90	66.58	0.84	64.88	0.60	63.08	1.55	63.51	1.90

Table A1 (continued) Swelling ratio of chitosan/PAA hydrogel film as a function of concentration of aqueous NaCl solution at room temperature.

CS:PAA:B 3:1:0.1												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	62.58	9.71	58.13	16.51	60.86	1.41	82.71	5.36	73.13	7.52	77.10	4.42
25	103.07	6.13	87.09	3.27	89.56	2.43	92.28	6.56	86.67	4.17	91.94	3.87
40	114.15	2.97	93.43	7.64	95.84	2.13	95.94	5.98	90.25	1.83	96.66	4.90
55	113.57	3.99	97.86	3.07	97.52	3.42	94.11	3.39	90.68	1.19	95.00	4.41
70	113.45	2.40	95.16	8.65	97.52	3.42	91.87	6.32	88.17	7.78	95.29	5.90
85	113.47	2.12	94.87	7.43	98.58	1.63	92.53	3.15	88.75	4.46	95.35	4.04
100	113.10	3.56	93.77	7.95	98.23	1.63	93.18	4.97	89.05	1.81	94.29	4.19
115	109.34	3.85	94.06	8.48	97.92	1.07	92.65	6.86	88.08	5.48	93.17	5.98
130	110.08	3.32	94.06	8.48	98.53	3.17	94.03	4.46	89.43	2.10	94.34	3.25
Equilibrium swelling ratio (%)	112.17	1.93	94.96	1.52	98.05	0.48	93.06	0.89	89.03	0.96	94.57	0.83

CS:PAA:B 3:1:0.2												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	62.89	6.69	58.49	2.58	58.86	6.27	61.57	10.61	70.05	1.92	73.45	8.63
25	111.29	3.12	105.96	1.79	97.43	2.35	91.47	4.78	95.02	3.57	94.55	3.76
40	106.42	5.87	112.95	2.58	103.67	3.22	97.71	3.08	96.13	5.22	97.47	3.16
55	104.53	6.53	115.91	2.47	103.76	4.38	97.35	3.29	97.68	4.19	100.34	3.41
70	99.46	5.09	117.88	1.81	107.03	4.81	100.69	4.69	98.82	4.17	99.63	4.51
85	96.86	5.84	118.24	3.15	105.21	2.71	97.69	6.12	99.20	3.33	99.66	2.27
100	97.18	7.06	118.53	2.12	105.95	4.12	99.93	5.32	100.33	4.35	99.60	1.69
115	96.15	5.27	118.86	3.72	106.37	2.62	100.43	6.58	99.97	3.05	96.33	2.85
130	92.18	5.05	114.35	5.63	103.33	4.24	97.71	5.01	96.55	4.21	101.13	3.84
145	94.66	5.56	120.14	1.31	103.32	2.63	100.07	3.30	99.18	5.46	100.37	1.70
Equilibrium swelling ratio (%)	97.29	3.91	117.70	1.95	104.99	1.53	99.13	1.47	98.82	1.31	99.58	1.54

Table A1 (continued) Swelling ratio of chitosan/PAA hydrogel film as a function of concentration of aqueous NaCl solution at room temperature.

CS:PAA:B 3:1:0.3												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	117.27	18.71	95.68	7.87	85.04	11.58	91.48	3.71	91.14	3.80	90.92	5.72
25	197.33	10.32	149.89	5.38	135.06	6.67	122.64	4.27	119.74	7.20	120.96	1.67
40	195.54	15.50	158.66	3.91	143.81	3.64	127.74	5.68	123.75	7.30	126.90	1.65
55	198.17	18.34	161.46	4.53	149.83	8.12	128.75	1.85	125.64	5.19	133.70	5.69
70	191.12	15.29	165.28	5.27	149.27	3.53	130.37	3.72	126.95	7.56	129.84	4.20
85	190.25	16.22	167.34	3.86	147.63	4.95	129.59	3.51	128.12	6.25	130.69	1.72
100	187.16	15.52	168.21	4.58	149.72	4.38	131.12	3.10	127.77	8.66	130.29	1.63
115	184.96	15.43	168.13	3.04	151.05	6.61	130.00	4.18	128.14	6.85	130.29	1.63
130	183.63	16.75	169.02	4.17	150.98	4.36	133.09	3.71	126.14	6.88	129.01	2.41
145	181.88	15.13	170.28	5.32	153.95	5.25	130.48	6.43	129.34	6.89	131.55	1.68
Equilibrium swelling ratio (%)	188.17	5.54	167.10	2.92	150.35	1.96	130.49	1.37	127.44	1.28	130.77	1.51

CS:PAA:B 3:1:0.4												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	86.93	3.78	75.33	4.62	76.78	1.20	85.06	7.72	73.39	4.65	86.47	4.60
25	145.12	3.56	118.09	7.81	117.04	3.57	117.44	3.20	109.79	2.82	100.69	1.19
40	145.58	2.22	126.52	7.57	125.03	4.17	123.50	4.92	119.45	3.34	103.96	2.82
55	144.03	1.95	130.59	8.53	126.52	3.37	126.31	6.86	121.53	4.21	107.35	1.73
70	142.18	3.71	129.47	9.12	126.86	4.25	126.75	5.71	123.61	4.21	106.09	4.67
85	139.02	2.09	130.96	8.91	129.77	3.43	131.24	4.34	122.27	4.24	105.37	4.31
100	137.63	2.89	131.34	9.61	130.13	3.10	129.18	5.84	124.28	3.15	105.04	3.73
115	139.53	4.86	131.83	7.43	131.19	4.79	131.23	4.16	124.31	3.01	105.71	4.90
130	138.75	3.12	133.42	6.89	130.86	4.49	131.21	5.56	126.02	3.70	104.61	4.98
145	138.74	4.84	132.51	9.89	131.21	4.33	130.77	7.84	123.28	3.96	106.47	4.53
Equilibrium swelling ratio (%)	139.98	2.27	131.45	1.29	129.51	2.00	129.53	2.18	123.61	1.47	105.80	0.92

Table A1 (continued) Swelling ratio of chitosan/PAA hydrogel film as a function of concentration of aqueous NaCl solution at room temperature.

CS:PAA:B 3:1:0.5												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	40.70	1.10	43.07	3.80	43.83	1.61	47.17	3.24	44.71	1.27	45.58	2.44
25	46.24	3.82	48.42	3.69	45.44	1.79	48.02	3.85	47.36	2.73	48.33	3.59
40	44.66	2.51	48.13	3.19	46.17	0.42	48.92	3.19	46.78	3.23	47.25	1.01
55	42.25	2.68	47.24	0.88	46.18	1.12	50.07	3.22	48.28	4.91	49.96	1.50
70	43.89	2.55	48.15	3.13	46.12	3.10	48.29	4.93	48.27	4.20	47.33	2.00
85	41.20	2.86	46.82	3.96	45.46	2.59	49.18	4.02	46.77	0.90	48.89	3.13
100	40.41	3.73	48.17	4.66	44.55	2.39	49.79	3.03	45.89	1.36	47.85	1.90
115	41.99	2.51	48.40	3.91	45.41	1.65	47.45	3.37	45.34	5.03	47.50	2.87
130	38.81	1.77	48.12	2.39	43.04	3.07	49.25	1.76	46.78	2.12	47.50	2.87
145	38.85	2.73	46.49	5.65	46.00	2.62	48.09	0.74	47.37	2.70	45.87	2.24
Equilibrium swelling ratio (%)	41.06	1.86	47.63	0.76	45.25	1.13	48.87	0.96	46.96	1.11	47.84	1.29

CS:PAA:B 3:1:2												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	63.28	4.81	74.07	7.06	64.58	7.68	71.93	2.12	73.47	4.69	76.22	3.28
25	121.06	20.48	94.74	5.48	98.83	12.68	96.52	17.48	100.24	6.17	102.82	7.05
40	124.09	26.38	96.52	8.55	105.32	14.35	101.38	22.62	104.73	5.52	108.78	9.11
55	118.49	31.29	96.87	9.16	108.03	16.78	101.45	23.61	106.20	6.45	110.99	9.23
70	117.37	27.77	96.48	9.51	110.36	18.76	101.81	22.99	108.45	5.91	112.48	9.71
85	115.87	28.25	95.73	9.28	110.31	16.87	103.42	24.38	106.92	7.30	112.49	9.94
100	114.37	28.74	96.87	9.16	110.39	19.83	102.64	24.63	106.90	8.41	113.56	9.23
115	112.50	28.23	94.98	9.93	110.40	20.47	101.52	24.61	107.66	7.70	113.24	10.45
130	110.63	28.83	95.73	10.16	110.05	21.27	102.74	27.53	107.28	8.37	113.23	10.00
145	109.12	27.09	96.48	9.51	111.57	21.55	103.03	25.94	109.52	8.25	113.20	9.35
Equilibrium swelling ratio (%)	114.05	3.48	96.16	0.70	110.16	1.06	102.37	0.78	107.56	1.11	112.74	0.87

Table A1 (continued) Swelling ratio of chitosan/PAA hydrogel film as a function of concentration of aqueous NaCl solution at room temperature.

CS:PAA:B:GA 3:1:0:1												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	33.52	4.95	33.05	0.43	34.45	3.07	38.45	6.29	38.12	4.00	40.11	2.39
25	41.30	3.33	42.77	1.16	43.64	1.81	43.48	4.10	45.89	2.07	47.13	1.46
40	40.50	3.09	43.98	2.17	44.26	0.75	45.83	2.70	47.19	2.51	48.68	1.15
55	39.23	3.69	42.75	1.57	44.48	1.31	45.61	2.36	46.18	3.40	48.28	0.70
70	38.78	2.89	43.79	1.92	45.10	1.92	45.24	2.92	46.02	3.26	47.64	2.33
85	35.98	4.75	43.99	1.84	44.26	2.94	45.15	1.96	45.61	4.13	48.07	1.28
100	37.70	2.22	42.75	0.96	44.86	0.89	43.42	3.12	45.90	3.66	46.89	1.20
115	37.04	3.33	41.91	1.94	45.10	2.53	43.70	4.36	45.55	2.43	46.88	0.56
130	37.92	3.62	43.99	1.84	42.23	1.93	44.50	0.53	46.33	3.18	46.64	2.42
145	37.71	3.27	41.93	2.54	42.40	1.92	43.48	1.73	44.66	1.58	46.27	1.11
Equilibrium swelling ratio (%)	37.76	1.07	43.02	0.92	44.06	1.23	44.44	0.92	45.75	0.56	47.24	0.76

CS:PAA:B:GA 3:1:0.3:0.1												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	16.29	3.12	19.76	3.36	18.44	2.94	23.34	4.30	30.07	3.79	28.03	4.79
25	38.51	0.59	37.65	2.43	42.36	1.50	43.66	0.51	49.06	1.97	47.27	1.71
40	38.52	2.79	39.85	2.95	45.33	1.42	46.53	1.12	49.56	1.25	49.96	2.41
55	39.03	0.17	42.07	1.78	44.60	2.09	46.25	1.24	49.06	1.43	51.12	2.70
70	38.24	1.52	41.34	0.79	45.55	1.70	45.61	3.52	49.04	1.21	50.08	1.79
85	38.97	1.54	40.34	0.17	45.56	1.68	46.53	1.12	49.06	1.97	49.55	1.86
100	37.98	1.04	39.61	0.60	44.38	1.94	45.72	1.80	49.86	2.90	50.61	1.83
115	38.78	0.41	40.35	0.61	44.42	1.85	45.45	1.55	48.19	1.49	50.12	2.27
130	38.21	1.44	41.09	1.21	44.81	2.30	46.47	2.43	49.31	1.07	49.15	2.40
145	38.02	0.43	40.33	1.64	44.64	1.77	44.07	3.22	47.62	2.42	50.06	2.59
Equilibrium swelling ratio (%)	38.46	0.45	40.73	0.82	44.85	0.50	45.73	0.85	48.88	0.74	50.10	0.65

Table A1 (continued) Swelling ratio of chitosan/PAA hydrogel film as a function of concentration of aqueous NaCl solution at room temperature.

CS:PAA:B:GA 3:1:0.3:0.5												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	33.22	1.98	34.67	2.56	35.31	1.07	37.18	2.87	40.83	0.58	40.34	0.44
25	35.44	2.43	37.64	0.61	39.26	0.24	41.12	0.69	44.70	0.77	44.61	1.46
40	34.49	2.43	38.55	1.48	39.18	1.54	40.82	0.68	44.07	1.87	45.69	3.56
55	34.82	1.96	37.60	1.34	38.98	0.73	41.69	0.61	42.45	2.61	45.20	2.00
70	35.12	1.96	39.17	0.73	39.20	0.87	40.50	0.65	43.10	1.86	43.71	2.39
85	34.84	1.79	36.94	2.24	39.54	0.25	41.96	0.38	43.74	0.76	43.71	2.39
100	34.82	1.96	37.02	0.38	40.14	0.69	41.39	0.85	43.08	1.06	43.50	0.60
115	34.49	2.43	37.27	1.76	39.24	1.02	41.62	1.72	43.10	1.86	44.33	1.43
130	33.56	2.07	37.62	1.51	38.98	0.73	39.94	2.35	43.73	1.28	42.28	2.47
145	33.56	1.21	37.89	2.85	39.26	0.24	38.42	2.47	42.43	1.11	43.22	0.20
Equilibrium swelling ratio (%)	34.46	0.64	37.64	0.75	39.33	0.41	40.79	1.27	43.09	0.53	43.71	0.91

CS:PAA:B:GA 3:1:0.3:1												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	45.07	0.87	45.36	0.82	45.33	0.63	47.74	0.99	46.42	4.42	50.28	0.93
25	52.11	1.10	49.46	1.65	49.99	1.23	49.60	2.19	51.95	2.07	51.64	1.42
40	51.30	1.18	49.46	0.85	49.73	1.04	49.31	1.82	50.54	1.64	51.11	1.30
55	48.76	1.09	48.65	2.46	49.46	1.44	49.85	1.42	49.43	2.90	52.17	1.23
70	48.51	2.27	48.92	1.65	49.45	0.63	49.06	0.64	50.00	1.80	51.66	1.70
85	46.78	1.30	48.92	1.65	49.72	1.57	49.06	0.64	48.91	2.37	49.75	2.56
100	46.24	2.60	48.92	1.65	48.90	0.23	48.02	1.78	48.64	1.45	51.39	2.10
115	45.11	1.96	47.82	1.64	49.45	0.24	48.80	0.70	50.27	2.10	51.09	1.67
130	44.83	2.22	48.10	2.45	48.90	0.86	49.60	1.42	49.99	2.56	51.62	0.06
145	43.13	1.39	46.45	1.29	49.18	1.90	48.52	2.35	49.15	2.05	50.85	2.16
Equilibrium swelling ratio (%)	46.19	2.03	48.25	0.91	49.30	0.31	48.99	0.62	49.48	0.62	51.22	0.77

Table A1 (continued) Swelling ratio of chitosan/PAA hydrogel film as a function of concentration of aqueous NaCl solution at room temperature.

CS:PAA:B:Glu 3:1:0.3:1												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	84.65	30.32	88.80	21.35	86.79	19.02	90.83	23.36	57.99	5.14	102.85	5.50
25	145.28	12.81	138.10	20.55	138.96	16.43	131.35	15.79	115.96	1.90	133.03	4.60
40	142.07	14.23	150.78	26.85	151.71	13.65	141.42	12.42	133.38	6.08	136.36	5.80
55	139.41	13.19	155.34	28.61	155.49	12.61	144.78	12.32	140.32	5.42	140.47	5.82
70	133.45	16.83	158.52	27.93	157.52	11.71	147.75	12.96	141.69	7.77	141.94	6.59
85	132.07	14.49	162.10	31.06	160.60	11.92	146.19	13.51	144.35	8.02	144.46	6.21
100	127.90	13.37	162.25	29.60	163.33	14.33	149.62	13.87	145.51	6.18	142.44	5.73
115	126.80	12.59	164.30	31.31	166.56	15.29	151.38	14.27	147.56	5.98	145.51	5.81
130	126.09	11.73	167.92	34.22	166.84	16.50	151.10	12.35	149.26	5.71	144.94	8.14
145	124.58	11.45	170.13	34.45	168.87	15.50	150.64	12.24	150.65	8.84	144.96	5.35
Equilibrium swelling ratio (%)	130.04	5.23	162.94	5.11	162.75	5.06	148.78	2.59	145.62	3.82	143.53	1.91

CS:PAA:B:Cit 3:1:0.3:1												
Time (min)	H ₂ O		0.3% (w/w) NaCl		0.6% (w/w) NaCl		0.9% (w/w) NaCl		1.2% (w/w) NaCl		1.5% (w/w) NaCl	
	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.	swelling ratio (%)	S.D.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	63.81	8.15	63.75	4.77	60.20	2.04	59.61	7.14	58.69	2.92	59.34	1.74
25	65.00	13.23	68.17	4.15	63.29	2.17	60.42	6.62	60.47	1.71	61.77	4.24
40	62.03	11.87	68.48	3.63	63.97	1.99	61.46	7.53	60.47	1.00	61.77	4.24
55	59.76	12.61	67.86	4.67	62.63	2.90	60.64	8.08	60.83	0.81	61.07	3.68
70	59.06	10.66	67.49	5.03	63.27	1.40	59.62	7.15	60.47	1.71	61.50	2.97
85	57.32	10.68	66.60	3.96	62.62	2.49	59.84	8.54	59.08	0.46	60.71	4.28
100	55.05	11.24	67.20	4.10	63.31	2.41	61.12	7.22	60.12	1.25	60.37	3.15
115	55.26	10.02	66.54	4.24	61.61	3.26	58.56	9.88	58.73	1.20	61.11	2.70
130	54.66	9.87	67.46	3.39	62.95	1.94	60.06	6.51	57.33	0.72	60.44	2.99
145	52.91	9.48	65.90	2.98	62.26	2.13	59.28	6.91	58.73	1.20	60.76	3.31
Equilibrium swelling ratio (%)	56.29	2.50	67.01	0.68	62.66	0.60	59.87	0.85	59.33	1.22	60.85	0.40

Appendix B

Bending Behavior

Table B1 The bending time (min) of CS/PAA hydrogel films on the first 10 degree in aqueous NaCl solutions at 25 V.

Compositions	Bending Time (min) on the first 10 degree				
	0.3% (w/w) NaCl	0.6% (w/w) NaCl	0.9% (w/w) NaCl	1.2% (w/w) NaCl	1.5% (w/w) NaCl
CS:PAA 1:1	3.45	1.75	1.73	5.30	4.89
CS:PAA 2:1	7.20	4.59	3.92	3.22	3.69
CS:PAA 3:1	3.54	0.85	0.83	0.33	0.40
CS:PAA 4:1	1.10	0.85	1.21	2.07	0.89
CS:PAA 5:1	2.80	8.57	3.76	4.71	2.34
CS:PAA:B 3:1:0.05	9.32	6.79	3.82	6.49	8.27
CS:PAA:B 3:1:0.1	1.81	2.63	3.75	1.98	1.04
CS:PAA:B 3:1:0.2	3.03	2.33	2.08	0.21	0.55
CS:PAA:B 3:1:0.3	9.91	4.19	1.05	0.61	0.33
CS:PAA:B 3:1:0.4	8.95	3.20	8.20	1.12	10.08
CS:PAA:B 3:1:0.5	11.23	7.83	6.74	4.46	3.93
CS:PAA:B 3:1:2	7.17	7.32	1.00	1.83	4.80
CS:PAA:B:GA 3:1:0:1	5.39	1.85	5.33	2.82	2.51
CS:PAA:B:GA 3:1:0.3:0	9.91	4.19	1.05	0.61	0.33
CS:PAA:B:GA 3:1:0.3:0.1	2.13	7.06	3.58	2.44	2.58
CS:PAA:B:GA 3:1:0.3:0.5	6.21	3.16	2.44	2.15	2.11
CS:PAA:B:GA 3:1:0.3:1	9.00	7.22	3.51	3.42	2.05
CS:PAA:B:Glu 3:1:0.3:1	4.32	1.51	0.41	0.27	0.12
CS:PAA:B:Cit 3:1:0.3:1	10.95	8.97	1.44	0.76	1.64

Table B2 The equilibrium bending angle (degree) of CS/PAA hydrogel films in aqueous NaCl solutions at 25 V.

Compositions	Equilibrium bending angle (Degree)				
	0.3% (w/w) NaCl	0.6% (w/w) NaCl	0.9% (w/w) NaCl	1.2% (w/w) NaCl	1.5% (w/w) NaCl
CS:PAA 1:1	-60.00	90.00	-30.00	-10.00	-20.00
CS:PAA 2:1	-10.00	-40.00	-30.00	-40.00	-30.00
CS:PAA 3:1	90.00	90.00	40.00	80.00	90.00
CS:PAA 4:1	90.00	90.00	90.00	10.00	10.00
CS:PAA 5:1	17.50	7.50	5.00	26.66	20.00
CS:PAA:B 3:1:0.05	-30.00	-30.00	-33.33	-10.00	-30.00
CS:PAA:B 3:1:0.1	60.00	90.00	90.00	35.00	60.00
CS:PAA:B 3:1:0.2	75.00	90.00	50.00	90.00	90.00
CS:PAA:B 3:1:0.3	-5.00	83.33	90.00	90.00	83.33
CS:PAA:B 3:1:0.4	-25.00	37.50	36.66	55.00	90.00
CS:PAA:B 3:1:0.5	-25.00	-25.00	-20.66	-30.00	70.00
CS:PAA:B 3:1:2	16.66	23.33	30.00	46.66	16.66
CS:PAA:B:GA 3:1:0:1	55.00	70.00	90.00	-30.00	-35.00
CS:PAA:B:GA 3:1:0.3:0	-5.00	83.33	90.00	90.00	83.33
CS:PAA:B:GA 3:1:0.3:0.1	90.00	-18.33	-30.00	-27.50	-30.00
CS:PAA:B:GA 3:1:0.3:0.5	-62.50	-27.50	75.00	-26.66	-23.33
CS:PAA:B:GA 3:1:0.3:1	-27.33	15.00	90.00	60.00	90.00
CS:PAA:B:Glu 3:1:0.3:1	-85.00	20.00	73.33	85.00	90.00
CS:PAA:B:Cit 3:1:0.3:1	-20.00	22.50	76.66	56.66	90.00

The bending behavior of 0.3% (w/w) barakol-CS/PAA hydrogel films crosslinked with 1% glutaraldehyde under 25 V electric fields

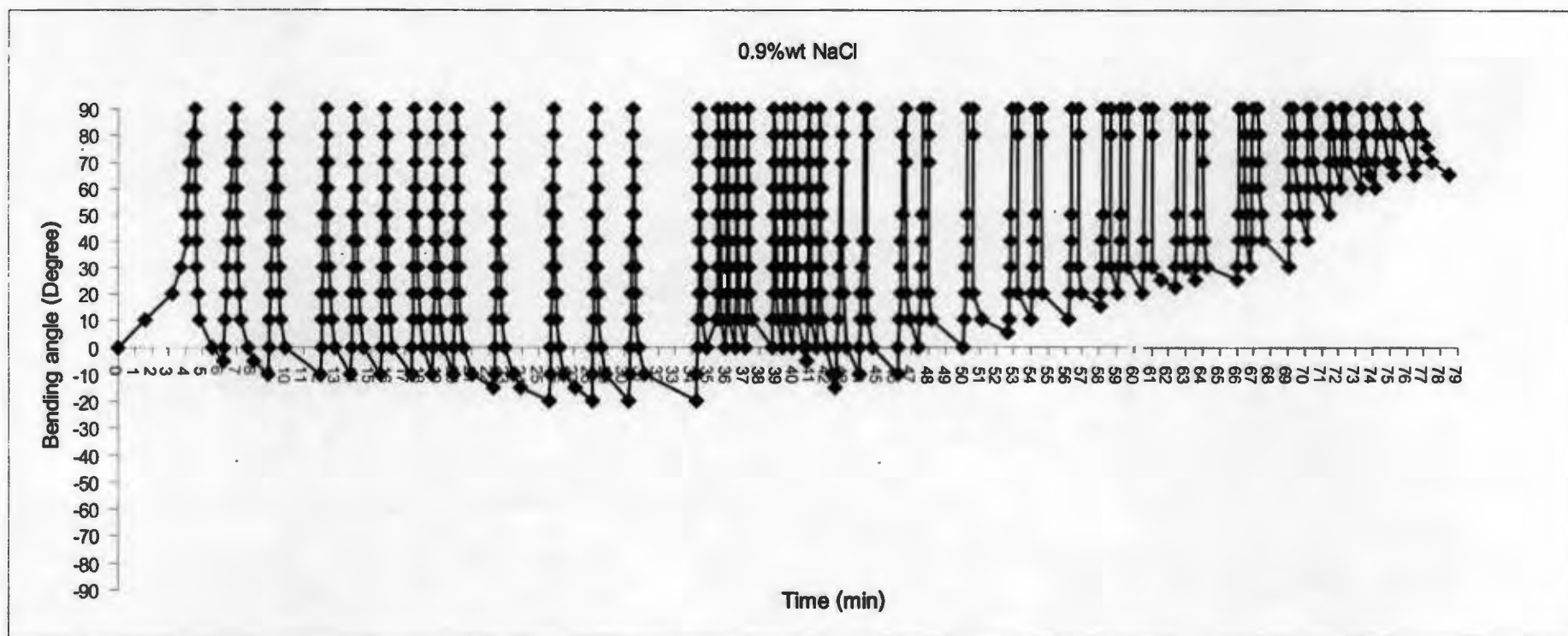


Figure B1 Effect of 0.9% (w/w) NaCl solution on the bending angle at a constant 25 V voltage

The bending behavior of 0.3% (w/w) barakol-CS/PAA hydrogel films crosslinked with 1% glutaraldehyde under 25 V electric fields

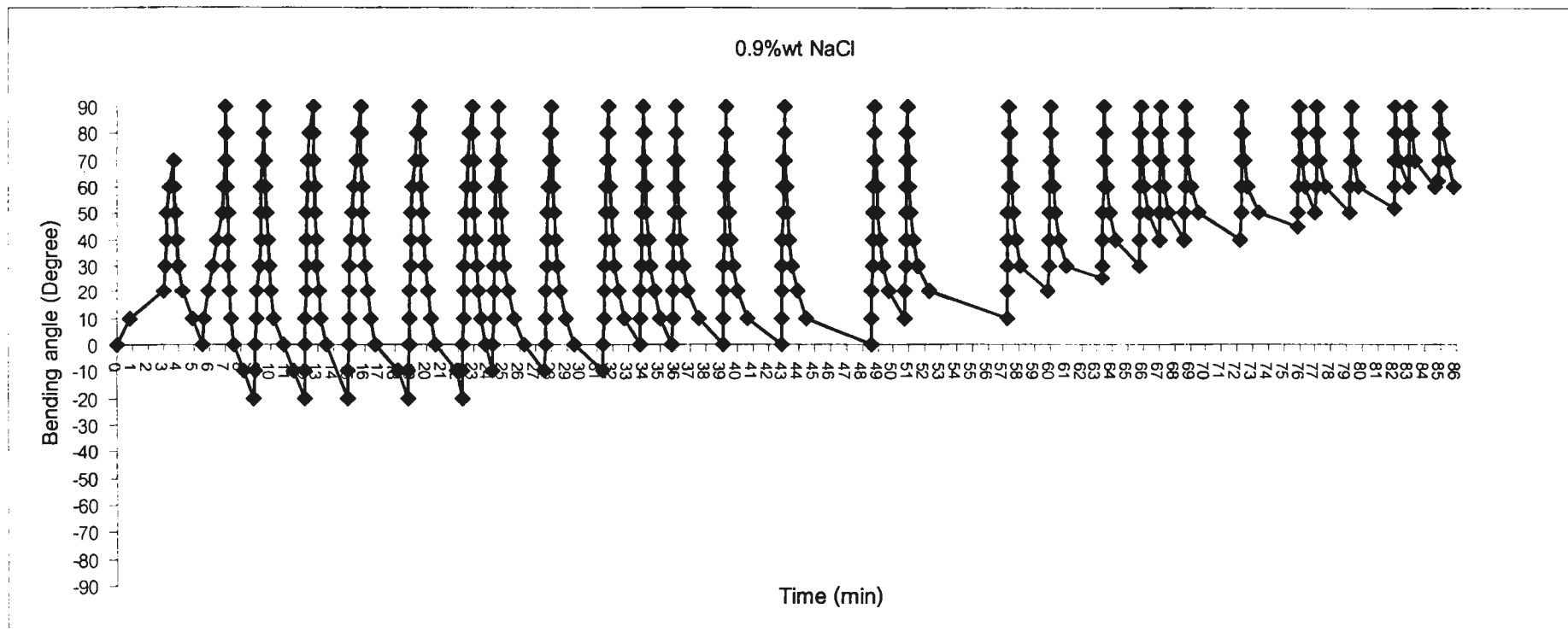


Figure B2 Effect of 0.9% (w/w) NaCl solution on the bending angle at a constant 25 V voltage

The bending behavior of 0.3% (w/w) barakol-CS/PAA hydrogel films crosslinked with 1% glutaraldehyde under 25 V electric fields

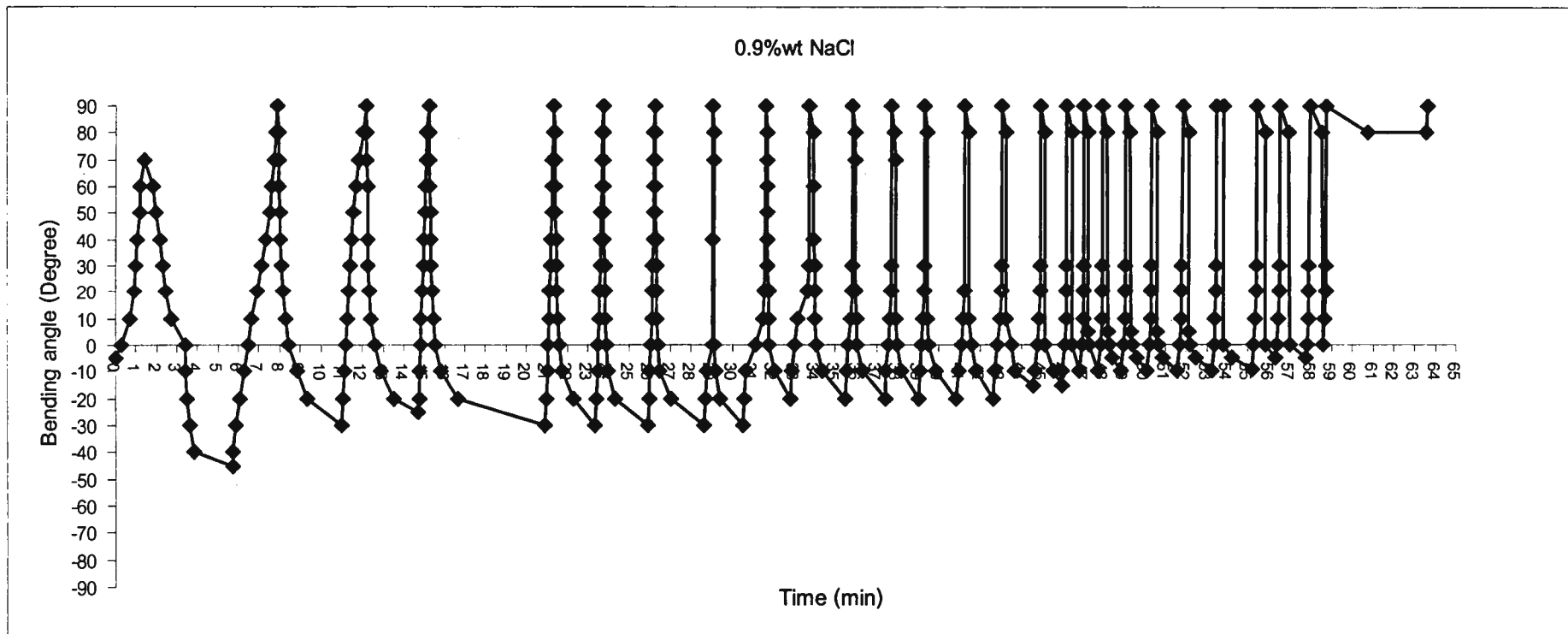


Figure B3 Effect of 0.9% (w/w) NaCl solution on the bending angle at a constant 25 V voltage

VITA

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