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APPENDICES

Appendix A Tensile Properties and Tear Strength of Pure PP and PP Nanocomposite Films

Table A1 Film thickness of pure PP, PP/Surlyn, and PP nanocomposite films for tensile tests

Sample	Thickness (mm)	
	machine direction	transverse direction
Neat PP	0.032	0.025
PP/Surlyn	0.045	0.044
PP/OBEN	0.045	0.041
PP/OBEN-Cu5	0.055	0.054
PP/OBEN-Cu10	0.048	0.050
PP/OBEN-Cu15	0.044	0.045
PP/OBEN-Cu20	0.052	0.050

Table A2 Tensile strength of pure PP, PP/Surlyn, and PP nanocomposite films

Sample	Tensile strength (MPa)			
	machine direction		transverse direction	
	average	S.D.	average	S.D.
Neat PP	37.6	4.95	26.4	3.08
PP/Surlyn	32.2	2.91	26.3	2.43
PP/OBEN	26.4	2.89	20.6	3.36
PP/OBEN-Cu5	22.2	1.05	22.0	1.17
PP/OBEN-Cu10	26.8	2.88	21.1	3.48
PP/OBEN-Cu15	30.3	3.85	22.1	1.55
PP/OBEN-Cu20	29.7	1.35	22.6	2.45

Table A3 Percentage of elongation at break of of pure PP, PP/Surlyn, and PP nanocomposite films

Sample	% Elongation at break			
	machine direction		transverse direction	
	average	S.D.	average	S.D.
Neat PP	400	44.27	320	10.29
PP/Surlyn	360	37.01	340	40.60
PP/OBEN	340	17.60	290	34.48
PP/OBEN-Cu5	280	27.02	320	15.67
PP/OBEN-Cu10	330	37.27	320	24.86
PP/OBEN-Cu15	310	14.39	290	19.03
PP/OBEN-Cu20	340	10.91	290	34.15

Table A4 Film thickness of of pure PP, PP/Surlyn, and PP nanocomposite films for tear tests

Sample	Thickness (mm)	
	machine direction	transverse direction
Neat PP	0.029	0.027
PP/Surlyn	0.047	0.047
PP/OBEN	0.038	0.035
PP/OBEN-Cu5	0.059	0.054
PP/OBEN-Cu10	0.057	0.053
PP/OBEN-Cu15	0.050	0.048
PP/OBEN-Cu20	0.050	0.050

Table A5 Maximum load of of pure PP, PP/Surlyn, and PP nanocomposite films

Sample	Maximum Load (kgf)			
	machine direction		transverse direction	
	average	S.D.	average	S.D.
Neat PP	0.197	0.029	0.246	0.021
PP/Surlyn	0.339	0.063	0.423	0.062
PP/OBEN	0.249	0.050	0.318	0.045
PP/OBEN-Cu5	0.378	0.077	0.456	0.049
PP/OBEN-Cu10	0.338	0.039	0.384	0.050
PP/OBEN-Cu15	0.352	0.061	0.414	0.047
PP/OBEN-Cu20	0.374	0.083	0.439	0.087

Table A6 Tear strength at maximum load of of pure PP, PP/Surlyn, and PP nanocomposite films

Sample	Tear strength at maximun Load (kgf/cm^2)			
	machine direction		transverse direction	
	average	S.D.	average	S.D.
Neat PP	27.185	1.260	35.343	1.261
PP/Surlyn	28.484	2.777	35.290	3.214
PP/OBEN	25.523	2.468	35.548	1.937
PP/OBEN-Cu5	25.017	2.892	33.717	3.317
PP/OBEN-Cu10	23.394	1.709	28.612	1.845
PP/OBEN-Cu15	27.545	3.109	34.391	3.451
PP/OBEN-Cu20	29.850	3.099	34.875	5.761

Appendix B TVBN Results

Table B1 TVBN results

Hours	0.01 HCl (ml)	TVB-N (mg/100g)
0	0.15	10.08
3	0.20	13.44
6	0.20	13.44
9	0.60	40.32
12	0.80	53.76
15	1.00	67.20
18	1.00	67.20
21	1.00	67.20
24	1.00	67.20

Appendix C Colour (in Lab system) of MGT/EVA films in the ammonia sensing test and fish spoilage test

Table C1 Colour (in Lab system) of 2 wt% MGT/EVA films in the ammonia sensing test

Sample No.	ammonia concentration (mg/ml)	pH	Before immersed in ammonia solution				After immersed in ammonia solution (14 hours)				Delta C	Avg. Delta C	Delta L	Avg. Delta L
			L	a	b	C	L	a	b	C				
1	distilled water	7.30	39.9	-0.5	0.0	0.50	40.3	-0.5	-0.1	0.51	0.01	0.203	0.4	0.333
			39.7	-0.4	0.1	0.41	40.0	-0.6	0.0	0.60	0.19		0.3	
			39.6	-0.3	0.1	0.32	39.9	-0.7	-0.2	0.73	0.41		0.3	
2	5	11.26	40.0	-0.2	-0.1	0.22	40.8	-0.4	0.2	0.45	0.22	0.332	0.8	0.700
			40.2	-0.2	0.0	0.20	40.9	-0.4	0.4	0.57	0.37		0.7	
			39.7	-0.4	0.0	0.40	40.3	-0.7	0.4	0.81	0.41		0.6	
3	10	11.37	39.5	-0.6	0.2	0.63	40.2	-0.7	0.6	0.92	0.29	0.368	0.7	0.833
			39.6	-0.3	0.0	0.30	40.5	-0.7	0.4	0.81	0.51		0.9	
			39.6	-0.4	-0.1	0.41	40.5	-0.6	0.4	0.72	0.31		0.9	
4	15	11.40	39.6	-0.5	-0.1	0.51	40.5	-0.7	0.3	0.76	0.25	0.341	0.9	0.900
			39.7	-0.3	0.2	0.36	40.7	-0.6	0.5	0.78	0.42		1.0	
			39.8	-0.5	0.1	0.51	40.6	-0.7	0.5	0.86	0.35		0.8	
5	20	11.40	40.2	-0.3	-0.1	0.32	41.1	-0.5	0.4	0.64	0.32	0.371	0.9	0.567

Sample No.	ammonia concentration (mg/ml)	pH	Before immersed in ammonia solution				After immersed in ammonia solution (14 hours)				Delta C	Avg. Delta C	Delta L	Avg. Delta L
			L	a	b	C	L	a	b	C				
			40.1	-0.4	0.1	0.41	40.9	-0.6	0.5	0.78	0.37		0.8	
			40.0	-0.3	0.0	0.30	40.0	-0.6	0.4	0.72	0.42		0.0	
6	25	11.41	40.2	-0.3	0.3	0.42	40.4	-0.7	0.4	0.81	0.38		0.2	
			39.9	-0.2	0.1	0.22	40.4	-0.5	0.5	0.71	0.48	0.470	0.5	0.367
			40.1	-0.3	0.1	0.32	40.5	-0.7	0.5	0.86	0.54		0.4	
7	30	11.40	39.7	-0.2	0.0	0.20	41.0	-0.6	0.6	0.85	0.65		1.3	
			39.7	-0.5	0.1	0.51	40.5	-0.7	0.6	0.92	0.41	0.491	0.8	1.067
			39.3	-0.5	0.1	0.51	40.4	-0.7	0.6	0.92	0.41		1.1	
8	35	11.41	40.2	-0.4	-0.2	0.45	40.5	-0.5	0.7	0.86	0.41		0.3	
			40.1	-0.2	-0.1	0.22	40.9	-0.5	0.4	0.64	0.42	0.426	0.8	0.667
			39.9	-0.4	0.1	0.41	40.8	-0.7	0.5	0.86	0.45		0.9	

Table C2 Colour (in Lab system) of 4 wt% MGT/EVA films in the ammonia sensing test

Sample No.	ammonia concentration (mg/ml)	pH	Before immersed in ammonia solution				After immersed in ammonia solution (14 hours)				Delta C	Avg. Delta C	Delta L	Avg. Delta L
			L	a	b	C	L	a	b	C				
1	distilled water	11.26	40.1	-1.2	-1.1	1.63	40.9	-1.0	-0.7	1.22	-0.41	0.167	0.8	0.367
			40.1	-1.1	-0.4	1.17	40.2	-1.0	-0.4	1.08	-0.09		0.1	
			40.1	-1.1	-0.4	1.17	40.3	-1.1	-0.4	1.17	0.00		0.2	
2	5	11.37	40.3	-1.1	-0.6	1.25	40.7	-1.1	-0.7	1.30	0.05	0.106	0.4	0.300
			40.2	-1.2	-0.6	1.34	40.2	-1.0	-0.6	1.17	-0.18		0.0	
			39.7	-1.1	-0.8	1.36	40.2	-1.0	-0.6	1.17	-0.19		0.5	
3	10	11.40	39.8	-1.2	-0.5	1.30	40.0	-1.0	-0.4	1.08	-0.22	0.123	0.2	0.333
			40.0	-1.4	-0.5	1.49	40.3	-1.2	-0.6	1.34	-0.14		0.3	
			39.9	-1.2	-0.7	1.39	40.4	-1.2	-0.7	1.39	0.00		0.5	
4	15	11.40	39.9	-1.2	-0.4	1.26	40.4	-1.1	-0.4	1.17	-0.09	0.022	0.5	0.433
			40.0	-1.1	-0.4	1.17	40.3	-1.1	-0.4	1.17	0.00		0.3	
			39.8	-1.2	-0.3	1.24	40.3	-1.2	-0.4	1.26	0.03		0.5	
5	20	11.41	40.2	-1.1	-0.7	1.30	40.4	-1.1	-0.6	1.25	-0.05	0.037	0.2	0.133
			40.4	-1.0	-0.8	1.28	40.5	-1.0	-0.7	1.22	-0.06		0.1	
			40.5	-1.1	-0.6	1.25	40.6	-1.1	-0.6	1.25	0.00		0.1	

Sample No.	ammonia concentration (mg/ml)	pH	Before immersed in ammonia solution				After immersed in ammonia solution (14 hours)				Delta C	Avg. Delta C	Delta L	Avg. Delta L
			L	a	b	C	L	a	b	C				
6	25	11.40	39.9	-1.1	-0.6	1.25	40.2	-1.1	-0.6	1.25	0.00	0.075	0.3	0.367
			40.0	-1.3	-0.5	1.39	40.3	-1.2	-0.6	1.34	-0.05		0.3	
			39.8	-1.3	-0.7	1.48	40.3	-1.1	-0.7	1.30	-0.17		0.5	
7	30	11.41	39.9	-1.1	-0.4	1.17	40.3	-1.1	-0.6	1.25	0.08	0.012	0.4	0.500
			40.0	-1.2	-0.7	1.39	40.4	-1.2	-0.7	1.39	0.00		0.4	
			40.1	-1.2	-0.7	1.39	40.8	-1.2	-0.6	1.34	-0.05		0.7	
8	35	7.30	39.8	-1.2	-0.5	1.30	40.1	-1.1	-0.4	1.17	-0.13	0.134	0.3	0.367
			40.0	-1.2	-0.6	1.34	40.4	-1.1	-0.5	1.21	-0.13		0.4	
			40.2	-1.3	-1.0	1.64	40.6	-1.2	-0.9	1.50	-0.14		0.4	

Table C3 Colour (in Lab system) of 6 wt% MGT/EVA films in the ammonia sensing test

Sample No.	ammonia concentration (mg/ml)	pH	Before immersed in ammonia solution				After immersed in ammonia solution (14 hours)				Delta C	Avg. Delta C	Delta L	Avg. Delta L
			L	a	b	C	L	a	b	C				
1	distilled water	11.26	39.8	-0.4	0.8	0.89	40.7	-0.7	0.6	0.92	0.03	0.974	0.9	0.933
			39.8	-0.3	1.0	1.04	40.7	-0.6	0.8	1.00	0.04		0.9	
			40.3	-0.3	0.8	0.85	41.3	-0.6	0.8	1.00	0.15		1.0	
2	5	11.37	40.4	0.0	0.6	0.60	43.5	-0.6	1.3	1.43	0.83	1.555	3.1	3.033
			40.1	-0.3	0.5	0.58	43.1	-0.5	1.4	1.49	0.90		3.0	
			39.6	-0.5	0.6	0.78	42.6	-0.4	1.7	1.75	0.97		3.0	
3	10	11.40	40.2	0.0	0.3	0.30	43.6	-0.6	1.6	1.71	1.41	1.632	3.4	3.033
			40.1	-0.2	0.3	0.36	43.3	-0.6	1.4	1.52	1.16		3.2	
			39.8	-0.6	0.2	0.63	42.3	-0.9	1.4	1.66	1.03		2.5	
4	15	11.40	40.5	-0.3	0.4	0.50	44.3	-0.9	1.4	1.66	1.16	1.693	3.8	3.433
			39.9	-0.5	0.5	0.71	43.9	-0.9	1.5	1.75	1.04		4.0	
			40.5	-0.5	0.5	0.71	43.0	-0.9	1.4	1.66	0.96		2.5	
5	20	11.41	40.5	-0.1	0.5	0.51	44.4	-0.7	1.5	1.66	1.15	1.514	3.9	4.033
			40.0	-0.2	0.7	0.73	44.2	-0.8	1.3	1.53	0.80		4.2	
			40.7	-0.3	0.5	0.58	44.7	-0.8	1.1	1.36	0.78		4.0	

Sample No.	ammonia concentration (mg/ml)	pH	Before immersed in ammonia solution				After immersed in ammonia solution (14 hours)				Delta C	Avg. Delta C	Delta L	Avg. Delta L
			L	a	b	C	L	a	b	C				
6	25	11.40	40.4	0.2	0.6	0.63	44.8	-0.9	1.0	1.35	0.71	1.274	4.4	4.300
			40.3	0.0	0.5	0.50	44.7	-0.9	0.9	1.27	0.77		4.4	
			40.4	0.1	0.7	0.71	44.5	-0.9	0.8	1.20	0.50		4.1	
7	30	11.41	39.8	-0.2	0.8	0.82	43.8	-0.9	1.1	1.42	0.60	1.644	4.0	3.867
			39.8	-0.2	0.8	0.82	43.9	-1.0	1.4	1.72	0.90		4.1	
			39.9	-0.2	0.8	0.82	43.4	-0.8	1.6	1.79	0.96		3.5	
8	35	7.30	39.9	-0.2	0.6	0.63	42.5	-0.8	1.8	1.97	1.34	1.985	2.6	3.000
			40.2	-0.1	0.6	0.61	43.6	-0.9	1.7	1.92	1.32		3.4	
			40.1	-0.2	0.6	0.63	43.1	-0.8	1.9	2.06	1.43		3.0	

Table C4 Colour (in Lab system) of 4 wt% MGT/EVA films in the fish spoilage test

Sample No.	Time	Before contacted to fresh fish meat				After contacted to spoilage fish meat				Delta C	Avg. Delta C	Delta L	Avg. Delta L
		L	a	b	C	L	a	b	C				
1	3	40.0	-0.3	1.1	1.14	40.5	-0.3	1.0	1.04	0.10	0.071	0.5	0.367
		39.8	-0.3	0.9	0.95	40.2	-0.4	0.8	0.89	0.05		0.4	
		40.1	-0.4	0.9	0.98	40.3	-0.6	0.7	0.92	0.06		0.2	
2	6	39.7	-0.3	1.3	1.33	39.8	-0.5	1.1	1.21	0.13	0.127	0.1	0.067
		40.1	-0.3	1.1	1.14	40.0	-0.6	0.9	1.08	0.06		0.1	
		40.0	-0.3	1.1	1.14	40.0	-0.5	0.8	0.94	0.20		0.0	
3	9	40.1	-0.6	0.9	1.08	40.4	-0.7	0.7	0.99	0.09	0.167	0.3	0.567
		39.6	-0.5	1.3	1.39	40.2	-0.5	1.0	1.12	0.27		0.6	
		39.6	-0.6	1.1	1.25	40.4	-0.5	1.0	1.12	0.13		0.8	
4	12	39.5	-0.5	1.4	1.49	39.8	-0.8	1.0	1.28	0.21	0.217	0.3	0.200
		39.6	-0.5	1.3	1.39	39.7	-0.6	1.0	1.17	0.23		0.1	
		39.7	-0.5	1.2	1.30	39.5	-0.6	0.9	1.08	0.22		0.2	
8	20	39.7	-0.5	1.0	1.12	40.8	-0.5	0.8	0.94	0.17	0.252	1.1	0.667
		39.6	-0.5	1.2	1.30	40.4	-0.4	0.8	0.89	0.41		0.8	
		39.9	-0.6	1.2	1.34	40.0	-0.6	1.0	1.17	0.18		0.1	

ต้นฉบับ หน้าขาดหาย

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Proceedings:

1. Naneraksa P., Magaraphan R. (2012, April 2-4) Blown films of nanocomposites prepared from organoclay/copper-nanoparticle polypropylene. Proceedings of the ANTEC@NPE 2012, Orlando, Florida, USA.

2. Naneraksa, P.; and Magaraphan, R. (2012, April 24) Smart packaging from plastic/nanocopper nanocomposite. Proceedings of the 3rd Research Symposium on Petrochemical, and Materials Technology and the 18th PPC Symposium on Petroleum, Petrochemicals, and Polymers, Bangkok, Thailand.

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