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APPENDICES

Appendix A: Data Sheet of Polymer and Compatibilizer

Table A1 Datasheet of Wonderlite PC110 from CHIMEI 奇美實業股份有限公司 CHI MEI CORPORATION

Physical	**Nominal Value**	**Unit**	**Test Method**
Melt Flow Index (300°C, 1.2 kg)	10	g/10 min	ASTM D1238
Specific Gravity (Density) 23/23°C	1.20	-	ASTM D792
Water Absorption (immersion) 24hr at 23°C	0.20	%	ASTM D570
Mold Shrinkage (parallel)	0.5-0.7	%	ASTM D955
Mold Shrinkage (across)	0.5-0.7	%	ASTM D955

Mechanical	**Nominal Value**	**Unit**	**Test Method**
Tensile Strength at yield (23°C)	61.80	MPa	ASTM D638
Tensile Elongation at yield (23°C)	6.0	%	ASTM D638
Tensile Elongation at break (23°C)	110	%	ASTM D638
Flexural Strength (23°C)	90.25	MPa	ASTM D790
Flexural Modulus (23°C)	2354.4	MPa	ASTM D790
Izod Impact Strength (Notched) 0.125 in	853.47	J/m	ASTM D256
Izod Impact Strength (Notched) 0.250 in	147.15	J/m	ASTM D256
Compressive Strength	76.52	MPa	ASTM D695

Hardness	**Nominal Value**	**Unit**	**Test Method**
Rockwell Hardness	M-77	M scale	ASTM D785

Thermal	**Nominal Value**	**Unit**	**Test Method**
HDT 4.6 kg/cm^2, 120°C/hr (unannealed)	136	°C	ASTM D648
HDT 18.6 kg/cm^2, 120°C/hr (unannealed)	125	°C	ASTM D648
Vicat Softening Temperature (1 Kg. 50°C/hr)	150	°C	ASTM D1525
Coefficient of Linear Expansion (40~100°C)	6~8	x10^{-5}cm/cm/°C	ASTM D696
Thermal Conductivity	0.2	W/m°C	ASTM C177

Electrical	**Nominal Value**	**Unit**	**Test Method**
Volume Resistivity	3	x10^{16} Ω.cm	ASTM D257
Dielectric Constant 60 Hz	2.95	-	ASTM D150
Dielectric Constant 10^6 Hz	2.9	-	ASTM D150
Dielectric Dissipation Factor (tan δ) 60 Hz	0.0004	-	ASTM D150
Dielectric Dissipation Factor (tan δ) 10^6 Hz	0.009	-	ASTM D150
Dielectric Breakdown Strength (1.6 mm)	30	kV/mm	ASTM D149
Arc Resistance (Tungsten electrode)	110	sec	ASTM D495

Flammability	**Nominal Value**	**Unit**	**Test Method**
Flame Rating (2.5 mm)	V-2	-	UL 94

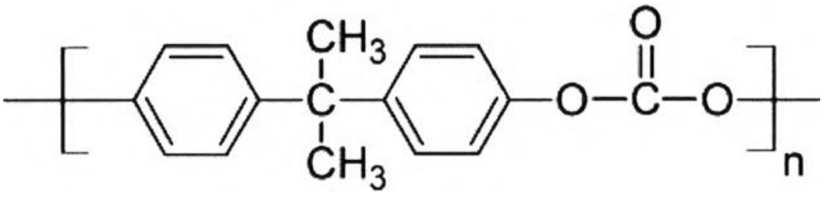

Figure A1 Polycarbonate structure.

Table A2 Datasheet of NATUREWORK PLA 3052D from NatureWorks LLC

Physical	Nominal Value	Unit	Test Method
Melt Mass-Flow Rate (MFR) (190°C, 2.16 kg)	18	g/10 min	ASTM D1238
Specific gravity	1.25	g/cm^3	ASTM D792

Mechanical	Nominal Value	Unit	Test Method
Tensile Strength (Yield)	48.3	MPa	ASTM D638
Tensile Elongation (Yield)	2.5	%	ASTM D638
Flexural Modulus	3830	MPa	ASTM D790
Flexural Strength	82.7	MPa	ASTM D790
Notched Izod Impact	16	J/m	ASTM D256

Thermal	Nominal Value	Unit	Test Method
Melting Temperature	160	°C	DSC

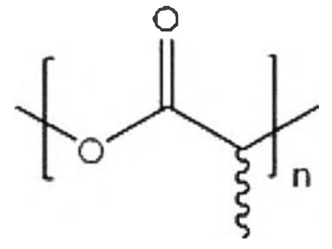

Figure A2 Polylactic acid structure.

Table A3 Datasheet of Dibutytin oxide (DBTO) from Sigma Aldrich

Typical Characteristics	
Composition	98% By Weight DBTO
Formula weight	248.94 g/mol
Appearances	White
Form	powder

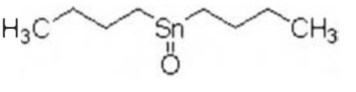

Figure A3 DBTO structure.

Table A4 Datasheet of Poly(ethylene-co-acrylic acid) (EAA) from Sigma Aldrich

Typical Characteristics	
Composition	15% By Weight acrylic acid
Acid Value	112 – 130 mg KOH/g
Appearances	Clear
Form	Beads

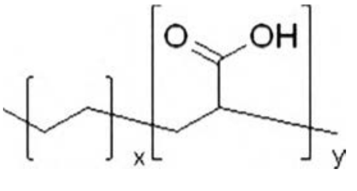

Figure A4 EAA structure.

Table A5 Datasheet of Lysine triisocyanate from Yick-Vic chemicals & pharmaceuticals (H. K.) L.td.

Typical Characteristics	
Composition	80% By Weight Lysin triisocyanate
Appearances	Dark brown
Form	Liquids

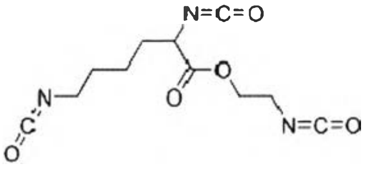

Figure A5 LTI structure.

Table A6 Datasheet of Poly(styrene-co-glycidyl methacrylate) (PS-g-GMA) from O-BASF the chemical company

Typical Characteristics	
Specific gravity	1.08 g/cm^3
Appearances	Clear
Form	Solid flake
M_w	6800
T_g	54 °C
Epoxy equivalent weight	285 g/mol

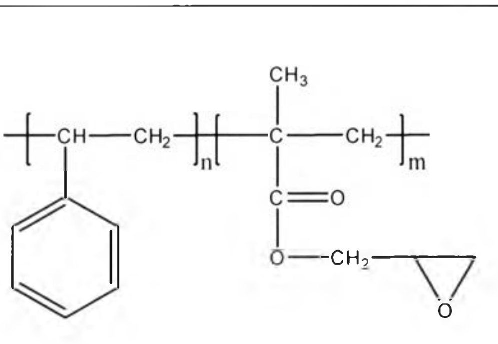

Figure A5 PS-g-GMA structure.

Appendix B: The properties of PC/PLA blends

Table B1 Melt Flow Index of PC, PLA and uncompatibilized PC/PLA alloys

Formulations	MFI (g/10min)
PC	3 ± 0.1
PLA	82.7 ± 2.3
PC90	7.1 ± 0.4
PC80	18.2 ± 0.3
PC70	26.2 ± 0.9
PC60	33.1 ± 1.0
PC50	60 ± 0.3
PC70E1	24.5 ± 0.05
PC70E3	31.3 ± 0.06
PC70E5	43.8 ± 0.15
PC70D0.01	42.9 ± 1.7
PC70D0.05	105.5 ± 4.4
PC70D0.1	140.6 ± 3.9
PC70E1D0.01	30.2 ± 1.5
PC70E1D0.05	31.3 ± 2.6
PC70E1D0.1	36.2 ± 0.2
PC70L0.1	8.8 ± 0.29
PC70L0.5	7.5 ± 0.17
PC70L1	6.8 ± 0.46
PC70L3	4.0 ± 0.27
PC70G0.25	4.0 ± 0.17
PC70G0.5	3.7 ± 0.15
PC70G0.75	3.6 ± 0.09
PC70G1	3.9 ± 0.34

Table B2 Specific gravity of PC/PLA blends

Formulations	Specific gravity (g/cc)
PC	1.205 ± 0.033
PC90	1.123 ± 0.010
PC80	1.188 ± 0.019
PC70	1.231 ± 0.089
PC60	1.242 ± 0.077
PC50	1.253 ± 0.085
PLA	1.282 ± 0.028
PC70E1	1.228 ± 0.004
PC70E3	1.232 ± 0.006
PC70E5	1.141 ± 0.014
PC70D0.01	1.192 ± 0.026
PC70D0.05	1.172 ± 0.025
PC70D0.1	1.144 ± 0.012
PC70E1D0.01	1.192 ± 0.021
PC70E1D0.05	1.072 ± 0.011
PC70E1D0.1	1.168 ± 0.003
PC70L0.1	1.206 ± 0.004
PC70L0.5	1.210 ± 0.003
PC70L1	1.212 ± 0.004
PC70L3	1.098 ± 0.047
PC70G0.25	1.220 ± 0.066
PC70G0.5	1.209 ± 0.001
PC70G0.75	1.204 ± 0.105
PC70G1	1.205 ± 0.003

Table B3 TGA results of PC/PLA blends

Formulations	T_d(°C)	% Weight loss
PC	498.6	76.2
PC90	355.3, 474.8	15.2, 66.8
PC80	329.2, 461.6	45.6, 44.3
PC70	348, 451.3	38.5, 51.6
PC60	348.3	90.5
PC50	350.8	93.5
PC70E1	350, 553	85, 15
PC70E3	346, 553	83, 17
PC70E5	336, 538	76, 24
PC70D0.01	321, 446	41.5, 45.6
PC70D0.05	316, 440	39.4, 48.6
PC70D0.1	290, 430	36.1, 49.5
PC70E1D0.01	340, 540	84.9, 15.0
PC70E1D0.05	323, 533	48.9, 50.2
PC70E1D0.1	310, 522	83.9, 15.5
PC70L0.1	352.9, 469.9	46.9, 39.7
PC70L0.5	340.1	93.8
PC70L1	343.4	90.7
PC70L3	345.5	92.2
PC70G0.25	352, 456	66.0, 29.8
PC70G0.5	347, 461	59.2, 30.2
PC70G0.75	351, 442	74.1, 14.2
PC70G1	349, 453	65.1, 26.1

Table B4 Tensile testing results of PC, PLA, and uncompatibilized PC/PLA blends

Formulations	Tensile Strength at yield (MPa)	Modulus (MPa)
PC	62.0 ± 0.3	2367 ± 133
PC90	63.6 ± 0.3	3133 ± 129
PC80	64.6 ± 0.5	3348 ± 105
PC70	66.3 ± 0.4	3585 ± 149
PC60	66.2 ± 0.3	3732 ± 135
PC50	65.1 ± 0.5	4043 ± 201
PLA	62.7 ± 0.4	4418 ± 185
PC70E1	64.1 ± 0.2	6384 ± 410
PC70E3	60.4 ± 0.6	4302 ± 360
PC70E5	51.4 ± 1.9	3423 ± 820
PC70D0.01	35.2 ± 0.9	3298 ± 350
PC70D0.05	31.5 ± 2.0	3760 ± 400
PC70D0.1	62.8 ± 0.3	5278 ± 406
PC70E1D0.01	63.6 ± 0.8	4026 ± 620
PC70E1D0.05	62.8 ± 1.1	4538 ± 366
PC70E1D0.1	60.2 ± 0.6	5449 ± 678
PC70L0.1	66.6 ± 0.5	2,713 ± 57
PC70L0.5	65.6 ± 1.1	2,685 ± 65
PC70L1	69.0 ± 0.2	2,747 ± 123
PC70L3	67.4 ± 0.8	2,710 ± 106
PC70G0.25	66.8 ± 0.7	3,060 ± 211
PC70G0.5	66.1 ± 0.7	2,842 ± 122
PC70G0.75	66.4 ± 0.7	2,989.04 ± 200
PC70G1	67.0 ± 0.5	3,016.95 ± 251

Table B5 Flexural testing results of PC/PLA blends

Formulations	Flexural Strength (MPa)	Flexural Modulus (MPa)
PC	93.4 ± 0.5	2482 ± 27
PC90	95.9 ± 0.7	2665 ± 28
PC80	96.9 ± 0.2	2786 ± 33
PC70	97.2 ± 3.8	2860 ± 103
PC60	84.2 ± 6.4	2948 ± 55
PC50	74.7 ± 13.3	3131 ± 21
PLA	97.4 ± 3.6	3502 ± 102
PC70E1	94.7 ± 1.0	2161 ± 38
PC70E3	86.2 ± 6.2	2662 ± 28
PC70E5	69.1 ± 4.9	2501 ± 42
PC70D0.01	53.7 ± 5.9	2792 ± 95
PC70D0.05	47.3 ± 4.1	2890 ± 70
PC70D0.1	92.8 ± 2.3	2678 ± 185
PC70E1D0.01	90.9 ± 0.9	2585 ± 51
PC70E1D0.05	94.7 ± 0.8	2711 ± 51
PC70E1D0.1	84.0 ± 6.4	2743 ± 37
PC70L0.1	106.8 ± 0.5	2,443.99 ± 86
PC70L0.5	104.9 ± 1.4	2,968.39 ± 65
PC70L1	109.8 ± 0.8	2,951.14 ± 47
PC70L3	108.5 ± 0.9	2,896.46 ± 49
PC70G0.25	104.97 ± 1.5	2,893.60 ± 54
PC70G0.5	103.65 ± 1	2,879.23 ± 52
PC70G0.75	103.43 ± 1.1	2,879.76 ± 40
PC70G1	106.59 ± 1	2,802.84 ± 134

Table B6 Notched izod impact of PC/PLA blends

Formulations	Notched Izod Impact Strength (kJ/m^2)
PC	80.6 ± 1.9
PC90	90 ± 4.2
PC80	15.7 ± 2.1
PC70	11.4 ± 2.0
PC60	6.7 ± 0.6
PC50	9.1 ± 2.2
PLA	8.4 ± 1.2
PC70E1	36.2 ± 5.2
PC70E3	26.1 ± 3.0
PC70E5	12.8 ± 1.1
PC70D0.01	7.6 ± 0.1
PC70D0.05	7.8 ± 0.8
PC70D0.1	5.6 ± 0.1
PC70E1D0.01	23.0 ± 1.1
PC70E1D0.05	10.7 ± 0.3
PC70E1D0.1	10.8 ± 0.5
PC70L0.1	14.7 ± 2.5
PC70L0.5	18.0 ± 2.7
PC70L1	16.8 ± 1.4
PC70L3	9.7 ± 1.1
PC70G0.25	80.6 ± 10.7
PC70G0.5	88.0 ± 15.1
PC70G0.75	82.6 ± 20.7
PC70G1	79.0 ± 30

Appendix C: Heat distortion temperature (HDT) of the selected PC/PLA blends

Table C1 HDT of the selected PC/PLA blends

Formulations	HDT (°C)
PC70	76.2 ± 2
PC70E1	70.5 ± 5.3
PC70L0.1	80.8 ± 5
PC70G0.5	112.9 ± 2.2

Appendix D: weather ability of the selected PC/PLA blends

Table D1 Young's and flexural modulus of the selected PC/PLA blends

Formulations	Young's modulus (MPa)	Flexural Modulus (MPa)
PC70	2971 ± 101	935 ± 59
PC70E1	3047 ± 231	898 ± 57
PC70L0.1	3243 ± 474	1004 ± 146
PC70G0.5	2785 ± 131	948 ± 45

Table D2 Notched izod impact of the selected PC/PLA blends

Formulations	Notched Izod Impact Strength (kJ/m^2)
PC70	4.9 ± 0.9
PC70E1	10.2 ± 1
PC70L0.1	9.3 ± 2.7
PC70G0.5	79 ± 8.8

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Proceedings:

1. Thissina, S.; Sornthummalee, P.; and Manuspiya, H. (2013, April 23) The PC/PLA Blends with Reactive Compatibilizers: Molecular Weight Distribution and Mechanical Properties. Proceeding of the 4th Research Symposium on Petroleum, Petrochemicals, and Advanced Materials and the 19th PPC Symposium on Petroleum, Petrochemicals, and Polymers, Bangkok, Thailand.

Presentations:

1. Thissina, S.; Sornthummalee, P.; and Manuspiya, H. (2013, May 21) The Influence of Reactive Compatibilizers on Morphology and Molecular Weight of PC/PLA Blends. Paper presented at Third International Symposium Frontiers in Polymer Science, Sitges, Spain.
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3. Thissina, S.; Sornthummalee, P.; and Manuspiya, H. (2012, December 12) Morphology and Mechanical Properties of PC/PLA Blend with Reactive Compatibilization. Paper presented at the 28th International Conference of The Polymer Processing Society, Pattaya, Thailand.