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APPENDICES

Appendix A Mechanical property

Table A1 Tensile strength data of neat sPP and sPP compounds

Sample no.	neat	DBS-filled sPP	MDBS-filled sPP	talc-filled sPP	marl-filled sPP	TiO_2-filled sPP
1	17.7	17.6	18.3	17.4	17.1	18.3
2	18.4	17.6	17.3	17.9	17.5	18.1
3	18.4	17.8	16.9	17.1	17.1	18.4
4	17.8	18.1	17.6	17.8	17.1	18.1
5	17.4	18.4	18.1	18.5	16.8	17.5
6	17.3	17.8	17.8	17.8	17.5	18.2
7	18.1	17.9	17.6	18.8	17.5	17.9
8	17.6	17.2	17.5	18.1	17.7	18.5
9	17.0	17.7	18.2	17.8	17.9	17.7
10	17.1	17.5	18.2	17.3	18.4	17.4
Avg (Mpa)	17.7	17.8	17.7	17.9	17.5	18.0
SD	0.5	0.3	0.5	0.5	0.5	0.4

Table A2 Percentage of elongation data of neat sPP and sPP compounds

Sample no.	neat	DBS-filled sPP	MDBS-filled sPP	talc-filled sPP	marl-filled sPP	TiO_2-filled sPP
1	14.4	13.1	15.2	13.5	13.9	14.2
2	14.6	14.8	13.9	14.2	14.4	14.5
3	13.4	14.7	13.9	13.2	13.5	13.1
4	13.0	14.6	14.2	13.4	13.9	14.5
5	14.0	13.7	14.6	12.9	13.8	14.6
6	13.2	15.0	14.5	13.7	13.8	14.8
7	13.7	14.8	15.7	14.1	14.1	13.0
8	14.2	14.2	15.4	13.3	14.9	13.5
9	13.7	14.1	15.0	13.7	13.9	14.1
10	13.4	14.9	13.9	14.3	14.0	14.0
Avg (%)	13.7	14.4	14.6	13.5	14.0	14.0
SD	0.6	0.6	0.7	0.4	0.4	0.6

Table A3 Young's modulus data of neat sPP and sPP compounds

Sample no.	neat	DBS-filled sPP	MDBS-filled sPP	talc-filled sPP	marl-filled sPP	TiO_2-filled sPP
1	558.4	518.0	608.7	724.5	796.1	666.4
2	827.1	622.7	593.9	689.6	874.7	690.6
3	867.8	547.7	611.2	761.0	833.8	645.4
4	636.1	636.1	567.6	788.3	885.7	533.4
5	562.2	553.4	585.3	694.6	693.3	687.6
6	586.4	556.1	645.5	598.7	659.0	675.6
7	630.9	586.8	597.8	590.9	627.2	558.0
8	589.5	571.3	525.8	513.2	623.8	541.0
9	544.0	759.0	574.1	654.8	924.9	611.8
10	595.5	536.4	618.1	739.6	772.2	625.1
Avg (Mpa)	639.8	588.8	592.8	663.0	768.2	623.5
SD	113.7	70.3	32.6	81.2	111.7	60.6

Table A4 Impact resistance data of neat sPP and sPP compounds

Sample no.	neat	DBS-filled sPP	MDBS-filled sPP	talc-filled sPP	marl-filled sPP	TiO_2-filled sPP
1	558.4	518.0	608.7	724.5	796.1	666.4
2	827.1	622.7	593.9	689.6	874.7	690.6
3	867.8	547.7	611.2	761.0	833.8	645.4
4	636.1	636.1	567.6	788.3	885.7	533.4
5	562.2	553.4	585.3	694.6	693.3	687.6
6	586.4	556.1	645.5	598.7	659.0	675.6
7	630.9	586.8	597.8	590.9	627.2	558.0
8	589.5	571.3	525.8	513.2	623.8	541.0
9	544.0	759.0	574.1	654.8	924.9	611.8
10	595.5	536.4	618.1	739.6	772.2	625.1
Avg (J/m)	639.8	588.8	592.8	663.0	768.2	623.5
SD	113.7	70.3	32.6	81.2	111.7	60.6

Table A5 Hardness data of neat sPP and sPP compounds

Sample no.	neat	DBS-filled sPP	MDBS-filled sPP	talc-filled sPP	marl-filled sPP	TiO_2-filled sPP
1	53.8	55.7	61.4	50.6	52.2	53.4
2	64.5	58.2	58.6	57.5	60.7	61.9
3	56.3	55.5	54.6	55.0	54.4	57.5
4	59.7	53.4	60.8	55.5	52.5	53.5
5	61.0	52.6	56.8	44.2	58.4	56.6
6	57.5	58.7	57.6	52.1	55.9	53.4
7	52.3	60.2	60.5	52.1	53.4	51.5
8	55.3	58.2	57.4	54.1	62.5	59.4
9	64.9	58.2	55.9	57.4	57.1	62.0
10	56.5	55.0	58.3	53.2	64.6	55.2
Avg (scale R)	58.5	57.0	58.3	53.2	57.2	56.4
SD	4.4	2.2	2.3	3.9	4.3	3.7

Table A6 Tensile strength data of neat sPP and sPP compounds after weathering 1 month

Sample no.	neat	talc-filled sPP	marl-filled sPP	TiO_2-filled sPP
1	18.8	19.6	19.4	18.6
2	19.1	19.8	19.4	18.4
3	19.0	19.7	19.7	18.5
4	19.1	19.6	19.6	18.3
5	19.3	19.8	19.5	18.1
6	18.9	20.2	19.9	18.6
7	19.3	19.6	19.7	18.1
8	19.1	19.8	19.5	18.4
9	19.1	19.8	19.5	19.0
10	19.2	19.8	19.4	18.7
Avg (Mpa)	19.1	19.8	19.6	18.5
SD	0.2	0.2	0.2	0.3

Table A7 Percentage of elongation data of neat sPP and sPP compounds after weathering 1 month

Sample no.	neat	talc-filled sPP	marl-filled sPP	TiO_2-filled sPP
1	13.8	13.6	14.7	12.9
2	12.4	12.9	16.0	13.0
3	13.6	13.4	14.5	13.3
4	12.8	12.7	13.8	13.2
5	12.9	10.5	14.8	13.1
6	13.8	13.4	13.2	13.8
7	13.6	10.1	14.6	13.7
8	12.6	11.0	15.2	12.7
9	13.7	13.2	13.8	13.0
10	13.0	12.1	15.2	13.3
Avg (%)	13.2	12.2	14.6	13.2
SD	0.5	1.4	0.8	0.3

Table A8 Young's Modulus data of neat sPP and sPP compounds after weathering 1 month

Sample no.	neat	talc-filled sPP	marl-filled sPP	TiO_2-filled sPP
1	866.2	784.4	698.2	637.0
2	798.5	735.0	564.1	814.2
3	796.5	820.2	641.4	861.3
4	603.9	895.2	735.3	536.4
5	823.9	659.8	851.3	895.5
6	929.9	618.1	652.7	670.3
7	760.5	777.9	717.4	729.0
8	633.0	848.7	647.3	948.0
9	803.0	683.8	713.6	849.7
10	910.6	785.5	806.7	807.9
Avg (Mpa)	792.6	760.9	706.0	775.0
SD	106.2	103.3	99.3	128.7

Table A9 Impact resistance data of neat sPP and sPP compounds after weathering 1 month

Sample no.	neat	talc-filled sPP	marl-filled sPP	TiO_2-filled sPP
1	692.5	127.2	109.6	64.7
2	666.6	143.4	112.6	120.6
3	661.0	135.3	110.6	165.4
4	672.8	136.7	109.6	105.6
5	649.0	126.6	90.8	98.3
6	708.9	144.9	119.6	92.5
7	653.1	151.0	113.6	155.0
8	676.9	137.7	106.6	133.0
9	703.6	130.6	94.7	102.1
10	682.2	156.7	117.6	180.5
Avg (J/m)	676.7	139.0	108.5	126.7
SD	20.4	10.0	9.2	39.4

Table A10 Hardness data of neat sPP and sPP compounds after weathering 1 month

Sample no.	neat	talc-filled sPP	marl-filled sPP	TiO_2-filled sPP
1	70.9	67.8	65.6	69.1
2	60.5	58.3	68.7	65.8
3	58.2	50.5	69.1	70.9
4	69.1	64.7	65.6	68.0
5	68.4	69.7	61.1	60.8
6	80.3	67.7	66.8	69.4
7	67.4	60.3	54.4	69.1
8	70.0	58.3	64.2	66.4
9	59.8	58.3	61.2	66.6
10	60.9	58.5	69.4	68.9
Avg (scale R)	66.6	61.4	64.6	67.5
SD	6.8	5.9	4.7	2.8

Table A11 Tensile strength data of neat sPP and sPP compounds after weathering 3 month

Sample no.	neat	talc-filled sPP	marl-filled sPP	TiO_2-filled sPP
1	19.6	17.8	18.2	17.5
2	19.1	19.9	19.0	17.0
3	18.9	16.9	17.8	17.1
4	18.8	16.9	19.5	17.4
5	18.7	18.6	19.2	17.0
6	19.6	17.4	19.0	16.6
7	18.7	18.2	19.1	17.1
8	18.9	17.4	18.3	17.0
9	19.2	16.7	20.1	16.9
10	18.4	16.9	18.2	16.6
Avg (MPa)	19.0	17.7	18.8	17.0
SD	0.4	1.0	0.7	0.3

Table A12 Percentage of elongation data of neat sPP and sPP compounds after weathering 3 month

Sample no.	neat	talc-filled sPP	marl-filled sPP	TiO_2-filled sPP
1	13.4	9.5	13.3	13.1
2	12.7	8.2	12.9	13.0
3	14.7	7.5	13.7	12.6
4	13.0	7.0	13.2	12.8
5	13.2	8.3	13.6	12.3
6	13.9	8.7	12.0	12.9
7	13.2	6.7	12.9	12.0
8	12.8	6.8	12.3	13.4
9	14.2	7.0	14.0	12.1
10	11.4	7.1	12.5	12.2
Avg (%)	13.2	7.5	13.0	12.6
SD	0.9	1.1	0.6	0.5

Table A13 Young's modulus data of neat sPP and sPP compounds after weathering 3 month

Sample no.	neat	talc-filled sPP	marl-filled sPP	TiO_2-filled sPP
1	603.1	782.6	660.8	606.3
2	670.9	739.4	689.5	736.7
3	575.3	855.4	720.6	632.7
4	664.6	867.9	710.9	567.1
5	600.7	790.9	656.0	617.0
6	655.1	955.3	852.6	539.7
7	635.5	864.6	679.9	637.2
8	646.4	725.8	725.4	639.2
9	542.2	782.6	668.4	806.9
10	707.4	785.5	735.3	589.5
Avg (MPa)	630.1	814.0	710.5	637.2
SD	49.5	76.6	64.4	79.4

Table A14 Impact resistance data of neat sPP and sPP compounds after weathering 3 month

Sample no.	neat	talc-filled sPP	marl-filled sPP	TiO_2-filled sPP
1	415.3	56.6	51.0	76.6
2	592.1	63.3	69.3	98.0
3	606.1	68.5	90.9	68.7
4	420.2	65.4	51.0	75.1
5	553.1	56.0	49.1	87.7
6	533.1	49.8	68.5	72.2
7	552.4	42.3	83.2	62.1
8	319.9	58.6	86.2	89.2
9	456.8	55.5	75.4	51.3
10	512.4	46.0	62.5	85.3
Avg (J/m)	497.5	55.5	68.7	75.7
SD	106.5	9.1	17.0	14.4

Table A15 Hardness data of neat sPP and sPP compounds after weathering 3 month

Sample no.	neat	talc-filled sPP	marl-filled sPP	TiO_2-filled sPP
1	73.0	51.7	70.8	70.6
2	75.1	77.2	75.6	61.9
3	70.1	72.1	65.3	64.0
4	65.3	83.1	70.7	70.6
5	72.2	71.3	68.6	63.5
6	71.9	67.6	72.3	64.0
7	65.5	60.0	62.2	64.4
8	72.4	63.4	67.5	66.8
9	80.7	74.6	67.2	71.0
10	64.3	69.4	69.7	70.0
Avg (J/m)	71.1	69.0	69.0	66.7
SD	5.0	9.0	3.8	3.5

APPENDIX B Particle Size Analysis

The particle size of samples was determined by a particle size analyzer (Malvern Instrument, Masterizer X). The result of this technique is volume based and expressed in terms of equivalent spheres (Instrument Manual, 1993). A mean diameter is defined by:

$$D[M,N] = \left[\frac{\int D^M n(D)dD}{\int D^N n(D)dD}\right]^{\frac{1}{M-N}} \quad \text{(B1)}$$

$$= \left[\frac{\sum V_i d_i^{M-3}}{\sum V_i d_i^{N-3}}\right]^{\frac{1}{M-N}} \quad \text{(B2)}$$

where V_i is the relative volume in size class i with mean class diameter d_i. In this work, the mean diameter over the volume distribution, D[4,3], is reported as shown in Table B1.

Table B1 The mean diameter of organic and inorganic filler used

Filler	Particle size (μm)			Average	SD
	no.1	no.2	no.3		
DBS	25.91	27.86	26.72	26.83	1.0
MDBS	5.63	5.57	4.59	5.26	0.6
DMDBS	7.21	6.48	6.20	6.69	0.6
kaolin	13.41	15.86	16.05	15.11	1.5
talcum	13.81	14.25	13.52	13.85	1.8
marl	42.47	44.08	43.92	42.47	2.0
TiO_2	5.29	5.97	6.21	5.29	1.0
SiO_2	36.99	35.66	36.66	36.44	0.7

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