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APPENDICES

APPENDIX A

Table A.1.1 Effect of RTR content on mechanical properties of blends.

Phr of rubber Details	20					30				
	1 st	2 nd	3 rd	Avg.	SD	1 st	2 nd	3 rd	Avg.	SD
Tensile (MPa)	15.7	16.8	15.2	15.9	0.8	13.1	14.2	12.9	13.4	0.7
Elongation at break (%)	10.6	11.1	10.5	10.7	0.3	11.4	11.5	11.8	11.6	0.2
Modulus (MPa)	553.4	714.4	549.4	605.7	94.1	517.2	557.6	440.6	505.1	59.4
Impact Strength (J/m)	21.7	27.0	21.8	23.5	3.1	25.3	16.3	28.9	23.5	6.5
Phr of rubber Details	40					50				
	1 st	2 nd	3 rd	Avg.	SD	1 st	2 nd	3 rd	Avg.	SD
Tensile (MPa)	9.3	9.9	10.5	9.9	0.6	7.9	7.7	8.4	8.0	0.4
Elongation at break (%)	11.8	10.7	12.0	11.5	0.7	7.9	8.6	10.8	9.1	1.5
Modulus (MPa)	390.0	445.0	331.9	389.0	56.6	339.0	230.2	312.3	293.8	56.7
Impact Strength (J/m)	27.6	21.1	22.1	23.6	3.5	19.7	18.9	22.4	20.4	1.8

Effect of RTR content on mechanical properties of blends.



Phr of rubber Details	60					70				
	1 st	2 nd	3 rd	Avg.	SD	1 st	2 nd	3 rd	Avg.	SD
Tensile (MPa)	6.5	6.2	6.8	6.5	0.3	4.7	4.2	4.8	4.6	0.3
Elongation at break (%)	9.8	7.4	8.7	8.6	1.2	8.1	7.3	6.9	7.4	0.6
Modulus (MPa)	218.4	266.5	199.3	228.1	34.6	126.1	180.2	203.1	169.8	39.5
Impact Strength (J/m)	17.4	19.9	21.7	19.7	2.1	20.3	20.9	23.2	21.5	1.5
Phr of rubber Details	80					100				
	1 st	2 nd	3 rd	Avg.	SD	1 st	2 nd	3 rd	Avg.	SD
Tensile (MPa)	3.0	3.2	3.2	3.1	0.1	5.1	4.9	5.1	5.0	0.1
Elongation at break (%)	11.8	11.6	13.4	12.2	1.0	56.2	54.4	60.8	57.1	3.3
Modulus (MPa)	75.4	91.4	81.8	82.9	8.1	14.7	16.1	12.5	14.5	1.8
Impact Strength (J/m)	Samples could not break down					Samples could not break down				

Effect of additives on mechanical properties of blends.

POE	3 phr of additives					5 phr of additives				
	1 st	2 nd	3 rd	Avg.	SD	1 st	2 nd	3 rd	Avg.	SD
Tensile (MPa)	13.5	14.0	12.4	13.3	0.8	14.3	14.8	13.0	14.0	0.9
Elongation (%)	6.2	7.3	4.5	6.0	1.4	8.9	9.4	5.0	7.8	2.4
Modulus (MPa)	189.6	177.5	242.3	203.1	34.5	377.5	422.7	248.1	349.4	90.7
Impact Strength (J/m)	23.87	33.31	23.56	26.9	5.5	26.3	27.4	24.1	25.9	1.7
MA-g-PP	3 phr of additives					5 phr of additives				
	1 st	2 nd	3 rd	Avg.	SD	1 st	2 nd	3 rd	Avg.	SD
Tensile (MPa)	13.8	14.1	14.3	14.0	0.3	13.9	14.8	15.1	14.6	0.6
Elongation (%)	4.2	6.2	9.1	6.5	2.5	6.5	8.5	10.1	8.4	1.8
Modulus (MPa)	292.0	197.2	404.0	297.7	103.6	192.3	432.7	382.1	335.7	126.7
Impact Strength (J/m)	34.5	30.0	28.5	31.0	3.1	25.4	26.5	25.1	25.7	0.7

Effect of additives on mechanical properties of blends.

POE	7 phr of additives					9 phr of additives				
	1 st	2 nd	3 rd	Avg.	SD	1 st	2 nd	3 rd	Avg.	SD
Tensile (MPa)	14.7	13.8	14.3	14.3	0.4	14.6	15.2	15.0	15.0	0.3
Elongation (%)	9.3	8.1	9.0	8.8	0.7	7.7	8.8	11.4	9.3	1.9
Modulus (MPa)	371.5	418.7	415.3	401.8	26.3	467.4	428.1	286.1	393.9	95.4
Impact Strength (J/m)	24.3	24.8	27.7	25.6	1.8	37.9	32.4	25.7	32.0	6.1
MA-g-PP	7 phr of additives					9 phr of additives				
	1 st	2 nd	3 rd	Avg.	SD	1 st	2 nd	3 rd	Avg.	SD
Tensile (MPa)	14.8	15.5	15.0	15.1	0.4	15.6	14.9	13.7	14.8	0.9
Elongation (%)	6.0	8.3	6.3	6.9	1.2	6.6	6.3	4.3	5.7	1.3
Modulus (MPa)	217.0	456.6	201.6	291.7	143.0	205.7	209.3	287.9	234.3	46.5
Impact Strength (J/m)	32.3	24.4	31.2	29.3	4.3	28.0	21.7	25.1	24.9	3.1

Effect of virgin rubbers on mechanical properties of blends.

Details	Type of rubber	0 phr of rubber					10 phr of rubber				
		1 st	2 nd	3 rd	Avg.	SD	1 st	2 nd	3 rd	Avg.	SD
Tensile strength	EPDM	13.07	14.23	12.85	13.38	0.74	11.13	10.61	11.10	10.94	0.29
	NR	13.07	14.23	12.85	13.38	0.74	13.18	13.20	12.58	12.98	0.35
Elongation at Break (%)	EPDM	11.40	11.52	11.76	11.56	0.18	14.45	15.11	13.70	14.42	0.71
	NR	11.40	11.52	11.76	11.56	0.18	27.95	23.98	23.81	25.25	2.34
Modulus (Mpa)	EPDM	517.2	557.58	440.55	505.11	59.44	531.52	487.43	447.12	488.69	42.21
	NR	517.2	557.58	440.55	505.11	59.44	532.04	517.87	520.15	523.35	7.61
Details	Type of rubber	20 phr of rubber					30 phr of rubber				
		1 st	2 nd	3 rd	Avg.	SD	1 st	2 nd	3 rd	Avg.	SD
Tensile strength	EPDM	10.78	11.21	10.87	10.95	0.23	9.88	9.19	9.86	9.64	0.39
	NR	10.91	11.02	11.34	11.09	0.22	10.56	10.28	11.46	10.77	0.62
Elongation at Break (%)	EPDM	14.49	14.67	13.44	14.20	0.67	38.34	39.91	36.20	38.15	1.86
	NR	55.59	70.58	70.58	65.58	8.65	128.50	115.12	106.45	116.69	11.11
Modulus (Mpa)	EPDM	136.65	147.40	151.74	145.26	7.77	38.34	39.91	36.20	38.15	1.86
	NR	380.03	386.80	567.77	444.87	106.49	255.98	282.11	289.94	276.01	17.78

☐☐☐☐☐☐☐☐ Mechanical properties of reprocessed T /PP and T /PP/N blends.

Reprocessing cycle Details		Ratio of blends	1 st					2 nd				
			1 st	2 nd	3 rd	Avg.	SD	1 st	2 nd	3 rd	Avg.	SD
Tensile strength	30/70 RTR/PP		13.1	14.2	12.9	13.4	0.7	14.0	13.9	13.8	13.9	0.1
	30/70/30 RTR/PP/NR		10.6	10.3	11.5	10.8	0.6	11.0	10.9	11.0	11.0	0.1
Elongation at Break (%)	30/70 RTR/PP		11.4	11.5	11.8	11.6	0.2	10.3	11.9	10.5	10.9	0.9
	30/70/30 RTR/PP/NR		128.5	115.1	106.4	116.7	11.1	100.1	104.9	88.7	97.9	8.3
Modulus (Mpa)	30/70 RTR/PP		517.2	557.6	440.6	505.1	59.4	727.0	793.0	780.0	766.7	35.0
	30/70/30 RTR/PP/NR		256.0	282.1	289.9	276.0	17.8	271.0	280.0	275.0	275.3	4.5
Reprocessing cycle Details		Ratio of blends	3 rd					4 th				
			1 st	2 nd	3 rd	Avg.	SD	1 st	2 nd	3 rd	Avg.	SD
Tensile strength	30/70 RTR/PP		14.1	13.9	14.1	14.0	0.1	7.9	8.3	8.7	8.3	0.4
	30/70/30 RTR/PP/NR		11.0	11.5	11.4	11.3	0.3	11.7	11.3	11.4	11.5	0.2
Elongation at Break (%)	30/70 RTR/PP		11.2	10.1	10.9	10.7	0.5	4.2	3.8	4.1	4.0	0.2
	30/70/30 RTR/PP/NR		91.7	114.0	75.1	93.6	19.5	90.7	75.4	72.7	79.6	9.7
Modulus (Mpa)	30/70 RTR/PP		678.0	780.2	820.4	759.5	73.4	789.9	785.0	768.0	781.0	11.5
	30/70/30 RTR/PP/NR		248.7	285.1	267.1	267.0	18.2	314.0	295.0	285.6	298.2	14.5



1 Complex viscosity

Freq (rad/s)	Ratio of RTR/PP blends								
	100/0	80/20	70/30	60/40	50/50	40/60	30/70	20/80	0/100
1.00E-01	1.02E+06	1.39E+06	7.50E+05	5.49E+04	2.68E+04	2.52E+04	1.75E+04	1.14E+04	1.68E+03
1.58E-01	6.35E+05	9.23E+05	4.97E+05	5.53E+04	2.43E+04	2.22E+04	1.29E+04	8.76E+03	1.61E+03
2.51E-01	4.01E+05	5.99E+05	3.25E+05	4.31E+04	2.03E+04	1.72E+04	9.53E+03	6.47E+03	1.56E+03
3.98E-01	2.54E+05	3.89E+05	2.17E+05	3.23E+04	1.65E+04	1.32E+04	7.27E+03	4.94E+03	1.49E+03
6.31E-01	1.61E+05	2.54E+05	1.44E+05	2.42E+04	1.33E+04	1.02E+04	5.78E+03	3.93E+03	1.42E+03
1.00E+00	1.02E+05	1.66E+05	9.68E+04	1.82E+04	1.08E+04	8.08E+03	4.75E+03	3.24E+03	1.35E+03
1.58E+00	6.45E+04	1.09E+05	6.59E+04	1.38E+04	8.85E+03	6.55E+03	3.99E+03	2.74E+03	1.27E+03
2.51E+00	4.08E+04	7.18E+04	4.51E+04	1.07E+04	7.26E+03	5.37E+03	3.39E+03	2.34E+03	1.19E+03
3.98E+00	2.58E+04	4.77E+04	3.13E+04	8.39E+03	5.97E+03	4.42E+03	2.89E+03	2.01E+03	1.09E+03
6.31E+00	1.64E+04	3.17E+04	2.19E+04	6.57E+03	4.89E+03	3.62E+03	2.45E+03	1.72E+03	9.84E+02
1.00E+01	1.04E+04	2.11E+04	1.53E+04	5.12E+03	3.96E+03	2.94E+03	2.06E+03	1.45E+03	8.75E+02
1.58E+01	6.57E+03	1.42E+04	1.08E+04	3.98E+03	3.16E+03	2.36E+03	1.70E+03	1.21E+03	7.65E+02
2.51E+01	4.17E+03	9.51E+03	7.58E+03	3.05E+03	2.49E+03	1.87E+03	1.39E+03	9.87E+02	6.55E+02
3.98E+01	2.65E+03	6.39E+03	5.33E+03	2.31E+03	1.93E+03	1.45E+03	1.11E+03	7.94E+02	5.51E+02
6.31E+01	1.68E+03	4.29E+03	3.73E+03	1.72E+03	1.47E+03	1.11E+03	8.67E+02	6.28E+02	4.53E+02
1.00E+02	1.07E+03	2.88E+03	2.59E+03	1.27E+03	1.10E+03	8.39E+02	6.67E+02	4.87E+02	3.66E+02

 Storage modulus

Freq (rad/s)	Ratio of RTR/PP blends								
	100/0	80/20	70/30	60/40	50/50	40/60	30/70	20/80	0/100
1.00E-01	1.01E+05	1.36E+05	7.05E+04	3.16E+03	1.48E+03	2.06E+03	1.55E+03	9.84E+02	1.86E+01
1.58E-01	1.00E+05	1.44E+05	7.56E+04	5.85E+03	2.32E+03	2.94E+03	1.74E+03	1.18E+03	2.95E+01
2.51E-01	1.01E+05	1.48E+05	7.84E+04	7.51E+03	3.04E+03	3.49E+03	1.91E+03	1.29E+03	5.17E+01
3.98E-01	1.01E+05	1.52E+05	8.25E+04	9.15E+03	3.85E+03	4.01E+03	2.13E+03	1.44E+03	8.47E+01
6.31E-01	1.01E+05	1.56E+05	8.68E+04	1.09E+04	4.83E+03	4.61E+03	2.43E+03	1.64E+03	1.50E+02
1.00E+00	1.02E+05	1.62E+05	9.17E+04	1.28E+04	6.10E+03	5.47E+03	2.89E+03	1.95E+03	2.62E+02
1.58E+00	1.02E+05	1.68E+05	9.84E+04	1.52E+04	7.83E+03	6.69E+03	3.59E+03	2.44E+03	4.60E+02
2.51E+00	1.02E+05	1.75E+05	1.06E+05	1.86E+04	1.03E+04	8.45E+03	4.67E+03	3.19E+03	7.93E+02
3.98E+00	1.03E+05	1.84E+05	1.16E+05	2.30E+04	1.37E+04	1.10E+04	6.30E+03	4.32E+03	1.34E+03
6.31E+00	1.03E+05	1.93E+05	1.27E+05	2.89E+04	1.85E+04	1.45E+04	8.70E+03	6.00E+03	2.22E+03
1.00E+01	1.04E+05	2.04E+05	1.41E+05	3.66E+04	2.50E+04	1.93E+04	1.21E+04	8.40E+03	3.57E+03
1.58E+01	1.04E+05	2.17E+05	1.57E+05	4.65E+04	3.35E+04	2.55E+04	1.68E+04	1.17E+04	5.58E+03
2.51E+01	1.05E+05	2.31E+05	1.76E+05	5.86E+04	4.41E+04	3.35E+04	2.29E+04	1.61E+04	8.44E+03
3.98E+01	1.05E+05	2.46E+05	1.97E+05	7.28E+04	5.72E+04	4.31E+04	3.07E+04	2.16E+04	1.24E+04
6.31E+01	1.06E+05	2.62E+05	2.20E+05	8.91E+04	7.22E+04	5.47E+04	4.02E+04	2.86E+04	1.75E+04
1.00E+02	1.06E+05	2.80E+05	2.44E+05	1.08E+05	8.93E+04	6.78E+04	5.14E+04	3.69E+04	2.42E+04

Loss modulus.

Freq (rad/s)	Ratio of RTR/PP blends								
	100/0	80/20	70/30	60/40	50/50	40/60	30/70	20/80	0/100
1.00E-01	7.70E+03	2.94E+04	2.56E+04	4.50E+03	2.23E+03	1.46E+03	8.13E+02	5.82E+02	1.67E+02
1.58E-01	7.01E+03	2.75E+04	2.23E+04	6.53E+03	3.07E+03	1.94E+03	1.06E+03	7.33E+02	2.53E+02
2.51E-01	6.59E+03	2.89E+04	2.30E+04	7.78E+03	4.08E+03	2.57E+03	1.44E+03	9.85E+02	3.89E+02
3.98E-01	6.35E+03	3.09E+04	2.50E+04	9.05E+03	5.30E+03	3.38E+03	1.96E+03	1.34E+03	5.86E+02
6.31E-01	6.36E+03	3.35E+04	2.72E+04	1.07E+04	6.87E+03	4.47E+03	2.72E+03	1.86E+03	8.86E+02
1.00E+00	6.02E+03	3.60E+04	3.10E+04	1.29E+04	8.93E+03	5.94E+03	3.77E+03	2.59E+03	1.33E+03
1.58E+00	5.96E+03	3.91E+04	3.52E+04	1.58E+04	1.16E+04	7.93E+03	5.21E+03	3.60E+03	1.97E+03
2.51E+00	6.02E+03	4.28E+04	4.03E+04	1.96E+04	1.51E+04	1.05E+04	7.13E+03	4.95E+03	2.87E+03
3.98E+00	6.13E+03	4.62E+04	4.62E+04	2.42E+04	1.94E+04	1.37E+04	9.65E+03	6.73E+03	4.12E+03
6.31E+00	6.16E+03	4.97E+04	5.27E+04	2.97E+04	2.47E+04	1.77E+04	1.28E+04	9.01E+03	5.80E+03
1.00E+01	6.29E+03	5.35E+04	5.93E+04	3.58E+04	3.07E+04	2.22E+04	1.67E+04	1.18E+04	7.99E+03
1.58E+01	6.51E+03	5.75E+04	6.62E+04	4.26E+04	3.73E+04	2.73E+04	2.11E+04	1.51E+04	1.08E+04
2.51E+01	6.77E+03	6.10E+04	7.27E+04	4.94E+04	4.43E+04	3.28E+04	2.62E+04	1.89E+04	1.41E+04
3.98E+01	7.20E+03	6.43E+04	7.88E+04	5.60E+04	5.15E+04	3.84E+04	3.15E+04	2.30E+04	1.81E+04
6.31E+01	7.81E+03	6.72E+04	8.42E+04	6.22E+04	5.82E+04	4.42E+04	3.71E+04	2.75E+04	2.26E+04
1.00E+02	8.38E+03	6.91E+04	8.79E+04	6.74E+04	6.42E+04	4.95E+04	4.24E+04	3.19E+04	2.75E+04

APPENDIX C

Effect of virgin rubber content on properties of blends

Table C.1 Complex viscosity

Freq (rad/s)	Ratio of RTR/PP/NR blends			
	30/70/0	30/70/10	30/70/20	30/70/30
1.00E-01	1.75E+04	5.95E+04	1.30E+05	1.58E+05
1.58E-01	1.29E+04	4.35E+04	8.98E+04	1.09E+05
2.51E-01	9.53E+03	3.12E+04	6.16E+04	7.36E+04
3.98E-01	7.27E+03	2.26E+04	4.26E+04	5.00E+04
6.31E-01	5.78E+03	1.66E+04	2.97E+04	3.42E+04
1.00E+00	4.75E+03	1.24E+04	2.09E+04	2.37E+04
1.58E+00	3.99E+03	9.49E+03	1.49E+04	1.66E+04
2.51E+00	3.39E+03	7.34E+03	1.08E+04	1.17E+04
3.98E+00	2.89E+03	5.71E+03	7.95E+03	8.36E+03
6.31E+00	2.45E+03	4.46E+03	5.88E+03	6.02E+03
1.00E+01	2.06E+03	3.48E+03	4.35E+03	4.35E+03
1.58E+01	1.70E+03	2.69E+03	3.22E+03	3.15E+03
2.51E+01	1.39E+03	2.07E+03	2.38E+03	2.28E+03
3.98E+01	1.11E+03	1.57E+03	1.74E+03	1.64E+03
6.31E+01	8.67E+02	1.18E+03	1.27E+03	1.18E+03
1.00E+02	6.67E+02	8.76E+02	9.18E+02	8.37E+02

Table C.2 Storage modulus

Freq (rad/s)	Ratio of RTR/PP/NR blends			
	30/70/0	30/70/10	30/70/20	30/70/30
1.00E-01	1.55E+03	5.31E+03	1.23E+04	1.51E+04
1.58E-01	1.74E+03	6.17E+03	1.35E+04	1.65E+04
2.51E-01	1.91E+03	6.91E+03	1.46E+04	1.78E+04
3.98E-01	2.13E+03	7.74E+03	1.59E+04	1.91E+04
6.31E-01	2.43E+03	8.78E+03	1.74E+04	2.05E+04
1.00E+00	2.89E+03	1.01E+04	1.91E+04	2.23E+04
1.58E+00	3.59E+03	1.19E+04	2.13E+04	2.44E+04
2.51E+00	4.67E+03	1.43E+04	2.39E+04	2.71E+04
3.98E+00	6.30E+03	1.74E+04	2.77E+04	3.03E+04
6.31E+00	8.70E+03	2.15E+04	3.22E+04	3.43E+04
1.00E+01	1.21E+04	2.68E+04	3.77E+04	3.92E+04
1.58E+01	1.68E+04	3.34E+04	4.43E+04	4.49E+04
2.51E+01	2.29E+04	4.15E+04	5.20E+04	5.15E+04
3.98E+01	3.07E+04	5.12E+04	6.10E+04	5.91E+04
6.31E+01	4.02E+04	6.26E+04	7.14E+04	6.78E+04
1.00E+02	5.14E+04	7.52E+04	8.26E+04	7.69E+04

Table C.3 Loss modulus

Freq (rad/s)	Ratio of RTR/PP/NR blends			
	30/70/0	30/70/10	30/70/20	30/70/30
1.00E-01	8.13E+02	2.69E+03	4.32E+03	4.91E+03
1.58E-01	1.06E+03	3.09E+03	4.54E+03	4.77E+03
2.51E-01	1.44E+03	3.71E+03	5.06E+03	5.10E+03
3.98E-01	1.96E+03	4.58E+03	5.82E+03	5.79E+03
6.31E-01	2.72E+03	5.72E+03	6.99E+03	6.76E+03
1.00E+00	3.77E+03	7.24E+03	8.48E+03	8.05E+03
1.58E+00	5.21E+03	9.21E+03	1.03E+04	9.63E+03
2.51E+00	7.13E+03	1.16E+04	1.26E+04	1.15E+04
3.98E+00	9.65E+03	1.46E+04	1.53E+04	1.37E+04
6.31E+00	1.28E+04	1.81E+04	1.84E+04	1.63E+04
1.00E+01	1.67E+04	2.22E+04	2.18E+04	1.90E+04
1.58E+01	2.11E+04	2.66E+04	2.55E+04	2.19E+04
2.51E+01	2.62E+04	3.13E+04	2.93E+04	2.48E+04
3.98E+01	3.15E+04	3.60E+04	3.31E+04	2.77E+04
6.31E+01	3.71E+04	4.08E+04	3.68E+04	3.06E+04
1.00E+02	4.24E+04	4.50E+04	4.01E+04	3.31E+04

VITAE

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